DP-1132
Blue File

Los Alamos
NATIONAL LABORATORY
EST. 1943

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, New Mexico 87545
(505) 667-7969/FAX: (505) 665-9344

Date: March 22, 2011
Refer To: ENV-RCRA-11-0047
LA-UR: 11-10128

GROUND WATER
MAR 28 2011
BUREAU

Mr. William C. Olson, Bureau Chief
Ground Water Quality Bureau
New Mexico Environment Department
Harold Runnels Building, Room N2250
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Dear Mr. Olson:

SUBJECT: TA-50 RADIOACTIVE LIQUID WASTE TREATMENT FACILITY, DISCHARGE PLAN (DP-1132), MINOR MODIFICATION

In accordance with 20.6.2.3107 of the New Mexico Water Quality Control Commission Regulations, Los Alamos National Laboratory (the Laboratory) is notifying you of a minor modification to the TA-50 Radioactive Liquid Waste Treatment Facility's Discharge Plan (DP-1132).

The Radioactive Liquid Waste Treatment Facility (RLWTF) is making modifications to the low-level wastewater treatment system. Modifications include installing pipes and components to bypass the existing RLWTF gravity sand filter and tubular ultra-filter (TUF) and replace the bypassed treatment processes with a pressure media filtration and cartridge filtration capability. The installation of these new filtration capabilities will provide the RLWTF with reliable filtration downstream of the process clarifier and upstream of the reverse osmosis unit. Additionally, the seawater reverse osmosis unit (SWRO) and associated reject tank have been removed from the treatment system. A pilot study was conducted to determine if the volume of the regular reverse osmosis (RO) concentrate stream could be reduced using a SWRO unit. The pilot study has been completed and the hoses to the SWRO have been disconnected. Enclosure 1 highlights the aforementioned treatment system modifications. Enclosure 2 represents the modified treatment schematic to be in operation in late July or early August 2011.

Additionally, in April 2011, the RLWTF will initiate the use of magnesium hydroxide instead of calcium hydroxide in the facility's treatment system clarifier. Magnesium hydroxide raises the pH in the clarifier and is the source of the hydroxide ion that precipitates with the ferric iron. RLWTF treatment operators would like to use magnesium hydroxide rather than calcium hydroxide because it has been proven to be more effective in silica removal in the clarifier, which then reduces silica

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fouling of the reverse osmosis (RO) membranes and the Hydrochem waste evaporator heat exchanger plates. The Material Safety Data Sheet (MSDS) for magnesium hydroxide is enclosed for your review (See Enclosure 3).

Please contact me at 505-667-7969 if you have questions.

Sincerely,

Robert Beers
Water Quality and RCRA Group

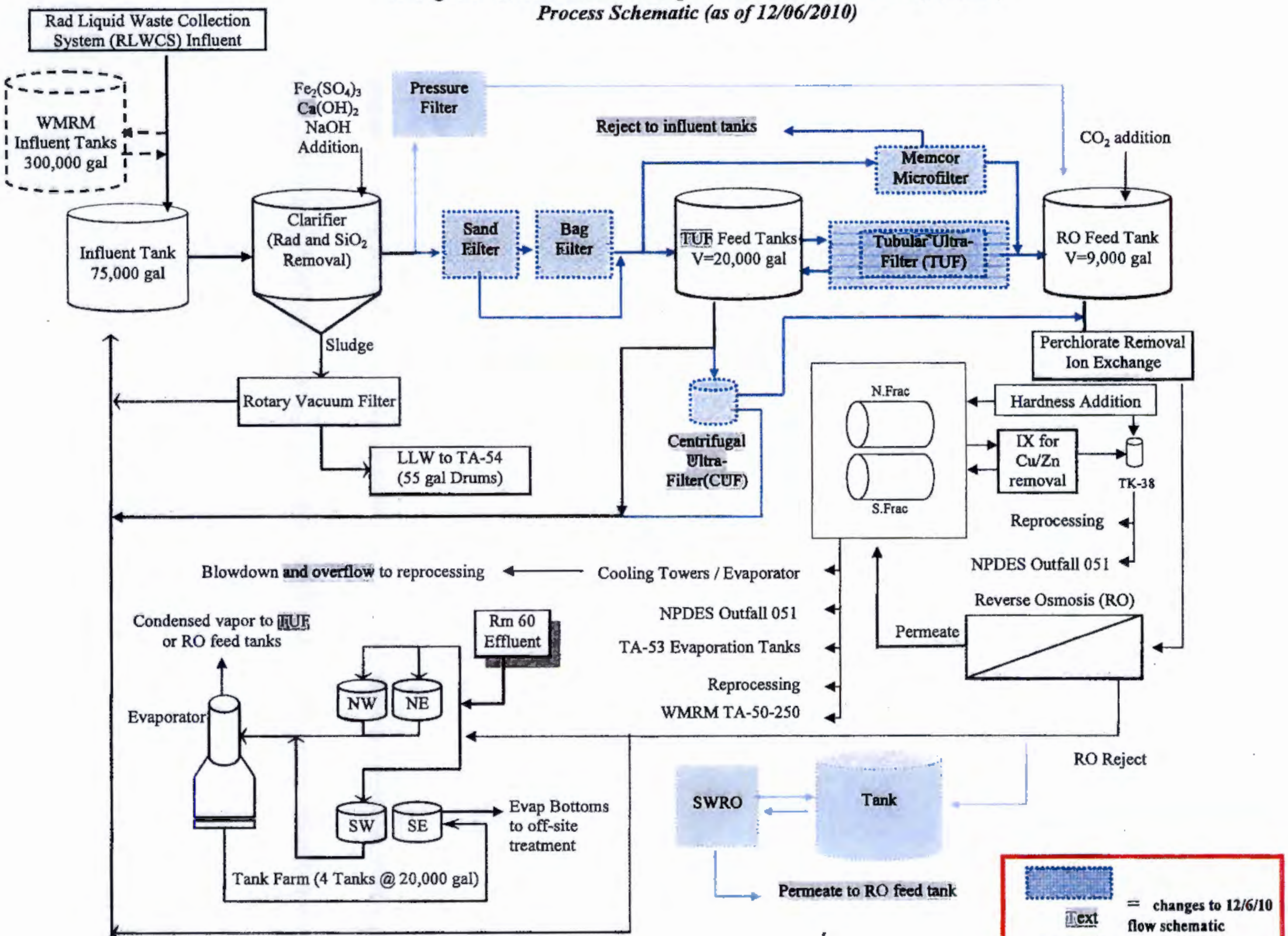
BB/lm

Enclosures: a/s

Cy: Hai Shen, LASO-EO, w/enc., A316
Gene Turner, LASO-EO, w/enc., A316
Steve Yanicak, LASO-GOV, w/enc., M894
Michael Mallory, PADOPS, w/o enc., A102
J. Chris Cantwell, ADESHQ, w/o enc., K491
Randy Johnson, ENV-ES, w/enc., E500
Mike Saladen, ENV-RCRA, w/o enc., K490, (E-File)
Robert C. Mason, TA55-DO, w/o enc., E583
Hugh McGovern, TA-55 RLW, w/enc., E518
Pete Worland, TA-55-RLW, w/enc., E518
Chris Del Signore, TA-55-RLW, w/enc., E518
ENV-RCRA File, w/enc., K490
IRM-RMMSO, w/enc., A150

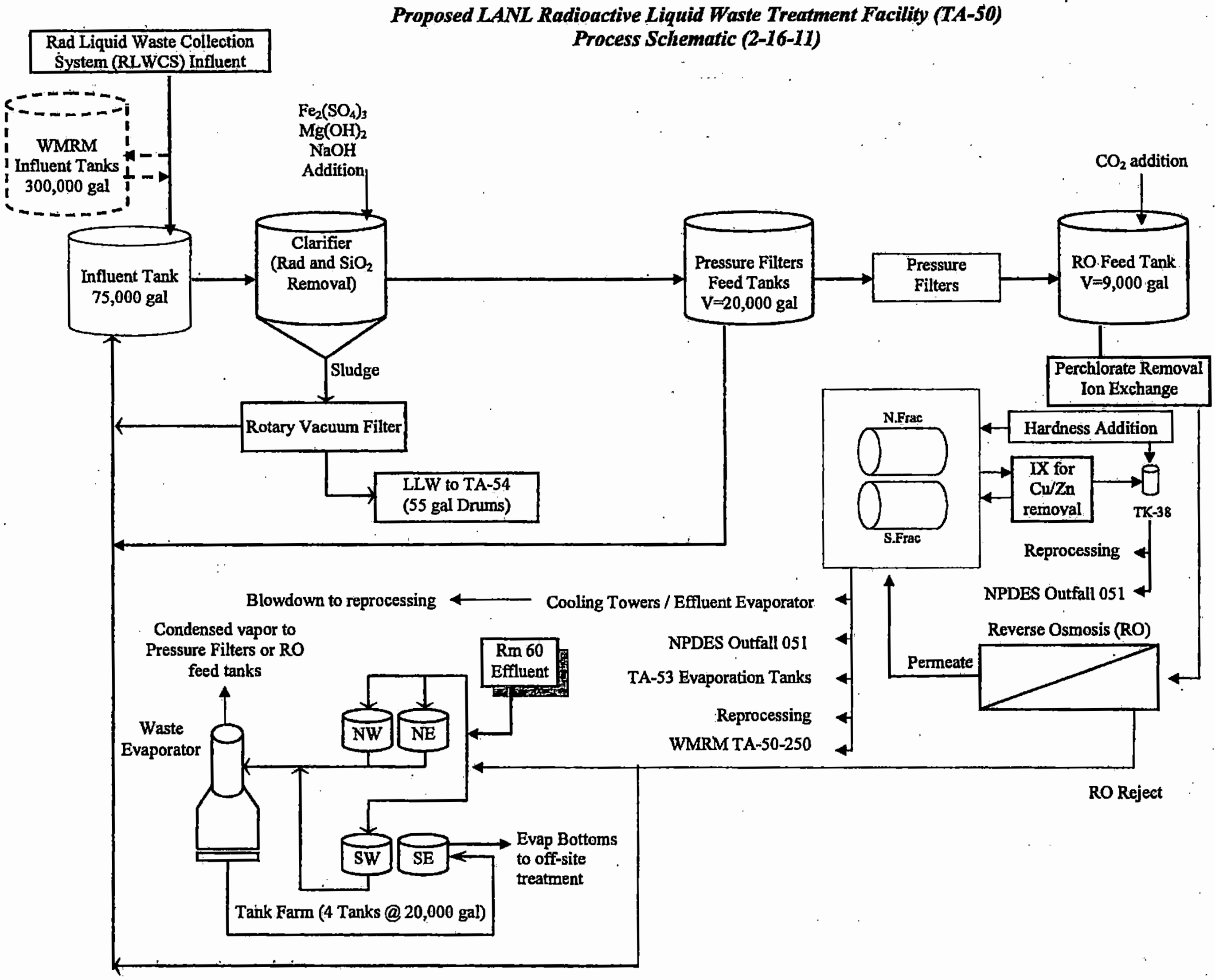
ENCLOSURE 1

Changes to LANL Radioactive Liquid Waste Treatment Facility (TA-50) Process Schematic (as of 12/06/2010)



ENCLOSURE 2

Proposed LANL Radioactive Liquid Waste Treatment Facility (TA-50)
Process Schematic (2-16-11)



04556

ENCLOSURE 3

May Hydrosodium

UNIVAR®

Univar USA Inc Material Safety Data Sheet

MSDS No:	P14725V
Version No:	010 2006-08-18
Order No:	

Univar USA Inc., 17425 NE Union Hill Rd., Redmond WA 98052
(425) 889 3400

Emergency Assistance

For emergency assistance involving chemicals call
Chemtrec - (800) 424-9300

The Version Date and Number for this MSDS is : 08/18/2006 - #010

****
SECTION I PRODUCT IDENTIFICATION
****

PRODUCT NAME: MAGNESIUM HYDROXIDE SOLUTION

MSDS #: P14725V

DATE ISSUED: 04/17/2000

SUPERSEDES: 08/08/1997

ISSUED BY: 008497

REVIEWED DATE: 07/16/2004

This MSDS has been reviewed on 07/16/2004, and is current as of the DATE ISSUED above.

SECTION I Chemical Product And Company Identification

Product Name: Magnesium Hydroxide Solution
Hi-Chem Mag-50

CAS NUMBER: 1309-42-8

Distributed by:
Univar USA Inc.
17425 NE Union Hill Road
Redmond, WA 98052
425-889-3400

Section II Composition/Information On Ingredients

			Exposure Limits (TWAs) in Air		
Chemical Name	CAS Number	%	ACGIH TLV	OSHA PEL	STEL
Magnesium Hydroxide	1309-42-8	51-65	10 mg/m3 (total dust) 5 mg/m3 (respirable dust)	15 mg/m3 (total dust)	N/A

Section III Hazard Identification

ROUTES OF EXPOSURE: N/A

SUMMARY OF ACUTE HEALTH HAZARDS The product presents a very low health risk. Magnesium hydroxide is a general purpose food additive. Dust generated from the dried product is classified as a nuisance dust.

INGESTION: Ingestion is unlikely. If ingested in sufficient quantity, may cause gastrointestinal disturbances. Symptoms may include irritation, nausea, vomiting, abdominal pain and diarrhea.

INHALATION: May irritate the respiratory tract on prolonged or repeated contact. May aggravate preexisting respiratory conditions.

SKIN: Repeated or prolonged contact may cause irritation

EYES: May irritate or injure eyes.

SUMMARY OF CHRONIC HEALTH HAZARDS: The excessive inhalation above (TLV) of mineral dust, over long periods of time, may cause industrial bronchitis, reduce breathing capacity, and lead to increased susceptibility to other lung disease.

SIGNS AND SYMPTOMS OF EXPOSURE: N/A
EFFECTS OF OVEREXPOSURE: N/A

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Dust from the dried product may aggravate pre-existing chronic lung conditions such as, but not limited to, bronchitis, emphysema, and asthma.

NOTES TO PHYSICIANS: N/A

Section IV First Aid Measures

INGESTION: Low toxicity. Give 1-2 glasses of water and seek immediate medical attention. Never give anything of mouth to an unconscious person. Leave decision to induce vomiting for medical personnel, since some particles may be aspirated into the lungs.

INHALATION: Move to fresh air; if discomfort persists, get medical attention.

SKIN: Wash with soap and water

EYES: Irrigate immediately with plenty of water. Obtain medical attention if necessary.

Section V Fire Fighting Measures

FLASH POINT: N/A AUTOIGNITION TEMPERATURE: N/A
LOWER EXPLOSIVE LIMIT: N/A UPPER EXPLOSIVE LIMIT: N/A
UNUSUAL FIRE AND EXPLOSION HAZARDS: N/A
EXTINGUISHING MEDIA: N/A
SPECIAL FIREFIGHTING PROCEDURES:
FIREFIGHTERS SHOULD WEAR NIOSH-APPROVED, POSITIVE PRESSURE, SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING WHEN APPROPRIATE.

Section VI Accidental Release Measures

Dike the spilled liquid, and either pump back into original container or cover with clay-type substance for absorption.

Section VII Handling and Storage

Store at ambient temperature. Prevent possible eye and skin contact by wearing protective clothing and equipment.

Section VIII Exposure Controls/Personal Protection

RESPIRATORY PROTECTION: Respirator approved by NIOSH/MSHA are adequate for contaminate concentrations encountered.
VENTILATION: N/A
PROTECTIVE CLOTHING: Gloves are recommended, rubber gloves re recommended when repeated or prolonged contact is likely.

EYE PROTECTION: Safety glasses are recommended.
OTHER PROTECTIVE CLOTHING OR EQUIPMENT: N/A
WORK/HYGIENIC PRACTICES: Avoid contact with the eyes and skin.

Section IX Physical and Chemical Properties

PHYSICAL STATE:	Milky liquid
MELTING POINT/RANGE:	N/A
pH:	10-11
BOILING POINT/RANGE:	212 DEG F, 100 DEG C
APPEARANCE/COLOR ODOR:	White - Off white, No odor
SOLUBILITY IN WATER:	NIL
SPECIFIC GRAVITY (Water = 1):	1.4-1.5
VAPOR DENSITY (Air = 1):	N/A
VAPOR PRESSURE (mmHg):	N/A
MOLECULAR WEIGHT:	N/A
% OF SOLUTION:	48-51 51-55 61-65
% VOLATILES:	49-52 45-49 35-39

Section X Stability and Reactivity

STABILITY: Stable HAZARDOUS POLYMERIZATION: Will Not Occur

CONDITIONS TO AVOID: N/A

MATERIALS TO AVOID: Acids and maleic anhydride Magnesium hydroxide is soluble in aqueous acids generating heat.

HAZARDOUS DECOMPOSITION PRODUCTS: HEAT AND STEAM

Section XI Toxicological Information

N/A

Section XII Ecological Information

N/A

Section XIII disposal Considerations

May be disposed of in a secured sanitary landfill. Disposal must be done in accordance with Local, State, and Federal regulations.

Section XIV Transport Information

DOT Proper Shipping Name: N/A
DOT Hazard Class/I.D. No: N/A

Section XV Regulatory Information

Reportable Quantity: N/A
NFPA Rating: Health - 1; Fire - 0; Reactivity - 0
0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme
Carcinogenicity Lists: No NTP: No IARC Monograph: No OSHA Regulated: No

Section XVI Other information

SYNONYMS/ COMMON NAMES: Brucite
CHEMICAL FAMILY TYPE: Magnesium Hydroxide

Univar USA Inc Material Safety Data Sheet

For Additional Information contact MSDS Coordinator during business hours, Pacific time: (425) 889-3400

Notice

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This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process

Fullam, Jennifer, NMENV

From:	Robert S. Beers <bbeers@lanl.gov>
Sent:	Monday, March 28, 2011 3:27 PM
To:	George, Robert, NMENV
Cc:	'Saladen, Michael T'; 'Gene E. Turner'; 'Sandoval, Tina M'; 'Phil Noll'; 'Hjeresen, Dennis L'; Schuman, George, NMENV; Fullam, Jennifer, NMENV; Knutson, Gerald, NMENV
Subject:	RE: March 30, 2011, Mtg w/LANL
Attachments:	NMED-LANL Meeting Agenda 3-30-11 (LANL revised) (3).doc

Robert—

I made a few changes to the agenda for our meeting on Weds. Most noticeably, I moved the discussion on DP-1132 (TA-50 RLWTF) from #7 on the agenda to #1 so that the presenter—Pete Worland (LANL RLWTF)—can make his presentation and then return to work.

On the minor side, I adjusted a few of the subject times, replaced the discussion topic 'ZLD evaporation tanks' with an update on the larger RLWTF Upgrades Project, and made a few minor word changes for clarity. Please let me know if you have questions.

Sincerely,

Bob Beers
Water Quality & RCRA Group
Los Alamos National Laboratory
505-667-7969

From: George, Robert, NMENV [mailto:robert.george@state.nm.us]
Sent: Thursday, March 24, 2011 12:06 PM
To: Robert S. Beers
Cc: 'Saladen, Michael T'; 'Gene E. Turner'; grieggst@lanl.gov; 'Sandoval, Tina M'; 'Phil Noll'; 'Hjeresen, Dennis L'; Schuman, George, NMENV; Fullam, Jennifer, NMENV; Knutson, Gerald, NMENV
Subject: RE: March 30, 2011, Mtg w/LANL

Bob,

NMED has a few proposed revisions to the agenda for our meeting on the 30th (shown in red). The attached Excel spreadsheet relates directly to agenda item #5 (proposed for addition by NMED). The highlighted areas are detected exceedances in MWs that NMED thinks should have been reported to GWQB, but apparently were not. We are providing it here so that you can research the issue before the meeting. We also put some approximate time limits on the various subjects...not trying to be overly-regimented here...just trying to use everyone's time effectively. Please interpret them as suggestions.

Let me know if you have any questions or if changes are necessary. Thanks

Robert J. George
Domestic Waste Team Leader
New Mexico Environment Department
Ground Water Quality Bureau
P.O. Box 5469
Santa Fe, New Mexico 87502-5469
Office Phone: (505) 476-3648

FAX: (505) 827-2965
E-mail: robert.george@state.nm.us

From: Robert S. Beers [mailto:bbeers@lanl.gov]
Sent: Friday, March 11, 2011 9:06 AM
To: George, Robert, NMENV
Cc: 'Saladen, Michael T'; 'Gene E. Turner'; grieggst@lanl.gov; 'Sandoval, Tina M'; 'Phil Noll'; 'Hjeresen, Dennis L'
Subject: March 30, 2011, Mtg w/LANL

Hi Robert—

Mike Saladen and I are available to meet with NMED GWQB staff on Wednesday, March 30, 2011, at 9:30 am, at your Santa Fe office.

Please see the attached draft agenda.

Thank you for accommodating our request for a meeting with you and your staff.

Sincerely,

Bob Beers
Water Quality & RCRA Group
Los Alamos National Laboratory
505-667-7969

Draft Meeting Agenda
LANL ENV-RCRA & NMED GWQB
Wednesday, March 30th, 9:30am

1. TA-50 RLWTF DP-1132 Application (25 minutes)
   - Pete Worland from LANL RLWTF will present GWQB with an update on RLWTF treatment process changes
   - Update GWQB on the RLWTF Upgrades Project (ie, new treatment plant)

2. Septic Tank/Leachfield Systems DP-1589 Application (20 min)
   - Update GWQB on changes to LANL's list of active septic tank/leachfield systems
   - Discuss mechanism to incorporate these changes into LANL's application
   - Discuss septic systems on LANL site that are owned & operated by others
   - Discuss path forward for the TA-33 system operating under Temporary Permission

3. SWWS Plant DP-857 Renewal Application (15 min)
   - Provide GWQB with an update on SERF expansion and outfall reduction
   - Discuss timetable for DP-857 renewal

4. Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree (10 min)
   - Discuss LANL Activities within the Buckman Well Field and submittal of an NOI
   - Provide GWQB with a status report on the CdV-16-4ip pumping test

5. Un-permitted Discharge Reporting Decision Tree (20 min)
   - Discuss potential updates to LANL's Decision Tree
   - Solicit NMED comments on draft updates discussed in December 2010
   - Discuss update on reporting notification
   - Potential changes requested by LANL regarding volumes and TRC limits currently in DT
   - Un-closed spills still under investigation (2009-231, 2010-280)

6. Questions Concerning Reporting of Ground Water exceedances in Monitoring Wells (20 min)
   - Clarifying reportable exceedances as defined under 3103 and the Toxin List
   - Discussion on ground water exceedances in monitoring wells which may meet the criteria but have not been not reported (please see attached spreadsheet)

7. Discussion Concerning General Information Needed by NMED (10 min)
   - Updated facility map (revised from the one provided in October 2009)
   - Comprehensive list of monitoring wells, location (including associated canyon), type (regional, intermediate, alluvial or other)

Estimated meeting length: Approximately 2 hrs.

New Mexico Environment Department
Ground Water Quality Bureau

Memorandum of Meeting or Phone Conversation

Memorandum of Meeting or Phone Conversation

Telephone Meeting	**Time:** 9:30am-12:00pm	**Date:** 03.30.11

Individuals Involved

George Schuman, NMED-GWQB Program Manager	called	Bob Beers
Robert George, NMED-GWQB Team Leader	returned call to	Pete Worland
Jennifer Fullam, NMED-GWQB Environmental Scientist	received call from	Make Saladen
Gerald Knutson, NMED-GWQB Environmental Scientist	other: **Teleconference**	

Subject: See Below

Discussion:

I. TA-50 Radioactive Liquid Waste Treatment Facility

LANL met with NMED to discuss treatment process changes occurring at the RLWTF.

- Worland gave presentation on the current system and the last four notices of minor modification.
- 03.08.10 modifications with plans and specifications for new plant have been haulted but is being re-evaluated due to cost. LANL is still looking at using the engineering plans but reducing costs through a new design.
- 08.25.10 modification proposes a short-term and long-term change at the plant. The short-term sends effluent to the cooling towers at the plant to reduce discharges (this was to be conducted through the fall 2010). The long-term includes an evaporative system for the effluent with a natural gas firing boiler. The facility has secondary containment and processes 400 gallons/hour (two boilers at 200 gallons/hour). This system is now on-line and functioning to reduce discharges from the facility. The facility discharged <2,000 gallons in August 2010 and have been on all evaporation since November 21, 2010.
- 09.27.10 modification proposes changes in the process to meet Cu and Zn NPDES limits. The old effluent tanks were contaminating treated effluent. They are using an experimental media but it is a slow process and the 1,000 gallon tank that is at the facility is not large enough which pushed the effluent evaporator (see 08.25.10 notice).
- 12.15.10 modification discusses adding Ca and Mg to the effluent for the wet test. They had 9 pass/15 fail with no dilution. It appears, to LANL, that the low hardness in the effluent (1 ppm with average being 50 ppm) was causing them to exceed Cu/Zn limitations
- 03.22.11 modification is proposing to by-pass the 3' deep gravity sand filter (online since 1963) and tubular ultra filters (online since 1998) and installing a pressure media and cartridge filter. The process would now be the clarifiers-tanks 71 & 72- pressure media filters (three in parallel each with 17 gpm) -Tank 9-cartridge filter (tightly wound polypropylene fiber cartridges)-ion exchange-reverse osmosis (seawater membranes). LANL stated they have already begun the bypass project and should be complete by the end of July 2011. The sand filter and Tubular Ultra Filter will physically stay at the plant but will be offline. The facility will be changing to magnesium hydroxide to remove silica more

effectively. The backwashing with pressure media effluent.

II. Septic Tank/Leach Field DP-1589

Update on changes to the list of active ST/LF systems

- There have been four systems that have been deemed inactive and one system that has been added. NMED stated that if the Public Notice covered the area in which the system is in the changes can be incorporated through an amendment/comment once the draft goes out for public comment. **LANL will comment during the public notice period.**
- Discuss septic systems on LANL property operated by outside entities. LANL stated that there are five systems which are operated by other entities although they are located on LANL property. There are two systems at TA-49 fire complex, one is inactive and being used as a holding tank; thwo systems in Rendija Canyon at the Sportsman's Club (one for the clubhouse and one for the caretakers mobile home); and a single system at the concrete batch plant owned by Mr. Cook (Beers has no information on this facilty). The issue lies with the public notice requirements as some of the locations were not included in the original public notice. NMED will review and determine point of action (may be to incorporate PN-1 with draft as it is sent out for PN-2). **NMED will follow up.**
- Temporary Permission for TA-33 is continually being renewed until the Discharge Permit is issued. This will have to continue until issued.

III. SWWS DP-857

LANL gave a brief on the SERF expansion. SERF was created to reduce water use that was needed for the Super Computer Complex (SCC). As it stands now SERF is unable to handle volume demands and can only do ¼ SWWS volume. LANL wants to get SERF operational and discharge to outfall 001 and then to the powerplant and the SCC once the quality is confirmed. The SCC outfall may be able to be combined with 001 (Sandia Canyon wetland outfall). There are issues with reducing or eliminating outfall 001 due to trivalent chromium from historical blowdown which could be mobilized if the wetland were allowed to dry out. There are also issues with Federal Wetland Protection Regulations. LANL had funding for FY'11 to expand to handle the demands of the SCC and they are currently going through the design build and bidding. LANL anctipates it to be built and online by Augus 1, 2012. The volume of water it will be able to produce once expanded will be approximately 300,000 gpd. This may trigger an expansion of Sigma Mesa to receive concentrate. NMED will need additional information to incorporate it into the SWWS permit. **LANL will provide information as it becomes available.**

LANL was requesting some gross approximation on the timeline for renewal of DP-857. NMED is aiming to have a draft out for PN-2 mid-year with a 90 day comment period and some preliminary outreach. NMED is hoping to get DP-857 and DP1589 out in the same public notice to effectively handle comments and hearing requests if received.

IV. Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree

NMED inquired what the status is of LANL's sampling activities at the Buckman well field and if an NOI was going to be submitted for discharging purge water (as the Decision Tree is not applicable for wells outside of LANL property). LANL stated that the City of Santa Fe (owner of the wells) has agreed to take responsibility for obtaining authorization on the discharges from the wells.

LANL gave a brief update on the CdV-16-4ip pump test in which NMED gave temporary permission to treat and discharge on site. (GAC treatment for RDX) The first pump test has been completed on the upper screen and they are doing the second pump tests now. The second test should be completed by April 1, 2011. They are collecting three samples twice a day. The RDX concentrations in the raw water is between 20-200 ppb and the treated water is coming out with concentrations that are not detectable. **LANL will submit the final report once complete.**

V. Unpermitted Discharge Reporting Decision Tree

LANL is still considering proposing changes to the unpermitted discharge Decision tree which would include an increase in the volumes from 5,000 to 10,000 gallons. LANL is also wanting some change in the language regarding reaching surface water or groundwater and impacts to a SWMU. **NMED requested and proposed changes be submitted in writing for review and consideration.**

NMED inquired about updates to spill # 231 and #280. LANL is preparing a letter requesting closure.

VI. Ground Water Exceedance Reporting under 20.6.2.1203

NMED has cross-referenced documentation from the 1203 spill reports for ground water exceedances and the reports sent to the Hazardous Waste Bureau on ground water detections. It was noted that there was some descrepancies on what is being reported. Based on the February 10, 2010 NMED letter to LANL, all analytes detected at a concentration that define it as a toxic pollutant under 20.6.2.7(WW) must be reported under 1203 in addition to any detections above the ground water standards listed under 20.6.2.3103. LANL stated that at least in the case of exceedances in nitrates, it was discussed in the report to the HWB (cc to GWQB). In regards to springs, there was confusion as to whether they are considered ground water and are reportable. There was one incidence in which LANL reported an exceedance under 1203 but several others where it was not reported. Springs are considered ground water as the samples are taken from the source but the reporting under 1203 would need to be clarified. LANL and NMED agreed that clarification of reportable exceedances would be helpful. **NMED will discuss internally and provide clarification to LANL.**

VII. General Information

NMED is seeking to obtain an updated map of the facility with the new wells. LANL will most likely be able to provide one if NMED submits the request in writing and references the map number from the current map. **NMED will e-mail the request to Beers**

NMED is also seeking a list of all wells that are being used for monitoring. Information needed on each of the wells includes drilling logs (with visual log and lithology), date of drilling, top and bottom of screen, the depth in which water was encountered during drilling, screening intervals if multiple, well ID, location, aquifer attributes and canyons associated with. **LANL requested this be submitted in writing to LANL.**

Conclusions:

LANL will:

1. Provide comment on the septic tank/leachfield systems that have been deemed inactive or new systems during the public comment period
2. Will provide information on the upgrades occurring at SERF for the DP-857 permit
3. Will provide the final pump test report on CdV-16-4ip once complete
4. Will propose changes to the unpermitted discharge decision tree

GWB will:

1. Review the requirements for the public notice for systems that are on LANL property but are operated by outside entities and were not included in the original application.
2. Will review and provide LANL clarification on reporting requirements for ground water exceedances under 20.6.2.1203 NMAC
3. Will submit a request for an updated facility map and wells to LANL

Distribution:

FILE-LANL-GWQB-Discharge Permit-TA-50-Meetings

Initialed JF

Draft Meeting Agenda
LANL ENV-RCRA & NMED GWQB
Wednesday, March 30th, 9:30am

1. TA-50 RLWTF DP-1132 Application (25 minutes) SUBMIT AND WE WILL REVIEW WILL PROCEED AFTER -857
   - Pete Worland from LANL RLWTF will present GWQB with an update on RLWTF treatment process changes
   - Update GWQB on the RLWTF Upgrades Project (ie, new treatment plant)

2. Septic Tank/Leachfield Systems DP-1589 Application (20 min)
   - Update GWQB on changes to LANL's list of active septic tank/leachfield systems PUBLIC NOTICE
   - Discuss mechanism to incorporate these changes into LANL's application IF NOT ALREADY DONE
   - Discuss septic systems on LANL site that are owned & operated by others – LANL RESPONSIBILITY
   - Discuss path forward for the TA-33 system operating under Temporary Permission
     EXPIRED SHOULD BE UNDER NEW PERMIT OR REQUEST TP

3. SWWS Plant DP-857 Renewal Application (15 min)
   - Provide GWQB with an update on SERF expansion and outfall reduction
   - Discuss timetable for DP-857 renewal → try for mid-year to PN-2

4. Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree (10 min)
   - Discuss LANL Activities within the Buckman Well Field and submittal of an NOI – OUTLINE BACKGROUND NEED • QUALITY • VOLUME • LOCATIONS • CONTRACTS W/ OWNERS
   - Provide GWQB with a status report on the CdV-16-4ip pumping test
     submittals

5. Un-permitted Discharge Reporting Decision Tree (20 min)
   - Discuss potential updates to LANL's Decision Tree –
   - Solicit NMED comments on draft updates discussed in December 2010
   - Discuss update on reporting notification
   - Potential changes requested by LANL regarding volumes and TRC limits currently in DT
   - Un-closed spills still under investigation (2009-231, 2010-280)

6. Questions Concerning Reporting of Ground Water exceedances in Monitoring Wells (20 min)
   - Clarifying reportable exceedances as defined under 3103 and the Toxin List – Copy of letter
   - Discussion on ground water exceedances in monitoring wells which may meet the criteria but have not been not reported (please see attached spreadsheet)

7. Discussion Concerning General Information Needed by NMED (10 min)
   - Updated facility map (revised from the one provided in October 2009)
   - Comprehensive list of monitoring wells, location (including associated canyon), type (regional, intermediate, alluvial or other) – construction –

Estimated meeting length: Approximately 2 hrs.

- Top + bottom of screen
- Water encountered drilling
- screening intervals if multiple
- Visual log – lithology

Ground Water Exceedances in Monitoring Wells at Los Alamos National Laboratory

CA= a detection of a contaminant in a well screen interval or spring at concentration that exceeds either the NMWQCC water quality standard or the federal MCL if that contaminant has not previoulsy exceeded
C1= first detection of an organic not previously detected
C2= first detection of a metal or inorganic not previously detected
C3= first detection exceeding 1/2 WQCC standard or 1/2 MCL or 1/2 EPA Screening Limit
C4= first detection of perchlorate above 2ug/L
C5= detection of metal or inorganic 2x background for third consecutive sampling event
C6=dectection of contaminant that exceeds 1/2 WQCC or 1/2 MCL and has increased for third consecutive sampling event

Date Sampled	Well ID	Well Type	Constituent	WQCC Listing	Concentration	units	Filtered/Unfiltered	Qualifiers	Verbal Notification	7/15 day report	Consent Order Well Report Submitted	Comments	CA Qualifier not reported under 1203	Unreportable
4/12/2010	CdV 5.0 Spring	Spring-Intermediate	Iron		1380	ug/L	F	none	None	None	8/9/2010		Not Reported Under 1203	Spring
4/13/2010	CdV-16-02655	Alluvial	Aluminum		23700	ug/L	F	none	7/9/2010	2010-269	8/9/2010		Reported	OK
4/13/2010	CdV-16-02655	Alluvial	Beryllium		4.01	ug/L	UF	J	None	None	8/9/2010		Not Reported Under 1203	NOT UNDER WQCC
4/13/2010	CdV-16-02655	Alluvial	Lead		19	ug/L	UF	none	None	None	8/9/2010		Not Reported Under 1203	Unfiltered Sample
	CdV-R-15-3	Regional	Manganese		313	ug/L			10/15/2010	2010-279			Reported	OK
4/14/2010	Fish Ladder Spring	Spring-Intermediate	Iron		2340	ug/L	F	*	None	None	8/9/2010		Not Reported Under 1203	Spring
	MCO-2	Alluvial	Chloride		3300	mg/L			3/24/2010	2010-255			Reported	OK
	MCO-2	Alluvial	Fluoride		8.75	mg/L			3/24/2010	2010-255			Reported	OK
7/7/2010	MCOI-5	Intermediate	Methylene Chloride		6.97	ug/L	UF	J	None	None	10/18/2010		Not Reported Under 1203	Qualifier
	MCOI-6	Intermediate	Chromium		51.8	ug/L			2/17/2010	2010-244			Reported	OK
4/7/2010	MSC-16-06293	Alluvial	Boron		929	ug/L	F	none	7/9/2010	2010-269	8/9/2010		Reported	OK
	PCAO-9	Alluvial	Cl		590	mg/L		?	8/17/2010	2010-271			Reported	OK
	PCAO-9	Alluvial	TDS		1740	mg/L		?	8/17/2010	2010-271			Reported	OK
4/19/2010	Peter Spring	Spring-Intermediate	Barium		2010	ug/L	F	none	None	None	8/9/2010		Not Reported Under 1203	Spring
11/9/2010	R-15	Regional	Lead		29.5	ug/L	UF		None	None	2/16/2011		Not Reported Under 1203	Unfiltered Sample
	R-16		Aroclor-1242	PCB	1.1	ug/L			2/15/2011	2011-300			Reported	OK
	R-16		Aroclor-1254	PCB	2.1	ug/L			2/15/2011	2011-300			Reported	OK
10/14/2010	R-19	Regional	Nitrate		793	mg/L	F		None	None	2/16/2011		Not Reported Under 1203	
9/21/2010	R-25	Intermediate	Uranium	Uranium	43.7	ug/L	F		None	None	1/24/2011	unfiltered	Not Reported Under 1203	
9/14/2010	R-27	Regional	Indeno(1,2,3-cd)pyrene)		0.4	ug/L	UF	J	None	None	1/24/2011		Not Reported Under 1203	NOT UNDER WQCC
9/23/2010	R-29	Regional	Manganese		214	ug/L	F		12/15/2010	2010-287	1/24/2011		Reported	OK
	R-40	Intermediate	Manganese		400	ug/L			3/16/2010	2010-253			Reported	OK
3/6/2010	R-50	Regional	Chromium		0.0697	mg/L	F	none	5/18/2010	2010-263	7/13/2011		Reported	OK
2/15/2010	R-54	Regional	Di(2-ethylhexyl)phthalate		0.0112	mg/L	?	?	None	None	6/7/2010	Cant find	Not Reported Under 1203	
7/27/2010	R-54	Regional	Iron		1940	ug/L	F	none	9/16/2010	2010-278	10/18/2010		Reported	OK
7/27/2010	R-54	Regional	Manganese		216	ug/L	F	none	9/16/2010	2010-278	10/18/2010		Reported	OK
	Sacred Spring		Manganese		424	ug/L			2/15/2011	2011-300			Reported	OK
	SCA-1	Alluvial	Chloride		263	mg/L			4/20/2010	2010-256			Reported	OK
	SCA-1-DP		Iron		2150	ug/L			2/15/2011	2011-300			Reported	OK
	SCI-2	Intermediate	Cyanide		0.304	mg/L			3/16/2010	2010-252			Reported	OK
3/24/2010	Spring 4C	Regional	Iron		1280	ug/L	F	none	None	None	8/9/2010		Not Reported Under 1203	
4/23/2010	Test Well DT-9	Regional	Lead		20.1	ug/L	UF	none	None	None	8/9/2010		Not Reported Under 1203	Unfiltered Sample
4/12/2010	Water Canyon Gallery	Spring-Intermediate	Iron		1500	ug/L	F	none	None	None	8/9/2010		Not Reported Under 1203	Spring

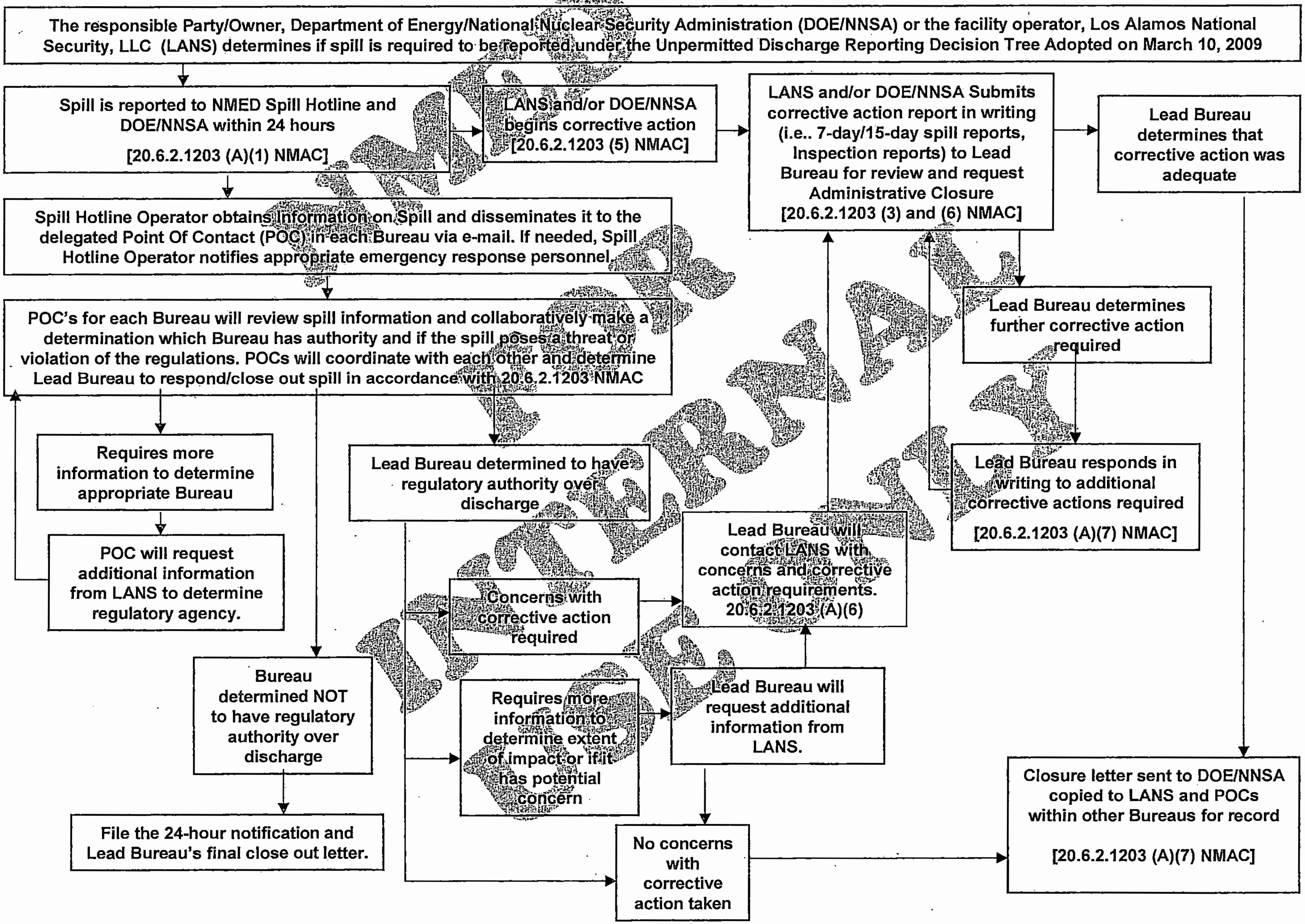
Location Name	Start Date	Analyte	Analyte Desc	Anyl Meth Code	Fld Prep Code		Std Result	Units	Std Mdl	Lab Qual Code	Concat Flag Code	Lab Code	Sample Id	Fld Qc Type Code
R-54	2/15/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF		11.2	ug/L	2			GELC	CAPA-10-12691	
R-54	2/21/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	11.6	ug/L	2.3	U	U	GELC	CAPA-10-13095	
R-54	6/18/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10.5	ug/L	2.1	U	U	GELC	CAPA-10-18473	
R-54	6/18/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10.6	ug/L	2.1	U	U	GELC	CAPA-10-18480	FD
R-54	6/18/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	11	ug/L	2.2	U	U	GELC	CAPA-10-18479	
R-54	6/18/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	11.1	ug/L	2.2	U	U	GELC	CAPA-10-18474	FD
R-54	7/27/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10.6	ug/L	2.1	U	U	GELC	CAPA-10-24165	
R-54	7/27/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10.4	ug/L	2.1	U	U	GELC	CAPA-10-24160	
R-54	7/27/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10.4	ug/L	2.1	U	U	GELC	CAPA-10-24554	FD
R-54	7/27/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10	ug/L	2	U	U	GELC	CAPA-10-24555	FD
R-54	10/13/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10.5	ug/L	2.1	U	U	GELC	CAPA-10-27446	
R-54	10/13/2010	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10	ug/L	2	U	U	GELC	CAPA-10-27444	
R-54	1/12/2011	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10.6	ug/L	2.1	U	U	GELC	CAPA-11-3050	
R-54	1/14/2011	117-81-7	Bis(2-ethylhexyl)phthalate	SW-846:8270C	UF	<	10	ug/L	2	U	U	GELC	CAPA-11-3047	

04575

Location Name	Start Date	Analyte	Anyl Meth Code	Fld Prep Code		Std Result	Std Uom	Std Mdl	Lab Qual Code	Concat Flag Code	Lab Code	Sample Id
R-25	4/6/2010	U	EPA:200.8	UF	<	0.2	ug/L	0.2	U		EES6	CAWA-10-15241
R-25	4/6/2010	U	EPA:200.8	F	<	0.2	ug/L	0.2	U		EES6	CAWA-10-15243
R-25	4/7/2010	U	SW-846:6020	UF		0.587	ug/L	0.05			GELC	CAWA-10-15187
R-25	4/7/2010	U	SW-846:6020	F		0.449	ug/L	0.05			GELC	CAWA-10-15185
R-25	4/7/2010	U	SW-846:6020	F		0.345	ug/L	0.05			GELC	CAWA-10-15215
R-25	4/8/2010	U	SW-846:6020	F		0.388	ug/L	0.05			GELC	CAWA-10-15194
R-25	4/8/2010	U	SW-846:6020	F		0.564	ug/L	0.05			GELC	CAWA-10-15192
R-25	4/8/2010	U	SW-846:6020	UF		0.608	ug/L	0.05			GELC	CAWA-10-15191
R-25	4/8/2010	U	SW-846:6020	UF		0.388	ug/L	0.05			GELC	CAWA-10-15196
R-25	4/9/2010	U	SW-846:6020	UF	<	0.433	ug/L	0.05		U	GELC	CAWA-10-15198
R-25	4/9/2010	U	SW-846:6020	F	<	0.382	ug/L	0.05		U	GELC	CAWA-10-15197
R-25	9/21/2010	U	SW-846:6020	UF		0.506	ug/L	0.05			GELC	CAWA-10-25800
R-25	9/21/2010	U	SW-846:6020	F		0.696*	ug/L	0.067			GELC	CAWA-10-25798
R-25	9/21/2010	U	SW-846:6020	F		0.812	ug/L	0.05			GELC	CAWA-10-25805
R-25	9/21/2010	U	SW-846:6020	F		43.7	ug/L	0.05			GELC	CAWA-10-25798
R-25	9/21/2010	U	SW-846:6020	UF		0.828	ug/L	0.05			GELC	CAWA-10-25802
R-25	9/22/2010	U	SW-846:6020	F		0.682	ug/L	0.05			GELC	CAWA-10-25849
R-25	9/22/2010	U	SW-846:6020	UF		0.687	ug/L	0.05			GELC	CAWA-10-25851
R-25	9/23/2010	U	SW-846:6020	F	<	0.445	ug/L	0.05		U	GELC	CAWA-10-25844
R-25	9/23/2010	U	SW-846:6020	F	<	0.563	ug/L	0.05		U	GELC	CAWA-10-25867
R-25	9/23/2010	U	SW-846:6020	UF	<	0.471	ug/L	0.05		U	GELC	CAWA-10-25846
R-25	9/23/2010	U	SW-846:6020	UF	<	0.563	ug/L	0.05		U	GELC	CAWA-10-25865
R-25	9/24/2010	U	SW-846:6020	UF	<	0.622	ug/L	0.05		U	GELC	CAWA-10-25885
R-25	9/24/2010	U	SW-846:6020	F	<	0.58	ug/L	0.05		U	GELC	CAWA-10-25887

*reanalysis

New Mexico Environment Department (NMED) Reporting and Close Out Protocol for Spills Occurring at Los Alamos National Laboratory
November 10, 2009



DP-1132 Blue file MRS

GROUND WATER

APR 26 2011

BUREAU

Los Alamos
NATIONAL LABORATORY
EST.1943

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, New Mexico 87545
(505) 667-7969/FAX: (505) 665-9344

Date: April 19, 2011
Refer To: ENV-RCRA-11-0070
LAUR: 11-10367

Mr. William C. Olson, Bureau Chief
Ground Water Quality Bureau
New Mexico Environment Department
Harold Runnels Building, Room N2250
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Dear Mr. Olson:

SUBJECT: GROUNDWATER DISCHARGE PLAN (DP-1132) QUARTERLY REPORT, FIRST QUARTER 2011, TA-50 RADIOACTIVE LIQUID WASTE TREATMENT FACILITY

This letter is intended to serve as Los Alamos National Laboratory's Groundwater Discharge Plan (DP-1132) quarterly report for the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) for the first quarter (January, February, and March) of 2011. Since the first quarter of 1999, Los Alamos National Laboratory (the Laboratory) has provided your agency with voluntary quarterly reports containing analytical results from effluent and groundwater monitoring.

During the first quarter of 2011, no effluent was discharged by the TA-50 RLWTF through National Pollutant Discharge Elimination System (NPDES) Outfall 051to Mortandad Canyon; all effluent was evaporated on-site at the recently installed effluent evaporator. Your agency was informed of this process change in the Laboratory's August 25, 2010, Minor Modification letter (ENV-RCRA-10-166).

Quarterly Monitoring Results, Mortandad Canyon Alluvial Groundwater Wells
Table 1.0 presents the analytical results from sampling conducted at two Mortandad Canyon alluvial wells, MCO-6 and MCO-7, during the first quarter of 2011. No samples were collected from alluvial wells MCO-3 and MCO-4B because the wells were dry. Samples were submitted to General Engineering Laboratories (GEL), Charleston, SC, for analysis. All of the analytical results were below the New Mexico Water Quality Control Commission (NMWQCC) 3103 standards for nitrate-nitrogen (NO_3-N), fluoride (F), and total dissolved solids (TDS).

Analytical results from the sampling of intermediate and regional aquifer wells in Mortandad Canyon can be accessed online at the Risk Analysis, Communication, Evaluation and Reduction (RACER) Web site (www.racernm.com).

TA-50 RLWTF Effluent Monitoring Results

Table 2.0 presents the analytical results from the weekly composite sampling of RLWTF effluent discharged through NPDES Outfall 051 to Mortandad Canyon. The final weekly composite (FWC) samples are flow-proportioned composite samples prepared from each tank of effluent discharged to Mortandad Canyon during a 7-day period. Samples are submitted to GEL for analysis. In addition, the TA-50 RLWTF analytical laboratory analyzes duplicate FWC samples as part of the Laboratory's compliance monitoring program. No FWC samples were collected during the first quarter of 2011 because no RLWTF effluent was discharged to Mortandad Canyon.

Table 3.0 presents the final monthly composite (FMC) sample results for NO_3-N, ClO_4, F, and TDS for the first quarter of 2011. No FMC samples were collected during the first quarter of 2011 because no effluent was discharged to Mortandad Canyon.

Please contact me at (505) 667-7969 if you would like additional information regarding this quarterly report.

Sincerely,

Robert Beers
Water Quality & RCRA Group (ENV-RCRA)

BB/lm

Enclosures: a/s

Cy: Hai Shen, LASO-EO, A316
Gene Turner, LASO-EO, A316
Steve Yanicak, LASO-GOV, M894
Michael Mallory, PADOPS, A102
J. Chris Cantwell, ADESHQ, K491
Randy Johnson, ENV-EAQ, E500
Mike Saladen, ENV-RCRA, K490, (E-File)
Robert C. Mason, TA55-DO, E583
Hugh McGovern, TA-55 RLW, E518
Pete Worland, TA-55-RLW, E518
ENV-RCRA File, K490
IRM-RMMSO, A150

Table 1.0. Mortandad Canyon Alluvial Well Sampling, 1st Quarter, 2011.

Sampling Location	Sample Field Prep (F/UF)[1]	Sample Date	Perchlorate (ug/L)	NO_3+NO_2-N (mg/L)	TKN[2] (mg/L)	NH3-N (mg/L)	TDS (mg/L)	F (mg/L)
MCO-4B	The well was dry, no sample was collected.							
MCO-3	The well was dry, no sample was collected.							
MCO-6	F	02/09/11	4.28	0.725	0.077J	<0.05	304	0.033
MCO-7	F	02/10/11	7.17	0.685	0.053J	<0.05	348	0.812
NM WQCC 3103 Ground Water Standards			*NA*[2]	*10 mg/L*[3]	*NA*[2]	*NA*[2]	*1000 mg/L*	*1.6 mg/L*

Notes:

[1]All samples filtered with the exception of TKN.

[2]NA means that there is no NM WQCC 3103 standard for this analyte.

[3]The NM WQCC 3103 Ground Water Standard is for NO_3-N.

J- means that the reported value is expected to be more uncertain than usual with a potential negative bias.

J+ means that the reported value is expected to be more uncertain than usual with a potential positive bias.

J means the reported value is greater than the Method Detection Limit (MDL) but less than the Reporting Limit (RL).

Table 2.0. RLWTF Final Weekly Composite (FWC) Effluent Sampling, 1st Quarter, 2011.

			Analysis by RLWTF[1]		Analysis by General Engineering Laboratories, Inc.			
Monitoring Period	**Sample Composite Date**	**Sample ID#**	**NO_3-N (mg/L)**	**NO_2-N (mg/L)**	**NO_3+NO_2-N (mg/L)**	**Perchlorate (ug/L)**	**Fluoride (mg/L)**	**TDS (mg/L)**
January	1/3/11	No Discharges[2]	-----	-----	-----	-----	-----	-----
	1/10/11	No Discharges	-----	-----	-----	-----	-----	-----
	1/17/11	No Discharges	-----	-----	-----	-----	-----	-----
	1/24/11	No Discharges	-----	-----	-----	-----	-----	-----
	1/31/11	No Discharges	-----	-----	-----	-----	-----	-----
February	2/7/11	No Discharges	-----	-----	-----	-----	-----	-----
	2/14/11	No Discharges	-----	-----	-----	-----	-----	-----
	2/21/11	No Discharges	-----	-----	-----	-----	-----	-----
	2/28/11	No Discharges	-----	-----	-----	-----	-----	-----
March	3/7/11	No Discharges	-----	-----	-----	-----	-----	-----
	3/14/11	No Discharges	-----	-----	-----	-----	-----	-----
	3/21/11	No Discharges	-----	-----	-----	-----	-----	-----
	3/28/11	No Discharges	-----	-----	-----	-----	-----	-----
1st Quarter 2011 Averages[3]			-----	-----	-----	-----	-----	-----
NMWQCC 3103 Groundwater Standards			***10 mg/L***	***NA[5]***	***10 mg/L[4]***	***NA[5]***	***1.6 mg/L***	***1000 mg/L***

Notes:

[1]Analysis by the TA-50 Radioactive Liquid Waste Treatment Facility's analytical laboratory.

[2]No Discharge means that the RLWTF did not discharge any effluent during the 7-day period precedeing the composite date.

[3]1st quarter 2011 averages include the results from Dec 2010, if applicable.

[4]The NM WQCC Regulation 3103 Ground Water Standard is for nitrate (NO_3-N).

[5]NA means that there is no NM WQCC 3103 standard for this analyte.

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Table 3.0. RLWTF Final Monthly Composite (FMC) Effluent Sampling, 1st Quarter, 2011.

Monitoring Period	RLWTF FMC Results[1]			
	NO_3-N (mg/L)	Perchlorate by IC[2] (ug/L)	TDS (mg/L)	F (mg/L)
January 2011	---- No Discharges ----			
February 2011	---- No Discharges ----			
March 2011	---- No Discharges ----			
NMWQCC 3103 Groundwater Standards	***10 mg/L***	***NA[3]***	***1000 mg/L***	***1.6 mg/L***

Notes:

[1]Analysis by the TA-50 Radioactive Liquid Waste Treatment Facility's analytical laboratory.

[2]IC means EPA Method 314.0, perchlorate analysis by Ion Chromatography.

[3]NA means that there is no NM WQCC 3103 standard for this analyte.

23583

ENCLOSURE 3
Radioactive Liquid Waste Treatment Facility
Project 100761 (RLWTF-UP)
ZLD Subproject
July 13, 22011

ENV-RCRA-11-0136
LAUR-11-11041

Los Alamos
NATIONAL LABORATORY
Los Alamos NM 87545

60% Design Package: Drawings, Specifications, Calculations

UNCLASSIFIED

"Enclosure 3_CD_Design Calculations" file

:04585

ZERO LIQUID DISCHARGE SUBPROJECT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

100761-11-000090_Calcs

60% Design Submittal

Specifications, Calculations, Test and Inspection Plan, Master Document List, and Field Change Notice Criteria Document

July 13, 2011

Prepared For:

ECC
1640 Cole Boulevard
Building 21, Suite 350
Lakewood, CO 80401

Prepared By:

BURNS AND ROE ENTERPRISES
800 KINDERKAMACK ROAD
ORADELL, NJ 07649

Table of Contents

This submittal book contains the following documents:

Burns and Roe Enterprises, Inc.

W.O. No: 03131-001 **Calc.** 03131-001-CS-100 **Sheet No:** 1 **Cont'd on Sht:** 2

Client: ECC / LANL **Project:** Zero Liquid Discharge Subproject

Title: Evaporation Tank – Structural Design

REVISION RECORD 100761-11-000090

Revision	Status	Description of Revision	Preparer print/sign/date	Checker print/sign/date	Approver print/sign/date
A	Preliminary	Original Issue – 60% Design	J. Cook J. Cook 07-08-2011	M. Wong 7/8/2011	B. Urgo 7/8/2011

PE Seal (if required)

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	**Calc.**	03131-001-CS-100	**Sheet No:**	2	**Cont'd on Sht:**	3
Client:	ECC / LANL	**Project:**	Zero Liquid Discharge Subproject				
Title:	Evaporation Tank -- Structural Design						

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Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-CS-100	Sheet No:	3	Cont'd on Sht:	4
Prepared By:	JC	Date:	06/30/2011	Checked By:	MLW	Date:	7/8/2011
Title:	Evaporation Tank – Structural Design						

PURPOSE

The purpose of this calculation is to perform the structural analysis and design of the Reinforced Concrete Evaporation Tank.

REFERENCES

1. "LANL Engineering Standards Manual ISD 341-2". Chapter 5 – Structural, Section I, Revision 5. Dated 11/19/2008.
2. "LANL Engineering Standards Manual ISD 341-2". Chapter 5 – Structural, Section II, Revision 5. Dated 06/16/2008.
3. International Building Code, 2006 Edition.
4. ASCE Standard 7-05, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, 2005 Edition.
5. ACI Standard 318-05, Building Code Requirements for Structural Concrete and Commentary, American Concrete Institute, 2005 Edition.
6. ACI Standard 350.3-01, Seismic Design of Liquid-Containing Concrete Structures and Commentary, American Concrete Institute, 2001 Edition.
7. "Geotechnical Evaluation – Zero Liquid Discharge Project". Western Technologies Inc., Dated 06/23/2011.
8. "Zero Liquid Discharge (ZLD) Subproject – Requirements and Criteria Document, Document ID: 100761-ZLD-RCD-0003, Revision 0, November 2010.
9. "Principles of Geotechnical Engineering". Fifth Edition, Braja M. Das, 2002.

DESIGN REQUIREMENTS

1. Follow all of the design and analysis requirements for a Natural Phenomena Hazards Performance Category (PC) 1 structure in accordance with References 1, 2 and 7.
2. All applicable load configurations and load combinations shall be used in accordance with References 3.

UNCONFIRMED ASSUMPTIONS

None

DESIGN PROCEDURES

1. Calculate all of the design loads (i.e. wind, snow and earthquake loads) for a PC-1 Structure.
2. Calculate all of the lateral forces applied to the evaporation tank due to earth pressures, water pressures and surcharges.
3. Evaluate the sliding and overturning stability of the evaporation tank. Analyze the tank similar to a retaining wall, following the requirements of Section 15.7.6.1 of Reference 4. The shortest lateral dimension of the tank is approximately 70 feet. Using this large value as the footing width for a 4 foot high wall will not give an accurate representation of the lateral force resistance and transfer that will exist. Therefore, evaluate the stability criteria using a smaller footing width. A width of 7 feet (approximately 10% of the actual width) is selected for this analysis. Any construction or expansion joints placed in the tank will be larger than 7 feet from the edge of the tank, so this analysis will provide conservative stability results. Each of the Allowable Stress Design Load Combinations listed in Reference 3 will be evaluated for two separate, worst-case loading configurations.
4. Load Configuration 1 evaluates the stability of the exterior walls of an empty tank with a grade elevation at six inches below the top of the tank walls.
5. Load Configuration 2 evaluates the stability of the interior wall that separates the two halves of the tank. One side of the tank is full with water (with 1 foot of freeboard), and the other side is empty.

6. Calculate the applied bearing pressure considering a third load configuration (Load Configuration 3), which applies the maximum amount of pressure on the slab. This configuration evaluates a full tank (with 1 foot of freeboard), and the grade elevation is located six inches below the top of the tank walls.
7. Each of the Load Factor and Resistance Design Load Combinations listed in Reference 3 will be evaluated for Load Configurations 1 and 2. Use these loads to determine the maximum shear and moment applied to the reinforced concrete walls and slabs.
8. Design the reinforced concrete walls and slab of the evaporation tank using these shears and moments.

COMPUTER TYPE: NA , OPERATING SYSTEM: NA .

1. COMPUTER PROGRAM: NA VERSION: NA .

☐ APPROVED ☐ AUTHORIZED

ESI No.

2. COMPUTER PROGRAM: N/A VERSION: N/A .

☐ APPROVED ☐ AUTHORIZED

ESI No.

CONCLUSIONS

The Reinforced Concrete Evaporation Tank is designed to withstand all applicable loads, as determined by Reference 3. All walls will require a minimum thickness of 10 inches, with steel reinforcement as #4 bars spaced at 12 inches on each face. The slab will be a minimum of 8 inches thick, with steel reinforcement as #4 bars spaced at 12 inches in both directions. The slab will be thickened to 15 inches below all perimeter and interior walls.

BODY OF CALCULATION

SEE NEXT PAGE

BURNS AND ROE ENTERPRISES, INC.

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Prepared By:	JC	Date:	06/30/11	Checked By:	MLW	Date:	7/8/2011

Title: Evaporation Tank - Structural Design

DESIGN LOADS FOR PC-1 SSC

(Per IBC 2006 & ASCE 7-05, as further amended by LANL Engineering Standards Manual ISD 341-2)

OCCUPANCY CATEGORY

Occupancy Category = II *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.1 A)*

DEAD LOADS

Future Floor Dead Load = 10 psf *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.3.1)*

(This allowance shall be included in addition to actual project dead loads.)

LIVE LOADS

Truck Live Load (q) = 50 psf *(IBC 2006, Section 1607.6)*

(Applied as a surcharge load on the side of the tank wall.)

Minimum Roof Live Load (L_r) = 30 psf *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.4.2 A)*

(This load shall not be reduced. This load is not applicable for an open tank, buried in the ground.)

WIND LOADS

Basic Wind Speed (V) = 90 mph *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.6 A)*

Exposure Category = C *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.6 B)*

Importance Factor (I_W) = 1.0 *(ASCE 7-05, Table 6-1)*

SNOW LOADS

Ground Snow Load (p_g) = 16 psf *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.5 A)*

Exposure Factor (C_e) = 0.9 *(ASCE 7-05, Table 7-2)*

(Terrain Category C, Fully Exposed)

Thermal Factor (C_t) = 1.2 *(ASCE 7-05, Table 7-3)*

Importance Factor (I_S) = 1.0 *(ASCE 7-05, Table 7-4)*

Snow Load (p_f):

$p_f = 0.7\, C_e\, C_t\, I_S\, p_g =$ 0.7 (0.9)(1.2)(1)(16 psf) = 12 psf *(ASCE 7-05, Equation 7-1)*

For $p_g < 20$ psf $\rightarrow$ $p_f \geq (I)\, p_g =$ 16 psf *(ASCE 7-05, Section 7.3)*

For $p_g > 20$ psf $\rightarrow$ $p_f \geq 20\,(I) =$ 20 psf *(ASCE 7-05, Section 7.3)*

Snow Load (p_f) = 16 psf

EARTHQUAKE LOADS

Occupancy Importance Factor (I_E) = 1.0 *(ASCE 7-05, Table 11.5-1)*

Component Importance Factor (I_P) = 1.0 *(ASCE 7-05, Section 13.1.3)*

Spectral Response Acceleration Coeffiecients, S_S and S_1:

$S_S =$ 0.49 g *(IBC 2006, Figure 1613.5(1))*

$S_1 =$ 0.16 g *(IBC 2006, Figure 1613.5(2))*

Site Classification:

Site Class = C *(Western Technologies Inc. - Geotechnical Evaluation, Section 6.4)*

Site Coefficients, F_a and F_v:

F_a = 1.41 *(IBC 2006, Table 1613.5.3(1) OR ASCE 7-05, Table 11.4-1)*

F_v = 2.17 *(IBC 2006, Table 1613.5.3(2) OR ASCE 7-05, Table 11.4-2)*

Max Considered Earthquake Spectral Response Accelerations, S_{MS} and S_{M1}:

$S_{MS} = F_a S_S = (1.41)(0.49\ g) =$ 0.69 g *(IBC 2006, Eq. 16-37 OR ASCE 7-05, Eq. 11.4-1)*

$S_{M1} = F_v S_1 = (2.17)(0.16\ g) =$ 0.35 g *(IBC 2006, Eq. 16-38 OR ASCE 7-05, Eq. 11.4-2)*

Design Earthquake Spectral Response Acceleration Parameters, S_{DS} and S_{D1}:

$S_{DS} = ⅔\, S_{MS} =$ 0.46 g *(IBC 2006, Eq. 16-39 OR ASCE 7-05, Eq. 11.4-3)*

$S_{D1} = ⅔\, S_{M1} =$ 0.23 g *(IBC 2006, Eq. 16-40 OR ASCE 7-05, Eq. 11.4-4)*

Use, S_{DS} = 0.75 g *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.7.1 A)*

Use, S_{D1} = 0.64 g *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.7.1 A)*

Seismic Design Category:

Based on S_{DS} = D *(IBC 2006, Table 1613.5.6(1) OR ASCE 7-05, Table 11.6-1)*

Based on S_{D1} = D *(IBC 2006, Table 1613.5.6(2) OR ASCE 7-05, Table 11.6-2)*

Seismic Design Category = D *(LANL Engineering Standards Manual ISD 341-2: Ch. 5, Sect. II, Item 1.7.1 B)*

SEISMIC BASE SHEAR

(According to the Equivalent Lateral Force Procedure of ASCE 7-05, Sections 12.8 and 15.4)

Seismic Response Coefficient (C_s):

R = 2.0 *(ASCE 7-05, Table 15.4-2 Flat-bottom ground-supported tanks - Reinforced concrete - Reinforced nonsliding base)*

I = 1.0

S_{DS} = 0.75 g

S_1 = 0.16 g

$C_s \geq$ 0.03 *(ASCE 7-05, Equation 15.4-1)*

If $S_1 \geq 0.6\ g$

$C_s \geq 0.8\, S_1 / (R/I) =$ 0.8 (0.16) / (2 / 1) = 0.064 ($S_1 < 0.6\ g$) → NA *(ASCE 7-05, Equation 15.4-2)*

$$C_s = \frac{S_{DS}}{R/I} = \frac{0.75\ g}{2\ /\ 1.0} = \mathbf{0.375} \geq 0.03$$ ***OK*** *(ASCE 7-05, Equation 12.8-2)*

Seismic Base Shear (V):

$V = C_s W$ = 0.375 W

REINFORCED CONCRETE EVAPORATION TANK CALCULATION

The Reinforced Concrete Evaporation Tank will resist lateral loads similar to a retaining wall. The tank is approximately 500 ft long and 70 ft wide.

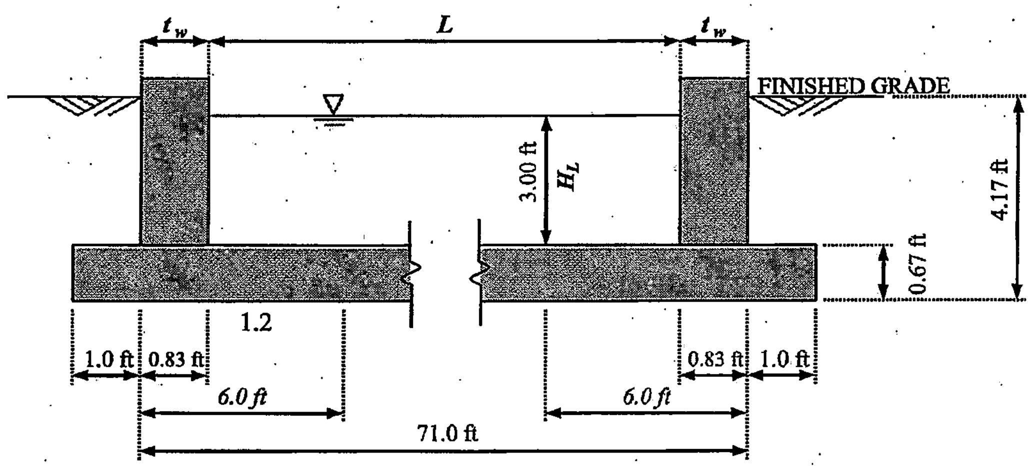
Due to the large dimensions of the base slab, the retaining wall stability criteria will be evaluated using a center of overturning that measures 7 ft from the edge of the slab. This evaluation will be completed in order to show that the tank will not have any problems related to overturning stability.

The thickened slab around the perimeter of the Reinforced Concrete Evaporation Tank is conservatively neglected in the stability calculations.

The groundwater depth is assumed to be below the bottom of the foundation.

Wind loads are neglected.

The 3 ft water level depth shown below includes the depth of rain water. Refer to BREI Calculation 03131-001-ME-100 for more details.



CONSTANTS

Unit Weight of Soil (γ) =	115 pcf	*(Western Technologies Inc. - Geotechnical Evaluation, Section 6.3)*
Unit Weight of Concrete (γ_c) =	150 pcf	
Unit Weight of Water (γ_w) =	62.4 pcf	
Adhesion Factor (c') =	0 psf	*(Western Technologies Inc. - Geotechnical Evaluation, Section 6.3)*
Effective Friction Angle (ϕ') =	30.0 °	*(Western Technologies Inc. - Geotechnical Evaluation, Section 6.3)*
Slope of Soil/Wall Interface (θ) =	0.0 °	*(Conservatively use the effective friction angle for native undisturbed soil.)*
Soil/Wall Friction Angle (δ) =	0.0 °	
Slope of Ground Surface (α) =	0.0 °	
Truck Surcharge (q) =	50 psf	
Coefficient of Friction (μ) =	0.45	*(Western Technologies Inc. - Geotechnical Evaluation, Section 6.3)*

LATERAL EARTH PRESSURES

(All earth pressure formulas per Chapter 12 of "Principles of Geotechnical Engineering", Das 2002.)

(Per IBC 2006, Section 1610.1 - Retaining walls free to move and rotate at the top are permitted to be designed for active pressure.)

ACTIVE EARTH PRESSURE

(According to Rankine's Theory of Active Pressure)

Active Earth Pressure Coefficient (K_a):

$$K_a = \tan^2\left(45 - \frac{\phi'}{2}\right) = \frac{1-\sin\phi'}{1+\sin\phi'} = \frac{1-\sin(30)}{1+\sin(30)} = 0.333$$

Total force per unit lenth of wall (at H/3):

$$P_a = \frac{K_a \gamma H^2}{2} = \frac{[\ 0.333\ ][\ 115\text{ pcf}\ ][\ 4.2\text{ ft}\ ]^2}{2} \quad \frac{1\ k}{1000\ lb} = \mathbf{0.333\ klf}$$

Surcharge force per unit lenth of wall (at $H/2$):

$$P_{a,\,truck} = K_a q = (0.333)\quad(50\text{ psf})\quad(1\text{ ft width})\quad \frac{1\ k}{1000\ lb} = \mathbf{0.017\ klf}$$

$$P_{a,\,snow} = K_a p_f = (0.333)\quad(16\text{ psf})\quad(1\text{ ft width})\quad \frac{1\ k}{1000\ lb} = \mathbf{0.005\ klf}$$

ACTIVE EARTHQUAKE FORCE ON THE RETAINING WALL

(According to Coulomb's Theory of Active Pressure - Utilizing the Mononobe-Okabe Equations)

Seismic Coefficients:

k_h = *Horizontal Component of Earthquake Acceleration / g* = 0.375

k_v = *Vertical Component of Ea* 1.2 0.000

$$\beta = \tan^{-1}\left(\frac{k_h}{1-k_v}\right) = \tan^{-1}\left(\frac{0.375}{1-0}\right) = 20.6$$

Seismically Induced Active Earth Pressure Coefficient (K_{ae}):

$$K_{ae} = \frac{\cos^2\ (\phi' - \theta - \beta)}{\cos^2(\theta)\quad \cos(\beta)\quad \cos(\delta+\theta+\beta)\left(1 + \sqrt{\dfrac{\sin\ (\delta+\phi')\quad \sin\ (\phi'-\alpha-\beta)}{\cos\ (\delta+\theta+\beta)\quad \cos\ (\theta-\alpha)}}\right)^2}$$

$$K_{ae} = \frac{\cos^2\ (30-0-20.56)}{\cos^2(0)\quad \cos(20.6)\quad \cos\ (0+0+20.6)\left(1 + \sqrt{\dfrac{\sin\ (0+30)\quad \sin\ (30-0-20.6)}{\cos\ (0+0+20.6)\quad \cos\ (0-0)}}\right)^2}$$

K_{ae} = 0.661

Total force per unit lenth of wall (at 0.6H):

$$P_{ae} = \frac{K_{ae}(1-k_v)\gamma H^2}{2} = \frac{[\ 0.661\ ][\ 1.000\ ][\ 115\text{ pcf}\ ][\ 4.2\text{ ft}\ ]^2}{2} \quad \frac{1\ k}{1000\ lb}$$

P_{ae} = **0.660 klf**

Surcharge force per unit lenth of wall (at $H/2$):

$$P_{ae,\,truck} = K_{ae}\,q = (0.661)\quad(50\text{ psf})\quad(1\text{ ft width})\quad\frac{1\,k}{1000\,lb} = \mathbf{0.033\ klf}$$

$$P_{ae,\,snow} = K_{ae}\,p_f = (0.661)\quad(16\text{ psf})\quad(1\text{ ft width})\quad\frac{1\,k}{1000\,lb} = \mathbf{0.011\ klf}$$

LATERAL WATER PRESSURE

(All water pressures result from water inside the Reinforced Concrete Evaporation Tank.)

HYDROSTATIC PRESSURE

$$u_w = (\gamma_w)(H_w) = (62.4\text{ pcf})\quad(3.00\text{ ft}) = 187\text{ psf}$$

Total force per unit lenth of wall (at $H_w/3$):

$$F_w = \frac{(u_w)(H_w)}{2} = \frac{(187\text{ psf})\quad(3.00\text{ ft})}{2} * \frac{1\,k}{1000\,lb} = \mathbf{0.281\ klf}$$

SEISMIC DESIGN OF LIQUID-CONTAINING CONCRETE STRUCTURES

(According to ACI 350.3-01)

Per ASCE 7-05, Section 15.7.6.1.1 - The method given in ACI 350.3 is permitted to be used to determine the vertical and horizontal distribution of the hydrodynamic and inertia forces on the walls of rectangular tanks.

DESIGN PARAMETERS - TYPE 1 RECTANGULAR TANK

Length Parallel to the Direction of the Earthquake Force (L) =	70.0 ft	
Length Perpendicular to the Direction of the Earthquake Force (B) =	250.0 ft	
Average Wall Thickness (t_w) =	10.0 in	
Wall Height (H_w) =	4.0 ft	
Design Depth of Stored Liquid (H_L) =	3.0 ft	
Specific Weight of Concrete (γ_c) =	150 pcf	
Specific Weight of the Contained Liquid (γ_L) =	62.4 pcf	*(Water)*
Specified Compression Strength of Concrete (f'_c) =	4000 psi	
Mass Density of Concrete (ρ_c) =	4.66	(γ_c / g) → units = lb-s^2 / ft^4
Mass Density of the Contained Liquid (ρ_L) =	1.94	(γ_L / g) → units = lb-s^2 / ft^4

Seismic Zone Factor (Z) =	0.2	*(ACI 350.3, Fig. 4.1 & Table 4(a))*
Site Profile Coefficient (S) =	1.5	*(ACI 350.3, Table 4(b))*
Importance Factor (I) =	1.0	*(ACI 350.3, Table 4(c))*
Response Modification Factor for the Impulsive Component (R_{wi}) =	4.0	*(ACI 350.3, Table 4(d))*
Response Modification Factor for the Convective Component (R_{wc}) =	1.0	*(ACI 350.3, Table 4(d))*

Mass of One Wall Perpendicular to the Direction of the Earthquake Force (W_w'):

$$W_w' = (\gamma_c)\ (B)\ (H_w)\ \ 1.2$$

$$W_w' = (150\text{ pcf})\ (250.0\text{ ft})\ (4.0\text{ ft})\ (0.83\text{ ft})\ \frac{1\ k}{1000\ lb} = 125\text{ k}$$

Height from the Base of the Wall to the Center of Gravity of the Tank Wall (h_w):

$$h_w = \frac{H_w}{2} = \frac{4.0\text{ ft}}{2} = 2.0\text{ ft}$$

Total Mass of the Stored Liquid (W_L):

$$W_L = (\gamma_L)\ (B)\ (L)\ (H_L)$$

$$W_L = (62.4\text{ pcf})\ (250.0\text{ ft})\ (70.0\text{ ft})\ (3.00\text{ ft})\ \frac{1\ k}{1000\ lb} = 3{,}276\text{ k}$$

EQUIVALENT MASSES OF ACCELERATING LIQUID

(ACI 350.3, Section 9.2.1)

Impulsive Component:

$$\frac{W_i}{W_L} = \frac{\tanh[0.866(L/H_L)]}{0.866(L/H_L)} \qquad \textit{(ACI 350.3, Equation 9-1)}$$

$$\frac{W_i}{W_L} = \frac{\tanh[0.866 \quad (70.0\text{ ft}) \quad / \quad (3.0\text{ ft})]}{0.866 \quad (70.0\text{ ft}) \quad / \quad (3.0\text{ ft})} = 0.049$$

$$W_i = 0.049 \quad W_L = 0.049 \quad (3{,}276\text{ k}) = \mathbf{162\text{ k}}$$

Convective Component:

$$\frac{W_c}{W_L} = 0.264(L/H_L)\tanh[3.16(H_L/L)] \qquad \textit{(ACI 350.3, Equation 9-2)}$$

$$\frac{W_c}{W_L} = 0.264 \quad \frac{(70.0\text{ ft})}{(3.0\text{ ft})} \tanh\left(\frac{3.16 \quad (3.0\text{ ft})}{(70.0\text{ ft})}\right) = 0.829$$

$$W_c = 0.829 \quad W_L = 0.829 \quad (3{,}276\text{ k}) = \mathbf{2{,}716\text{ k}}$$

HEIGHT TO CENTER OF GRAVITY, EBP

(ACI 350.3. Section 9.2.2)

Impulsive Lateral Force:

$$\frac{L}{H_L} = \frac{(70.0\text{ ft})}{(3.0\text{ ft})} = 23.3 \geq 1.333$$

For $L/H_L < 1.333$: → *NOT APPLICABLE FOR THIS TANK*

$$\frac{h_i}{H_L} = 0.5 - 0.09375\frac{L}{H_L} \qquad \textit{(ACI 350.3, Equation 9-3)}$$

$$\frac{h_i}{H_L} = 0.5 - 0.09375 \quad (23.3) = -1.688 \quad \textit{(NA)}$$

For $L/H_L \geq 1.333$:

$$\frac{h_i}{H_L} = 0.375 \quad \textit{(GOVERNS)} \qquad \textit{(ACI 350.3, Equation 9-4)}$$

Height to Center of Gravity (h_i):

$$h_i = 0.375 \quad H_L = 0.375 \quad (3.0\text{ ft}) = \mathbf{1.13\text{ ft}}$$

Convective Lateral Force:

$$\frac{h_c}{H_L} = 1 - \frac{\cosh[3.16(H_L/L)] - 1}{3.16(H_L/L)\sinh[3.16(H_L/L)]} \qquad \textit{(ACI 350.3, Equation 9-5)}$$

$$\frac{h_c}{H_L} = 1 - \frac{\cosh[3.16 \quad (3.0\text{ ft}) \quad / \quad (70.0\text{ ft})] - 1}{3.16 \quad (3.0\text{ ft}) \quad / \quad (70.0\text{ ft}) \sinh[3.16 \quad (3.0\text{ ft}) \quad / \quad (70.0\text{ ft})]}$$

$$\frac{h_c}{H_L} = 0.501$$

Height to Center of Gravity (h_c):

$$h_c = 0.501 \quad H_L = 0.501 \quad (3.0\text{ ft}) = \mathbf{1.50\text{ ft}}$$

SPECTRAL AMPLIFICATION FACTORS

(ACI 350.3. Section 9.4)

Factor of the Horizontal Motion of the Impulsive Component (C_i):

$$C_i = \frac{2.75}{S} = \frac{2.75}{1.5} = 1.83$$

(C_i may be conservatively taken as 2.75 / S for any tank.) *(ACI 350.3, Section R9.4)*

Factor of the Horizontal Motion of the Convective Component (C_c):

$$C_c = \frac{6.0}{T_c^{\,2}}$$ *(ACI 350.3. Equation 9-33)*

Coefficient (λ_c):

$$\lambda = \sqrt{3.16\,(g)\tanh[3.16\,(H_L/L)]}$$ *(ACI 350.3, Equation 9-13)*

$$\lambda = \sqrt{3.16\left(32.17\ \text{ft/s}^2\right)\tanh\left(\frac{3.16\ (3.0\ \text{ft})}{(70.0\ \text{ft})}\right)} = 3.70$$

Circular Frequency of the Convective Mode of Sloshing (ω_c):

$$\omega_c = \frac{\lambda}{\sqrt{L}} = \frac{3.70}{\sqrt{70.0\ \text{ft}}} = 0.44\ \frac{\text{rad}}{\text{s}}$$ *(ACI 350.3. Equation 9-12)*

Natural Period of the Convective Mode of Sloshing (T_c):

$$T_c = \frac{2\pi}{\omega_c} = \frac{2\pi}{0.44\ \text{rad/s}} = 14.2\ \text{s}$$ *(ACI 350.3, Equation 9-14)*

Factor of the Horizontal Motion of the Convective Component (C_c):

$$C_c = \frac{6.0}{T_c^{\,2}} = \frac{6.0}{(14.2\ \text{s})^2} = 0.03$$ *(ACI 350.3, Equation 9-33)*

EFFECTIVE MASS COEFFICIENT FOR RECTANGULAR TANKS

(ACI 350.3. Section 9.5.1)

$$\varepsilon = 0.0151\left(\frac{L}{H_L}\right)^2 - 0.1908\,\frac{L}{H_L} + 1.021 \leq 1.0$$ *(ACI 350.3, Equation 9-34)*

$$\varepsilon = 0.0151\left(\frac{70.0\ \text{ft}}{3.0\ \text{ft}}\right)^2 - 0.1908\,\frac{70.0\ \text{ft}}{3.0\ \text{ft}} + 1.021 = 4.79 \leq 1.0$$

$$\varepsilon = 1.0$$

DYNAMIC LATERAL FORCES

(ACI 350.3, Section 4.1.1)

Lateral Inertia Force of One Accelerating Wall Perpendicular to the Direction of the Earthquake Force (P_w'):

$$P_w' = (Z)(S)(I)(C_i)\frac{(\varepsilon)(W_w')}{(R_{wi})}$$ *(ACI 350.3, Equation 4-1a)*

$$P_w' = (0.2)(1.5)(1.0)(1.83)\frac{(1.0)(125\text{ k})}{4.0} = \mathbf{17.2\ k}$$

Total Lateral Impulsive Force (P_i):

$$P_i = (Z)(S)(I)(C_i)\frac{(\varepsilon)(W_i)}{(R_{wi})}$$ *(ACI 350.3, Equation 4-3)*

$$P_i = (0.2)(1.5)(1.0)(1.83)\frac{(1.0)(162\text{ k})}{4.0} = \mathbf{22.3\ k}$$

Total Lateral Convective Force (P_c):

$$P_c = (Z)(S)(I)(C_c)\frac{(\varepsilon)(W_c)}{(R_{wc})}$$ *(ACI 350.3, Equation 4-4)*

$$P_c = (0.2)(1.5)(1.0)(0.03)\frac{(1.0)(2716\text{ k})}{1.0} = \mathbf{24.2\ k}$$

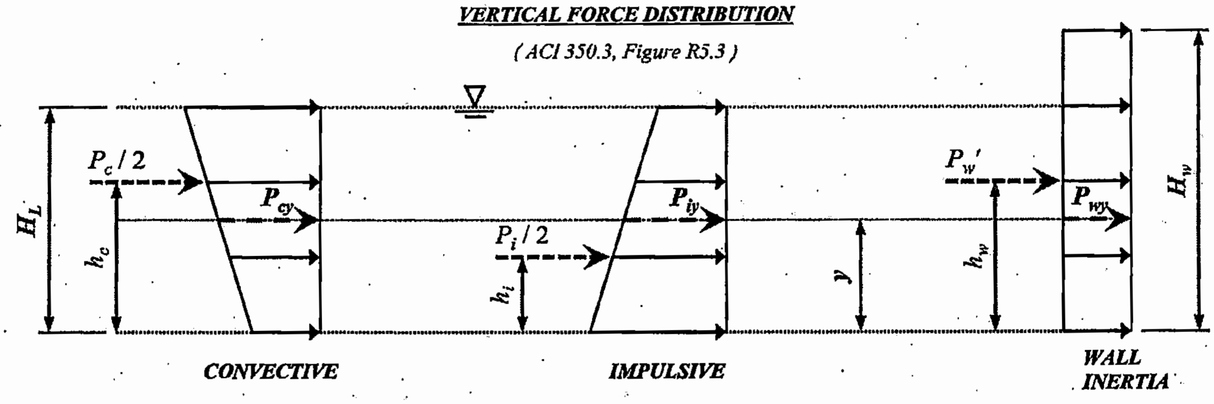
DYNAMIC FORCE DISTRIBUTION ABOVE BASE FOR RECTANGULAR TANKS

(ACI 350.3, Section 5.3.1)

Liquid Level at Which the Wall is Being Investigated (y):

VERTICAL FORCE DISTRIBUTION

(ACI 350.3, Figure R5.3)



$$y = \frac{\tfrac{1}{2}P_c h_c + \tfrac{1}{2}P_i h_i + P_w' h_w}{\tfrac{1}{2}P_c + \tfrac{1}{2}P_i + P_w'}$$ *(ACI 350.3, Section R5.3.1)*

$$y = \frac{\tfrac{1}{2}(24.2\text{ k})(1.5\text{ ft}) + \tfrac{1}{2}(22.3\text{ k})(1.13\text{ ft}) + (17.2\text{ k})(2.0\text{ ft})}{\tfrac{1}{2}(24.2\text{ k}) + \tfrac{1}{2}(22.3\text{ k}) + (17.2\text{ k})}$$

$$y = 1.61\text{ ft}$$

[The Unit Equivalent Hydrodynamic Pressure Due to Vertical Acceleration (p_{vy}) is not considered in the calculation of y. This force is extremely small relative to P_c, P_i and P_w' and will not significantly affect the value of y.]

Lateral Inertia Force per Unit Height of Tank Wall Occurring at Level y above the Tank Base (P_{wy}):

$$P_{wy} = (Z)\ (S)\ (I)\ \frac{(C_i)}{(R_{wi})} * \frac{(\varepsilon)\ (\gamma_c)\ (B)\ (t_w)}{12}$$ *(ACI 350.3, Figure R5.3)*

$$P_{wy} = (0.2)\ (1.5)\ (1.0)\ \frac{(1.83)}{4.0} * \frac{(1.0)\ \ (150\text{ pcf})\ \ (250.0\text{ ft})\ \ (10.00\text{ in})}{12} * \frac{1\ k}{1000\ lb}$$

P_{wy} = 4.30 k *(per unit height of wall)*

Applied to the entire height of the wall ($P_{wy}\ H_w$):

P_{wy} = 4.30 k (4.00 ft) = **17.2 k** *(applied across the entire wall width)*

Lateral Impulsive Force per Unit Height of Tank Wall Occurring at Level y above the Tank Base (P_{iy}):

$$P_{iy} = \frac{\tfrac{1}{2} P_i [\,4 H_L - 6 h_i - (\,6 H_L - 12 h_i\,)(\,y/H_L\,)}{H_L^{\,2}}$$ *(ACI 350.3, Figure R5.3)*

$$P_{iy} = \frac{\tfrac{1}{2}(\,22.3\text{ k})[\,4(\,3\text{ ft}) - 6(\,1.13\text{ ft}) - (\,6 * 3\text{ ft} - 12 * 1.13\text{ ft})(\,1.61\text{ ft}/3\text{ ft})\,]}{(\,3.0\text{ ft})^{2}}$$

P_{iy} = 3.51 k *(per unit height of wall)*

Applied to the entire height of the wall ($P_{iy}\ H_L$):

P_{iy} = 3.51 k (3.00 ft) = **10.5 k** *(applied across the entire wall width)*

Lateral Convective Force per Unit Height of Tank Wall Occurring at Level y above the Tank Base (P_{ic}):

$$P_{cy} = \frac{\tfrac{1}{2} P_c [\,4 H_L - 6 h_c - (\,6 H_L - 12 h_c\,)(\,y/H_L\,)}{H_L^{\,2}}$$ *(ACI 350.3, Figure R5.3)*

$$P_{cy} = \frac{\tfrac{1}{2}(\,24.2\text{ k})[\,4(\,3\text{ ft}) - 6(\,1.5\text{ ft}) - (\,6 * 3\text{ ft} - 12 * 1.5\text{ ft})(\,1.61\text{ ft}/3\text{ ft})\,]}{(\,3.0\text{ ft})^{2}}$$

P_{cy} = 4.04 k *(per unit height of wall)*

Applied to the entire height of the wall ($P_{cy}\ H_L$):

P_{cy} = 4.04 k (3.00 ft) = **12.1 k** *(applied across the entire wall width)*

VERTICAL ACCELERATION *(ACI 350.3, Section 4.1.4)*

Effective Spectral Acceleration from an Inelastic Vertical Response Spectrum ($\ddot{u}_v$):

$$\ddot{u}_v = (Z)\ (S)\ (I)\ (C_v)\ \frac{b}{(R_{wi})}$$ *(ACI 350.3, Equation 4-15)*

$$\ddot{u}_v = (0.2)\ (1.5)\ (1.0)\ (1.0)\ \frac{2/3}{4.0} = 0.050$$

(Where C_v = 1.0 for Rectangular Tanks and $b \geq 2/3$) *(ACI 350.3, Section 4.1.4)*

Unit Hydrostatic Pressure at Level y above the Tank Base (q_{hy}):

$$q_{hy} = (\gamma_L)\ (H_L - y)$$ *(ACI 350.3, Section 1.2)*

q_{hy} = (62.4 pcf) [3.0 ft - 1.61 ft] = 86.7 psf *(per unit height of wall)*

Unit Equivalent Hydrodynamic Pressure Due to the Vertical Acceleration at Level y above the Tank Base (p_{vy}):

$$p_{vy} = (\ddot{u}_v)(q_{hy})$$ *(ACI 350.3, Equation 4-14)*

$$p_{vy} = (0.050)\ (86.7\text{ psf})\ \frac{1\,k}{1000\,lb} = 0.004\text{ ksf}$$

Applied to the entire height of the wall ($p_{vy}\ H_L\ B$):

$$P_{vy} = (p_{vy})(H_L)(B)$$

$$P_{vy} = 0.004\text{ ksf}\ (3.00\text{ ft})\ (250.0\text{ ft}) = \mathbf{3.3\ k}$$ *(applied across the entire wall width)*

COMBINING DYNAMIC FORCES FOR RECTANGULAR TANKS *(ACI 350.3. Section 5.3.2)*

Combined Horizontal Force at Level y above the Tank Base (P_y):

$$P_y = \sqrt{(P_{iy} + P_{wy})^2 + P_{cy}^{\ 2} + (P_{vy})^2}$$ *(ACI 350.3, Equation 5-1)*

[Equation 5-1 has been modified to calculate the total lateral dynamic forces applied to the tank wall.]

$$P_y = \sqrt{[\,(10.5\text{ k}) + (17.2\text{ k})\,]^2 + (12.1\text{ k})^2 + (3.3\text{ k})^2}$$

$$P_y = \mathbf{30.4\ k}$$ *(applied across the entire wall width)*

Combined Horizontal Distribution of the Dynamic Pressures Across the Wall Width B :

$$\frac{P_y}{B} = \frac{30.4\text{ k}}{250.0\text{ ft}} = \mathbf{0.12\ k}$$ *(per linear foot of wall)*

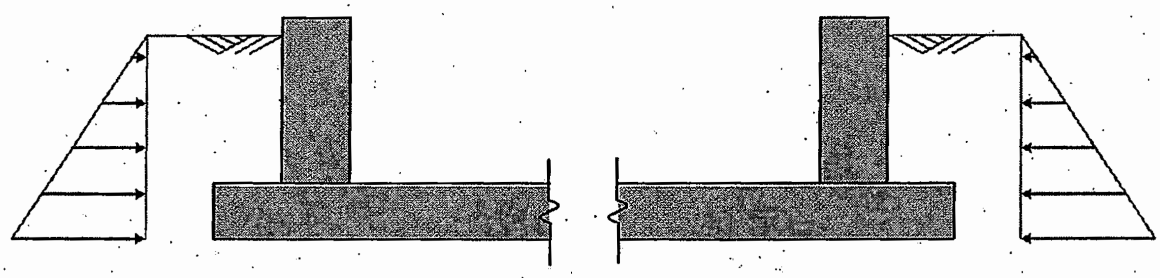
$$\frac{P_y}{B}(y) = (0.12\text{ k})\ (1.61\text{ ft}) = \mathbf{0.19\ ft\text{-}k}$$ *(per linear foot of wall)*

LOAD CONFIGURATION 1

(The Evaporation Tank is empty. The grade elevation is six inches below the top of the tank walls.)

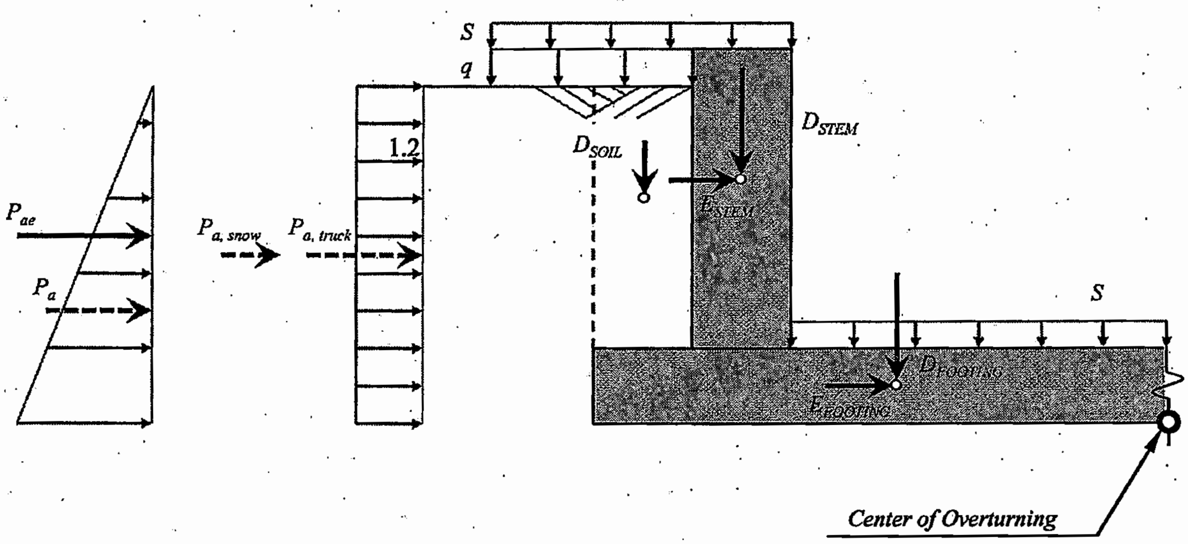
(Per IBC 2006, Section 15.7.6.1(c) - Calculate the overturning stability of the wall following the requirements of Section 15.4.)

SLIDING STABILITY



Since the top of the tank is located six inches above the grade elevation, lateral earth pressures on both side walls of the tank will prevent sliding.

OVERTURNING STABILITY



Snow load on top of the tank will create a resisting moment about the center of overturning. This moment will be neglected. A a lateral snow surcharge will be consider when calculating the driving moments.

DEAD LOAD *(Applied at the centroids)*

Concrete Stem (D_{STEM}) =	(150 pcf)	(4.0 ft)	(0.83 ft)	(1 k / 1000 lb)	=	0.500 klf
Concrete Footing ($D_{FOOTING}$) =	(150 pcf)	(0.67 ft)	(7.0 ft)	(1 k / 1000 lb)	=	0.700 klf
Soil Above Tank (D_{SOIL}) =	(115 pcf)	(3.5 ft)	(1.0 ft)	(1 k / 1000 lb)	=	0.403 klf

EARTHQUAKE LOAD *(Applied at the centroids)*

Concrete Stem (E_{STEM}) = C_s D_{STEM} =	0.375	(0.500 klf)	=	0.188 klf
Concrete Footing ($E_{FOOTING}$) = C_s $D_{FOOTING}$ =	0.375	(0.700 klf)	=	0.263 klf

LOAD COMBINATIONS (ASD) *(IBC 2006, Section 1605.3)*

Condsider the following load combinations:

$D + F$ *(IBC 2006, Equation 16-8)*

$D + H + F + L + T$ *(IBC 2006, Equation 16-9)*

$D + H + F + (L_r \text{ or } S \text{ or } R)$ *(IBC 2006, Equation 16-10)*

$D + H + F + 0.75(L + T) + 0.75(L_r \text{ or } S \text{ or } R)$ *(IBC 2006, Equation 16-11)*

$D + H + F + (W \text{ or } 0.7E)$ *(IBC 2006, Equation 16-12)*

$D + H + F + 0.75(W + 0.7E) + 0.75L + 0.75(L_r \text{ or } S \text{ or } R)$ *(IBC 2006, Equation 16-13)*

$0.6D + W + H$ *(IBC 2006, Equation 16-14)*

$0.6D + 0.7E + H$ *(IBC 2006, Equation 16-15)*

$D + F$ *(IBC 2006, Equation 16-8)*

[D as defined, F = 0]

By inspection, this load combination does not govern. (This load combination does not consider any of the driving forces that will cause overturning for this load configuration.)

$D + H + F + L + T$ *(IBC 2006, Equation 16-9)*

[D as defined, $H = P_a$, $F = 0$, $L = P_{a,\,truck}$, $T = 0$ *]*

OVERTURNING STABILITY

Calculate the driving moments that cause overturning [$\Sigma(M_D/b)$]:

$$\Sigma(M_D/b) = P_a\,(H/3) + P_{a,\,truck}\,(H/2)$$
$$= 0.333\text{ klf}\,(1.39\text{ ft}) + 0.017\text{ klf}\,(2.08\text{ ft}) = 0.50\text{ ft-k/ft}$$

Calculate the resisting moments [$\Sigma(M_R/b)$]:

$$\Sigma(M_R/b) = D_{STEM}\,(\textit{moment arm}) + D_{FOOTING}\,(\textit{moment arm}) + D_{SOIL}\,(\textit{moment arm})$$
$$= 0.500\text{ klf}\,(5.58\text{ ft}) + 0.700\text{ klf}\,(3.50\text{ ft}) + 0.403\text{ klf}\,(6.50\text{ ft})$$
$$= 7.86\text{ ft-k/ft}$$

Retaining walls shall be designed for a safety factor of 1.5 against overturning. *(IBC 2006, Section 1806.1)*

$$F = \frac{\Sigma(P_R/b)}{\Sigma(P_D/b)} = \frac{7.86\text{ ft-k/ft}}{0.50\text{ ft-k/ft}} = 15.81 > 1.5$$

OVERTURNING CRITERIA SATISFIED

$D + H + F + (L_r$ or S or $R)$ *(IBC 2006, Equation 16-10)*

[D as defined, $H = P_a$, $F = 0$, $L_r = 0$, $S = P_{a,\,snow}$, $R = 0$]

By inspection, this load combination does not govern. (This load combination does not consider the live load caused by a truck surcharge, which will reduce the driving forces/moments calculated using Equation 16-9. The surcharge created by snow load on the ground is only a fraction of the truck surcharge.)

$D + H + F + 0.75(L + T) + 0.75(L_r$ or S or $R)$ *(IBC 2006, Equation 16-11)*

[D as defined, $H = P_a$, $F = 0$, $L = P_{a,\,truck}$, $T = 0$, $L_r = 0$, $S = P_{a,\,snow}$, $R = 0$]

By inspection, this load combination does not govern. (Equation 16-13 considers each of the forces included in this load combination in addition to earthquake induced forces.)

$D + H + F + (W$ or $0.7E)$ *(IBC 2006, Equation 16-12)*

[D as defined, $H = P_{ae}$, $F = 0$, $W = 0$, E as defined]

OVERTURNING STABILITY

Calculate the driving moments that cause overturning [$\Sigma(M_D/b)$]:

$$\Sigma(M_D/b) = P_{ae}\,(0.6H) + 0.7\,[E_{STEM}\,(H_{STEM}/2 + H_{FOOTING}) + E_{FOOTING}\,(H_{FOOTING}/2)]$$
$$= 0.660 \text{ klf } (2.50 \text{ ft}) + 0.7\,[\,0.188 \text{ klf } (2.67 \text{ ft}) + 0.263 \text{ klf } (0.33 \text{ ft})\,]$$
$$= 2.06 \text{ ft-k/ft}$$

Calculate the resisting moments [$\Sigma(M_R/b)$]:

$$\Sigma(M_R/b) = D_{STEM}\,(\textit{moment arm}) + D_{FOOTING}\,(\textit{moment arm}) + D_{SOIL}\,(\textit{moment arm})$$
$$= 0.500 \text{ klf } (5.58 \text{ ft}) + 0.700 \text{ klf } (3.50 \text{ ft}) + 0.403 \text{ klf } (6.50 \text{ ft})$$
$$= 7.86 \text{ ft-k/ft}$$

Retaining walls shall be designed for a safety factor of 1.5 against overturning. *(IBC 2006, Section 1806.1)*

$$F = \frac{\Sigma(P_R/b)}{\Sigma(P_D/b)} = \frac{7.86 \text{ ft-k/ft}}{2.06 \text{ ft-k/ft}} = 3.81 > 1.5$$

OVERTURNING CRITERIA SATISFIED

$D + H + F + 0.75(W + 0.7E) + 0.75L + 0.75(L_r$ or S or $R)$ *(IBC 2006, Equation 16-13)*

[D as defined, $H = P_{ae}$, $F = 0$, $W = 0$, E as defined, $L = P_{ae,\,truck}$, $L_r = 0$, $S = P_{ae,\,snow}$, $R = 0$]

OVERTURNING STABILITY

Calculate the driving moments that cause overturning [$\Sigma(M_D/b)$]:

$$\Sigma(M_D/b) = P_{ae}\,(0.6H) + 0.75(0.7)[E_{STEM}\,(H_{STEM}/2 + H_{FOOTING}) + E_{FOOTING}\,(H_{FOOTING}/2)] + 0.75\,P_{ae,\,truck}\,(H/2) + 0.75\,P_{ae,\,snow}\,(H/2)$$
$$= 0.660 \text{ klf } (2.50 \text{ ft}) + 0.75\,(0.7)\,[\,0.188 \text{ klf } (2.67 \text{ ft}) + 0.263 \text{ klf } (0.33 \text{ ft})\,] + 0.75\,(0.033 \text{ klf})\,(2.08 \text{ ft}) + 0.75\,(0.011 \text{ klf})\,(2.08 \text{ ft})$$
$$= 2.03 \text{ ft-k/ft}$$

Calculate the resisting moments [$\Sigma(M_R/b)$]:

$$\Sigma(M_R/b) = D_{STEM}\,(\textit{moment arm}) + D_{FOOTING}\,(\textit{moment arm}) + D_{SOIL}\,(\textit{moment arm})$$
$$= 0.500 \text{ klf } (5.58 \text{ ft}) + 0.700 \text{ klf } (3.50 \text{ ft}) + 0.403 \text{ klf } (6.50 \text{ ft})$$
$$= 7.86 \text{ ft-k/ft}$$

Retaining walls shall be designed for a safety factor of 1.5 against overturning. *(IBC 2006, Section 1806.1)*

$$F = \frac{\Sigma(P_R/b)}{\Sigma(P_D/b)} = \frac{7.86 \text{ ft-k/ft}}{2.03 \text{ ft-k/ft}} = 3.88 > 1.5$$

OVERTURNING CRITERIA SATISFIED

$0.6D + W + H$ *(IBC 2006, Equation 16-14)*

[D as defined, $W = 0$, $H = P_a$]

By inspection, this load combination does not govern. (Equation 16-15 considers larger driving moments by combining both lateral earthquake induced forces and earth pressure forces.)

$0.6D + 0.7E + H$ *(IBC 2006, Equation 16-15)*

[D as defined, E as defined, $H = P_{ae}$]

OVERTURNING STABILITY

Calculate the driving moments that cause overturning [$\Sigma(M_D/b)$]:

$$\Sigma(M_D/b) = P_{ae}\,(0.6H) + 0.7\,[E_{STEM}\,(H_{STEM}/2 + H_{FOOTING}) + E_{FOOTING}\,(H_{FOOTING}/2)]$$
$$= 0.660\text{ klf}\ (2.50\text{ ft}) + 0.7\ [\,0.188\text{ klf}\ (2.67\text{ ft}) + 0.263\text{ klf}\ (0.33\text{ ft})\,]$$
$$= 2.06\text{ ft-k/ft}$$

Calculate the resisting moments [$\Sigma(M_R/b)$]:

$$\Sigma(M_R/b) = 0.6\,[D_{STEM}\,(moment\ arm) + D_{FOOTING}\,(moment\ arm) + D_{SOIL}\,(moment\ arm)]$$
$$= 0.6\,(\,0.500\text{ klf}\ (5.58\text{ ft}) + 0.700\text{ klf}\ (3.50\text{ ft}) + 0.403\text{ klf}\ (6.50\text{ ft})\,)$$
$$= 4.71\text{ ft-k/ft}$$

Retaining walls shall be designed for a safety factor of 1.5 against overturning. *(IBC 2006, Section 1806.1)*

$$F = \frac{\Sigma(P_R/b)}{\Sigma(P_D/b)} = \frac{4.71\text{ ft-k/ft}}{2.06\text{ ft-k/ft}} = 2.29 > 1.5$$

OVERTURNING CRITERIA SATISFIED

Equation 16-15 is the govering load combination. As an additional check, use this load combination to consider the impulsive and convective dynamic forces that would be produced by a full tank (3 ft of water) in addition to the lateral earth pressures. The dynamic force due to the inertia of the wall has already been incorporated into P_y/B; therefore, the force E_{STEM} is removed. This new load combination applies to the trailing half of the tank, as discussed in Section 5.3.1 of ASCE 350.3-01.

Calculate the driving moments that cause overturning [$\Sigma(M_D/b)$]:

$$\Sigma(M_D/b) = P_{ae}\,(0.6H) + 0.7\,[P_y/B\,(y) + E_{FOOTING}\,(H_{FOOTING}/2)]$$
$$= 0.660\text{ klf}\ (2.50\text{ ft}) + 0.7\ [\,0.12\text{ klf}\ (1.61\text{ ft}) + 0.263\text{ klf}\ (0.33\text{ ft})\,]$$
$$= 1.85\text{ ft-k/ft}$$

Calculate the resisting moments [$\Sigma(M_R/b)$]:

$$\Sigma(M_R/b) = 0.6\,[D_{STEM}\,(moment\ arm) + D_{FOOTING}\,(moment\ arm) + D_{SOIL}\,(moment\ arm)]$$
$$= 0.6\,(\,0.500\text{ klf}\ (5.58\text{ ft}) + 0.700\text{ klf}\ (3.50\text{ ft}) + 0.403\text{ klf}\ (6.50\text{ ft})\,)$$
$$= 4.71\text{ ft-k/ft}$$

Retaining walls shall be designed for a safety factor of 1.5 against overturning. *(IBC 2006, Section 1806.1)*

$$F = \frac{\Sigma(P_R/b)}{\Sigma(P_D/b)} = \frac{4.71\text{ ft-k/ft}}{1.85\text{ ft-k/ft}} = 2.55 > 1.5$$

OVERTURNING CRITERIA SATISFIED

LOAD CONFIGURATION 2

(One side of the Evaporation Tank is full [with 1 foot of freeboard].)

(Per IBC 2006, Section 15.7.6.1(c) - Calculate the overturning stability of the wall following the requirements of Section 15.4.)

SLIDING STABILITY

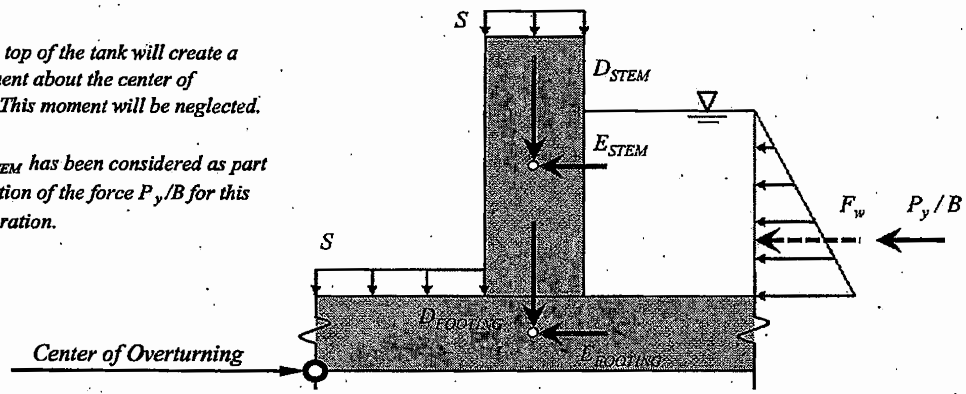
This load configuration considers the concrete wall that divides the tank into two separate sections. No lateral earth pressures are present; therefore, sliding will not occur. The concrete wall will be designed to resist all of the applied lateral earthquake induced forces and water pressures.

OVERTURNING STABILITY

A footing width of 7 ft will also be used for this load configuration.

Snow load on top of the tank will create a resisting moment about the center of overturning. This moment will be neglected.

The force E_{STEM} has been considered as part of the calculation of the force P_y/B for this Load Configuration.



DEAD LOAD *(Applied at the centroids)*

Concrete Stem (D_{STEM}) =	(1 pcf)	(4.0 ft)	(0.83 ft)	(1 k / 1000 lb)	=	0.004 klf
Concrete Footing ($D_{FOOTING}$) =	(150 pcf)	(0.67 ft)	(7.0 ft)	(1 k / 1000 lb)	=	0.700 klf

EARTHQUAKE LOAD *(Applied at the centroids)*

Concrete Stem (E_{STEM}) = C_s D_{STEM} =	0.375	(0.004 klf)	=	0.002 klf
Concrete Footing ($E_{FOOTING}$) = C_s $D_{FOOTING}$ =	0.375	(0.700 klf)	=	0.263 klf

FLUID LOAD *(Applied at the centroid)*

Water Weight on Tank (F_{VERT}) =	(62.4 pcf)	(3.1 ft)	(3.0 ft)	(1 k / 1000 lb)	=	0.577 klf

LOAD COMBINATIONS (ASD) *(IBC 2006, Section 1605.3)*

$D + F$	*(IBC 2006, Equation 16-8)*
$D + H + F + L + T$	*(IBC 2006, Equation 16-9)*
$D + H + F + (L_r \text{ or } S \text{ or } R)$	*(IBC 2006, Equation 16-10)*
$D + H + F + 0.75(L + T) + 0.75(L_r \text{ or } S \text{ or } R)$	*(IBC 2006, Equation 16-11)*
$D + H + F + (W \text{ or } 0.7E)$	*(IBC 2006, Equation 16-12)*
$D + H + F + 0.75(W + 0.7E) + 0.75L + 0.75(L_r \text{ or } S \text{ or } R)$	*(IBC 2006, Equation 16-13)*
$0.6D + W + H$	*(IBC 2006, Equation 16-14)*
$0.6D + 0.7E + H$	*(IBC 2006, Equation 16-15)*

$D + F$ *(IBC 2006, Equation 16-8)*

[D as defined, F = F_w]

OVERTURNING STABILITY

Calculate the driving moments that cause overturning [$\Sigma(M_D/b)$]:

$\Sigma(M_D/b) = F_w\,(H_w/3)$

$= 0.281$ klf (1.00 ft) $=$ 0.28 ft-k /ft

Calculate the resisting moments [$\Sigma(M_R/b)$]:

$\Sigma(M_R/b) = D_{STEM}$ (moment arm) $+ D_{FOOTING}$ (moment arm) $+ F_{VERT}$ (moment arm)

$=$ 0.004 klf (3.50 ft) + 0.700 klf (3.50 ft) + 0.577 klf (5.46 ft)

$=$ 5.61 ft-k /ft

Retaining walls shall be designed for a safety factor of 1.5 against overturning. *(IBC 2006, Section 1806.1)*

$$F = \frac{\Sigma(P_R/b)}{\Sigma(P_D/b)} = \frac{5.61 \text{ ft-k/ft}}{0.28 \text{ ft-k/ft}} = 19.99 > 1.5$$

OVERTURNING CRITERIA SATISFIED

$D + H + F + L + T$ *(IBC 2006, Equation 16-9)*

[D as defined, H = 0, F = F_w, L = 0, T = 0]

By inspection, this load combination does not govern. (The forces H, L and T are not applied; therefore, this load combination will produce the same results as Equation 16-8.)

$D + H + F + (L_r$ or S or $R)$ *(IBC 2006, Equation 16-10)*

[D as defined, H = 0, F = 0, L_r = 0, S = 0, R = 0]

By inspection, this load combination does not govern. (The snow load is being neglected as discussed on the previous page.)

$D + H + F + 0.75(L + T) + 0.75(L_r$ or S or $R)$ *(IBC 2006, Equation 16-11)*

[D as defined, H = 0, F = F_w, L = 0, T = 0, L_r = 0, S = 0, R = 0]

By inspection, this load combination does not govern. (As previously mentioned H, L, T and S are not applied; therefore, this load combination will produce the same results as Equation 16-8.)

$D + H + F + (W$ or $0.7E)$ *(IBC 2006, Equation 16-12)*

[D as defined, H = 0, F = F_w, W = 0, E as defined]

OVERTURNING STABILITY

Calculate the driving moments that cause overturning [$\Sigma(M_D/b)$]:

$\Sigma(M_D/b) = F_w\,(H_w/3) + 0.7\,[\,P_y/B\,(y) + E_{FOOTING}\,(H_{FOOTING}/2)\,]$

$=$ 0.281 klf (1.00 ft) + 0.7 [0.12 klf (1.61 ft) + 0.263 klf (0.33 ft)]

$=$ 0.48 ft-k /ft

Calculate the resisting moments [$\Sigma(M_R/b)$]:

$\Sigma(M_R/b) = D_{STEM}$ (moment arm) $+ D_{FOOTING}$ (moment arm) $+ F_{VERT}$ (moment arm)

$=$ 0.004 klf (3.50 ft) + 0.700 klf (3.50 ft) + 0.577 klf (5.46 ft)

$=$ 5.61 ft-k /ft

Retaining walls shall be designed for a safety factor of 1.5 against overturning. *(IBC 2006, Section 1806.1)*

$$F = \frac{\Sigma(P_R/b)}{\Sigma(P_D/b)} = \frac{5.61 \text{ ft-k/ft}}{0.48 \text{ ft-k/ft}} = 11.76 > 1.5$$

OVERTURNING CRITERIA SATISFIED

D + H + F + 0.75(W + 0.7E) + 0.75L + 0.75(L_r or S or R) *(IBC 2006, Equation 16-13)*

[D as defined, H = 0, F = F_w, W = 0, E as defined, L = 0, L_r = 0, S = 0, R = 0]

By inspection, this load combination does not govern. (This load combination considers a reduced seismic driving force as compared to Equation 16-12.)

0.6D + W + H *(IBC 2006, Equation 16-14)*

[D as defined, W = 0, H = 0]

By inspection, this load combination does not govern. (Equation 16-15 considers larger driving forces and moments by considering the lateral earthquake forces.)

0.6D + 0.7E + H *(IBC 2006, Equation 16-15)*

[D as defined, E as defined, H = 0]

OVERTURNING STABILITY

Calculate the driving moments that cause overturning [$\Sigma(M_D/b)$]:

$$\Sigma(M_D/b) = 0.7\,[\,P_y/B\,(y) + E_{FOOTING}\,(H_{FOOTING}/2)\,]$$
$$= 0.7\,[\,0.12\text{ klf}\;(1.61\text{ ft}) + 0.263\text{ klf}\;(0.33\text{ ft})\,]$$
$$= 0.20\text{ ft-k/ft}$$

Calculate the resisting moments [$\Sigma(M_R/b)$]:

$$\Sigma(M_R/b) = 0.6\,[\,D_{STEM}\,(\textit{moment arm}) + D_{FOOTING}\,(\textit{moment arm})\,]$$
$$= 0.6\,[\,0.004\text{ klf}\;(3.50\text{ ft}) + 0.700\text{ klf}\;(3.50\text{ ft})\,]$$
$$= 1.48\text{ ft-k/ft}$$

Retaining walls shall be designed for a safety factor of 1.5 against overturning. *(IBC 2006, Section 1806.1)*

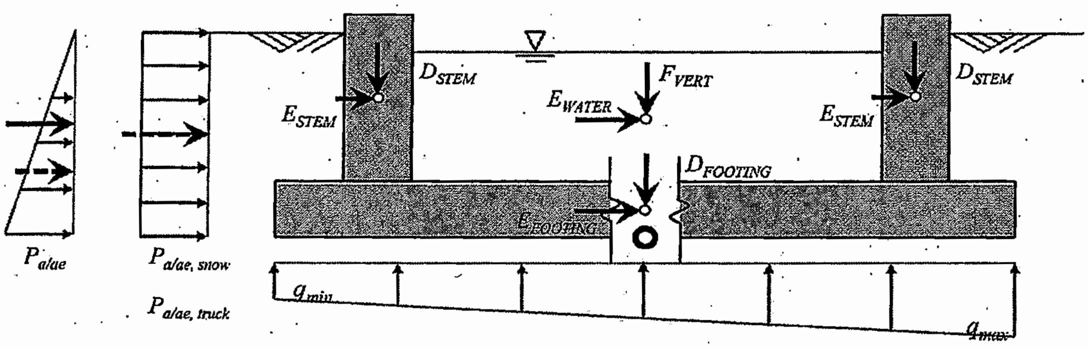
$$F = \frac{\Sigma(P_R/b)}{\Sigma(P_D/b)} = \frac{1.48\text{ ft-k/ft}}{0.20\text{ ft-k/ft}} = 7.52 > 1.5$$

OVERTURNING CRITERIA SATISFIED

LOAD CONFIGURATION 3

(The Evaporation Tank is full [with 1 foot of freeboard]. The grade elevation is six inches below the top of the tank walls.)

(Per IBC 2006, Section 15.7.6.1(a) - Calculate the bearing pressure as if the tank and the entire contents are a rigid mass system.)



BEARING PRESSURE

Allowable Bearing Pressure (q_A) = 1.50 ksf *(Western Technologies Inc. - Geotechnical Evaluation, Section 6.2)*

DEAD LOAD *(Applied at the centroids)*

Concrete Stem (D_{STEM}) =	(150 pcf)	(4.0 ft)	(0.8 ft)	(1 k / 1000 lb)	=	(0.50 klf)
Concrete Footing ($D_{FOOTING}$) =	(150 pcf)	(0.67 ft)	(73.0 ft)	(1 k / 1000 lb)	=	(7.30 klf)

FLUID LOAD *(Applied at the cen* 1.2

Water Weight on Tank (F_{VERT}) =	(62.4 pcf)	(69.3 ft)	(3.0 ft)	(1 k / 1000 lb)	=	(12.98 klf)

EARTHQUAKE LOAD *(Applied at the centroids)*

Concrete Stem (E_{STEM}) = $C_s\ D_{STEM}$ =	0.375	(0.50 klf)	=	(0.19 klf)
Concrete Footing ($E_{FOOTING}$) = $C_s\ D_{FOOTING}$ =	0.375	(7.30 klf)	=	(2.74 klf)
Water (E_{WATER}) = $C_s\ F_{VERT}$ =	0.375	(12.98 klf)	=	(4.87 klf)

LOAD COMBINATIONS (ASD) *(IBC 2006, Section 1605.3)*

$D + F$ *(IBC 2006, Equation 16-8)*

$D + H + F + L + T$ *(IBC 2006, Equation 16-9)*

$D + H + F + (L_r \text{ or } S \text{ or } R)$ *(IBC 2006, Equation 16-10)*

$D + H + F + 0.75(L + T) + 0.75(L_r \text{ or } S \text{ or } R)$ *(IBC 2006, Equation 16-11)*

$D + H + F + (W \text{ or } 0.7E)$ *(IBC 2006, Equation 16-12)*

$D + H + F + 0.75(W + 0.7E) + 0.75L + 0.75(L_r \text{ or } S \text{ or } R)$ *(IBC 2006, Equation 16-13)*

$0.6D + W + H$ *(IBC 2006, Equation 16-14)*

$0.6D + 0.7E + H$ *(IBC 2006, Equation 16-15)*

D + F *(IBC 2006, Equation 16-8)*

[D as defined, F = F VERT]

BEARING PRESSURE

Calculate the total vertical load [$\Sigma(P/b)$]:

$$\Sigma(P/b) = 2D_{STEM} + D_{FOOTING} + F_{VERT} = 2 \quad (0.50 \text{ klf}) + (7.30 \text{ klf}) + (12.98 \text{ klf})$$
$$= 21.28 \text{ klf}$$

Calculate the total moment applied to the bottom center of the slab [$\Sigma(M/b)$]:

$$\Sigma(M/b) = 0.00 \text{ ft-k/ft}$$

Eccentricity (e):

$$e = \frac{\Sigma(M/b)}{\Sigma(P/b)} = \frac{0.00 \text{ ft-k/ft}}{21.28 \text{ klf}} = 0.00 \text{ ft} < \frac{L}{6} = 12.17 \text{ ft} \quad \textit{OK}$$

Calculate the maximum and minimum bearing pressures [q_{max} & q_{min}]:

$$q_{max} = \frac{\Sigma(P/b)}{BL}\left(1 + \frac{6e}{L}\right) = \frac{21.28 \text{ klf}}{(1.00 \text{ ft})\ (73.00 \text{ ft})}\left(1 + \frac{6\ (0.00 \text{ ft})}{(73.00 \text{ ft})}\right) = 0.29 \text{ ksf} \quad \textit{OK}$$

$$q_{min} = \frac{\Sigma(P/b)}{BL}\left(1 - \frac{6e}{L}\right) = \frac{21.28 \text{ klf}}{(1.00 \text{ ft})\ (73.00 \text{ ft})}\left(1 - \frac{6\ (0.00 \text{ ft})}{(73.00 \text{ ft})}\right) = 0.29 \text{ ksf} \quad \textit{OK}$$

D + H + F + L + T *(IBC 2006, Equation 16-9)*

[D as defined, $H = P_a$, $F = F_{VERT}$, $L = P_{a,\,truck}$, $T = 0$]

BEARING PRESSURE

Calculate the total vertical load [$\Sigma(P/b)$]:

$$\Sigma(P/b) = 2D_{STEM} + D_{FOOTING} + F_{VERT} = 2 \quad (0.50 \text{ klf}) + (7.30 \text{ klf}) + (12.98 \text{ klf})$$
$$= 21.28 \text{ klf}$$

Calculate the total moment applied to the bottom center of the slab [$\Sigma(M/b)$]:

$$\Sigma(M/b) = P_a\ (H/3) + P_{a,\,truck}\ (H/2)$$
$$= 0.333 \text{ klf} \quad (1.39 \text{ ft}) + 0.017 \text{ klf} \quad (2.08 \text{ ft})$$
$$= 0.50 \text{ ft-k/ft}$$

Eccentricity (e):

$$e = \frac{\Sigma(M/b)}{\Sigma(P/b)} = \frac{0.50 \text{ ft-k/ft}}{21.28 \text{ klf}} = 0.02 \text{ ft} < \frac{L}{6} = 12.17 \text{ ft} \quad \textit{OK}$$

Calculate the maximum and minimum bearing pressures [q_{max} & q_{min}]:

$$q_{max} = \frac{\Sigma(P/b)}{BL}\left(1 + \frac{6e}{L}\right) = \frac{21.28 \text{ klf}}{(1.00 \text{ ft})\ (73.00 \text{ ft})}\left(1 + \frac{6\ (0.02 \text{ ft})}{(73.00 \text{ ft})}\right) = 0.29 \text{ ksf} \quad \textit{OK}$$

$$q_{min} = \frac{\Sigma(P/b)}{BL}\left(1 - \frac{6e}{L}\right) = \frac{21.28 \text{ klf}}{(1.00 \text{ ft})\ (73.00 \text{ ft})}\left(1 - \frac{6\ (0.02 \text{ ft})}{(73.00 \text{ ft})}\right) = 0.29 \text{ ksf} \quad \textit{OK}$$

D + H + F + (L_r or S or R) *(IBC 2006, Equation 16-10)*

[D as defined, $H = P_a$, $F = F_{VERT}$, $L_r = 0$, $S = P_{a,\,snow}$, $R = 0$]

By inspection, this load combination does not govern. (The surcharge from the snow load is smaller than the surcharge from the truck load.)

$D + H + F + 0.75(L + T) + 0.75(L_r$ or S or $R)$ *(IBC 2006, Equation 16-11)*

[D as defined, $H = P_a$; $F = F_{VERT}$, $L = P_{a,\,truck}$, $T = 0$, $L_r = 0$, $S = P_{a,\,snow}$, $R = 0$]

By inspection, this load combination does not govern. (Equation 16-13 considers each of the forces included in this load combination in addition to earthquake induced forces.)

$D + H + F + (W$ or $0.7E)$ *(IBC 2006, Equation 16-12)*

[D as defined, $H = P_{ae}$, $F = F_{VERT}$, $W = 0$, E as defined]

BEARING PRESSURE

Calculate the total vertical load [$\Sigma(P/b)$]:

$$\Sigma(P/b) = 2\,D_{STEM} + D_{FOOTING} + F_{VERT} = 2\ (0.50\text{ klf}) + (7.30\text{ klf}) + (12.98\text{ klf}) = 21.28\text{ klf}$$

Calculate the total moment applied to the bottom center of the slab [$\Sigma(M/b)$]:

$$\Sigma(M/b) = P_{ae}\,(0.6H) + 0.7\,[E_{STEM}\,(H_{STEM}/2 + H_{FOOTING}) + E_{FOOTING}\,(H_{FOOTING}/2) + E_{WATER}\,(H_w/2 + H_{FOOTING})]$$

$$= 0.660\text{ klf}\ (2.50\text{ ft}) + 0.7\ [\ 0.19\text{ klf}\ (2.67\text{ ft}) + 2.74\text{ klf}\ (0.33\text{ ft}) + 4.87\text{ klf}\ (2.17\text{ ft})\ ]$$

$$= 10.02\text{ ft-k/ft}$$

Eccentricity (e):

$$e = \frac{\Sigma(M/b)}{\Sigma(P/b)} = \frac{10.02\text{ ft-k/ft}}{21.28\text{ klf}} = 0.47\text{ ft} < \frac{L}{6} = 12.17\text{ ft} \qquad \textit{OK}$$

Calculate the maximum and minimum bearing pressures [q_{max} & q_{min}]:

$$q_{max} = \frac{\Sigma(P/b)}{B\,L}\left(1 + \frac{6\,e}{L}\right) = \frac{21.28\text{ klf}}{(1.00\text{ ft})\ (73.00\text{ ft})}\left(1 + \frac{6\ (0.47\text{ ft})}{(73.00\text{ ft})}\right) = 0.30\text{ ksf} \qquad \textit{OK}$$

$$q_{min} = \frac{\Sigma(P/b)}{B\,L}\left(1 - \frac{6\,e}{L}\right) = \frac{21.28\text{ klf}}{(1.00\text{ ft})\ (73.00\text{ ft})}\left(1 - \frac{6\ (0.47\text{ ft})}{(73.00\text{ ft})}\right) = 0.28\text{ ksf} \qquad \textit{OK}$$

$D + H + F + 0.75(W + 0.7E) + 0.75L + 0.75(L_r$ or S or $R)$ *(IBC 2006, Equation 16-13)*

[D as defined, $H = P_{ae}$, $F = F_{VERT}$, $W = 0$, E as defined, $L = P_{ae,\,truck}$; $L_r = 0$, $S = P_{ae,\,snow}$, $R = 0$]

BEARING PRESSURE

Calculate the total vertical load [$\Sigma(P/b)$]:

$$\Sigma(P/b) = 2\,D_{STEM} + D_{FOOTING} + F_{VERT} = 2\ (0.50\text{ klf}) + (7.30\text{ klf}) + (12.98\text{ klf}) = 21.28\text{ klf}$$

Calculate the total moment applied to the bottom center of the slab [$\Sigma(M/b)$]:

$$\Sigma(M/b) = P_{ae}\,(0.6H) + 0.75(0.7)[E_{STEM}\,(H_{STEM}/2 + H_{FOOTING}) + E_{FOOTING}\,(H_{FOOTING}/2) + E_{WATER}\,(H_w/2 + H_{FOOTING})] + 0.75\,P_{ae,\,truck}\,(H/2) + 0.75\,P_{ae,\,snow}(H/2)$$

$$= 0.660\text{ klf}\ (2.50\text{ ft}) + 0.75\ (0.7)\ [\ 0.19\text{ klf}\ (2.67\text{ ft}) + 2.74\text{ klf}\ (0.33\text{ ft}) + 4.87\text{ klf}\ (2.17\text{ ft})\ ] + 0.75\ (0.033\text{ klf})\ (2.08\text{ ft}) + 0.75\ (0.011\text{ klf})\ (2.08\text{ ft})$$

$$= 8.00\text{ ft-k/ft}$$

Eccentricity (e):

$$e = \frac{\Sigma(M/b)}{\Sigma(P/b)} = \frac{8.00\text{ ft-k/ft}}{21.28\text{ klf}} = 0.38\text{ ft} < \frac{L}{6} = 12.17\text{ ft} \qquad \textit{OK}$$

Calculate the maximum and minimum bearing pressures [q_{max} & q_{min}]:

$$q_{max} = \frac{\Sigma(P/b)}{B\,L}\left(1 + \frac{6\,e}{L}\right) = \frac{21.28 \text{ klf}}{(1.00 \text{ ft})\ (73.00 \text{ ft})}\left(1 + \frac{6\ (0.38 \text{ ft})}{(73.00 \text{ ft})}\right) = 0.30 \text{ ksf} \quad \textit{OK}$$

$$q_{min} = \frac{\Sigma(P/b)}{B\,L}\left(1 - \frac{6\,e}{L}\right) = \frac{21.28 \text{ klf}}{(1.00 \text{ ft})\ (73.00 \text{ ft})}\left(1 - \frac{6\ (0.38 \text{ ft})}{(73.00 \text{ ft})}\right) = 0.28 \text{ ksf} \quad \textit{OK}$$

0.6D + W + H *(IBC 2006, Equation 16-14)*

[D as defined, W = 0, H = P_a *]*

By inspection, this load combination does not govern. (Equation 16-15 considers larger driving forces and moments by considering the lateral earthquake forces.)

0.6D + 0.7E + H *(IBC 2006, Equation 16-15)*

[D as defined, E as defined, H = P_{ae} *]*

BEARING PRESSURE

Calculate the total vertical load [$\Sigma(P/b)$]:

$$\Sigma(P/b) = 0.6\,(2\,D_{STEM} + D_{FOOTING}) = 0.6\ [\ 2\ (0.50 \text{ klf}) + (7.30 \text{ klf})\ ]$$
$$= 4.98 \text{ klf}$$

Calculate the total moment applied to the bottom center of the slab [$\Sigma(M/b)$]:

$$\Sigma(M/b) = P_{ae}\,(0.6H) + 0.7\,[\,E_{STEM}\,(H_{STEM}/2 + H_{FOOTING}) + E_{FOOTING}\,(H_{FOOTING}/2)\,]$$
$$= 0.660 \text{ klf}\ (2.50 \text{ ft}) + 0.7\ [\ 0.19 \text{ klf}\ (2.67 \text{ ft}) + 2.74 \text{ klf}\ (0.33 \text{ ft})\ ]$$
$$= 2.64 \text{ ft-k/ft}$$

Eccentricity (e):

$$e = \frac{\Sigma(M/b)}{\Sigma(P/b)} = \frac{2.64 \text{ ft-k/ft}}{4.98 \text{ klf}} = 0.53 \text{ ft} < \frac{L}{6} = 12.17 \text{ ft} \quad \textit{OK}$$

Calculate the maximum and minimum bearing pressures [q_{max} & q_{min}]:

$$q_{max} = \frac{\Sigma(P/b)}{B\,L}\left(1 + \frac{6\,e}{L}\right) = \frac{4.98 \text{ klf}}{(1.00 \text{ ft})\ (73.00 \text{ ft})}\left(1 + \frac{6\ (0.53 \text{ ft})}{(73.00 \text{ ft})}\right) = 0.07 \text{ ksf} \quad \textit{OK}$$

$$q_{min} = \frac{\Sigma(P/b)}{B\,L}\left(1 - \frac{6\,e}{L}\right) = \frac{4.98 \text{ klf}}{(1.00 \text{ ft})\ (73.00 \text{ ft})}\left(1 - \frac{6\ (0.53 \text{ ft})}{(73.00 \text{ ft})}\right) = 0.07 \text{ ksf} \quad \textit{OK}$$

LOAD CONFIGURATION 1 - CONCRETE DESIGN LOADS

LOAD COMBINATIONS (LRFD) *(IBC 2006, Section 1605.2)*

Condsider the following load combinations:

$1.4\,(D + F)$		*(IBC 2006, Equation 16-1)*
$1.2(D + F + T) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$		*(IBC 2006, Equation 16-2)*
$1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (f_1 L \text{ or } 0.8W)$	$\rightarrow (f_1 = 0.5)$	*(IBC 2006, Equation 16-3)*
$1.2D + 1.6W + f_1 L + 0.5(L_r \text{ or } S \text{ or } R)$	$\rightarrow (f_1 = 0.5)$	*(IBC 2006, Equation 16-4)*
$1.2D + 1.0E + f_1 L + f_2 S$	$\rightarrow (f_1 = 0.5 \text{ and } f_2 = 0.2)$	*(IBC 2006, Equation 16-5)*
$0.9D + 1.6W + 1.6H$		*(IBC 2006, Equation 16-6)*
$0.9D + 1.0E + 1.6H$		*(IBC 2006, Equation 16-7)*

$1.4\,(D + F)$ *(IBC 2006, Equation 16-1)*

$[\,D \text{ as defined},\ F = 0\,]$

By inspection, this load combination does not govern. (This load combination does not consider any of the forces that will cause shear or moment in the concrete.)

$1.2(D + F + T) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$ *(IBC 2006, Equation 16-2)*

$[\,D \text{ as defined},\ F = 0,\ T = 0,\ H = P_a,\ L = P_{a,\,truck},\ L_r = 0,\ S = P_{a,\,snow},\ R = 0\,]$

$$V_u = 1.6\,P_a + 1.6\,P_{a,\,truck} + 0.5\,P_{a,\,snow}$$
$$= 1.6\ (0.333\text{ klf}) + 1.6\ (0.017\text{ klf}) + 0.5\ (0.005\text{ klf})$$
$$= 0.562\text{ klf}$$

$$M_u = 1.6\,P_a\,(H/3) + 1.6\,P_{a,\,tr}\ \ 1.2$$
$$= 1.6\ (0.333\text{ klf})\ (1.39\text{ ft}) + 1.6\ (0.017\text{ klf})\ (2.08\text{ ft}) + 0.5\ (0.005\text{ klf})\ (2.08\text{ ft})$$
$$= 0.80\text{ ft-k/ft}$$

$1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (f_1 L \text{ or } 0.8W) \rightarrow (f_1 = 0.5)$ *(IBC 2006, Equation 16-3)*

$[\,D \text{ as defined},\ L_r = 0,\ S = P_{a,\,snow},\ R = 0,\ L = P_{a,\,truck},\ W = 0\,]$

By inspection, this load combination does not govern. (This load combination does not consider lateral earth pressures or earthquake induced forces, which are the primary forces that will cause shear or moment in the concrete.)

$1.2D + 1.6W + f_1 L + 0.5(L_r \text{ or } S \text{ or } R) \rightarrow (f_1 = 0.5)$ *(IBC 2006, Equation 16-4)*

$[\,D \text{ as defined},\ W = 0,\ L = P_{a,\,truck},\ L_r = 0,\ S = P_{a,\,snow},\ R = 0\,]$

By inspection, this load combination does not govern. (This load combination does not consider lateral earth pressures or earthquake induced forces, which are the primary forces that will cause shear or moment in the concrete.)

$1.2D + 1.0E + f_1L + f_2S$ $\rightarrow (f_1 = 0.5 \text{ and } f_2 = 0.2)$ *(IBC 2006, Equation 16-5)*

[D as defined, E as defined, $L = P_{ae,\,truck}$, $S = P_{ae,\,snow}$]

$V_u = 1.0\,(E_{STEM} + E_{FOOTING}) + 0.5\,P_{ae,\,truck} + 0.2\,P_{ae,\,snow}$

$= 1.0\ [\ 0.188\text{ klf} + 0.263\text{ klf}\ ] + 0.5\ [\ 0.033\text{ klf}\ ] + 0.2\ [\ 0.011\text{ klf}\ ]$

$= 0.469\text{ klf}$

$M_u = 1.0\,[E_{STEM}\,(H_{STEM}/2 + H_{FOOTING}) + E_{FOOTING}\,(H_{FOOTING}/2)] + 0.5\,P_{ae,\,truck}\,(H/2) + 0.2\,P_{ae,\,snow}\,(H/2)$

$= 1.0\ [\ 0.188\text{ klf}\ (2.67\text{ ft}) + 0.263\text{ klf}\ (0.33\text{ ft})\ ] + 0.5\ (0.033\text{ klf})\ (2.08\text{ ft}) + 0.2\ (0.011\text{ klf})\ (2.08\text{ ft})$

$= 0.63\text{ ft-k/ft}$

$0.9D + 1.6W + 1.6H$ *(IBC 2006, Equation 16-6)*

[D as defined, $W = 0$, $H = P_a$]

By inspection, this load combination does not govern. (Equation 16-7 considers both lateral earthquake induced forces and earth pressure forces, which are the primary forces that will cause shear or moment in the concrete.)

$0.9D + 1.0E + 1.6H$ *(IBC 2006, Equation 16-7)*

[D as defined, E as defined, $H = P_{ae}$]

$V_u = 1.6\,P_{ae} + 1.0\,(E_{STEM} + E_{FOOTING}) =$

$= 1.6\ (0.660\text{ klf}) + 1.0\ [\ 0.188\text{ klf} + 0.263\text{ klf}\ ]$

$= 1.505\text{ klf}$ ***(max shear)***

$M_u = 1.6\,P_{ae}\,(0.6H) + 1.0\,[E_{STEM}\,(H_{STEM}/2 + H_{FOOTING}) + E_{FOOTING}\,(H_{FOOTING}/2)]$

$= 1.6\ (0.660\text{ klf})\ (2.50\text{ ft}) + 1.0\ [\ 0.188\text{ klf}\ (2.67\text{ ft}) + 0.263\text{ klf}\ (0.33\text{ ft})\ ]$

$= 3.23\text{ ft-k/ft}$ ***(max moment)***

Equation 16-7 is the govering load combination. As an additional check, use this load combination to consider the impulsive and convective dynamic forces that would be produced by a full tank (3 ft of water) in addition to the lateral earth pressures. The dynamic force due to the inertia of the wall has already been incorporated into P_y/B; therefore, the force E_{STEM} is removed. This new load combination applies to the trailing half of the tank, as discussed in Section 5.3.1 of ASCE 350.3-01.

$V_u = 1.6\,P_{ae} + 1.0\,(P_y/B + E_{FOOTING})$

$= 1.6\ (0.660\text{ klf}) + 1.0\ [\ 0.12\text{ klf} + 0.263\text{ klf}\ ] = 1.438\text{ klf}$

$M_u = 1.0\,[P_y/B\,(y) + E_{FOOTING}\,(H_{FOOTING}/2)] + 1.6\,P_{ae}\,(0.6H)$

$= 1.0\ [\ 0.12\text{ klf}\ (1.61\text{ ft}) + 0.263\text{ klf}\ (0.33\text{ ft})\ ] + 1.6\ (0.660\text{ klf})\ (2.50\text{ ft})$

$= 2.92\text{ ft-k/ft}$

MAXIMUM DESIGN SHEAR ($V_{u,\,max}$):

$V_{u,\,max}$ = **1.505 klf**

MAXIMUM DESIGN MOMENT ($M_{u,\,max}$):

$M_{u,\,max}$ = **3.23 ft-k/ft**

LOAD CONFIGURATION 2 - CONCRETE DESIGN LOADS

LOAD COMBINATIONS (LRFD) *(IBC 2006, Section 1605.2)*

Condsider the following load combinations:

$1.4\,(D + F)$		(IBC 2006, Equation 16-1)
$1.2(D + F + T) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$		(IBC 2006, Equation 16-2)
$1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (f_1 L \text{ or } 0.8W)$	$\rightarrow (f_1 = 0.5)$	(IBC 2006, Equation 16-3)
$1.2D + 1.6W + f_1 L + 0.5(L_r \text{ or } S \text{ or } R)$	$\rightarrow (f_1 = 0.5)$	(IBC 2006, Equation 16-4)
$1.2D + 1.0E + f_1 L + f_2 S$	$\rightarrow (f_1 = 0.5 \text{ and } f_2 = 0.2)$	(IBC 2006, Equation 16-5)
$0.9D + 1.6W + 1.6H$		(IBC 2006, Equation 16-6)
$0.9D + 1.0E + 1.6H$		(IBC 2006, Equation 16-7)

$1.4\,(D + F)$ *(IBC 2006, Equation 16-1)*

[D as defined, $F = F_w$]

$$V_u = 1.4 \quad F_w$$
$$= 1.4 \quad (0.281 \text{ klf})$$
$$= 0.393 \text{ klf} \qquad \textit{(max shear)}$$

$$M_u = F_w\,(H_w/3)$$
$$= 1.4 \quad (0.281 \text{ klf}) \quad (1.00 \text{ ft})$$
$$= 0.39 \text{ ft-k/ft} \qquad \textit{(max moment)}$$

$1.2(D + F + T) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$ *(IBC 2006, Equation 16-2)*

[D as defined, $F = F_w$, $T = 0$, $H = 0$, $L = 0$, $L_r = 0$, $S = 0$, $R = 0$]

By inspection, this load combination does not govern. (The forces T, L and H are not applied. The force S is conservatively neglected. Reducing the factor on the force F from 1.4 to 1.2 will produce smaller shears and moments than those calculated using Equation 16-1.)

$1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (f_1 L \text{ or } 0.8W) \rightarrow (f_1 = 0.5)$ *(IBC 2006, Equation 16-3)*

[D as defined, $L_r = 0$, $S = 0$, $R = 0$, $L = 0$, $W = 0$]

By inspection, this load combination does not govern. (This load combination does not consider lateral fluid pressures or earthquake induced forces, which are the primary forces that will cause shear and moment in the concrete for this load configuration.)

$1.2D + 1.6W + f_1 L + 0.5(L_r \text{ or } S \text{ or } R) \rightarrow (f_1 = 0.5)$ *(IBC 2006, Equation 16-4)*

[D as defined, $W = 0$, $L = 0$, $L_r = 0$, $S = 0$, $R = 0$]

By inspection, this load combination does not govern. (This load combination does not consider lateral fluid pressures or earthquake induced forces, which are the primary forces that will cause shear and moment in the concrete for this load configuration.)

$1.2D + 1.0E + f_1 L + f_2 S$ $\rightarrow (f_1 = 0.5 \text{ and } f_2 = 0.2)$ *(IBC 2006, Equation 16-5)*

[D as defined, $E = P_y/b$ and $E_{FOOTING}$, $L = 0$, $S = 0$]

$V_u = 1.0\,(P_y/B + E_{FOOTING})$

$= 1.0\,[\ 0.12\text{ klf} + 0.263\text{ klf}\ ]$

$= 0.383\text{ klf}$

$M_u = 1.0\,[\,P_y/B\,(y) + E_{FOOTING}\,(H_{FOOTING}/2)\,]$

$= 1.0\,[\ 0.12\text{ klf}\ (1.61\text{ ft}) + 0.263\text{ klf}\ (0.33\text{ ft})\ ]$

$= 0.28\text{ ft-k/ft}$

$0.9D + 1.6W + 1.6H$ *(IBC 2006, Equation 16-6)*

[D as defined, $W = 0$, $H = 0$]

By inspection, this load combination does not govern. (This load combination does not consider lateral fluid pressures or earthquake induced forces, which are the primary forces that will cause shear and moment in the concrete for this load configuration.)

$0.9D + 1.0E + 1.6H$ *(IBC 2006, Equation 16-7)*

[D as defined, $E = P_y/B$ and $E_{FOOTING}$, $H = 0$]

By inspection, this load combination does not govern. (This load combination will produce the same results as Equation 16-5.)

MAXIMUM DESIGN SHEAR ($V_{u,max}$):

$V_{u,max} = 0.393\text{ klf}$

MAXIMUM DESIGN MOMENT ($M_{u,max}$):

$M_{u,max} = 0.39\text{ ft-k/ft}$

REINFORCED CONCRETE DESIGN - WALL

DESIGN PARAMETERS

Specified Compression Strength of Concrete (f'_c) =	4 ksi	
Specified Yield Strength of Reinforcement (f_y) =	60 ksi	
Width of the Compression Face (b) =	12.00 in	
Total Thickness of Concrete Section (h) =	10.00 in	
Concrete Cover Thickness (d_c) =	2.00 in	← *ACI 318-05 - Section 7.7.1(b) requires a minimum concrete cover of 1.5 in for No. 5 bars and smaller.*
Reinforcement Bar Diameter (d_b) =	0.25 in	*(#4 bars)*
Effective Depth of Concrete Section (d) =	7.88 in	*($d = h - d_c - d_b/2$)*
Design Moment (M_u) =	3.23 ft-k	*(Load Configuration 1)*
Design Shear (V_u) =	1.51 k	*(Load Configuration 1)*

FLEXURAL REINFORCEMENT

Force Equalibrium:

$$a = \frac{A_s f_y}{0.85 f'_c b}$$

Moment Equilibrium:

$$M_u \le \phi A_s f_y \left(d - \frac{a}{2} \right)$$

Required Amount of Flexural Reinforcement (*Direct Solution Method*):

(Substitute the force equalibrium equation into the moment equilibrium equation and provide a simultaneous algebraic solution)

$$\rho = \frac{0.85 f'_c}{f_y} \left(1 - \sqrt{1 - \left(\frac{2 \left(\frac{M_u}{\phi b d^2} \right)}{0.85 f'_c} \right)} \right)$$

$$\frac{M_u}{\phi b d^2} = \frac{3.23 \text{ ft-k}}{0.9 \ (12.00 \text{ in}) \ (7.88 \text{ in})^2} \ \frac{12 \text{ in}}{1 \text{ ft}} * \frac{1000 \text{ lb}}{1 \text{ k}} = 58 \text{ psi}$$

$$\rho = \frac{0.85 \ (4000 \text{ psi})}{(60000 \text{ psi})} \left(1 - \sqrt[1.2]{1 - \left(\frac{2 \quad (58 \text{ psi})}{0.85 \ (4000 \text{ psi})} \right)} \right) = 0.0010$$

$A_{s, req'd} = \rho b d =$ 0.0010 (12.00 in) (7.88 in) = 0.09 in^2 *(Apply At Each Face)*

Minimum Vertical Reinforcement ($A_{sv, min}$): *(ACI 318-05 - Section 14.3.2)*

$A_{sv, min} = 0.0015\, b\, h =$ 0.0015 (12.00 in) (10.00 in) = 0.18 in^2 / 2 = 0.09 in^2 *(Each Face)*

Use → #4 bars, spaced at 12.00 in *(Each Face)* — $A_{s, provided}$ = 0.20 in^2 *(Each Face)* **OK**

Minimum Horizontal Reinforcement ($A_{sh, min}$): *(ACI 318-05 - Section 14.3.3)*

$A_{sh, min} = 0.0025\, b\, h =$ 0.0025 (12.00 in) (10.00 in) = 0.30 in^2 / 2 = 0.15 in^2 *(Each Face)*

Use → #4 bars, spaced at 12.00 in *(Each Face)* — $A_{s, provided}$ = 0.20 in^2 *(Each Face)* **OK**

Verify ϕ Factor (Tension Controlled → $\phi = 0.9$ → $c/d_t \le 0.375$): *(ACI 318-05 - Section R9.3.2.2)*

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{0.20 \text{ in}^2 \quad (60000 \text{ psi})}{0.85 \ (4000 \text{ psi}) \ (12.00 \text{ in})} = 0.29 \text{ in}$$

$$c = \frac{a}{0.85} = \frac{0.29 \text{ in}^2}{0.85} = 0.35 \text{ in} \rightarrow \frac{c}{d_t} = \frac{0.35 \text{ in}}{7.88 \text{ in}} = 0.044 \quad \textbf{OK}$$

Check Shear Stress in Stem:

$$\phi V_c = \phi 2 \sqrt{f'_c}\ b\, d \qquad \textit{(ACI 318-05 - Section 11.3.1.1)}$$

$$\phi V_c = 0.75\ (2)\sqrt{4000\ \text{psi}}\ (12.00\ \text{in})\ (7.88\ \text{in})\ \frac{1\ k}{1000\ lb} = 8.97\ \text{klf}$$

$$\phi V_c = 8.97\ \text{k} \quad > \quad V_u = 1.51\ \text{k} \qquad \textit{OK}$$

SHEAR FRICTION REINFORCEMENT (A_{vf})

Assuming only the compression side reinforcement will be considered shear friction reinforcement:

$A_{vf,\ provided}$ = 0.20 in^2

μ = 1.0 λ *(concrete placed on hardened concrete, surface intentionally roughened)* *(ACI 318-05 - Section 11.7.4.3)*

λ = 1.0 *(normal weight concrete)*

$$A_{vf,\ req'd} = \frac{V_u}{\phi f_y \mu} = \frac{1.51\ \text{k}}{0.75\ (60\ \text{ksi})\ (1.0)\ (1.0)} = 0.03\ \text{in}^2 \quad < \quad A_{vf,\ provided} \qquad \textit{OK}$$

DEVELOPMENT LENGTH OF DEFORMED BARS IN TENSION (l_d)

Modification Factors:

ψ_t = Reinforcement Location Factor =	1.0	*(< 12 inches concrete below)*	*(ACI 318-05 - Section 12.2.4(a))*
ψ_e = Reinforcement Coating Factor =	1.0	*(uncoated reinforcement)*	*(ACI 318-05 - Section 12.2.4(b))*
ψ_s = Reinforcement Size Factor =	0.8	*(No. 6 bars and smaller)*	*(ACI 318-05 - Section 12.2.4(c))*
λ = Unit Weight of Concrete Factor =	1.0	*(normal weight concrete)*	*(ACI 318-05 - Section 12.2.4(d))*
c_b = ($h - d$) or (½ s) =	2.12 in	*(smaller value controls)*	
K_{tr} = Transverse Reinforcement Index =	0.0	*(conservative)*	*(ACI 318-05 - Section 12.2.3)*

Deformed Bars (*General Equation*): *(ACI 318-05 - Section 12.2.3)*

$$l_d = \frac{3}{40} * \frac{f_y \psi_t \psi_e \psi_s \lambda}{\sqrt{f'_c}\ \ (c_b + K_{tr}) / d_b}\ d_b \quad \geq \quad 12\ \text{in}$$

$$l_d = \frac{3}{40} * \frac{(60000\ \text{psi})\ \ (1.0)\ (1.0)\ (0.8)\ (1.0)}{\sqrt{4000\ \text{psi}}\ [\ 2.12\ \text{in} + 0.0\ ]\ /\ (0.50\ \text{in})}\ (0.50\ \text{in}) = 6.71\ \text{in}$$

Use → $l_{d,\ min} \geq$ 12.00 in

: 04619

REINFORCED CONCRETE DESIGN - FOOTING

DESIGN PARAMETERS

Specified Compression Strength of Concrete (f'_c) =	4 ksi	
Specified Yield Strength of Reinforcement (f_y) =	60 ksi	
Width of the Compression Face (b) =	12.00 in	
Total Thickness of Concrete Section (h) =	8.00 in	
Concrete Cover Thickness (d_c) =	2.00 in	
Reinforcement Bar Diameter (d_b) =	0.25 in	*(#4 bars)*
Effective Depth of Concrete Section (d) =	5.88 in	*($d = h - d_c - d_b/2$)*
Design Moment (M_u) =	3.23 ft-k	*(Load Configuration 1)*
Design Shear (V_u) =	0.00 k	

Bars located 2.00" from the TOC.

ACI 318-05 - Section 7.7.1(b) requires a minimum concrete cover of 1.5 in for No. 5 bars and smaller.

FLEXURAL REINFORCEMENT

Force Equalibrium:

$$a = \frac{A_s f_y}{0.85 f'_c b}$$

Moment Equilibrium:

$$M_u \leq \phi A_s f_y \left(d - \frac{a}{2} \right)$$

Required Amount of Flexural Reinforcement (*Direct Solution Method*):

(Substitute the force equalibrium equation into the moment equilibrium equation and provide a simultaneous algebraic solution)

$$\rho = \frac{0.85 f'_c}{f_y} \left(1 - \sqrt{1 - \left(\frac{2 \left(\frac{M_u}{\phi b d^2} \right)}{0.85 f'_c} \right)} \right)$$

$$\frac{M_u}{\phi b d^2} = \frac{3.23 \text{ ft-k}}{0.9 \ (12.00 \text{ in}) \ (5.88 \text{ in})^2} \ \frac{12 \text{ in}}{1 \text{ ft}} * \frac{1000 \text{ lb}}{1 \text{ k}} = 104 \text{ psi}$$

$$\rho = \frac{0.85 \ (4000 \text{ psi})}{(60000 \text{ psi})} \left(1 - \sqrt{1 - \left(\frac{2 \quad (104 \text{ psi})}{0.85 \ (4000 \text{ psi})} \right)} \right) = 0.0018$$

1.2

$A_{s,req'd} = \rho b d =$ 0.0018 (12.00 in) (5.88 in) = 0.12 in^2 *(Apply In Both Directions)*

Minimum Reinforcement ($A_{s,min}$): *(ACI 318-05 - Section 10.5.4)*

$A_{s,min} = 0.0018\, b\, h =$ 0.0018 (12.00 in) (8.00 in) = 0.17 in^2 / 2 = 0.09 in^2 *(Both Ways)*

Use → #4 bars, spaced at 12.00 in *(Both Ways)* $A_{s,provided}$ = 0.20 in^2 *(Both Ways)* **OK**

Verify ϕ Factor (Tension Controlled → $\phi = 0.9$ → $c/d_t \leq 0.375$): *(ACI 318-05 - Section R9.3.2.2)*

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{0.20 \text{ in}^2 \ (60000 \text{ psi})}{0.85 \ (4000 \text{ psi}) \ (12.00 \text{ in})} = 0.29 \text{ in}$$

$$c = \frac{a}{0.85} = \frac{0.29 \text{ in}^2}{0.85} = 0.35 \text{ in} \rightarrow \frac{c}{d_t} = \frac{0.35 \text{ in}}{5.88 \text{ in}} = 0.059$$ **OK**

DEVELOPMENT LENGTH OF STANDARD HOOKS IN TENSION (l_d)

Modification Factors:

ψ_e = Reinforcement Coating Factor =	1.0	*(uncoated reinforcement)*	*(ACI 318-05 - Section 12.2.4(b))*
λ = Unit Weight of Concrete Factor =	1.0	*(normal weight concrete)*	*(ACI 318-05 - Section 12.2.4(d))*

Deformed Bars: *(ACI 318-05 - Section 12.5.2)*

$$l_{dh} = 0.02 \frac{f_y \psi_e \lambda}{\sqrt{f'_c}} d_b \geq 6 \text{ in}$$

$$l_{dh} = 0.02 \frac{(60000 \text{ psi}) \quad (1.0) \quad (1.0)}{\sqrt{4000 \text{ psi}}} (0.50 \text{ in}) = 9.49 \text{ in}$$

Use → $l_{dh,\,min} \geq$ 10.00 in

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc.	03131-001-CS-100	Sheet No:	A1	Cont'd on Sht:	—
Prepared By:	JC	Date:	06/30/2011	Checked By:	MLW	Date:	7/8/2011
Title:	Evaporation Tank – Structural Design						

APPENDIX __A__ TO CALCULATION (for Calculation References)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 1

NO REFENCES AT THIS TIME

Burns and Roe Enterprises, Inc.

W.O. No: 03131-001 Calc. 03131-001-CS-200 Sheet 1 Cont'd 2

Client: LANL/ECC Project ZERO LIQUID DISCHARGE SUBPROJECT

Title: PUMP HOUSE ENCLOSURE - PAD DESIGN

REVISION RECORD

100761-11-000090

Revision	Status	Description of Revision	Preparer print/sign/date	Checker print/sign/date	Approver print/sign/date
A	PRELIMINARY	ORIGINAL ISSUE - 60% DESIGN	MUN LAI WONG MLWong 7/8/2011	JEFFREY COOK	BRIAN URGO

PE Seal (if required)

Burns and Roe Enterprises, Inc.

W.O. No: 03131-001 Calc. 03131-001-CS-200 Sheet 2 Cont'd 3

Client: LANL/ECC Project ZERO LIQUID DISCHARGE SUBPROJECT

Title: PUMP HOUSE ENCLOSURE - PAD DESIGN

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BURNS AND ROE ENTERPRISES, LLC

W.O. No:	03131-001	Calc. No:	03131-001-CS-200	Sheet No:	3	Cont'd on:	4
Prepared By:	M. WONG	Date:	06/20/11	Checked By:		Date:	

Title: PUMP HOUSE ENCLOSURE – PAD DESIGN

PURPOSE

The purpose of this calculation is to analyze and design the exterior transfer pump house foundation and related system equipment anchorage in TA-52.

REFERENCES

1. IBC 2006 International Building Code.
2. ASCE 7-05, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, 2005.
3. ACI 318-05, Building Code Requirements for Structural Concrete and Commentary, American Concrete Institute, 2005.
4. LANL Engineering Standards Manual, ESM ISD 341-2, Chapter 5 – Structural, Revision 5, November 19, 2008.
5. ASCE 32-01, Design and Construction of Frost-Protected Shallow Foundations, American Society of Civil Engineers, 2001.
6. ESR-1917, "HILTI Kwik Bolt TZ Carbon and Stainless Steel Anchors in Cracked and Uncracked Concrete", International Code Council – Evaluation Service Report, Reissued May 01, 2011.
7. Zero Liquid Discharge (ZLD) Sub-Project – Requirements and Criteria Document, Document ID: 100761-ZLD-RCD-0003, Revision 0, November 2010.

DESIGN REQUIREMENTS

1. The Natural Phenomena Hazard (NPH) requirements for Performance Category-1 TA-52 structure and component per Reference 7 are as follows:

- Wind Load:

Exposure Category	= C	(ESM Section II-1.6 SECTION 1609)
Wind Speed (3-sec gust)	= 90 mph	(ESM Section II-1.6 SECTION 1609)
Importance Factor, I_w	= 1.0	(ASCE 7-05 Table 6-1, Occupancy Category II)

- Seismic Load:

Seismic Design Category	= D	(ESM Section II-1.7 SECTION 1613)
Importance Factor, I_E	= 1.0	(ASCE 7-05 Table 11.5-1, Occupancy Category II)
S_{DS}	= 0.75g	(ESM Section II-1.7 SECTION 1613)
S_{D1}	= 0.64g	(ESM Section II-1.7 SECTION 1613)

- Snow Load:

Ground Snow Load	= 16 psf	(ESM Section II-1.5 SECTION 1608)
Snow Exposure Factor, Ce	= 0.9	(ASCE 7-05 Table 7-2, Exposure C, Fully Exposed)
Snow Exposure Factor, Ct	= 1.0	(ASCE 7-05 Table 7-3, All structures)
Importance Factor, I_S	= 1.0	(ASCE 7-05 Table 7-4, Occupancy Category II)

- Materials:

Concrete Compressive Strength	f'c = 4000 psi
Post-Installed Anchors	HILTI Kwik Bolt TZ (304 Stainless Steel)

2. All applicable load cases and load combinations shall be used in accordance to IBC 2006 Chapter 16.

UNCONFIRMED ASSUMPTIONS

Pump House Foundation and Anchorage Design Parameters:

- Pump house enclosure dimensions
  - Length: 10'-0"
  - Width: 10'-0"
  - Height: 10'-0"
- Pump house enclosure weights
  - For Foundation Design 3000 lb
  - For Anchor Bolt Design 1000 lb
- Pump house foundation dimensions
  - Length: 12'-0"
  - Width: 12'-0"
  - Thickness 1'-6"
- Anchor Bolt Design
  - Minimum number of anchors 4
  - Anchor size ¾"
  - Anchor spacing Size of Enclosure

PROCEDURES

1. Calculate the design snow load, wind pressure, and seismic forces in accordance with Reference 2.
2. Determine all applicable loadings and load combinations per Chapter 16 of Reference 1.
3. Design foundation to support the exterior pump house enclosure and pump system equipment in accordance with Reference 3 and 5.
4. Determine the anchor bolt forces.
5. Design anchor bolt in accordance with Reference 6.

COMPUTER TYPE: N/A OPERATING SYSTEM: N/A

1. COMPUTER PROGRAM: N/A VERSION: N/A

☐ APPROVED ☐ AUTHORIZED

ESI NUMBER: N/A

CONCLUSIONS

The exterior pump house foundation and related anchorage design are determined to be sufficient in supporting the active transfer pump system from the TA-50 treatment facility to the TA-52 area.

SNOW LOAD ON PUMP HOUSE ENCLOSURE

ASCE 7-05 Minimum Design Loads for Buildings and Other Structures

Exposure Factor $Ce := 0.9$ (*ASCE 7-05, Table 7-2, Exposure C, Fully Exposed*)

Thermal Factor $Ct := 1.2$ (*ASCE 7-05, Table 7-3, Unheated Structures - Conservative*)

Ground Snow Load $p_g := 16 \cdot psf$ (*ESM Section II-1.5, Section 1608*)

Important Factor $Is := 1.0$ (*ASCE 7-05, Table 7-4, Occupancy Category II*)

Maximum Balanced Snow Load $p_{fmax} := Is \cdot 20 \cdot psf$

Minimum Balanced Snow Load $p_{fmin} := Is \cdot p_g$

Balanced Snow Load $pf := \max(0.7 \cdot Ce \cdot Ct \cdot Is \cdot p_g, \text{if}(p_g \le 20 \cdot psf, p_{fmin}, p_{fmax}))$

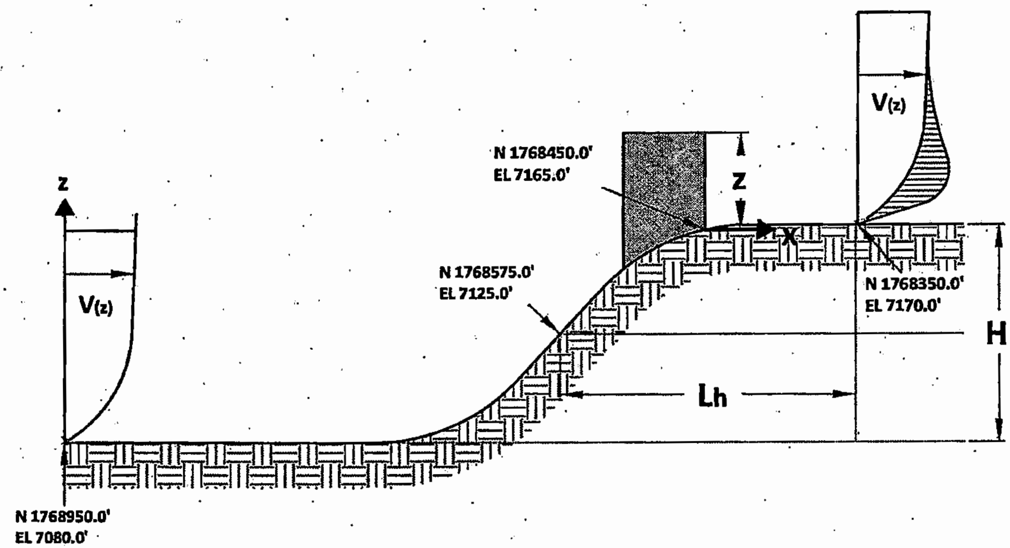
$pf = 16.00\,psf$

TA-52 TOPOGRAPHIC FACTOR (TOWARD SOUTH)

ASCE 7-05 Minimum Design Loads for Buildings and Other Structures

Site Condition

Escarpment
2D-Ridge
3D-Axisymmetrical Hill



Height of Hill or Escarpment $H \equiv (7170 - 7080) \cdot ft$ $H = 90.0\ ft$

Distance Upwind of Crest $L_h \equiv (1768575 - 1768350) \cdot ft$ $L_h = 225.0\ ft$

Distance from Crest to Building Site $x \equiv 150 \cdot ft$

Height of Structure above Local Ground Level $z \equiv 10 \cdot ft$

$a := \frac{H}{L_h}$ $a = 0.400$

$b := \frac{x}{L_h}$ $b = 0.667$

$c := \frac{z}{L_h}$ $c = 0.044$

$K_1 = 0.340$ *(ASCE 7-05 Figure 6-4)*

$K_2 = 0.837$ *(ASCE 7-05 Figure 6-4)*

$K_3 = 0.902$ *(ASCE 7-05 Figure 6-4)*

$K_{zt} := (1 + K_1 \cdot K_2 \cdot K_3)^2$ *(ASCE 7-05 Eq 6-3)*

$K_{zt} = 1.579$

DESIGN WIND LOADS ON PUMP HOUSE ENCLOSURE

ASCE 7-05 Minimum Design Loads for Buildings and Other Structures

Design Parameter:

Basic Wind Speed	$V := 90$	*(ESM Section II-1.6 SECTION 1609.3)*
Exposure Category	$E := \text{"C"}$	*(ESM Section II-1.6 SECTION 1609.4)*
Occupancy Category	$Occu := 2$	*(ESM Section II-1.6 SECTION 1604.5)*
Important Factor	$I = 1.00$	*(ASCE 7-05, Table 6-1)*

Pump House Dimensions:

Height	$h := 10 \cdot ft$
Width	$B := 10 \cdot ft$
Length	$L := 10 \cdot ft$
Height Component Above Grade	$z := h$

$\alpha = 9.5$	*(ASCE 7-05, Table 6-2)*	$\varepsilon = \frac{1}{5}$	*(ASCE 7-05, Table 6-2)*
$z_g = 900$	*(ASCE 7-05, Table 6-2)*	$z_{min} = 15$	*(ASCE 7-05, Table 6-2)*
$c = 0.20$	*(ASCE 7-05, Table 6-2)*	$g_Q := 3.4$	*(ASCE 7-05, Section 6.5.8.1)*
$l = 500$	*(ASCE 7-05, Table 6-2)*	$g_v := 3.4$	*(ASCE 7-05, Section 6.5.8.1)*

$$z_{bar} := \max\left(\frac{0.6 \cdot h}{ft}, z_{min}\right)$$

$$z_{bar} = 15.00$$

$$I_z := c \cdot \left(\frac{33}{z_{bar}}\right)^{\frac{1}{6}} \qquad I_z = 0.23 \qquad \textit{(ASCE 7-05, Eq 6-5)}$$

$$L_z := l \cdot \left(\frac{z_{bar}}{33}\right)^{\varepsilon} \qquad L_z = 427.06 \qquad \textit{(ASCE 7-05, Eq 6-7)}$$

$$Q := \sqrt{\frac{1}{1 + 0.63 \cdot \left(\frac{B + h}{L_z \cdot ft}\right)^{0.63}}} \qquad Q = 0.96 \qquad \textit{(ASCE 7-05, Eq 6-6)}$$

Gust-Effect Factor

$$G := 0.925 \cdot \left(\frac{1 + 1.7 \cdot g_Q \cdot I_z \cdot Q}{1 + 1.7 \cdot g_v \cdot I_z}\right) \qquad \textit{(ASCE 7-05, Section 6.5.8)}$$

$$G = 0.90$$

Wind Directionality Factor	$K_d := 0.85$	*(ASCE 7-05, Table 6-4, Solid Signs)*
Topographic Factor	$K_{zt} := 1.579$	*(Refer to Sheet 6 of Calculation)*

Velocity Pressure Exposure Coefficient

$$K_z := \begin{cases} 2.01 \cdot \left(\dfrac{z}{z_g \cdot ft}\right)^{\frac{2}{\alpha}} & \text{if } 15 \le \dfrac{z}{ft} \le z_g \\ 2.01 \cdot \left(\dfrac{15}{z_g}\right)^{\frac{2}{\alpha}} & \text{if } \dfrac{z}{ft} < 15 \\ \text{"Exceeded Height Limit"} & \text{otherwise} \end{cases}$$

$$K_z = 0.85$$

Velocity Pressure $q_z := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 \cdot I \cdot psf$ *(ASCE 7-05, Equation 6-15)*

$$q_z = 23.63 \text{ psf}$$

Least Horizontal Dimensions of Component $D := \min(B, L)$

$$D = 10.00 \text{ ft}$$

$$C_f := \begin{cases} 1.3 & \text{if } \dfrac{h}{D} < 1 \\ 1.3 + (1.4 - 1.3) \cdot \dfrac{\frac{h}{D} - 1}{7 - 1} & \text{if } 1 \le \dfrac{h}{D} < 7 \\ 1.4 + (2.0 - 1.4) \cdot \dfrac{\frac{h}{D} - 7}{25 - 7} & \text{if } 7 \le \dfrac{h}{D} < 25 \\ 2.0 & \text{otherwise} \end{cases}$$

(ASCE 7-05, Figure 6-21, Square-Wind Normal to Face)

$$C_f = 1.30$$

Design Wind Loads on HVAC Unit $F := q_z \cdot G \cdot C_f$

$$F = 27.72 \text{ psf}$$

CONSERVATIVELY, USE $\boxed{F = 30.00 \text{ psf}}$

ASCE 7-05 Seismic Design Requirements for Pump House Enclosure

Design Spectral Acceleration	$S_{DS} := 0.75$	
Reliability Factor	$\rho := 1.30$	
Component Amplification Factor	$a_p := 1.0$	(*ASCE 7-05, Table 13.6-1*)
Component Response Modification Factor	$R_p := 1.5$	(*ASCE 7-05, Section 13.4.2*)
Component Importance Factor	$I_p := 1.0$	(*ASCE 7-05, Section 13.1.3*)
Height of Attachment of Component	$z := 0 \cdot ft$	
Height of Component	$h = 10.0\,ft$	

$F_{pmax} := (1.6 \cdot S_{DS} \cdot I_p)\ W_p$ $\quad F_{pmax} = 1.200\ W_p$

$F_{pmin} := (0.3 \cdot S_{DS} \cdot I_p)\ W_p$ $\quad F_{pmin} = 0.225\ W_p$

$$F_p := \max\left[F_{pmin}, \min\left[F_{pmax}, \frac{0.4 \cdot a_p \cdot S_{DS}}{\frac{R_p}{I_p}} \cdot \left(1 + 2 \cdot \frac{z}{h}\right)\right]\right]\ W_p$$

$F_p = 0.225\ W_p$

BURNS AND ROE ENTERPRISE, LLC

W.O. No: 03131-001 Calc No: 03131-001-CS-200 Sheet No: 10 Cont'd on: 11

Prepared By: M. Wong Date: 06/15/11 Checked By: Date:

Title: PUMP HOUSE ENCLOSURE - PAD DESIGN

LOADINGS FOR MAT FOUNDATION DESIGN

Lenght of Enclosure =	10	ft	
Width of Enclosure =	10	ft	
Height of Enclosure =	10	ft	
Weight of Enclosure =	3000	lb	(*Conservative*)
Design Snow Load =	16	psf	
Design Wind Load =	30	psf	
Design Seismic Coefficient =	0.225	W	

LOAD COMB. [A]	DL [lb/ft]	SL [lb/ft]	W [lb/ft]	E [lb/ft]	R_A [lb/ft]	R_B [lb/ft]
1	75	-	-	-	105.00	105.00
2	75	40	20	-	142.00	78.00
3	75	40	-	6.75	116.00	102.50
4	75	-	20		99.50	35.50
5	75	-	-	6.75	63.00	49.50

Note A:

Load Combination 1:	***1.4 DL***
Load Combination 2:	***1.2 DL + 0.5SL ± 1.6W***
Load Combination 3:	***1.2 DL + 0.2SL + 1.0 Ev ± 1.0Eh***
Load Combination 4:	***0.9 DL ± 1.6W***
Load Combination 5:	***0.9 DL - 1.0 Ev ± 1.0Eh***

MAT FOUNDATION DESIGN

(per ACI 318-05 Building Code Requirements for Structural Concrete)

Concrete Properties:

Compressive Strength	$f'_c := 4000 \cdot psi$
Specific Weight	$\gamma_c := 150 \cdot pcf$
Clear Cover	$cover := 2.0 \cdot in$

Additional Equipment Loadings:

Approximated Weight of Pumps	$W_p := 2000 \cdot lbf$	
Bearing Area	$Ae := (36 \cdot in) \cdot (36 \cdot in)$	
Unit Weight of Equipment	$wu := \dfrac{W_p}{Ae}$	$wu = 222.22\, psf$
Approximated Weight of Enclosure	$W_e := 3000 \cdot lbf$	

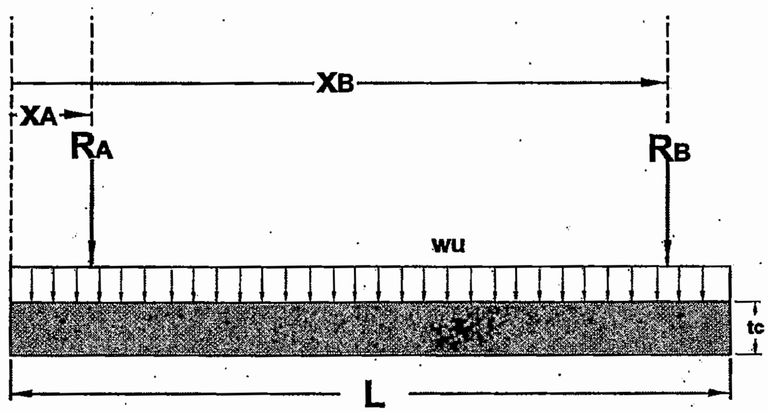
Reinforcement Properties:

Yield Strength	$f_y := 60 \cdot ksi$
Elastic Modulus	$E := 29000 \cdot ksi$

Footing Dimensions:

Length	$L := 12 \cdot ft$
Thickness	$t_c := 1.50 \cdot ft$
Enclosure Length	$L_E := 10 \cdot ft$
	$B_E := 10 \cdot ft$

1. Determine Design Loadings for Foundation



$$x_A := \frac{L - L_E}{2} \qquad x_A = 1.00\ ft$$

$$x_B := x_A + L_E \qquad x_B = 11.00\ ft$$

$$R_A := 142 \cdot \frac{lbf}{ft}$$

$$R_B := 78 \cdot \frac{lbf}{ft}$$

$$Q := R_A + R_B + (1.2)\cdot(\gamma_c \cdot t_c + wu)\cdot L \qquad Q = 6.660\ \frac{kip}{ft}$$

$$x_i := \frac{x_A \cdot R_A + x_B \cdot R_B + \frac{(1.2)\cdot(\gamma_c \cdot t_c + wu)\cdot L^2}{2}}{Q} \qquad x_i = 5.952\ ft$$

$$e_x := \frac{L}{2} - x_i \qquad e_x = 0.048\ ft$$

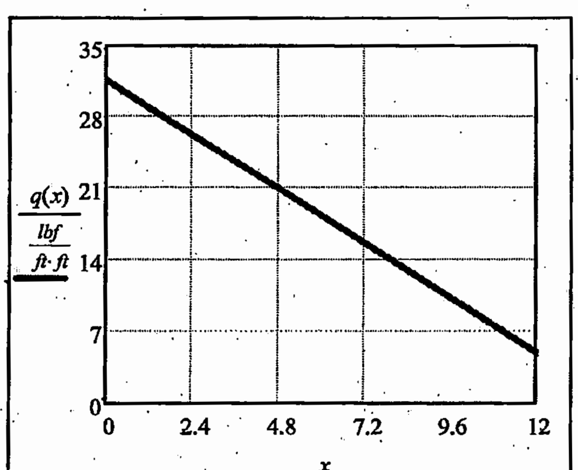
$$q_1 := \frac{Q}{L}\cdot\left(1 + \frac{6 \cdot e_x}{L}\right) \qquad q_1 = 568.333\ psf$$

$$q_2 := \frac{Q}{L}\cdot\left(1 - \frac{6 \cdot e_x}{L}\right) \qquad q_2 = 541.667\ psf$$

$$q(x) := \left(\frac{q_2 - q_1}{L}\cdot x + q_1\right) - (1.2)\cdot(\gamma_c \cdot t_c + wu)$$

$$q(0) = 31.667\ psf$$

$$q(L) = 5.000\ psf$$



$$\int_0^L q(x)\,dx = 0.220\,\frac{kip}{ft}$$

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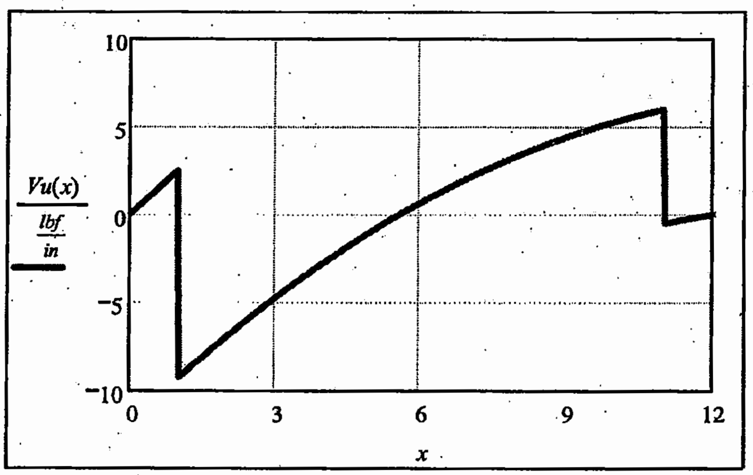

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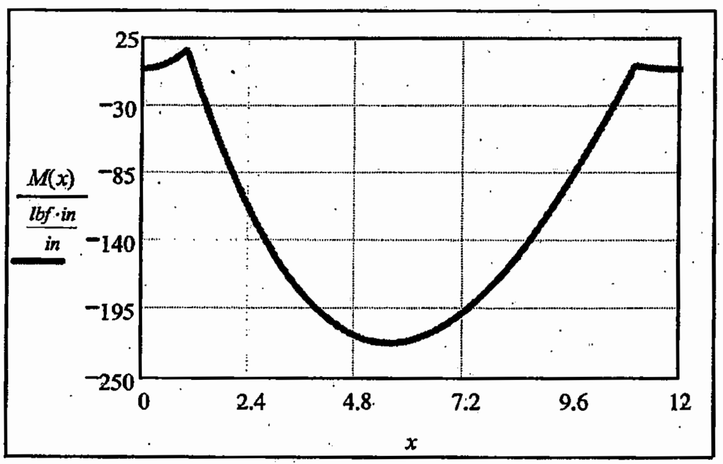


Maximum Moment occurs at:

$$\boxed{x' = 5.575\,ft}$$

$$M_{max} := M(x_A - 0.01 \cdot in)$$

$$M_{max} = 15.438\,\frac{lbf \cdot in}{in}$$

$$M_{min} := M(x')$$

$$M_{min} = -221.716\,\frac{lbf \cdot in}{in}$$

$$Mu := \max(|M_{max}|, |M_{min}|)$$

$$\boxed{Mu = 221.716\,\frac{lbf \cdot in}{in}}$$

2. Design for Reinforcement

$$\beta_1 := \begin{cases} 0.85 & \text{if } 2500 \cdot psi \le f'_c < 4000 \cdot psi \\ 0.85 - 0.05 \cdot \left(\dfrac{f'_c}{ksi} - 4\right) & \text{if } 4000 \cdot psi \le f'_c < 8000 \cdot psi \\ 0.65 & \text{otherwise} \end{cases}$$

(ACI 318-05 Section 10.2.7.3)

$$\beta_1 = 0.850$$

$d := t_c - cover$ $\qquad d = 16.000\,in$

$\varepsilon_y := \dfrac{f_y}{E}$ $\qquad \varepsilon_y = 0.0021$

$$c(a) := \frac{a}{\beta_1}$$

$$\varepsilon_t(a) := \frac{d - c(a)}{c(a)} \cdot 0.003$$ (ACI 318-05 Section 10.3.4)

$$\phi(a) := \begin{vmatrix} 0.65 \text{ if } \varepsilon_t(a) < \varepsilon_y \\ 0.90 \text{ if } \varepsilon_t(a) \ge 0.005 \\ 0.65 + (\varepsilon_t(a) - 0.002) \cdot \left(\frac{250}{3}\right) \text{ otherwise} \end{vmatrix}$$ (ACI 318-05 Figure R9.3.2)

$$Mom(a, As) := \phi(a) \cdot \left[0.85 \cdot f'_c \cdot a \cdot \left(c(a) - \frac{a}{2}\right) + As \cdot f_y \cdot (d - c(a))\right]$$

$\boxed{NoBar := 4}$ @ $\boxed{Spacing := 12.0 \cdot in}$

Given $a := 1 \cdot in$ $As = 0.200 \frac{in^2}{ft}$

$$0.85 \cdot f'_c \cdot a = As \cdot f_y$$
$$Mom(a, As) = Mu$$
$$sol := Find(a, As)$$

$$\begin{pmatrix} a \\ As_{req} \end{pmatrix} := sol \qquad a = 0.005\, in \qquad As_{req} = 0.003 \frac{in^2}{ft}$$

$$As_{min1} := \left(\frac{0.0018 \cdot t_c}{2}\right)$$ (ACI 318-05 Section 7.12.2.1)

$$As_{min2} := min\left(max\left(\frac{3 \cdot \sqrt{\frac{f'_c}{psi}} \cdot psi \cdot d}{f_y}, \frac{200 \cdot psi \cdot d}{f_y}\right), \frac{4}{3} \cdot As_{req}\right)$$ (ACI 318-05 Section 10.5)

$$As_{min} := max(As_{min1}, As_{min2}) \qquad As_{min} = 0.194 \frac{in^2}{ft}$$

$$\phi(a) = 0.900$$

$$a := \frac{As \cdot f_y}{0.85 \cdot f'_c}$$

$$Mn := Mom(a, As) \qquad Mn = 14267.647 \frac{lbf \cdot in}{in}$$

$$Design := \begin{vmatrix} \text{"OK" if } (As \ge As_{min}) \wedge (Mn \ge Mu) \\ \text{"NG" otherwise} \end{vmatrix}$$

$\boxed{Design = \text{"OK"}}$

3. Check Stresses at the Top of Foundation

$$M_{max} = 15.438 \frac{lbf \cdot in}{in}$$

$$f_t := \frac{6 \cdot M_{max}}{t_c^2}$$

$$f_t = 0.286\ psi$$

Modulus of Rupture of Concrete

$$f_r := 7.5 \cdot \sqrt{\frac{f'_c}{psi}} \cdot psi$$

$$f_r = 474.342\ psi \qquad > \qquad f_t = 0.286\ psi$$

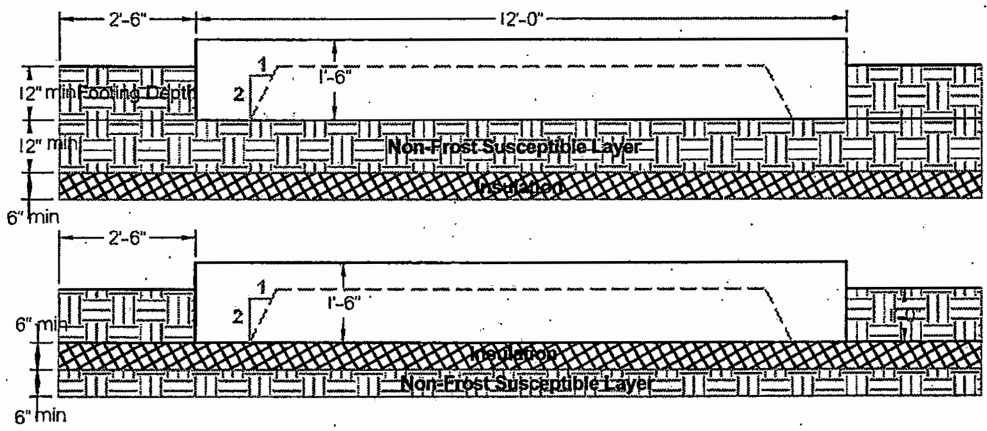
Therefore, the concrete is remained uncracked at the top of the footing due to service loads.

PUMP HOUSE FOUNDATION FROST DESIGN

(ASCE 32-01 Design and Construction of Frost-Protected Shallow Foundations)

The exterior pump house enclosure and relating system equipment are supported on a mat foundations. To eliminate a deep foundation design in satisfying the 3' frost depth design criteria, the frost-protected shallow foundation method is used in designing the foundation to prevent frost damage in cold wheather with seasonal ground freezing. The preliminary mat foundation shall be a 12' X 12' X 1'-6" reinforced concrete foundation with top surface 6" above grade. The foundation is fully exposed; and therefore, Section 7 Frost-Protected Shallow Foundation Method for Unheated Buildings design criteria is used.

Air Freezing Index, AFI	$F_{100} := 750$	*(ASCE 32-01 Figure A1)*
Mean Annual Exterior Temperature	$MAT := 50\ \text{deg}$	*(ASCE 32-01 Figure A2)*
Ground Insulation	$R_g := 5.7 \cdot in$	*(ASCE 32-01 Table A8)*
Horizontal Extension	$D_g := 30 \cdot in$	



Minimum Footing Depth	$D_{min} := 12.0 \cdot in$
Minimum Non-Susceptible Soil Layer	$D_{soil} := 12.0 \cdot in$

R_g may be reduced by 0.3R for every 1-inch thickness of non-frost susceptible layer is increased:

Insulation + Non-Frost Susceptible Layer $D_{ins} := \dfrac{R_g}{0.30}$ $D_{ins} = 19.0\ in$

Total Depth $D_T := D_{min} + D_{soil} + D_{ins}$

$D_T = 43.0\ in$

→ USE 32" OF NON-FROST FILL BELOW BOTTOM OF PAD

SEE CONTRACT DRAWINGS FOR DETAILS

PUMP HOUSE ENCLOSURE ANCHORAGE DESIGN

Design Parameters:

Weight of Enclosure	$W_e := 1000 \cdot lbf$	*(Conservative)*
Height of Enclosure	$h = 120.00\,in$	
Length of Enclosure	$L = 120.00\,in$	
Width of Enclosure	$B = 120.00\,in$	
Approximated Number of Anchors	$N_b := 4$	*(minimum required number of anchors)*
Design Wind Force	$F_w := F$	
	$F_w = 30.00\,psf$	

Shear due to Wind

$V_{wx} := F_w \cdot B \cdot h$ $\quad V_{wx} = 3.00\,kip$

$V_{wz} := F_w \cdot L \cdot h$ $\quad V_{wz} = 3.00\,kip$

Moment due to Wind (*applied at 2/3 of height of equipment*)

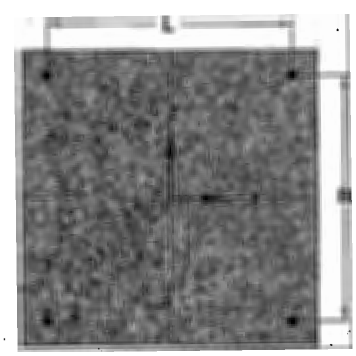
$M_{WOx} := V_{wz} \cdot h \cdot \left(\frac{2}{3}\right)$ $\quad M_{WOx} = 240.00\,kip \cdot in$

$M_{WOz} := V_{wx} \cdot h \cdot \left(\frac{2}{3}\right)$ $\quad M_{WOz} = 240.00\,kip \cdot in$

Bolt Locations

$a := 0$

$$X := \begin{pmatrix} \frac{-L}{2} \\ \frac{L}{2} \\ \frac{-L}{2} \\ \frac{L}{2} \end{pmatrix} \qquad Z := \begin{pmatrix} \frac{-B}{2} \\ \frac{-B}{2} \\ \frac{B}{2} \\ \frac{B}{2} \end{pmatrix}$$



$$I_x := \left| \begin{array}{l} \text{for } m \in 1 .. N_b \\ \quad a \leftarrow a + \left(Z_m\right)^2 \\ a \end{array} \right. \qquad I_z := \left| \begin{array}{l} \text{for } m \in 1 .. N_b \\ \quad a \leftarrow a + \left(X_m\right)^2 \\ a \end{array} \right.$$

$I_x = 14400\,in^2$ $\quad I_z = 14400\,in^2$

WIND LOAD (CASE 1):

$$M_x := 1.6 \cdot M_{WOx}$$

$$Fw_1 := \frac{0.9W_e}{N_b} - \frac{M_x \cdot Z}{I_x}$$

$Fw_1 =$ (lbf)

	1
1	1825.0
2	1825.0
3	-1375.0
4	-1375.0

WIND LOAD (CASE 3):

$$M_x := 1.6 \cdot (0.75 \cdot M_{WOx}) \qquad M_z := 1.6 \cdot (0.75 \cdot M_{WOz})$$

$$Fw_2 := \frac{0.9 \cdot W_e}{N_b} - \frac{M_x \cdot Z}{I_x} + \frac{M_z \cdot X}{I_z}$$

$Fw_2 =$ (lbf)

	1
1	225.0
2	2625.0
3	-2175.0
4	225.0

$$T := \min(Fw_1, Fw_2) \qquad T = -2175.00 \text{ lbf}$$

$$T_1 := \begin{cases} 0 & \text{if } T \geq 0 \\ |T| & \text{otherwise} \end{cases}$$

$$T_1 = 2175.00 \text{ lbf}$$

$$V_1 := \frac{\max[1.6 \cdot \max(V_{wx}, V_{wz}), 1.6 \cdot (0.75) \cdot (V_{wx} + V_{wz})]}{N_b}$$

$$V_1 = 1800.00 \text{ lbf}$$

PUMP HOUSE ENCLOSURE ANCHORAGE DESIGN

Weight of Component	$W_e = 1000\,lbf$
Height of Component	$h = 120.0\,in$
Length of Component	$L = 120.0\,in$
Width of Component	$B = 120.0\,in$
Approximated Number of Anchors	$N_b = 4$

Shear due to Seismic

$V_{sx} := \rho \cdot F_p \cdot W_e$ $\quad V_{sx} = 0.292\,kip$

$V_{sz} := \rho \cdot F_p \cdot W_e$ $\quad V_{sz} = 0.292\,kip$

Moment due to Seismic *(applied at the height of component)*

$M_{SOx} := V_{sz} \cdot h$ $\quad M_{SOx} = 35.100\,kip \cdot in$

$M_{SOz} := V_{sx} \cdot h$ $\quad M_{SOz} = 35.100\,kip \cdot in$

CASE 1 (100%Ex + 30%Ez)

$M_x := M_{SOx}$ $\quad M_z := 0.3 \cdot M_{SOz}$

$$Fs_1 := \frac{(0.9 - 0.2 \cdot S_{DS}) \cdot W_e}{N_b} - \frac{M_x \cdot Z}{I_x} + \frac{M_z \cdot X}{I_z}$$

$Fs_1 =$ (lbf)

	1
1	289.88
2	377.63
3	-2.62
4	85.13

CASE 2 (-30%Ex - 100%Ez)

$M_x := -0.3 \cdot M_{SOx}$ $\quad M_z := -M_{SOz}$

$$Fs_2 := \frac{(0.9 - 0.2 \cdot S_{DS}) \cdot W_e}{N_b} - \frac{M_x \cdot Z}{I_x} + \frac{M_z \cdot X}{I_z}$$

$Fs_2 =$ (lbf)

	1
1	289.88
2	-2.62
3	377.63
4	85.13

$T := \min(Fs_1, Fs_2)$ $\quad T = -2.625\,lbf$

$$T_2 := \begin{cases} 0 & \text{if } T \ge 0 \\ |T| & \text{otherwise} \end{cases} \quad \boxed{T_2 = 2.625\,lbf}$$

$$V_2 := \frac{(1.0 + 0.3) \cdot V_{sx}}{N_b} \quad \boxed{V_2 = 95.063\,lbf}$$

Design Anchor Bolt Forces:

$Nu := \max(T_1, T_2)$ $\quad Nu = 2.175\,kip$

$Vu := \max(V_1, V_2)$ $\quad Vu = 1.800\,kip$

PUMP HOUSE ENCLOSURE ANCHOR BOLT DESIGN - HILTI KB-TZ

(per ESR-1917 Reissued May 01, 2011 and ACI 318-05 Appendix D)

Design Loadings:

Tension Load $Nu = 2.175\,kip$

Shear Load $Vu = 1.800\,kip$

Component Response Modification Factor $R_p = 1.50$

Concrete Properties:

Compressive Strength $f'_c := 4000 \cdot psi$

Thickness of Material $h := 8 \cdot in$

Concrete Type $ConcType :=$ "Normal"

Anchor Bolt Properties:

Bolt Diameter $d \equiv \frac{3}{4} \cdot in$

Type of Anchor

Carbon Steel
Stainless Steel

Embedment Depth $h_a := 6.50 \cdot in$

Yield Strength $f_y = 76.125\,ksi$ *(ESR-1917 Table 3 & 4)*

Ultimate Strength $f_u = 101.500\,ksi$ *(ESR-1917 Table 3 & 4)*

Design Parameters:

Seismic Design Category $Seismic :=$ "D"

Load Combination $LB :=$ "Section 9.2"

Type of Concrete Design $ConcDes :=$ "Uncracked"

Supplementary Reinforcement (Tension) $SR1 :=$ "Condition B"

Supplementary Reinforcement (Shear) $SR2 :=$ "Condition B"

Built-Up Grout Pad Included? $G :=$ "Yes"

Cracked Concrete Coefficient

$$k_{cr} := \begin{cases} 24 & \text{if } (d = 0.5 \cdot in) \wedge (h_a \le 2 \cdot in) \\ 24 & \text{if } (d = 0.75 \cdot in) \wedge (h_a \le 3.75 \cdot in) \\ 17 & \text{otherwise} \end{cases}$$

$k_{cr} = 17$

Uncracked Concrete Coefficient $k_{uncr} := 24$ *(ESR-1917 Table 3 & 4)*

Strength Reduction Factors

Steel Failure Modes $\phi_{Ns} := 0.75$ *(ESR-1917 Table 3 & 4)*

$\phi_{Vs} := 0.65$ *(ESR-1917 Table 3 & 4)*

Concrete Failure Modes

$$\phi_{Nc} := \begin{cases} 0.75 & \text{if } SR1 = \text{"Condition A"} \\ 0.65 & \text{otherwise} \end{cases} \qquad \phi_{Nc} = 0.650$$

$$\phi_{Vc} := \begin{cases} 0.75 & \text{if } SR2 = \text{"Condition A"} \\ 0.70 & \text{otherwise} \end{cases} \qquad \phi_{Vc} = 0.700$$

Anchor Configurations:

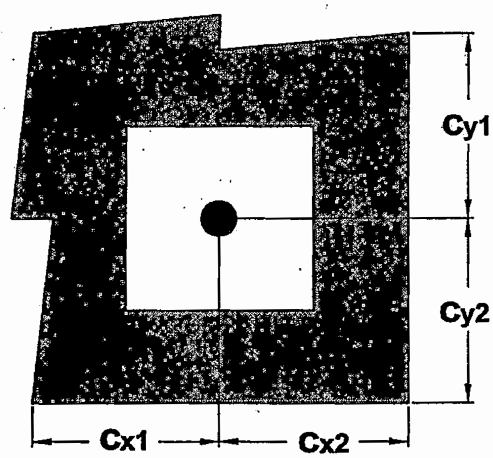
$c_{x1} := 120.0in \qquad e_N := 0.0\cdot in$

$c_{x2} := 12.0in \qquad e_V := 0.0\cdot in$

$c_{y1} := 120.0in$

$c_{y2} := 12.0in$

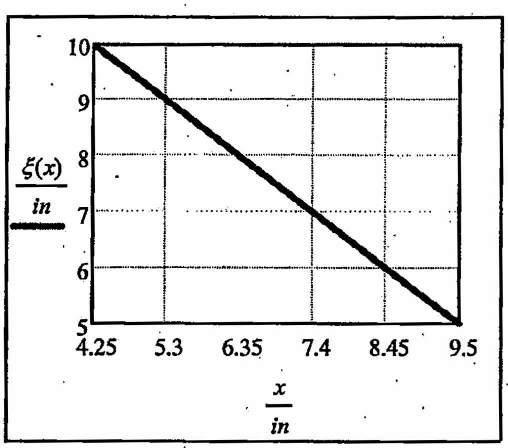
$s_1 := 120in$



$c_{amax} := max(c_{x1}, c_{x2}, c_{y1}, c_{y2})$

$c_{amin} := min(c_{x1}, c_{x2}, c_{y1}, c_{y2})$

$\xi(x) := m\cdot x + b$



$\boxed{c_{min} = 4.250\ in}$

$\boxed{s_{min} = 5.000\ in}$

Check Minimum Requirements (per ESR-1917 Section 4.1.9)

$h_{min} = 8.000\ in$ *(ESR-1917 Table 3 & 4)*

$c_{min} = 4.250\ in$

$s_{min} = 5.000\ in$

$$Req := \begin{cases} \text{"OK"} & \text{if } (h \ge h_{min}) \wedge (c_{amin} \ge c_{min}) \wedge (s_1 \ge s_{min}) \\ \text{"NG"} & \text{otherwise} \end{cases} \qquad \boxed{Req = \text{"OK"}}$$

$$count := \left| \begin{array}{l} count \leftarrow 0 \\ for\ \ i \in 1..1 \\ \quad \left| \begin{array}{l} count \leftarrow count + 1 \ \ if\ \ c_{x1} < 1.5 \cdot h_a \\ count \leftarrow count + 1 \ \ if\ \ c_{x2} < 1.5 \cdot h_a \\ count \leftarrow count + 1 \ \ if\ \ c_{y1} < 1.5 \cdot h_a \\ count \leftarrow count + 1 \ \ if\ \ c_{y2} < 1.5 \cdot h_a \end{array} \right. \\ count \end{array} \right.$$

$count = 0$

$$h_{ef} := \left| \begin{array}{l} max\left(\dfrac{c_{amax}}{1.5}, \dfrac{1}{3} \cdot s_1\right) \ \ if\ \ count \geq 3 \\ h_a \ \ otherwise \end{array} \right.$$

(ACI 318-05 Appendix D.5.2.3)

$h_{ef} = 6.500\ in$

TENSILE STRENGTH

ESR-1917 Section 4.1.2 Requirements for Static Steel Strength in Tension

$A_{se} = 0.237\ in^2$ *(ESR 2322 Table 3 & 4)*

$N_s := N_{sa}$ *(ESR 2322 Table 3 & 4)*

$\boxed{N_s = 24.055\ kip}$

ESR-1917 Section 4.1.3 Requirements for Static Concrete Breakout Strength in Tension

$hef_{eff} = 4.750\ in$ *(ESR-1917 Table 3 & 4)*

$$\lambda := \left| \begin{array}{l} 0.75 \ \ if\ \ ConcType = \text{"All-Lightweight"} \\ 0.85 \ \ if\ \ ConcType = \text{"Sand-Lightweight"} \\ 1.00 \ \ otherwise \end{array} \right.$$

(ACI 318-05 Chapter 11.7.4.3)

$\lambda = 1.000$

$$N_b := \left| \begin{array}{l} k_{cr} \cdot \lambda \cdot \sqrt{\dfrac{f'_c}{psi}} \cdot \left(\dfrac{hef_{eff}}{in}\right)^{1.5} \cdot lbf \ \ if\ \ ConcDes = \text{"Cracked"} \\ k_{uncr} \cdot \lambda \cdot \sqrt{\dfrac{f'_c}{psi}} \cdot \left(\dfrac{hef_{eff}}{in}\right)^{1.5} \cdot lbf \ \ otherwise \end{array} \right.$$

(ACI 318-05 Appendix D EQ D-7)

$N_b = 15.714\ kip$

$$A_{Nco} := 9 \cdot h_{ef}^{2}$$ (ACI 318-05 Appendix D EQ D-6)

$$A_{Nco} = 380.250\ in^2$$

$$c_{ax1} := min(c_{x1}, 1.5 \cdot h_a)$$
$$c_{ax2} := min(c_{x2}, 1.5 \cdot h_a)$$
$$c_{ay1} := min(c_{y1}, 1.5 \cdot h_a)$$
$$c_{ay2} := min(c_{y2}, 1.5 \cdot h_a)$$

$$A_{Nc} := (c_{ax1} + c_{ax2}) \cdot (c_{ay1} + c_{ay2})$$ (ACI 318-05 Appendix D Fig.RD.5.2.1(b))

$$A_{Nc} = 380.250\ in^2$$

Modification Factor for Eccentricities

$$\psi_{ecN} := \frac{1}{1 + \frac{2 \cdot e_N}{3 \cdot h_{ef}}}$$ (ACI 318-05 Appendix D EQ D-9)

$$\psi_{ecN} = 1.000$$

Modification Factor for Edge Effects

$$c_{amin} = 12.000\ in$$

$$\psi_{edN} := \begin{cases} 1.0 & \text{if } c_{amin} \geq 1.5 \cdot h_{ef} \\ 0.7 + 0.3 \cdot \frac{c_{amin}}{1.5 \cdot h_{ef}} & \text{otherwise} \end{cases}$$ (ACI 318-05 Appendix D EQ D-10 & D-11)

$$\psi_{edN} = 1.000$$

Modification Factor for the Design of Cracked Concrete

$$\psi_{cN} := \frac{k_{uncr}}{k_{cr}}$$ (ESR-1917 Table 3 & 4)

$$\psi_{cN} = 1.412$$

$$h_{ef} := h_a$$

Modification Factor for Splitting (ESR-1917 Section 4.1.4)

$$c_{ac} = 10.000\ in$$ (ESR-1917 Table 3 & 4)

$$\psi_{cpN} := \begin{cases} 1.0 & \text{if } c_{amin} \ge c_{ac} \\ min\left(\frac{c_{amin}}{c_{ac}}, 1.5 \cdot \frac{h_{ef}}{c_{ac}}\right) & \text{otherwise} \end{cases}$$ (ACI 318-05 Appendix D EQ D-12 & D-13)

$\psi_{cpN} = 1.000$

$$N_{cb} := \frac{A_{Nc}}{A_{Nco}} \cdot \psi_{ecN} \cdot \psi_{edN} \cdot \psi_{cN} \cdot \psi_{cpN} \cdot N_b$$ (ACI 318-05 Appendix D EQ D-5)

$\boxed{N_{cb} = 22.184\ kip}$

ESR-1917 Section 4.1.4 Requirements for Static Pullout Strength in Tension

$\psi_{cP} := 1.0$ (ESR-1917 Section 4.1.4)

$N_{pcr} = 8.110\ kip$ (ESR-1917 Table 3 & 4)

$N_{puncr} = 200.000\ kip$ (ESR-1917 Table 3 & 4)

$$N_{pn} := \begin{cases} \psi_{cP} \cdot N_{pcr} \cdot \sqrt{\frac{f'_c}{2500 \cdot psi}} & \text{if } ConcDes = \text{"Cracked"} \\ \psi_{cP} \cdot N_{puncr} \cdot \sqrt{\frac{f'_c}{2500 \cdot psi}} & \text{otherwise} \end{cases}$$ (ESR-1917 Eq. 1) (ESR-1917 Eq. 2)

$\boxed{N_{pn} = 252.982\ kip}$

ESR-1917 Section 4.1.5 Requirements for Static Steel Strength in Shear

$$seis := \begin{cases} \text{"Low"} & \text{if } (Seismic = \text{"A"}) \vee (Seismic = \text{"B"}) \\ \text{"Moderate High"} & \text{otherwise} \end{cases}$$

$seis = \text{"Moderate High"}$

$V_{sa} = 15.711\ kip$ (ESR-1917 Table 3 & 4)

$V_{seis} = 12.890\ kip$ (ESR-1917 Table 3 & 4)

$$V_s := \begin{cases} \text{if } seis = \text{"Low"} & \begin{cases} 0.80 V_{sa} & \text{if } G = \text{"Yes"} \\ V_{sa} & \text{otherwise} \end{cases} \\ \text{otherwise} & \begin{cases} 0.80 V_{seis} & \text{if } G = \text{"Yes"} \\ V_{seis} & \text{otherwise} \end{cases} \end{cases}$$ (ACI 318-05 Appendix D.6.1.3) (ACI 318-05 Appendix D.6.1.3)

$\boxed{V_s = 10.312\ kip}$

ESR-1917 Section 4.1.6 Requirements for Static Concrete Breakout Strength in Shear

$c_{a1x} := min(c_{x1}, c_{x2})$ $\quad$ $c_{a1y} := min(c_{y1}, c_{y2})$

$c_{a2x} := min(c_{y1}, c_{y2})$ $\quad$ $c_{a2y} := min(c_{x1}, c_{x2})$

$$c_{a1x} := \left| \begin{array}{l} max\left(\frac{c_{a2x}}{1.5}, \frac{h_a}{1.5}, \frac{s_1}{3}\right) \text{ if } count \ge 3 \\ c_{a1x} \end{array} \right.$$

$c_{a1x} = 12.000\ in$

$$c_{a1y} := \left| \begin{array}{l} max\left(\frac{c_{a2y}}{1.5}, \frac{h_a}{1.5}, \frac{s_1}{3}\right) \text{ if } count \ge 3 \\ c_{a1y} \end{array} \right.$$

$c_{a1y} = 12.000\ in$

$A_{Vcox} := 4.5 \cdot c_{a1x}^{\ 2}$ (ACI 318-05 Appendix D EQ D-23)

$A_{Vcox} = 648.000\ in^2$

$A_{Vcx} := (min(c_{y1}, 1.5 \cdot c_{a1x}) + min(c_{y2}, 1.5 \cdot c_{a1x})) \cdot min(h, 1.5 \cdot c_{a1x})$

$A_{Vcx} = 240.000\ in^2$ (ACI 318-05 Appendix D Fig.RD.6.2.1(b))

$A_{Vcoy} := 4.5 \cdot c_{a1y}^{\ 2}$ (ACI 318-05 Appendix D EQ D-23)

$A_{Vcoy} = 648.000\ in^2$

$A_{Vcy} := (min(c_{x1}, 1.5 \cdot c_{a1y}) + s_1 + min(c_{x2}, 1.5 \cdot c_{a1y})) \cdot min(h, 1.5 \cdot c_{a1y})$

$A_{Vcy} = 1200.000\ in^2$ (ACI 318-05 Appendix D Fig.RD.6.2.1(b))

$le := min(h_{ef}, 8 \cdot d)$ $\quad$ $le = 6.000\ in$ (ACI 318-05 Appendix D.6.2.2)

$$V_{bx} := \left[7 \cdot \left(\frac{le}{d}\right)^{0.2} \cdot \sqrt{\frac{d}{in}}\right] \cdot \lambda \cdot \sqrt{\frac{f_c}{psi}} \cdot \left(\frac{c_{a1x}}{in}\right)^{1.5} \cdot lbf$$

(ACI 318-05 Appendix D EQ D-24)

$V_{bx} = 24.157\ kip$

$$V_{by} := \left[7 \cdot \left(\frac{le}{d}\right)^{0.2} \cdot \sqrt{\frac{d}{in}}\right] \cdot \lambda \cdot \sqrt{\frac{f_c}{psi}} \cdot \left(\frac{c_{a1y}}{in}\right)^{1.5} \cdot lbf$$

(ACI 318-05 Appendix D EQ D-24)

$V_{by} = 24.157\ kip$

Modification Factor for Eccentricities

$$\psi_{ecVx} := \frac{1}{1 + \frac{2 \cdot e_V}{3 \cdot c_{a1x}}}$$ (ACI 318-05 Appendix D EQ D-26)

$$\psi_{ecVx} = 1.000$$

$$\psi_{ecVy} := \frac{1}{1 + \frac{2 \cdot e_V}{3 \cdot c_{a1y}}}$$ (ACI 318-05 Appendix D EQ D-26)

$$\psi_{ecVy} = 1.000$$

Modification Factor for Edge Effects

$$\psi_{edVx} := \begin{vmatrix} 1.0 \ \ if \ \ c_{a2x} \geq 1.5 \cdot c_{a1x} \\ 0.7 + 0.3 \cdot \frac{c_{a2x}}{1.5 \cdot c_{a1x}} \ \ otherwise \end{vmatrix}$$ (ACI 318-05 Appendix D EQ D-27 & D-28)

$$\psi_{edVx} = 0.900$$

$$\psi_{edVy} := \begin{vmatrix} 1.0 \ \ if \ \ c_{a2y} \geq 1.5 \cdot c_{a1y} \\ 0.7 + 0.3 \cdot \frac{c_{a2y}}{1.5 \cdot c_{a1y}} \ \ otherwise \end{vmatrix}$$

$$\psi_{edVy} = 0.900$$

Modification Factor for the Design of Cracked Concrete

$$\psi_{cV} := \begin{vmatrix} 1.40 \ \ if \ \ ConcDes = \text{"Uncracked"} \\ 1.20 \ \ if \ \ ConcDes = \text{"Cracked"} \wedge SR2 = \text{"Condition A"} \\ 1.00 \ \ otherwise \end{vmatrix}$$ (ACI 318-05 Appendix D.6.2.7)

$$\psi_{cV} = 1.400$$

Modification Factor for the Thickness of Base Material

$$\psi_{hVx} := \begin{vmatrix} min\left(\sqrt{\frac{1.5 \cdot c_{a1x}}{h}}, 1.0\right) \ \ if \ \ h < 1.5 \cdot c_{a1x} \\ 1.0 \end{vmatrix}$$ (ACI 318-08 Appendix D.6.2.8)

$$\psi_{hVx} = 1.000$$

$$\psi_{hVy} := \begin{vmatrix} min\left(\sqrt{\frac{1.5 \cdot c_{a1y}}{h}}, 1.0\right) \ \ if \ \ h < 1.5 \cdot c_{a1y} \\ 1.0 \end{vmatrix}$$ (ACI 318-08 Appendix D.6.2.8)

$$\psi_{hVy} = 1.000$$

$$V_{cbx} := \frac{A_{Vcx}}{A_{Vcox}} \cdot \psi_{ecVx} \cdot \psi_{edVx} \cdot \psi_{cV} \cdot \psi_{hVx} \cdot V_{bx}$$ (ACI 318-05 Appendix D EQ D-22)

$V_{cbx} = 11.273\ kip$

$$V_{cby} := \frac{A_{Vcy}}{A_{Vcoy}} \cdot \psi_{ecVy} \cdot \psi_{edVy} \cdot \psi_{cV} \cdot \psi_{hVy} \cdot V_{by}$$ (ACI 318-05 Appendix D EQ D-22)

$V_{cby} = 56.367\ kip$

$V_{cb} := min(V_{cbx}, V_{cby})$

$\boxed{V_{cb} = 11.273\ kip}$

ESR-1917 Section 4.1.8 Requirements for Static Concrete Pryout Strength in Shear

$$k_{cp} := \begin{cases} 1.0 & if\ (h_a \le 2.0 \cdot in) \wedge \left(d \le \frac{1}{2} \cdot in\right) \\ 2.0 & otherwise \end{cases}$$ (ESR-1917 Table 3 & 4)

$k_{cp} = 2.000$

$V_{cp} := k_{cp} \cdot N_{cb}$ (ACI 318-05 Appendix D EQ D-30)

$\boxed{V_{cp} = 44.368\ kip}$

Summary

$$S_N := \begin{cases} \phi_{Ns} \cdot N_s & if\ seis = \text{"Low"} \\ 0.75 \cdot (\phi_{Ns} \cdot N_s) & otherwise \end{cases}$$ $S_N = 13.531\ kip$ (ACI 318-05 Appendix D.3.3.3)

$$S_V := \begin{cases} \phi_{Vs} \cdot V_s & if\ seis = \text{"Low"} \\ 0.75 \cdot (\phi_{Vs} \cdot V_s) & otherwise \end{cases}$$ $S_V = 5.027\ kip$ (ACI 318-05 Appendix D.3.3.3)

$$C_N := \begin{cases} \phi_{Nc} \cdot min(N_{cb}, N_{pn}) & if\ seis = \text{"Low"} \\ 0.75 \cdot \phi_{Nc} \cdot min(N_{cb}, N_{pn}) & otherwise \end{cases}$$ $C_N = 10.815\ kip$ (ACI 318-05 Appendix D.3.3.3)

$$C_V := \begin{cases} \phi_{Vc} \cdot min(V_{cb}, V_{cp}) & if\ seis = \text{"Low"} \\ 0.75 \cdot \phi_{Vc} \cdot min(V_{cb}, V_{cp}) & otherwise \end{cases}$$ $C_V = 5.919\ kip$ (ACI 318-05 Appendix D.3.3.3)

$$\phi Nn := \begin{cases} min(S_N, C_N) & \text{if } S_N \le C_N \\ \frac{0.6 \cdot \lambda}{R_p} \cdot min(S_N, C_N) & \text{otherwise} \end{cases}$$

(ESM Section II - A.11(F) Section 1913.3.2)

$$\phi Nn = 4.326\ kip$$

$$\phi Vn := \begin{cases} min(S_V, C_V) & \text{if } S_V \le C_V \\ \frac{0.6 \cdot \lambda}{R_p} \cdot min(S_V, C_V) & \text{otherwise} \end{cases}$$

(ESM Section II - A.11(F) Section 1913.3.2)

$$\phi Vn = 5.027\ kip$$

$$Interaction := \begin{cases} \frac{Nu}{\phi Nn} & \text{if } Vu \le 0.2 \cdot \phi Vn \\ \frac{Vu}{\phi Vn} & \text{if } Nu \le 0.2 \cdot \phi Nn \\ \frac{Nu}{\phi Nn} + \frac{Vu}{\phi Vn} & \text{otherwise} \end{cases}$$

$$\boxed{Interaction = 0.861}$$

Burns and Roe Enterprises, Inc.

W.O. No: 03131-001 Calc. 03131-001-EE-001 Sheet No: 1 Cont'd on Sht: 2

Client: LANL Project: LANL Radioactive Liquid Waste Treatment Discharge Facility

Title: Short Circuit Calculation

REVISION RECORD 100761-11-000090

Revision	Status	Description of Revision	Preparer print/sign/date	Checker print/sign/date	Approver print/sign/date
A	Preliminary	Original Issue	R. Kollo 6/27/11	JACOB FICK 6/28/11	

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc.	03131-001-EE-001	Sheet No:	2	Cont'd on Sht:	3
Client:	LANL	Project:	LANL Radioactive Liquid Waste Treatment Discharge Facility				
Title:	Short Circuit Calculation						

TABLE OF CONTENTS

PURPOSE

Determine fault duty ratings of equipment at 13.2kV and 480V; to support completion of one-line diagrams and specification of equipment.

REFERENCES

1. ANSI/IEEE Standard 242 (1986): IEEE Recommended Practice Protection and Coordination of Industrial and Commercial Power Systems. (Buff Book)
2. ANSI Standard C37.16 (2000): Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors – Preferred Ratings, Related Requirements and Application Recommendations.
3. IEEE Standard C57.12.00 (2000): General Requirements for Liquid Immersed Distribution, Power and Regulating Transformers.
4. IEEE Standard 141 (1993): IEEE Recommended Practice for Electric Power Distribution for Industrial Plants. (Red Book)
5. BRE Drawing E6000 (Rev. A): Zero Liquid Discharge System Electrical One Line
6. Email from Brophy, Joe to Lopez, Thomas A, dated 6/02/2011, ZLD subproject-RFI-007.

DESIGN REQUIREMENTS

1. The model for short circuit analysis is based on latest one-line information of plant configuration (Reference 5).
2. 13.2kV system is normally operating at 13.4kV per Reference 6. Conservative calculation for short circuit will consider 5% increase in voltage.
3. To be conservative for small motors where cables are not being considered a value of 17% of sub-transient impedance was used.
4. The nominal transformer bank rating is 112.5kVA, (3-37.5kVA, Single Phase).

UNCONFIRMED ASSUMPTIONS

Final horse power for the pumps

DESIGN PROCEDURES

COMPUTER TYPE: **Dell Optiplex GX620** ,
OPERATING SYSTEM: **Microsoft Windows XP Professional, Ver. 2002, S.P. 3.**

1. COMPUTER PROGRAM: SKM Power Tools VERSION: 6.0.2.1 (Build 1)

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-EE-001	Sheet No:	4	Cont'd on	5
Prepared By:	R. Korio	Date:	06/27/11	Checked By:	[signature]	Date:	6/28/11
Title:	Short Circuit Calculation						

☒ APPROVED ☐ AUTHORIZED

ESI No. EE-0012-07

2. A_Fault module of SKM's Power Tools was used for short circuit analysis with set up as below:

- Fault Type: Three Phase Only
- Calculation Method: Transformer Tap: Unchecked (Mid Range)
  Pre-Fault Voltage: 1.05 pu
- Solution Method: E/X
- NACD (No AC Current Delay): Predominant

3. This short circuit analysis was performed under the following situations:

Study Case	Case Description
SC Case 1	• Utility at 1.05 pu • All motors running

CONCLUSIONS

Short circuit calculation results for Case 1 are presented in the following tables:
Table 1-1 Three Phase Interrupting Fault Levels

In Table 1-1 the calculated max value for 480V Bus fault level is at 7.1 KA.

Table 1-1: Three Phase Interrupting Fault Levels.

Selected Buses	SC Case 1 (kA)
480 V Bus	7.1

BODY OF CALCULATION

The calculation is completely done by PTW software. Electrical loads for 480 bus are tabulated below.

1. The following low voltage motor loads are located on 480V Bus:

Load	Rating (HP)
ZLD Transfer Pump	25
Spray Pump A	15
Spray Pump B	15
Total	**55**

Non-motor loads:

Load	Rating (kVA)
Panel Board	15
Total Load	**15**

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-EE-001	Sheet No:	A1	Cont'd on	-
Prepared By:	R. Korio	Date:	06/27/11	Checked By:	A	Date:	6/28/11
Title:	Short Circuit Calculation						

APPENDIX _A_ TO CALCULATION (for Computer Analysis Input Sheets)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 6

THE COMPUTER INPUT CONTAINED IN THIS APPENDIX HAS BEEN PREPARED AND CHECKED BY THE INDVIDUALS NOTED.

INPUT/OUTPUT PRODUCED ON COMPUTER NO. __C 1562

ATTACHMENTS:

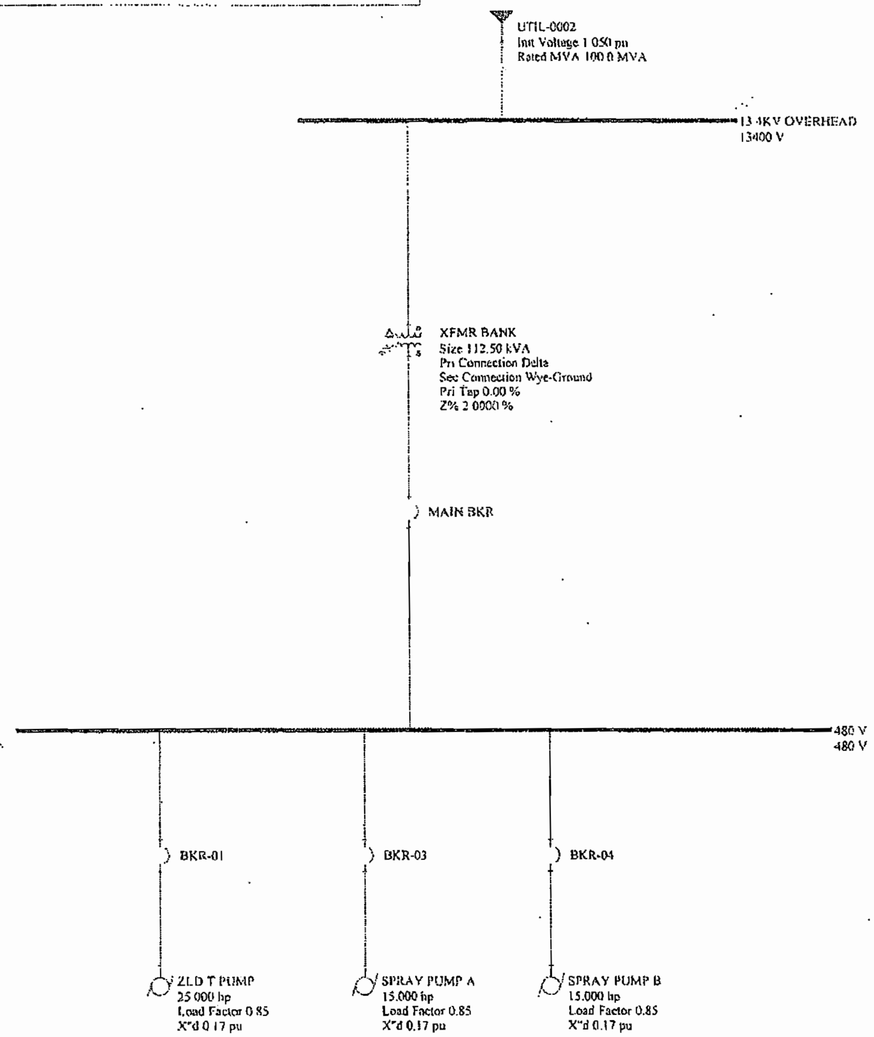
1. SKM POWER*TOOLS SHORT CIRCUIT STUDY INPUT DATA ONE LINE DIAGRAMS AND REPORT.

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY
SKM DISCLAIMS ANY RESPONSIBILITY AND LIABILITY RESULTING
FROM THE USE AND INTERPRETATION OF THIS SOFTWARE.

SKM POWER*TOOLS FOR WINDOWS
INPUT DATA REPORT

ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE.

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
INPUT DATA



83958

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
INPUT DATA

TRANSFORMER INPUT DATA

```
===================================================================================
TRANSFORMER   PRIMARY RECORD    VOLTS   * SECONDARY RECORD    VOLTS  FULL-LOAD   NOMINAL
NAME          NO NAME           L-L      NO NAME              L-L    KVA         KVA
===================================================================================
XFMR BANK     13.4KV OVERHEA D  13200.0  480 V           YG   480.00  112.50      112.50
              Pos. Seq. Z%:     2.00 + J  0.000    (Zpu  17.78 + j  0.000 )    Shell Type
              Zero Seq. Z%:     2.00 + J  0.000    (Sec  17.78 + j  0.000 Pri  Open)
              Taps  Pri. 0.000 %  Sec. 0.000 %  Phase Shift (Pri. Leading Sec.):  30.00 Deg.
```

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
INPUT DATA

GENERATION CONTRIBUTION DATA

BUS NAME	CONTRIBUTION NAME	VOLTAGE L-L	MVA	X"d	X/R
13.4KV OVERHEA	UTIL-0002	13400.0	149.35		

Three Phase Contribution: 6435.00 AMPS 2.57
Pos Sequence Impedance (100 MVA Base) 0.2428 + J 0.6240 PU
Zero Sequence Impedance (100 MVA Base) 10000000 + J 10000000 PU

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
INPUT DATA

MOTOR CONTRIBUTION DATA

BUS NAME	CONTRIBUTION NAME	VOLTAGE L-L	BASE kVA	X"d	X/R	Motor Number
480 V	SPRAY PUMP B	480	15.49	0.1677	6.00	1.00
	Pos Sequence Impedance (100 MVA Base) 165.74 + j 994.43 PU					
480 V	SPRAY PUMP A	480	15.49	0.1677	6.00	1.00
	Pos Sequence Impedance (100 MVA Base) 165.74 + j 994.43 PU					
480 V	ZLD T PUMP	480	25.81	0.1677	6.00	1.00
	Pos Sequence Impedance (100 MVA Base) 99.44 + j 596.66 PU					

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-EE-001	Sheet No:	B1	Cont'd on	-
Prepared By:	R. Korio	Date:	06/27/11	Checked By:		Date:	
Title:	Short Circuit Calculation						

APPENDIX _B_ TO CALCULATION (for Computer Analysis Output Sheets)

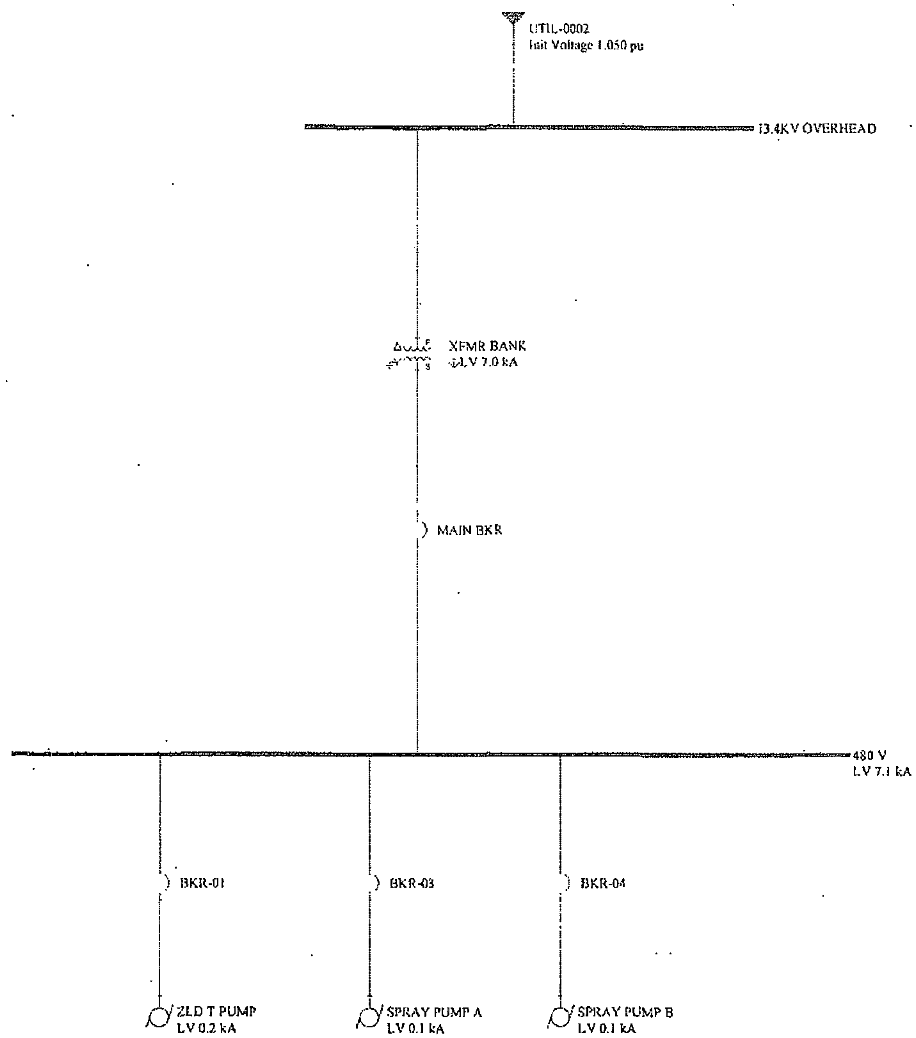
TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 9

INPUT/OUTPUT PRODUCED ON COMPUTER NO. __C 1562____

ATTACHMENTS:

1. SKM POWER*TOOLS TYPICAL OUTPUT SHORT CIRCUIT (CASE #1) KEY ONE LINE DIAGRAM AND A_FAULT ANALYSIS REPORT.

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
SHORT CIRCUIT CALCULATION



04663

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
SHORT CIRCUIT CALCULATION
Jun 28, 2011 16:00:42

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY
SKM DISCLAIMS ANY RESPONSIBILITY AND LIABILITY RESULTING
FROM THE USE AND INTERPRETATION OF THIS SOFTWARE.

SKM POWER*TOOLS FOR WINDOWS
A_FAULT SHORT CIRCUIT ANALYSIS REPORT

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
SHORT CIRCUIT CALCULATION

THREE PHASE FAULT REPORT
(FOR APPLICATION OF LOW VOLTAGE BREAKERS)
PRE FAULT VOLTAGE: 1.0500
MODEL TRANSFORMER TAPS: NO

==

```
480 V       3P Duty:  7.107 KA AT   -5.67 DEG (   6.20 MVA)  X/R:      0.05
            VOLTAGE:    480.   EQUIV. IMPEDANCE=  0.0407 + J  0.0040  OHMS
            LOW VOLTAGE POWER CIRCUIT BREAKER    7.107 KA
            MOLDED CASE CIRCUIT BREAKER < 10KA   7.107 KA
            MOLDED CASE CIRCUIT BREAKER < 20KA   7.107 KA
            MOLDED CASE CIRCUIT BREAKER > 20KA   7.107 KA
            CONTRIBUTIONS:  SPRAY PUMP B      0.125 KA     ANG:    -80.54
                            ZLD T PUMP        0.209 KA     ANG:    -80.54
                            SPRAY PUMP A      0.125 KA     ANG:    -80.54
            XFMR BANK       13.4KV OVERHEA    7.001 KA     ANG:   -182.04
```

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
SHORT CIRCUIT CALCULATION

FAULT STUDY SUMMARY
(FOR APPLICATION OF LOW VOLTAGE BREAKERS)
PRE-FAULT VOLTAGE: 1.0500
MODEL TRANSFORMER TAPS: NO

BUS RECORD NO NAME	VOLTAGE L-L	AVAILABLE FAULT DUTIES (KA) 3 PHASE	X/R	LINE/GRND	X/R
480 V	480.	7.107	0.05		

1 FAULTED BUSES, 5 BRANCHES, 4 CONTRIBUTIONS

*** SHORT CIRCUIT STUDY COMPLETE ***

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
SHORT CIRCUIT CALCULATION

T H R E E   P H A S E   M O M E N T A R Y   D U T Y   R E P O R T
PRE FAULT VOLTAGE: 1.0500
MODEL TRANSFORMER TAPS: NO

===

480 V VOLTAGE: 480. (SEE LOW VOLTAGE REPORT)

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
SHORT CIRCUIT CALCULATION

M O M E N T A R Y D U T Y S U M M A R Y R E P O R T
PRE FAULT VOLTAGE: 1.0500
MODEL TRANSFORMER TAPS: NO
SOLUTION METHOD : E/X

BUS NO	RECORD NAME	VOLTAGE L-L	* 3 P H A S E * KA	X/R	* * * SLG * * * KA	X/R

0 FAULTED BUSES, 5 BRANCHES, 4 CONTRIBUTIONS

*** WARNING: Check Breaker Manufacturers' Data
For Application At Other Than NOMINAL VOLTAGE ***

*** SHORT CIRCUIT STUDY COMPLETE ***

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
SHORT CIRCUIT CALCULATION

THREE PHASE INTERRUPUTING DUTY REPORT
PRE FAULT VOLTAGE: 1.0500
MODEL TRANSFORMER TAPS: NO

==

480 V VOLTAGE: 480. (SEE LOW VOLTAGE REPORT)

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
ZERO LIQUID DISCHARGE SYSTEM
SHORT CIRCUIT CALCULATION

INTERRUPTING DUTY SUMMARY REPORT
PRE FAULT VOLTAGE: 1.0500
MODEL TRANSFORMER TAPS: NO
NACD OPTION: PREDOMINANT

BUS NO	RECORD NAME	VOLTAGE L-L	NACD RATIO	*3 PHASE* E/X KA	X/R	***SLG*** E/X KA	X/R

0 FAULTED BUSES, 5 BRANCHES, 4 CONTRIBUTIONS

*** WARNING: Check Breaker Manufacturers' Data
For Application At Other Than NOMINAL VOLTAGE ***

*** SHORT CIRCUIT STUDY COMPLETE ***

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-EE-001	Sheet No:	C1	Cont'd on	-
Prepared By:	R. Korio	Date:	06/27/10	Checked By:	[signature]	Date:	6/28/11
Title:	Short Circuit Calculation						

APPENDIX _C_ TO CALCULATION (for Computer Analysis Output Sheets)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 11

INPUT/OUTPUT PRODUCED ON COMPUTER NO. _

ATTACHMENTS:

EMAIL FROM Norman Lacy to Jacob Filak (BURNS & ROE), DATED 6/14/2011, ZLD Subproject - RFI-007 Response (additional information).

Reference 6:

Exhibit I Attachment A (Rev. 0, 2-23-09)

SUBCONTRACTOR TRANSMITTAL / STATUS SHEET

Los Alamos NATIONAL LABORATORY EST. 1943

<table>
<tr><td colspan="2">Subcontract Number: 117112-1</td><td colspan="2">STR Name: Keith Anderson</td></tr>
<tr><td rowspan="10">SUBCONTRACTOR</td><td colspan="2">Company Name: ECC</td><td>Date Submitted: 5/16/2011</td></tr>
<tr><td colspan="2">Street Address:1746 Cole Blvd Bld 21 Ste 350</td><td>Initial Submittal of a New Document
✓</td></tr>
<tr><td colspan="2">City, State, Zip code:Lakewood, CO 80401</td><td>Re-Submittal of Previous Document</td></tr>
<tr><td colspan="2">Subcontractor's Point of Contact:
Keith Anderson 303-298-7607 ext 1149</td><td></td></tr>
<tr><td>Submittal Number:</td><td colspan="2">RFI BREI-007</td></tr>
<tr><td>Submittal Title:</td><td colspan="2">RFI BREI-007</td></tr>
<tr><td>Revision Number:</td><td colspan="2">0</td></tr>
<tr><td colspan="3">Subcontractor's Representative's signature below indicates that submittal has been reviewed for accuracy and meets the requirements of the subcontract.</td></tr>
<tr><td colspan="3">Subcontractor's Representative's signature:
Timothy Langlois ,Quality Assurance Officer 5/16/11</td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td rowspan="9">CONTRACTOR</td><td colspan="2">Date Received:</td><td></td></tr>
<tr><td colspan="2">Statused By:</td><td></td></tr>
<tr><td colspan="2">Date:</td><td></td></tr>
<tr><td colspan="3">Comments:</td></tr>
<tr><td colspan="3">See Attached information</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">Status Code:
☐ 1 Reviewed-Work may proceed
☐ 2 Reviewed-Revise and resubmit. Work may proceed subject to incorporation of indicated comments.
☐ 3 Reviewed. Revise and resubmit. Work may not proceed.
☐ 4 Reject. Submittal does not meet requirements. Resubmit.
☐ 5 Permission to proceed not required.</td></tr>
<tr><td></td><td colspan="3">Submit comments to:</td></tr>
</table>

REQUEST FOR INFORMATION

~~SUBCONTRACT No. 117112-1~~	~~RFI No. BREI-007 Rev. 0~~	~~Date: 5/13/11~~	Page 1 of 1
Project ID: 100761	Date Reply Requested By: 5/20/11		

Reference Information (Document/Drawing/Specification/Location)
See SKM001 Rev. A "ZERO LIQUID DISCHARGE GENERAL ARRANGEMENT and
RFP Exhibit E U11004 COMP tblk TA52 SITE.pdf

INFORMATION REQUESTED / PROBLEM:

1. Please provide copy of 13.8kV distribution one-line that indicates electrical information at the interface pole for power supply to the ZLD pump house.
2. Please provide expected electrical fault current level (KA or MVA) with X/R ratio at the interface pole for power supply to the ZLD pump house.
3. Please provide the electrical detail for the interface pole (height of pole, elevation of circuit conductors above grade, diameter of pole, and location of guy wires, if any), see attached copy of a portion of RFP Exhibit E U11004 COMP tblk TA52 SITE.pdf, with callout to the interface pole.

PROPOSED RESPONSE / SOLUTION:

SUBCONTRACTOR Representative: STR: Receipt Date:

INFORMATION TO SUBCONTRACTOR

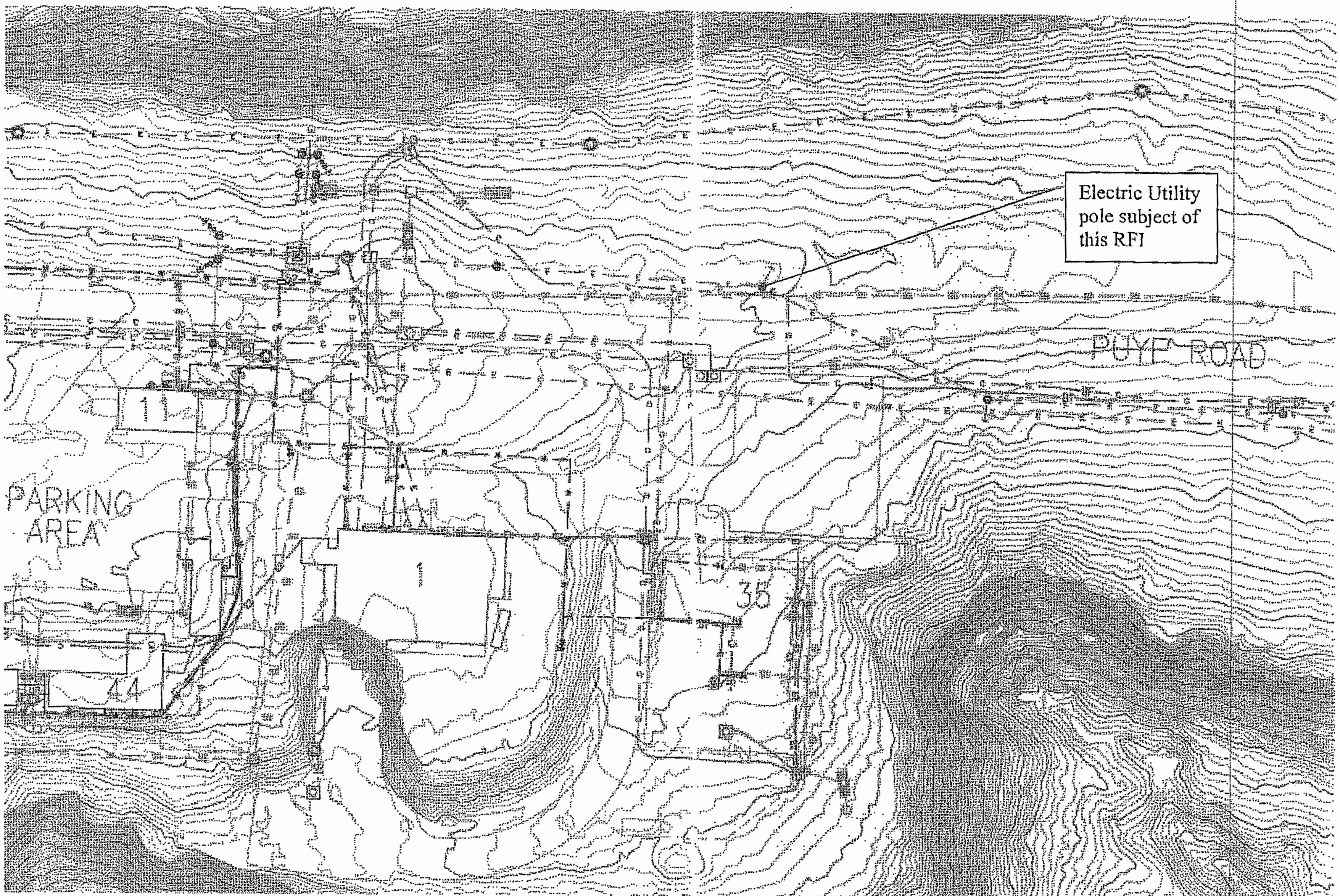
REQUESTED INFORMATION:

1.
2. See attached email dated June 1, 2011 from Tom Lopez, in response to Items I & 2 to RFI 7

3. Copy of CAD Drawing TA52_U11004 was submitted via email 5/25/2011.

Additional Info: 06/14/2011. See attached email dated June 14, 2011 via Don Bryant. Provides Pole calculation. Also see attached TA-52 Fault Current for Pole 2903 calculation pdf file.

CONTRACTOR Representative: Ed Artiglia [signature] Date: 05/25/2011


Electric Utility pole subject of this RFI
PUYE ROAD
PARKING AREA
11
1
35
44

Montoya, Dorothy A

From:	Joe Brophy [brophy@lanl.gov]
Sent:	Thursday, June 02, 2011 8:08 AM
To:	Lopez, Thomas A
Cc:	Montoya, Dorothy A; Artiglia, Edward W
Subject:	FW: ZLD subproject - RFI-007
Attachments:	RFI BREI-007 Form R0.PDF
Importance:	High

Tom,

Thanks a bunch for stepping up to the plate. This helps us a lot. We will be in touch...

Joseph A. Brophy (Joe)

Joseph A. Brophy, PMP
PMF-FUNCT Project Manager
Telephone: 5-1119
Pager: 104-3223
Schedule B

From: Tom Lopez [mailto:tlopez@lanl.gov]
Sent: Wednesday, June 01, 2011 9:57 AM
To: brophy@lanl.gov
Cc: charles@lanl.gov
Subject: FW: ZLD subproject - RFI-007
Importance: High

Joe,

It looks like Don Bryant, Michael Serrano and Charles are out the whole week. It appears that the pumphose is less than 1000 feet from the substation so there is not much distribution line impedance.

I can provide information about the substation 115KV/13.8KV Y-Y transformer. It is a 30 MVA base rating, 8.31% impedance.

Overhead 13KV/ 480V transformers have approximately 2% impedance on their base rating. Padmount transformers have approximately 5% impedance on their base rating.

This may allow Burns & Roe to perform an infinite bus fault calculation in the interim to determine equipment ratings. Equipment ratings usually come in nominal ratings of 10,000 Amps Interrupting, 22,000AIC, and 44,000AIC. If it is borderline on equipment ratings I expect them back next week. We can also have ES-DE perform SKM fault calculations if you desire.

I would be happy to speak with the Engineers in the meantime.

Thanks, Tom.

From: Smithour, Mell A [mailto:smithour_mell_a@lanl.gov]
Sent: Tuesday, May 31, 2011 2:17 PM
To: Lopez, Thomas A
Subject: FW: ZLD subproject - RFI-007
Importance: High

From: Smithour, Mell A
Sent: Wednesday, May 25, 2011 1:24 PM
To: Trujillo, Charles P; Bryant, Don B; Racinez, Emilio A
Subject: FW: ZLD subproject - RFI-007
Importance: High

Do you have the information requested in the RFI? Let me know.

Thanks

From: Edward W. Artiglia [mailto:artiglia@lanl.gov]
Sent: Tuesday, May 24, 2011 3:26 PM
To: Smithour, Mell A
Cc: Maestas, Roy P
Subject: FW: ZLD subproject - RFI-007

Mell,

Would you be able to provide any electrical information pertaining to the Zero Liquid Discharge Project RFI #7 attached?

Thanks, Ed

Edward W. Artiglia, PE (inactive), PMP
Engineering Manager
RLWTF Upgrade Project
664-0351 (W)
231-2542 (C)
665-9220 (F)

: 04676

From: Roy P. Maestas [mailto:roy_maestas@lanl.gov]
Sent: Monday, May 23, 2011 12:36 PM
To: 'Edward W. Artiglia'
Cc: 'Joseph A' 'Brophy'; 'Jolene C' 'Vigil'; 'Costa, Cindy L'
Subject: ZLD subproject - RFI-007

Ed - Attached is RFI 007

Roy Maestas
Los Alamos National Laboratory
Subcontract Technical Representative
Construction Management Division
Work 665-0546
Cell 500-5432
roy_maestas@lanl.gov

From: Tim Langlois [mailto:TNLanglois@ecc.net]
Sent: Monday, May 23, 2011 12:17 PM
To: roy_maestas@lanl.gov
Cc: Keith Anderson
Subject: ECC RFI-007

Roy,
Attached is RFI-007. Please le me know if there is anything else you need.

Thanks

Tim

Timothy Langlois
ECC
1746 Cole Blvd Bldg 21 Ste350
Lakewood, CO 80401
Ph#303-298-7607 X1155
Cell#720-300-1911
Fax#303-298-7837
tnlanglois@ecc.net

From:	Edward W. Artiglia
To:	Montoya, Dorothy A
Subject:	FW: ZLD subproject - RFI-007
Date:	Tuesday, June 14, 2011 8:40:11 AM
Attachments:	TA-52 Fault Current for Pole 2903.pdf

Dorothy,

Please amend the RFI-007 to include this additional information.

Thanks

Ed

Edward W. Artiglia, PE (inactive), PMP
Engineering Manager
RLWTF Upgrade Project
664-0351 (W)
231-2542 (C)
665-9220 (F)

From: Bryant, Don B [mailto:bryant_don_bruce@lanl.gov]
Sent: Tuesday, June 14, 2011 8:34 AM
To: Smithour, Mell A; Trujillo, Charles P; Racinez, Emilio A
Cc: Artiglia, Edward W; Bryant, Don B
Subject: RE: ZLD subproject - RFI-007

#2 Copy of fault current attached.

#3 Pole 2903 is a 45' class 3. Clearance of wire to ground should be measured by the linemen.

NOTE: This circuit EA-8 will Reconductor for the CMRR project. Any additional loads may be affected.

From: Smithour, Mell A
Sent: Wednesday, May 25, 2011 1:24 PM
To: Trujillo, Charles P; Bryant, Don B; Racinez, Emilio A
Subject: FW: ZLD subproject - RFI-007

Importance: High

Do you have the information requested in the RFI? Let me know.

Thanks

From: Edward W. Artiglia [mailto:artiglia@lanl.gov]
Sent: Tuesday, May 24, 2011 3:26 PM
To: Smithour, Mell A
Cc: Maestas, Roy P
Subject: FW: ZLD subproject - RFI-007

Mell,

Would you be able to provide any electrical information pertaining to the Zero Liquid Discharge Project RFI #7 attached?

Thanks, Ed

Edward W. Artiglia, PE (inactive), PMP
Engineering Manager
RLWTF Upgrade Project
664-0351 (W)
231-2542 (C)
665-9220 (F)

From: Roy P. Maestas [mailto:roy_maestas@lanl.gov]
Sent: Monday, May 23, 2011 12:36 PM
To: 'Edward W. Artiglia'
Cc: 'Joseph A' 'Brophy'; 'Jolene C' 'Vigil'; 'Costa, Cindy L'
Subject: ZLD subproject - RFI-007

Ed - Attached is RFI 007

Roy Maestas
Los Alamos National Laboratory
Subcontract Technical Representative
Construction Management Division

Work 665-0546
Cell 500-5432
roy_maestas@lanl.gov

From: Tim Langlois [mailto:TNLanglois@ecc.net]
Sent: Monday, May 23, 2011 12:17 PM
To: roy_maestas@lanl.gov
Cc: Keith Anderson
Subject: ECC RFI-007

Roy,
Attached is RFI-007. Please le me know if there is anything else you need.

Thanks

Tim

Timothy Langlois
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FAULT CURRENT CALCULATIONS

6/14/2011

Table Values   Wire Size = 2/0 ACSR Code 41   Utility Voltage = 13.4kV   EA-8

$R1 := .170$ Length := 2.070

$X1 := .155$

$L := \text{Length}$ $L = 2.07$

$Ro := .288$

$Xo := .496$

Last Value at Pole, Switch or Transformer

From Pole 2912 to Pole 2903 at TA-52   EA-8

At Pole 2912		At Pole 2903
FeedPt1 := .08367	$R_1 := \text{FeedPt1} + R1 \cdot L$	$R_1 = 0.43557$
FeedPt2 := .79968	$X_1 := \text{FeedPt2} + X1 \cdot L$	$X_1 = 1.12053$
	$Z_1 := \sqrt{R_1^2 + X_1^2}$	$Z_1 = 1.20220993$
FeedPt3 := .37120	$R_0 := \text{FeedPt3} + 2 \cdot R1 \cdot L + Ro \cdot L$	$R_0 = 1.67116$
FeedPt4 := 2.16951	$X_0 := \text{FeedPt4} + 2 \cdot X1 \cdot L + Xo \cdot L$	$X_0 = 3.83793$
	$Z_0 := \sqrt{R_0^2 + X_0^2}$	$Z_0 = 4.18598643$

Fault Current

$$F_{3P} := \frac{13400}{Z_1 \cdot \sqrt{3}} \qquad F_{3P} = 6.43522686 \cdot 10^3$$

$$F_{LG} := \frac{13400 \cdot \sqrt{3}}{Z_0} \qquad F_{LG} = 5.54456666 \cdot 10^3$$

3 Phase X/R = $\text{Phase} := \frac{X_1}{R_1}$ Phase = 2.57256009

Line to Gnd X/R = $\text{LineGnd} := \frac{X_0}{R_0}$ LineGnd = 2.29656646

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc.	03131-001-EE-002	Sheet No:	1	Cont'd on Sht:	2

Client: LANL Project: LANL Radioactive Liquid Waste Treatment Discharge Facility

Title: ZLD Transmission Line Sag and Tension Calculation

REVISION RECORD 100761-11-000090

Revision	Status	Description of Revision	Preparer print/sign/date	Checker print/sign/date	Approver print/sign/date
A	Preliminary	Original Issue	P. Donato Peter P. Donato 7/8/11	[illegible] 7/8/11	

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PURPOSE:

The purpose of this calculation is to establish appropriate tension to apply to overhead lines while minimizing the sag of the conductors.

REFERENCES:

1. National Electrical Safety Code (NESC)
2. NFPA 70 National Electric Code –2011.
3. Burns and Roe LANL Drawing C-55751-E1000 Revision A

DESIGN REQUIREMENTS:

1. The NESC Medium Loading Zone will be used for this calculation.
2. The following conductors will be used for this analysis:
   a) 2/0 ACSR
   b) 7 #8 Copperweld
3. The spans that will be evaluated are 110 ft. and 125ft.

UNCONFIRMED ASSUMPTIONS:

Final locations of poles required to complete calculation.

DESIGN PROCEDURES:

COMPUTER TYPE: **Dell Optiplex 755,**
OPERATING SYSTEM: **Microsoft Windows XP Professional, Ver. 2002, S.P. 3**

COMPUTER PROGRAM: Sag10, VERSION: 3.9.7

☒ APPROVED ☐ AUTHORIZED

ESI No. EE-0021-00

1. The Sag 10 version 3.9.7 is used to perform sag and tension calculations in order to verify the tension needed to minimize the sag of the conductors.

2. The NESC Medium Loading Zone is used due to the location of the LANL site. The criterion for this is selected in S1010.

3. The conductors are selected for according to the system ampacity, which are selected to be 2/0 ACSR with shield wire selected to be 7#8 Copperweld.

4. The following spans are inputted into Sag10 for analysis:

   a) 110 feet
   b) 125 feet

5. The final tension values are inputted into Sag10 and analyzed. These values are modified to provide the least amount of tension on the structure while limiting the sag of the conductors.

CONCLUSIONS:

The maximum tension for the 2/0 ACSR and 7#8 Copperweld cables was selected to be 500 lbs per conductor.

Appendix A Sh. 1 of 2

ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA

Conductor QUAIL #2/0 AWG 6/ 1 Stranding ACSR

Area= .1221 Sq. in Dia= .447 in Wt= .183 lb/f RTS= 5310 lb
Data from Chart No. 1-938
English Units
Using Exact Catenary Equations

Span= 115.0 feet NESC Medium Load Zone
Creep IS a Factor Rolled Rod

Design Points					Final		Initial	
Temp F	Ice in	Wind psf	K lb/f	Weight lb/f	Sag ft	Tension lb	Sag ft	Tension lb
15.	.25	4.00	.20	.709	2.38	493.	2.35	500.*
32.	.25	.00	.00	.400	2.41	275.	2.33	284.
0.	.00	.00	.00	.183	1.89	160.	1.75	173.
15.	.00	.00	.00	.183	2.11	144.	1.97	154.
30.	.00	.00	.00	.183	2.28	133.	2.18	139.
60.	.00	.00	.00	.183	2.59	117.	2.49	122.
90.	.00	.00	.00	.183	2.81	108.	2.77	109.
120.	.00	.00	.00	.183	2.96	102.	2.95	103.
167.	.00	.00	.00	.183	3.19	95.	3.18	95.
212.	.00	.00	.00	.183	3.40	89.	3.39	90.

* Design Condition

Span= 125.0 feet NESC Medium Load Zone
Creep IS a Factor Rolled Rod

Design Points					Final		Initial	
Temp F	Ice in	Wind psf	K lb/f	Weight lb/f	Sag ft	Tension lb	Sag ft	Tension lb
15.	.25	4.00	.20	.709	2.81	494.	2.78	500.*
32.	.25	.00	.00	.400	2.84	276.	2.76	283.
0.	.00	.00	.00	.183	2.32	154.	2.18	164.
15.	.00	.00	.00	.183	2.53	141.	2.40	149.
30.	.00	.00	.00	.183	2.70	132.	2.60	138.
60.	.00	.00	.00	.183	3.02	119.	2.92	123.
90.	.00	.00	.00	.183	3.25	110.	3.21	112.
120.	.00	.00	.00	.183	3.41	105.	3.39	106.
167.	.00	.00	.00	.183	3.64	98.	3.63	99.
212.	.00	.00	.00	.183	3.86	93.	3.85	93.

* Design Condition

ALUMINUM COMPANY OF AMERICA SAG AND TENSION DATA

Conductor 7 No. 8 CopperWeld

Area= .0908 Sq. in Dia= .385 in Wt= .324 lb/f RTS= 10460 lb
Data from Chart No. 1-1242
English Units
Using Exact Catenary Equations

Span= 115.0 feet NESC Medium Load Zone
Creep is NOT a Factor

Design Points					Final		Initial	
Temp	Ice	Wind	K	Weight	Sag	Tension	Sag	Tension
F	in	psf	lb/f	lb/f	ft	lb	ft	lb
15.	.25	4.00	.20	.799	2.65	500.	2.65	500.*
32.	.25	.00	.00	.521	2.68	322.	2.66	325.
0.	.00	.00	.00	.324	2.41	223.	2.37	226.
15.	.00	.00	.00	.324	2.51	214.	2.48	217.
30.	.00	.00	.00	.324	2.61	205.	2.58	208.
60.	.00	.00	.00	.324	2.80	191.	2.77	194.
90.	.00	.00	.00	.324	2.98	180.	2.95	182.
120.	.00	.00	.00	.324	3.16	170.	3.12	172.
167.	.00	.00	.00	.324	3.41	158.	3.38	159.
212.	.00	.00	.00	.324	3.63	148.	3.60	149.

* Design Condition

Span= 125.0 feet NESC Medium Load Zone
Creep is NOT a Factor

Design Points					Final		Initial	
Temp	Ice	Wind	K	Weight	Sag	Tension	Sag	Tension
F	in	psf	lb/f	lb/f	ft	lb	ft	lb
15.	.25	4.00	.20	.799	3.13	500.	3.13	500.*
32.	.25	.00	.00	.521	3.16	323.	3.14	325.
0.	.00	.00	.00	.324	2.89	220.	2.85	222.
15.	.00	.00	.00	.324	2.99	212.	2.96	214.
30.	.00	.00	.00	.324	3.09	205.	3.06	207.
60.	.00	.00	.00	.324	3.29	193.	3.25	195.
90.	.00	.00	.00	.324	3.47	183.	3.44	185.
120.	.00	.00	.00	.324	3.65	174.	3.61	176.
167.	.00	.00	.00	.324	3.90	163.	3.87	164.
212.	.00	.00	.00	.324	4.14	154.	4.11	155.

* Design Condition

APPENDIX B TO CALCULATION – REFERENCES

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX: (INCLUDING THIS PAGE) 2

Tank Area Pole Plan DWG: C-55751 SH. E-1000

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc.	03131-001-ME-100	Sheet No:	1	Cont'd on Sht:	2
Client:	Los Alamos National Laboratory	Project:	Zero Liquid Discharge Project				
Title:	Evaporation Tank And Enhanced Evaporation Design						

REVISION RECORD 100761-11-000090

Revision	Status	Description of Revision	Preparer print/sign/date	Checker print/sign/date	Approver print/sign/date
A	Preliminary	Original Issue 60% Submittal	G. Dunn DD 6/8/2011	C. Crosman C. Crosman 6/8/2011	S. Stuhrke

PE Seal (if required)

04689

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PURPOSE

The purpose of this calculation is to determine the conceptual design of evaporation tanks and enhanced evaporation devices that will be used to evaporate five million liters of waste water per year from the LANL facility.

REFERENCES

1. PADWP Average Discharge Volumes
2. Website: www.weather.lanl.gov
3. "Study on Simplified Model for Estimating Evaporation from Reservoirs," *Australian Journal of Basic and Applied Sciences*, 4(12): 6476, Equation 5; 2010
4. "Rainfall and Climate Variation over a Sloping New Mexico Plateau during the North American Monsoon," *Journal of Climate*, Volume 9: 3436, Table 2; 1996
5. "Evaporation Losses from Sprinkler Irrigation Systems under Various Operating Conditions," *Journal of Applied Sciences*, 9(3): 599, Equation 3; 2009
6. "Relative Humidity and Dew Point Table," US Department of Commerce Weather Bureau
7. Steel, E.W., and McGhee, Terence J., "3-17 Evaporation from Water Surfaces," *Water Supply and Sewerage*, 5th ed., New York, New York, 1979, p. 41

DESIGN REQUIREMENTS

1. Evaporate five million liters per year.
2. The evaporation tank area will consist of a two (2) tank arrangement.
3. The walls of the Evaporation Tank will be 36 inches tall.
4. The width of the evaporation tanks is 69 feet.
5. The end and dividing walls of the evaporation tank are 1 foot a piece.
6. The Spray Evaporation System will be used for 12 hours per day during operational days.

UNCONFIRMED ASSUMPTIONS

1. The flow rate of the Spray Evaporation System is 150gpm.

DESIGN PROCEDURES

1. Evaporation tank surface area will be determined based on natural evaporation of the discharge volume (approximately 5 million liters per year). The volume of water received in the evaporation tanks as a result of precipitation will be evaporated by spraying.
2. Pan evaporation can be found in Reference 2. The two closest locations to Los Alamos from which historical pan evaporation data are available are Sante Fe and Cochiti Dam.
3. Since these two locations are both within approximately 20 miles of Los Alamos, and because the data indicates significantly different evaporation rates, these are compared to evaporation rates predicted by the Linacre equation in Reference 3. The equation takes into account data specific to Los Alamos, including mean temperature of air, elevation, latitude and mean dew-point temperature.
4. The Linacre method predicts Lake Evaporation, which is then converted to Pan Evaporation. Lake Evaporation is 70% of Pan Evaporation (Reference 7).
5. The calculated Pan Evaporation using the Linacre method (120.27 inches/year) shows that the Pan Evaporation is greater than both locations where historical data is available, Santa Fe (60.22 inches/year) and Cochiti Dam (88.01 inches/year). Historical pan evaporation data from Cochiti Dam is selected as a conservative basis for sizing the evaporation tank.

6. The total surface area of the evaporation tanks will be found by dividing the total discharge volume (ft^3) by total Lake Evaporation (ft.). The result will be the surface area necessary to evaporate all of the discharge by use of evaporation alone.
7. The Evaporation Losses (% of nozzle discharge evaporated) will be calculated using the equation found in Reference 5, on a per month basis. The Evaporation Losses equation takes into account monthly wind speed, ambient dry bulb temperature, and relative humidity.
8. Monthly wind speeds and ambient dry bulb temperatures were found using historical data from Reference 2. Relative Humidity was found using monthly ambient dry bulb temperatures, dew point temperatures, and the charts in Reference 6.
9. Evaporation Losses (% of nozzle discharge evaporated) per month were calculated using Reference 5 and rounded down to the nearest whole percent to be conservative.
10. The flow per month, necessary to evaporate the total yearly precipitation volume is calculated by dividing Total Precipitation in a year by Monthly Evaporation Losses (%).
11. Monthly spraying will be allocated throughout the year by using the same ratio as Lake Evaporation. Lake Evaporation per month to Total Yearly Lake Evaporation will be equal to Actual Monthly Flow thru Spray Nozzles to flow in a month necessary to evaporate the total yearly precipitation volume. Since enhanced evaporation for December and January is 0, the Lake Evaporation for those months will be subtracted from the Total Yearly Lake Evaporation when completing the ratio.
12. The result is the volume that must flow through the spray evaporation system each month, based on each months specific Evaporation Losses (% of nozzle discharge evaporated), in order to evaporate the total yearly precipitation.
13. Dividing each month's Actual Monthly Flow thru Spray Nozzles by Evaporation Losses (%) results in the Monthly Evaporation Due to Spray Nozzles in liters.
14. The Total Evaporation Volume due to Spray Nozzles (1,479,470 liters) is equal to the Total Volume of Precipitation in a year.
15. It has been assumed that the Spray Evaporation System will have a flowrate of 150 gpm and will run for 12 hours per day when operational. At that rate, 408,780 liters flow through the nozzles each day they are operational. Dividing Actual Monthly Flow thru Spray Nozzles by 408,780 liters will result in the number of days per month the spray evaporation system is operational.
16. The assumption of 36 inch tall walls is checked based on volume discharge, precipitation and evaporation.
17. Using the acre-inch method, the Net Volume Change per Month will be based on the Average Discharge Volume, plus the Monthly Average Precipitation (based on surface area of the evaporation tank), minus the Average Pan Evaporation rate, and minus the Monthly Evaporation Due to Spray Nozzles on a monthly basis.
18. The month that has the greatest Cumulative Evaporation Tank Volume will be used to check the final basin size.
19. The evaluation year will begin in October to best reflect the maximum tank volume throughout the year, due to the lack of evaporation during the winter months.
20. The maximum depth of the water in the Evaporation Tank will be calculated by dividing the Maximum Cumulative Evaporation Tank Volume by the surface area of the evaporation tank.

CONCLUSIONS

The total surface area of the Evaporation Tank is 34,204 ft^2.

The overall size of a 2 tank arrangement is 499 feet long x 71 feet wide (outside-to-outside basin walls). Each tank will have a water surface area of 248 feet long x 69 feet wide.

Based on a flow rate of 150 gpm in the spray evaporation system and a 12 hour spray cycle per day, the spray evaporation system must be in operation 63 days per year. The monthly allocation of spray nozzle usage can be found on Sheet 12, in Body of Calculation.

Based on the Maximum Cumulative Evaporation Tank Volume, the Maximum Depth of Water in the Evaporation Tank is 13.51 inches, which is less than the design requirement of 36 inches.

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-ME-100	Sheet No:	6	Cont'd on Sht:	7
Prepared By:	G. Dunn	Date:	5/26/2011	Checked By:	C. Crosman	Date:	6/8/2011

Title: **EVAPORATION TANK AND ENHANCED EVAPORATION DESIGN**

BODY OF CALCULATION

To determine the evaporation tank's surface area, the process inflow rates and pan evaporation rates must be used. The Discharge Volume data supplied by LANL is as follows:

Average Discharge Volumes Provided by PADWP (per Ref. 1)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Liters per month (Average 2006 - 2010)	396,762	342,487	396,997	380,578	432,909	423,864	482,251	545,821	407,126	382,227	384,593	396,564	4,972,179
Cubic Feet per month	14,012	12,095	14,020	13,441	15,289	14,969	17,031	19,276	14,378	13,499	13,582	14,005	175,597

Pan Evaporation

The two closest locations to Los Alamos from which historical pan evaporation data are available are Sante Fe and Cochiti Dam. These are as follows:

Santa Fe Monthly Average Pan Evaporation (Inches) Between 1972 and 2005 (per Ref. 2)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pan Evaporation in/month (E_p)	0.00	0.00	0.00	7.10	9.76	11.31	10.36	9.20	7.41	5.08	0.00	0.00	60.22

Cochiti Dam Monthly Average Pan Evaporation (Inches) (per Ref. 2)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pan Evaporation in/month (E_p)	0.00	4.14	6.44	8.48	11.07	12.95	12.38	10.62	8.91	6.29	3.94	2.79	88.01

Since these two locations are within approximately 20 miles of Los Alamos, and because the data indicate significantly different evaporation rates, these are compared to evaporation rates predicted by the Linacre equation (per Reference 3) as follows:

$$E = \frac{\left(\frac{700(T_a+0.006h)}{100-L}\right)+15(T_a-T_d)}{80-T_a}$$

Where:

E = lake evaporation (mm/day)
T_a = mean temperature of air (C°)
h = elevation (meters) = 7174 feet = 2186.64 meters
L = latitude (degrees) = 35.89
T_d = mean dew-point temperature (C°)

The following data from Reference 2 and Reference 4 was used for the equation:

Monthly Mean Temperature (per Ref. 2)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Temperature F°	28.7	32.3	38.3	46.2	55.3	64.9	68.0	65.7	60.0	49.6	37.7	29.9
Mean Monthly Temperature C°	-1.8	0.2	3.5	7.9	12.9	18.3	20.0	18.7	15.6	9.8	3.2	-1.2

Monthly Mean Dew Point Temperature (per Ref. 4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Dew Point Temperature												
C°	-9.5	-8.0	-6.5	-5.5	-0.5	3.5	8.0	9.0	5.0	-0.5	-6.0	-8.5

The resulting monthly lake evaporation rates using the Linacre equation are as follows:

Lake Evaporation using Linacre Equation (per Ref. 3)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Lake Evaporation													
mm/day	2.92	3.36	4.33	5.97	7.22	9.15	9.02	8.04	7.33	5.76	4.11	2.95	
in/month (E_l)	3.56	3.70	5.28	7.05	8.81	10.81	11.01	9.81	8.66	7.03	4.85	3.60	84.19

A factor of 0.7 is used to convert lake evaporation rate to pan evaporation ($E_l = 0.7(E_p)$) as follows:

Pan Evaporation using Linacre Equation (per Ref. 7)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pan Evaporation													
in/month (E_p)	5.09	5.29	7.55	10.07	12.59	15.44	15.73	14.02	12.37	10.04	6.93	5.14	120.27

This is compared to available pan evaporation data as follows:

Santa Fe 2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pan Evaporation													
in/month (E_p)	0.00	0.00	0.00	7.10	9.76	11.31	10.36	9.20	7.41	5.08	0.00	0.00	60.22

Cochiti Dam	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pan Evaporation													
in/month (E_p)	0.00	4.14	6.44	8.48	11.07	12.95	12.38	10.62	8.91	6.29	3.94	2.79	88.01

Since the Linacre equation shows that pan evaporation at Los Alamos will be greater than Sante Fe and Chochiti Dam, the data from Cochiti Dam is selected as a conservative basis for sizing of the evaporation tanks.

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-ME-100	Sheet No:	8	Cont'd on Sht:	9
Prepared By:	G. Dunn	Date:	5/26/2011	Checked By:	C. Crosman	Date:	6/8/2011

Title: EVAPORATION TANK AND ENHANCED EVAPORATION DESIGN

Evaporation Tank Sizing

The evaporation tank will be sized using the total Yearly Average Discharge Volume provided by LANL as the basis. The discharge data is as follows:

Average Discharge Volumes Provided by PADWP (per Ref. 1)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Liters per month (Average 2006 - 2010)	396,762	342,487	396,997	380,578	432,909	423,864	482,251	545,821	407,126	382,227	384,593	396,564	4,972,179
Cubic Feet per month	14,012	12,095	14,020	13,441	15,289	14,969	17,031	19,276	14,378	13,499	13,582	14,005	175,597

The total surface area will be calculated using only pan evaporation and the data above. Additional volume (precipitation) added to the evaporation tank throughout the year will be used as the basis for the spray evaporation system design, found further along in this calculation. The total surface area of the evaporation tank will be found by dividing the total discharge volume (ft^3) by total lake evaporation (ft.). The result will be the surface area necessary to evaporate all of the discharge by use of pan evaporation alone.

Again, pan evaporation at Cochiti Dam is as follows:

Pan Evaporation Cochiti Dam (per Ref. 2)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pan Evaporation in/month (E_p)	0.00	4.14	6.44	8.48	11.07	12.95	12.38	10.62	8.91	6.29	3.94	2.79	88.01

Using a factor of 0.7, the pan evaporation rate was converted to lake evaporation.

Lake Evaporation Cochiti Dam (per Ref. 7)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Lake Evaporation in/month (E_l)	0.00	2.90	4.51	5.94	7.75	9.07	8.67	7.43	6.24	4.40	2.76	1.95	61.61

Total Discharge Volume = 175,597 ft^3

Total Lake Evaporation (Cochiti Dam) (in) = 61.61 in
Total Lake Evaporation (Cochiti Dam) (ft.) = 5.13 ft.

Total Evaporation Tank Surface Area = 34,204 ft^2

Width (given) = 69 ft.
Total Pond Length = 496 ft.
Total Length per Pond = 248 ft.

Total Width (including end walls, 1 ft. per wall) = 69 ft. + 2 ft. = 71 ft.
Total Length (including end walls and 1 common dividing wall, 1 ft. per wall) = 496 ft. + 2 ft. + 1ft. = 499 ft.

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-ME-100	Sheet No:	9	Cont'd on Sht:	10
Prepared By:	G. Dunn	Date:	5/26/2011	Checked By:	C. Crosman	Date:	6/8/2011

Title: EVAPORATION TANK AND ENHANCED EVAPORATION DESIGN

Spray Evaporation System Design

The Spray Evaporation System for the Evaporation Tank will be designed using precipitation as the basis. The precipitation data from Los Alamos, NM is as follows:

Precipitation (per Ref. 2)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Monthly Precipitation													
in	0.90	0.75	1.05	0.98	1.32	1.38	3.07	3.61	1.95	1.55	0.87	0.90	18.33

The Evaporation Tank sizing only took into account Discharge Volumes provided by LANL, therefore the Spray Evaporation System will be designed to relinquish the total yearly precipitation volume. The evaporation rate due to spray nozzles will be calculated using the following equation (per Ref. 5):

Equation (1): $E = 4.375e^{0.106u}(e_s - e_o)^{-0.0092}T^{-0.102}$

Where:

E = Evaporation Losses (% of nozzle discharge)
u = wind speed (mph)
T = Ambient Dry Bulb (C°)
$(e_s - e_o)$ = Vapor Pressure Deficit (mbar)

Where:

Equation (2): $(e_s - e_o) = 0.611e^{\frac{17.27T}{237.3+T}}(1 - \frac{RH}{100})$

$(e_s - e_o)$ = Vapor Pressure Deficit (mbar)
T = Ambient Dry Bulb (C°)
RH = Relative Humidity

The Evaporation Losses will be calculated on a per month basis. The inputs to the Vapor Pressure Deficit equation are as follows:

Ambient Dry Bulb Temperature (per Ref. 2)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Temperature												
F°	28.7	32.3	38.3	46.2	55.3	64.9	68.0	65.7	60.0	49.6	37.7	29.9
Mean Monthly Temperature												
C°	-1.8	0.2	3.5	7.9	12.9	18.3	20.0	18.7	15.6	9.8	3.2	-1.2

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-ME-100	Sheet No:	10	Cont'd on Sht:	11
Prepared By:	G. Dunn	Date:	5/26/2011	Checked By:	C. Crosman	Date:	6/8/2011

Title: EVAPORATION TANK AND ENHANCED EVAPORATION DESIGN

The Relative Humidity was found using Ambient Dry Bulb Temperature and Dew Point Temperature, both given for the Los Alamos site, and the "Relative Humidity and Dew Point Table" (Reference 6). The data is as follows:

Dew Point Temperature (per Ref. 4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Dew Point Temperature C°	-9.5	-8.0	-6.5	-5.5	-0.5	3.5	8.0	9.0	5.0	-0.5	-6.0	-8.5
Mean Monthly Dew Point Temperature F°	14.9	17.6	20.3	22.1	31.1	38.3	46.4	48.2	41	31.1	21.2	16.7

Resulting in the following:

Relative Humidity (per Ref. 6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Humidity %	56.61	54.38	47.33	38.89	39.73	37.16	46.10	53.70	49.00	49.10	50.61	57.26

The Vapor Pressure Deficit per month using Equation (2) is as follows:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vapor Pressure Deficit ($e_s - e_o$) mbar	0.2323	0.2828	0.4137	0.6514	0.8972	1.3221	1.2607	0.9988	0.9042	0.6169	0.3797	0.2392

Using information from above, and the Monthly Average Wind Speed in Los Alamos, the Evaporation Losses (% of nozzle discharge) were calculated using Equation (1) and rounded down to the nearest whole percent to be conservative. The information is as follows:

Wind Speed Los Alamos, NM (per Ref. 2)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Wind Speed mph	3.9	5.7	7.5	8.1	7.1	7.3	5.3	4.8	5.7	5.1	4.4	3.2

Evaporation Losses due to Spray Nozzles

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evaporation Losses due to Spray Nozzles % (Rounded Down)	0	9	8	8	7	7	5	5	6	5	6	0

The flow is calculated by dividing Total Precipitation in a year by Monthly Evaporation Losses. The resulting value is the total volume that must flow through the nozzles in one month to evaporate the total precipitation in one year. The spraying will be allocated throughout the year by using the same ratio Lake Evaporation. Lake Evaporation per month to Total Yearly Lake Evaporation will be equal to Actual Monthly Flow thru Spray Nozzles to Total Flow thru Spray Nozzles @ Monthly Evaporation Rate for All Necessary Yearly Evaporation. Since the Evaporation Losses due to Spray Nozzles for December and January are 0, the Lake Evaporation for those months will be subtracted from the Total Yearly Lake Evaporation when completing the ratio. The data is as follows:

Monthly Precipitation Los Alamos, NM (per Ref. 2)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Monthly Precipitation in	0.90	0.75	1.05	0.98	1.32	1.38	3.07	3.61	1.95	1.55	0.87	0.90	18.33

Burns and Roe Enterprises, Inc.

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Title: **EVAPORATION TANK AND ENHANCED EVAPORATION DESIGN**

The total precipitation volume for the year is calculated by multiplying the surface area (including safety factor) of the evaporation tank by total precipitation:

Total Precipitation	=	18.33 inches
Total Evaporation Tank Surface Area	=	34,204 ft^2
Total Evaporation Tank Surface Area	=	0.7852 acres
Total Volume of Precipitation	=	14.3931 acre-inches
Total Volume of Precipitation	=	1,479,470 liters

The total flow necessary to evaporate the Total Volume in one specific month is calculated by dividing the Total Volume of Precipitation by Evaporation Losses due to Spray Nozzles.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evaporation Losses due to Spray Nozzles decimal	0	0.09	0.08	0.08	0.07	0.07	0.05	0.05	0.06	0.05	0.06	0
Total Flow thru Spray Nozzles liters	0	16,438,555.56	18,493,375.00	18,493,375.00	21,135,285.71	21,135,285.71	29,589,400.00	29,589,400.00	24,657,833.33	29,589,400.00	24,657,833.33	0

The amount of spraying is allocated throughout the year by using the same ratio of Monthly Lake Evaporation to Total Lake Evaporation (less December and January totals).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Lake Evaporation Cochiti Dam in/month	0.00	2.90	4.51	5.94	7.75	9.07	8.67	7.43	6.24	4.40	2.76	1.95	61.61
Actual Monthly Flow thru Spray Nozzles liters	0	798,587.42	1,397,527.99	1,840,223.19	2,745,454.27	3,211,710.28	4,298,483.60	3,687,390.61	2,578,048.52	2,183,962.99	1,140,012.48	0	
Evaporation Due to Spray Nozzles liters	0	71,872.87	111,802.24	147,217.85	192,181.80	224,819.72	214,924.18	184,369.53	154,682.91	109,198.15	68,400.75	0	1,479,470

The Total Evaporation Due to Spray Nozzles (1, 479,470 liters) is equal to the Total Volume of Precipitation.

It has been assumed that the Spray Evaporation System will have a flow rate of 150 gpm and will run for 12 hours per day when operational. At that rate, 408,780 liters flow through the nozzles each day they are operational. Dividing Actual Monthly Flow thru Spray Nozzles by 408,780 liters will give you how many days per month the spray evaporation system is operational.

150	gallons	minute
9000	gallons	hour (@ 12 hours per day)
108000	gallons	day
408780	liters	day

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Title: EVAPORATION TANK AND ENHANCED EVAPORATION DESIGN

Spray Evaporation System

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total Spraying Days per Month													
days	0	2	4	5	7	8	11	10	7	6	3	0	63

The Spray Evaporation System will be active a total of 63 days per year.

Basin Depth Check

Using the acre-inch method, the basin capacity will be based on the Average Discharge Volume, plus the Monthly Average Precipitation (based on surface area of the evaporation tank), minus the Average Pan Evaporation rate, and minus the Monthly Evaporation Due to Spray Nozzles on a monthly basis. The month that has the greatest inflow rate will be used to determine the final basin size.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Discharge Volumes													
(liters)	396,762	342,487	396,997	380,578	432,909	423,864	482,251	545,821	407,126	382,227	384,593	396,564	4,972,179
(acre-inch)	3.86	3.33	3.86	3.7	4.21	4.12	4.69	5.31	3.96	3.72	3.74	3.86	
-plus-													
Mean Monthly Precipitation													
(inches)	0.90	0.75	1.05	0.98	1.32	1.38	3.07	3.61	1.95	1.55	0.87	0.90	18.33
(acre-inch) (0.7557628 acre tank)	0.71	0.59	0.82	0.77	1.04	1.08	2.41	2.83	1.53	1.22	0.68	0.71	
-minus-													
Pan Evaporation (Cochiti Dam)													
(inches) (E_p)	0.00	4.14	6.44	8.48	11.07	12.95	12.38	10.62	8.91	6.29	3.94	2.79	88.01
Lake Evaporation (Cochiti Dam)													
(inches) ($E_l = 0.7 * E_p$)	0.00	2.90	4.51	5.94	7.75	9.07	8.67	7.43	6.24	4.40	2.76	1.95	61.61
(acre-inch) ($E_l = 0.7 * E_p$)	0.00	(2.28)	(3.54)	(4.66)	(6.08)	(7.12)	(6.80)	(5.84)	(4.90)	(3.46)	(2.17)	(1.53)	
-minus-													
Monthly Evaporation Due to Spray Nozzles													
liters	0.00	(71,872.87)	(111,802.24)	(147,217.85)	(192,181.80)	(224,819.72)	(214,924.18)	(184,369.53)	(154,682.91)	(109,198.15)	(68,400.75)	0.00	
(acre-inch)	0.00	(0.70)	(1.09)	(1.43)	(1.87)	(2.19)	(2.09)	(1.79)	(1.50)	(1.06)	(0.67)	0.00	
Net Volume Change in Month													
(acre-inch)	4.57	0.94	0.06	(1.62)	(2.71)	(4.10)	(1.80)	0.51	(0.91)	0.42	1.59	3.03	

The evaluation year will begin in October to best reflect basin volume accumulation due to lack of evaporation during the winter months.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Net Volume Change in Month (Year Ending in September)												
(acre-inch)	0.42	1.59	3.03	4.57	0.94	0.06	(1.62)	(2.71)	(4.10)	(1.80)	0.51	(0.91)

Burns and Roe Enterprises, Inc.

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Title: EVAPORATION TANK AND ENHANCED EVAPORATION DESIGN

The Cumulative Evaporation Tank Volume will be determined each month by summing each month's Net Volume Change with all previous months Net Volume Changes. The results are as follows:

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Net Volume Change in Month (Year Ending in September) (acre-inch)	0.42	1.59	3.03	4.57	0.94	0.06	(1.62)	(2.71)	(4.10)	(1.80)	0.51	(0.91)
Cumulative Evaporation Tank Volume (Year Ending in September) (acre-inch)	0.42	2.01	5.04	9.61	10.55	10.61	8.99	6.28	2.18	0.38	0.90	0

The maximum Cumulative Evaporation Tank Volume during the year is 10.61 acre-inches. The maximum depth of the water in the Evaporation Tank will be calculated by dividing this volume by the surface area of the evaporation tank. The results are as follows:

Maximum Cumulative Evaporation Tank Volume (Year Ending in September) (acre-inch)	10.61
Surface Area of Evaporation Tank (acre)	0.7852
Maximum Depth of Water in Evaporation Tank based on Surface Area (inches)	13.51

The Maximum Depth in the Evaporation Tank based on Surface Area is 13.51 inches, which is less than the design requirement tank height of 36 inches.

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Burns and Roe Enterprises, Inc.

W.O. No: 03131-001 Calc. 03131-001-ME-101 Sheet No: 1 Cont'd on Sht: 2

Client: Los Alamos National Laboratory Project: Zero Liquid Discharge Project

Title: Effluent Transfer System – Effluent Transfer System Discharge Pipe Sizing and Existing Effluent Transfer Pump Check

REVISION RECORD 100761-11-000090

Revision	Status	Description of Revision	Preparer print/sign/date	Checker print/sign/date	Approver print/sign/date
A	Preliminary	Original Issue 60% Submittal	G. Dunn G Dunn 7/6/2011	S. Stuhrke SP Stuhrke 7-6-11	S. Stuhrke

PE Seal (if required)

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Prepared By:	G. Dunn	Date:	6/17/2011	Checked By:		Date:	

Title: **Effluent Transfer System – Effluent Transfer System Discharge Pipe Sizing and Existing Effluent Transfer Pump Check**

PURPOSE

The purpose of this calculation is to size the Effluent Transfer Piping System and then proceed to check that the existing Effluent Transfer Pump is sufficient for the new routing that will pump effluent from TA-50-1 to the Evaporation Tanks located in TA-52.

REFERENCES

1. Website: www.weather.lanl.gov
2. Zero Liquid Discharge (ZLD) Sub-Project: Requirements and Criteria Document (Document ID: 100761-ZLD-RCD-0003)
3. Goulds Pump Data Sheet; Model: 3996; Size: 2X3-13; Group: MT
4. ASME B31.3 – 2002 "Process Piping"
5. LANL Radioactive Liquid Waste Treatment Facility (RLWTF): Zero Liquid Discharge P&ID and Sequence of Operation, C55751- M-6000 Rev. A and C55751- M-6001 Rev. A
6. Crane Technical Paper 410
7. LANL Radioactive Liquid Waste Treatment Facility (RLWTF): Zero Liquid Discharge P&ID and Sequence of Operation Sheets M-6000 Rev. A and M-6001 Rev. A
8. Georg Fischer Central Plastics – Connector and Equipment Catalog; Butt Fittings: Butt Reducers (p. 20-22) (https://communications.centralplastics.com/pls/portal/docs/PAGE/CENTRAL_PUBLIC/TAB10201/GF%20CENTRAL%20CATALOG%20CONVENTIONAL%20FUSION%20SECTION.PDF)
9. Burns and Roe Engineering Standard, R153450M1, Maximum Allowable Velocities for Flow of Water and Steam in Pipes
10. Heald, C.C., Cameron Hydraulic Data, 19th ed., 1st Printing, Canada, 2002

DESIGN REQUIREMENTS

1. All Effluent Transfer piping shall conform to ASME B31.3.
2. Design temperature will be equal to the maximum mean monthly temperature.
3. Design pressure will be equal to the maximum operational pressure, which equals suction side design pressure plus pump shut off head, plus 10%.
4. Design flow rate is equal to the design flow rate of the existing pumps (250 GPM) (per Ref. 3).
5. High Density Polyethylene (HDPE) piping will be used for the Effluent Transfer piping.
6. Fluid velocity will be less than 12 ft/sec (per Ref. 9)
7. 10% will be added to the pressure drop due to friction in the new piping to account for the unknown existing routing upstream of the terminal point (LANL side) and elevation changes in the routing.
8. Operating flow rate of the Effluent Transfer System is 150 GPM (per Ref. 2).

UNCONFIRMED ASSUMPTIONS

1. The operating pressure on the suction side of the existing Effluent Transfer Pumps is atmospheric pressure.
2. Routing upstream (LANL side) of termination point.
3. There is a holding tank upstream of the Effluent Transfer Pumps with +5 feet of static suction head.
4. The Friction Head Loss in the suction piping of the existing Effluent Transfer Pump is equal to 5 feet.

DESIGN PROCEDURES

1. Calculate design pressure and temperature of the suction piping of the existing Effluent Transfer Pump.
2. Calculate Total Suction Head using assumptions.

3. Calculate design pressure and temperature for the discharge piping for the existing Effluent Transfer Pump.
4. Using the calculated discharge design pressure and temperature, select the pipe class for all piping from Reference 4.
5. Calculate the discharge pipe length from the termination point located at TA-50 to the Evaporation Tanks located at TA-52.
6. Input all necessary discharge information into the Burns and Roe Standard Pressure Drop Calculation, including pipe lengths, fittings and design conditions.
7. The pressure drop through the discharge piping is determined based on the Darcy Formula. The Burns and Roe Standard Pressure Drop Calculation will perform these actions.
8. Per Reference 9, the Effluent Transfer Pump discharge piping velocity shall not exceed 12 ft/sec.
9. Select a discharge pipe size based on the Burns and Roe Standard Pressure Drop Calculation output.
10. 10% will be added to the calculated Friction Head Loss in the discharge piping to cover all losses that may exist in the unknown piping upstream of the termination point (LANL side) and the effects of elevation changes from TA-50 to TA-52 on pipe length.
11. Calculate Total Discharge Head based on the pressure drop at 250 GPM.
12. Calculate Total System Head.
13. Per Reference 2, the Effluent Transfer System will have a normal operating flow rate of 150 GPM. Using the pump curve (Reference 3), the total dynamic head available at 150 GPM will be compared to the Total System Head (including suction side assumptions). If the available TDH at 150 GPM is greater than Total Head Loss at 250 GPM, it has been proven that the existing Effluent Transfer Pump is sufficient for pumping effluent from TA-50 to the Evaporation Tanks located in TA-52.

COMPUTER TYPE: Desktop - Dell, OPERATING SYSTEM: Windows

1. COMPUTER PROGRAM: PDCALC - Pressure Drop Calculation (Excel Template) VERSION: 1.2

☒ APPROVED ☐ AUTHORIZED

ESI No. ESI# ME-008-02

CONCLUSIONS

A 4" High Density Polyethylene (HDPE) DR 17 (Piping Specification 502, ASME B31.3 "Process Piping") discharge pipe size was selected for the Effluent Transfer Piping from TA-50 to the Evaporation Tanks.

The Total System Head calculated for the Effluent Transfer System while pumping from TA-50 to the Evaporation Tanks at 250 GPM is 89.1 ft. Per Reference 2, the Effluent Transfer System shall have a working flow rate of 150 GPM. The pump curve (Appendix G) shows that at 150 GPM, there will be a Total Dynamic Head of 157 feet. The TDH of the existing Goulds 3996MT 2X3-13 at 150 GPM is sufficient for the Effluent Transfer System while pumping from TA-50 to the Evaporation Tanks.

BODY OF CALCULATION

System Boundaries

The Effluent Transfer System discharge piping begins at the outlet of the Effluent Transfer Pump (TA-50) and continues to the inlet of the Evaporation Tanks (TA-52). The design pressure and temperature shall remain constant throughout the Effluent Transfer piping. The pump location and pipe design upstream of termination point (LANL side) between new and existing piping is unknown.

Design Temperature

The design temperature is equal to the maximum Mean Monthly Temperature (per Reference 1):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Temperature °F	28.7	32.3	38.3	46.2	55.3	64.9	68.0	65.7	60.0	49.6	37.7	29.9

$T_{design} = 68.0$ °F

Use 70 °F as Design Temperature.

Suction Side Design Pressure

The suction side design pressure shall be the suction side operating pressure plus the elevation head from the high water level of the assumed holding tank to the pump inlet. Assumed operating pressure is atmospheric pressure and assumed water level height is 5 feet above pump inlet.

Atmospheric pressure = 11.10 psia (per Reference 2)
Specific Gravity @ 70 °F = 0.999
Elevation from pump inlet to assumed holding tank high water level = 5 ft.
Converting to psi head @ 70 °F = (5 ft. * 0.999) / 2.31 = 2.17 psi
$P_{Sdesign} = 11.10 + 2.17 = 13.27$ psia

Total Suction Head

Total Suction Head is equal to the static height in feet less all friction losses in the suction line (per Reference 10). Total Suction Head will be used to determine the Total System Head of the Effluent Transfer System. It has been assumed that there is a holding tank upstream of the Effluent Transfer Pumps with 5 feet of static head and the Friction Head Loss in the suction piping of the existing Effluent Transfer Pump is equal to 5 feet.

$h_s = h_{st} + h_{fs} = 5$ ft. – 5 ft. = 0 ft.

Discharge Side Design Pressure

The discharge side design pressure shall be equal to the suction side design pressure plus the pump shutoff head plus 10%.

$P_{Sdesign} = 13.27$ psia
Pump Shutoff Head (per Reference 3) = 162 ft.
Converting to psi head @ 70 °F = (162 ft. * 0.999) / 2.31 = 70.06 psi
$P_{Sdesign} + P_{ShutoffHead} = 13.27 + 70.06 = 83.33$ psia

Add 10%.
$P_{Ddesign} = 83.33 + 8.33 = 91.66$ psia
$P_{Ddesign} = 91.66 - 11.1 = 80.56$ psig

Use 85 psig as Discharge Design Pressure.

Summary of Design Conditions

The Effluent Transfer System design conditions are as follows:

Effluent Transfer Pump Discharge 85 psig / 70 °F

Pipe Class Selection

Piping for the Effluent Transfer System is HDPE, ASME B31.3.

From Reference 4, the following Pipe Class is appropriate:

Effluent Transfer Pump Discharge 502 Polyethylene Piping DR 17, 100 psig and below, ASME B31.3

Routing from TA-50 Terminal Point to Evaporation Tank

Using the Transfer Piping Plan drawings (per Reference 5), the length of straight pipe was calculated using the "Measure" capability in AutoCAD. Appendix A shows the piping estimates. The length of pipe used in the calculation of Friction Head Loss was the maximum distance, from the terminal point to the furthest East of the 2 tanks. The total length of pipe is 3546' – 7 $^1/_4$". 3600 feet will be used in the calculation.

Discharge Pipe Sizing

Using the Burns and Roe Standard Pressure Drop Calculation, the pressure drop due to friction in the pipe can be calculated. Design inputs are as follows:

Average Pressure = Design Pressure = 85 psig = 96.1 psia
Average Temperature = Design Temperature = 70 °F
@ 70 °F, Specific Volume of water (per Reference 6) = 0.016045 ft^3/lb
@ 70 °F, Absolute Viscosity of water (per Reference 6) = 0.97570 cP
Flow Rate (per Reference 3) = 250 GPM
Straight Pipe Length = 3600 ft.

Using the Process and Instrumentation Diagrams (Appendix B), the pipe fittings were added to the Pressure Drop Calculation. The fitting quantities are as follows:

Gate Valve – 3
Globe Valve – 3
Stop Check Valve – 1
Tee (Run) – 4
Tee (Branch) – 2
Reducer (6"x4") – 1
Elbows (Standard Radius 90°) – 8

The Resistance Coefficient (K) value for the 6"x4" reducer was calculated using the Burns and Roe Calculation of Reducer Resistance Coefficients, which is within the Burns and Roe Standard Pressure Drop Calculation file. The Calculation of Reducer Resistance Coefficients data sheet can be found in Appendix C. Reducer length can be found using Reference 8 (Appendix D). The inside diameters of the different sized HDPE DR 17 pipe were found in the Burns and Roe Standard Pressure Drop Calculation. The instructions for how to enter the calculated Resistance Coefficient into the Burns and Roe Standard Pressure Drop Calculation can be found in Appendix E. The resulting K factor of the 6"x4" reducer is 0.213.

A 4 inch discharge pipe size was selected for the Effluent Transfer Piping after running the Burns and Roe Standard Pressure Drop Calculation. The 4 inch pipe results in a fluid velocity of 6.58 ft/sec, which satisfies the design requirement of a maximum fluid velocity of 12 ft/sec (Reference 9).

The Friction Head Loss in the new discharge pipe is 144.1 feet. The completed Pressure Drop Calculation Sheet is in Appendix F.

In order to take into account the unknown existing discharge pipe routing upstream of the terminal point (LANL side) and elevation changes from TA-50 to TA-52, a factor of 0.1 is added to the Friction Head Loss of the new discharge piping (144.1 feet). The resulting Total Friction Head Loss in the discharge piping is 158.6 feet.

Total Discharge Head

Total Discharge Head is equal to the static discharge head in feet plus all friction losses in the discharge line (per Reference 10). Total Discharge Head will be used to determine the Total System Head of the Effluent Transfer System.

Per Reference 5, the elevation at the TA-50 terminal point is 7235.5 feet and the elevation at the Evaporation Tank (TA-52) is 7166 feet. The elevation difference (discharge elevation head) from termination point area (TA-50) to Evaporation Tank area (TA-52) is -69.5 feet.

$h_d = h_{st} + h_{fs} = -69.5 \text{ ft.} + 158.6 \text{ ft.} = 89.1 \text{ ft.}$

Total System Head

Total system head, formerly total dynamic head, is the total discharge head (h_d) minus the total suction head (h_s) if positive or plus if a suction lift (per Reference 10).

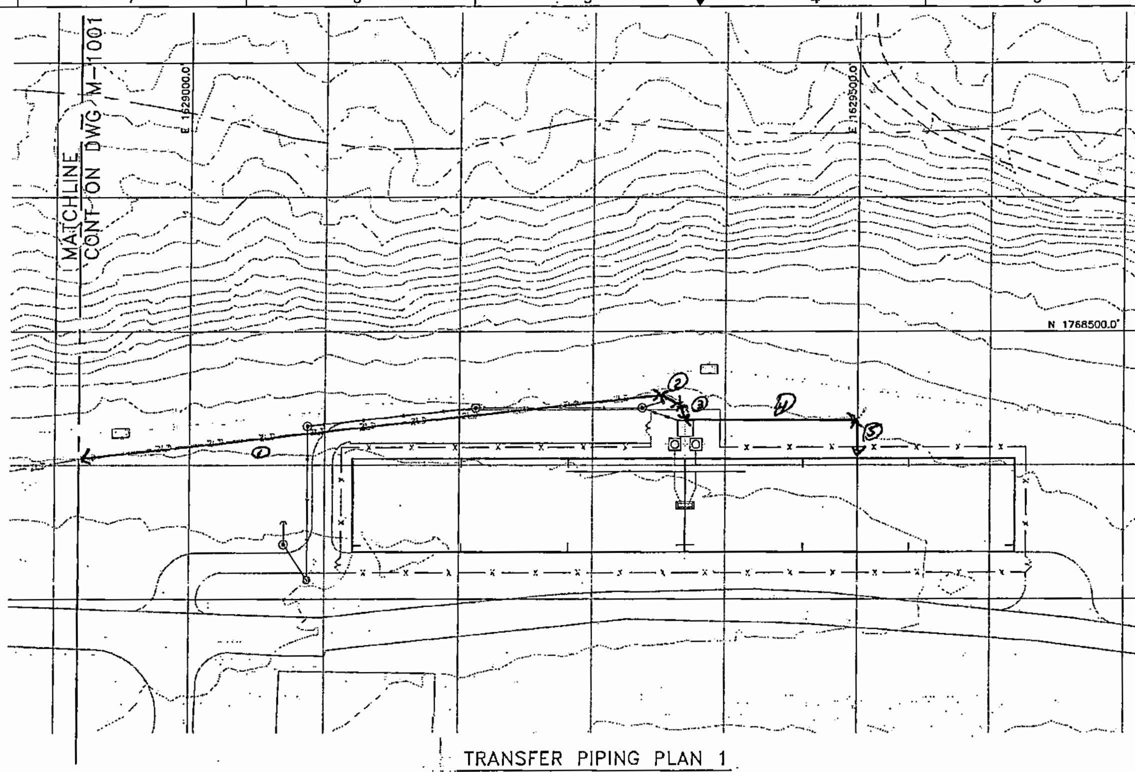
$H = h_d - h_s = 89.1 \text{ ft.} - 0 \text{ ft.} = 89.1 \text{ ft.}$

Appendix A

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 6

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



TRANSFER PIPING PLAN 1

1"=40'-0"

① 435' - 4 5/16"

② 18' - 0 1/16"

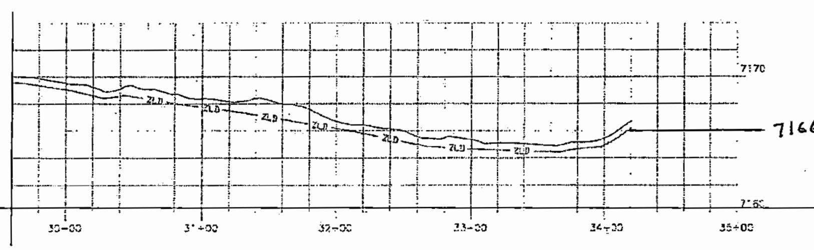
③ 10' - 3 11/16"

④ 129' - 11 1/4"

⑤ 28' - 9"

620' - 27 21/16"

= 622' - 4 5/16"



PIPING PROFILE

SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 1

DRAWN: T. HARPER
DESIGN: T. HARPER
CHECKED:
DATE:

BLDG 181,182,183 TA-52

SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

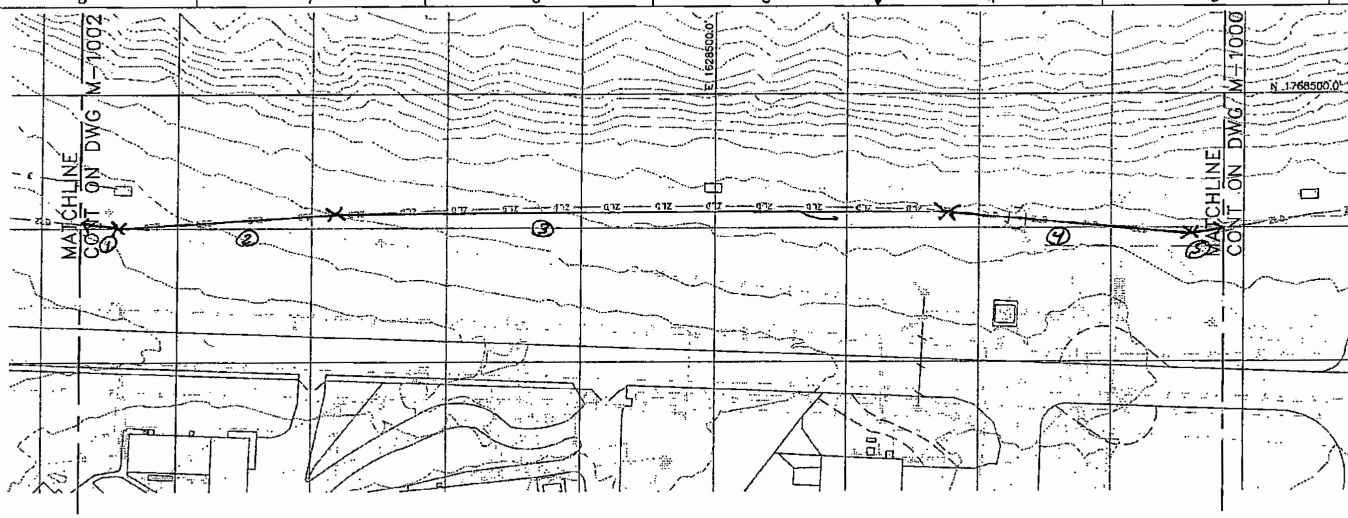
SHEET M-1000 of

CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: [redacted] Plot Date: 6/29/2011
FILE NAME: C55751-M-1000-RA.DWG

0173



TRANSFER PIPING PLAN 2

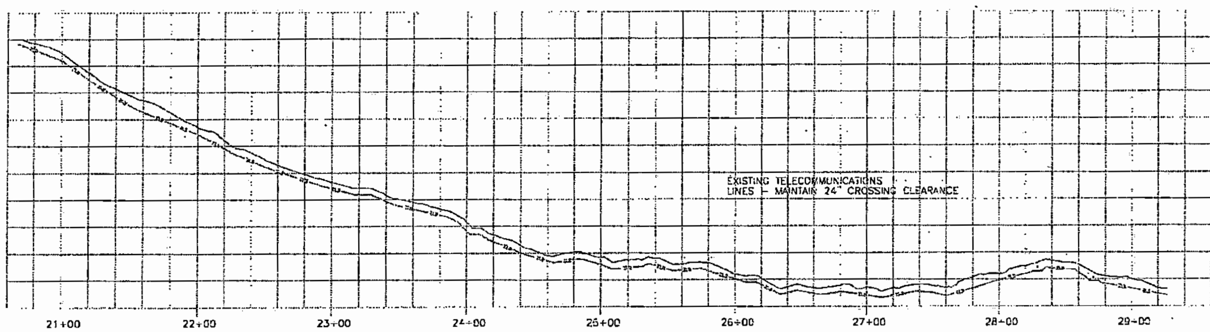
1"=40'-0"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

① 33' - 11 3/8"
② 154' - 11 9/16"
③ 454' - 6 5/16"
④ 190' - 1 15/16"
⑤ 24' - 3 1/16"

855' - 32 36/16"
= 857' - 10 1/4"



PIPING PROFILE
SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 2

DRAWN: T. HARPER
DESIGN: T. HARPER
CHECKED:
DATE:

BLDG 182 TA-52

SUBMITTED | APPROVED FOR RELEASE

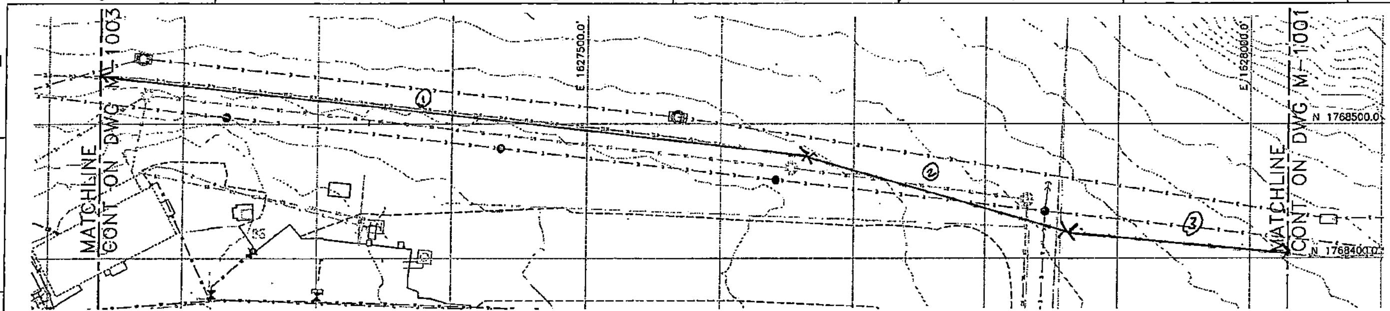
Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-1001 of

CLASSIFICATION U | REVIEWER EDWARD ARTIGLIA | DATE

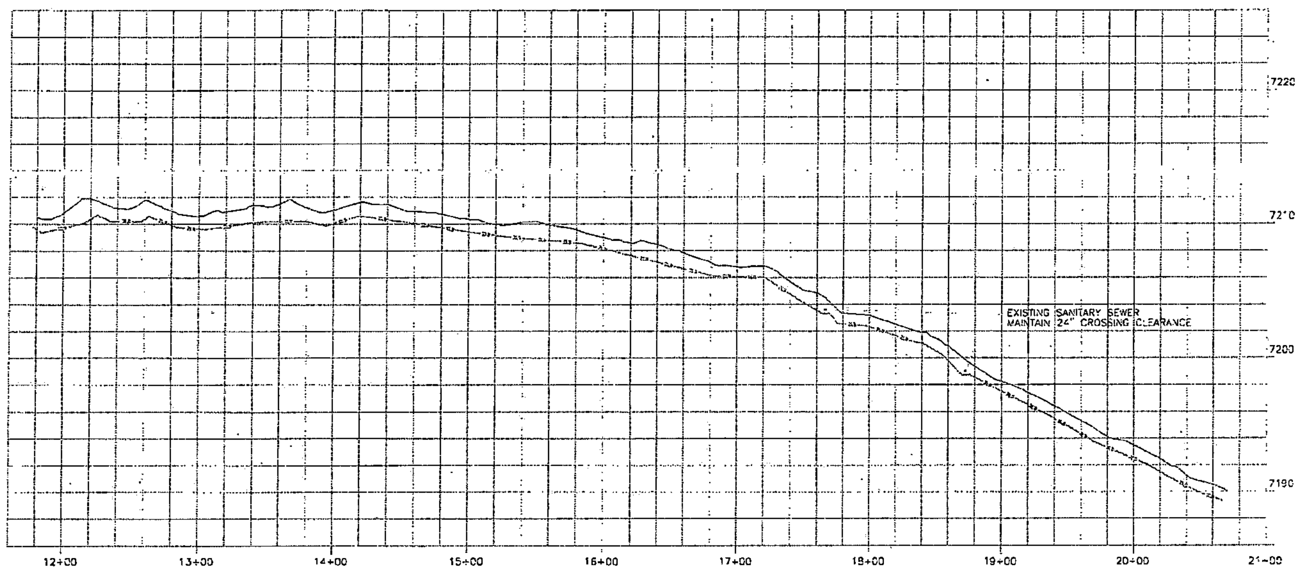
PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: ######## Plot Date: 5/20/2011
FILE NAME: C55751-M-1001-RA.DWG



TRANSFER PIPING PLAN 3

1"=40'-0"



PIPING PROFILE

SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

① 531' - 3 $\frac{15}{16}$"

② 203' - 2 $\frac{1}{2}$"

③ 168' - 1 $\frac{3}{16}$"

902' - 6 $\frac{26}{16}$"

= 902' - 7 $\frac{5}{8}$"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 3

DRAWN: T. HARPER
DESIGN: T. HARPER
CHECKED:
DATE:

BLDG 182 TA-52

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SHEET M-1002 OF

CLASSIFICATION | REVIEWER EDWARD ARTIGLIA | DATE

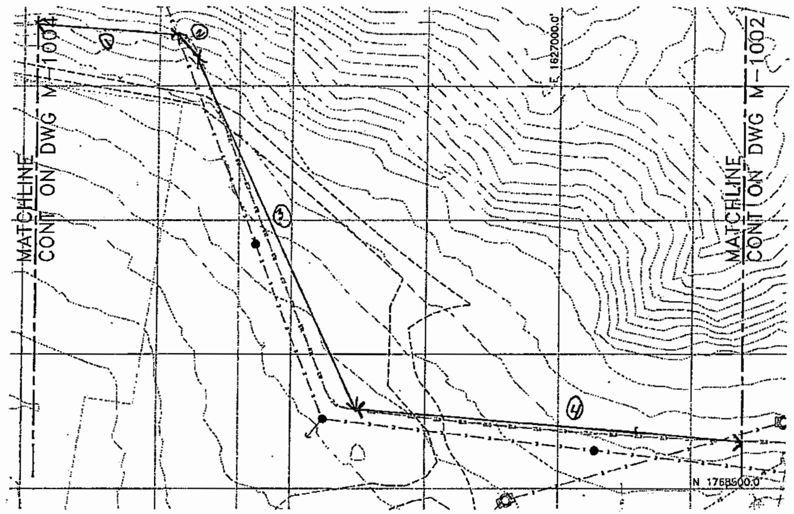
PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: [redacted] Plot Date: 5/25/2011
FILE NAME: C55751-M-1002-RA.DWG

2172

GENERAL NOTES:

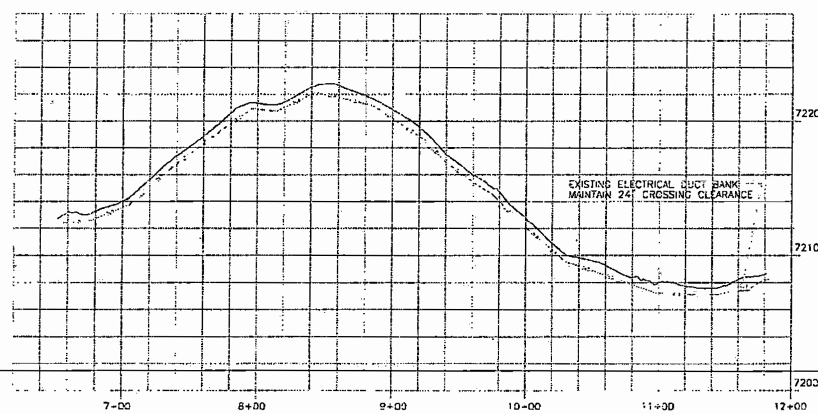
1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



TRANSFER PIPING PLAN 4

40' 20' 0 20' 40'

1"=40'-0"



PIPING PROFILE

SCALE: NONE

① 101' - 11 5/16"

② 20' - 5 3/8"

③ 290' - 3 3/4"

④ 297' - 1 1/8"

708' - 20 25/16"

= 709' - 9 9/16"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 4

DRAWN T. HARPER
DESIGN T. HARPER
CHECKED
DATE

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SHEET M-1003 OF

CLASSIFICATION | REVIEWER EDWARD ARTIGLIA | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

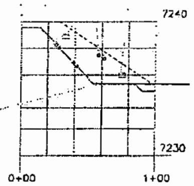
EXISTING LOW LEVEL RAD. WASTE PIPING MAINTAIN 24" CROSSING CLEARANCE

SEE PIPING PROFILE 2 THIS DWG.

ZLD TIE-IN VALVE BOX

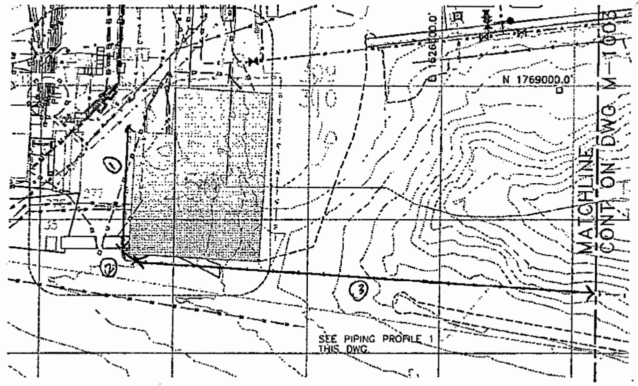
EXISTING ELECTRICAL DUCT BANK MAINTAIN 24" CROSSING CLEARANCE

SHUT OFF VALVE BOX



7235.5

PIPING PROFILE 2
SCALE: NONE



TRANSFER PIPING PLAN 5
1"=40'-0"

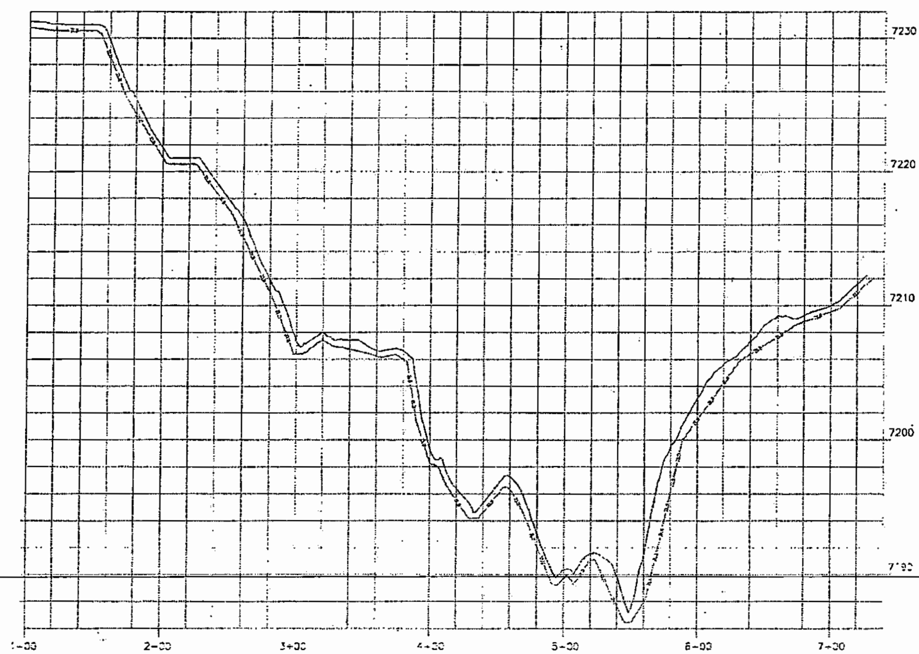
① 95' - 4 7/16"

② 7' - 0 5/8"

③ 351' - 6 7/16"

453' - 10 24/16"

= 453' - 11 1/2"



PIPING PROFILE 1
SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 5

DRAWN: T. HARPER
DESIGN: T. HARPER
CHECKED:
DATE:

BLDG 182 TA-52

SUBMITTED: -
APPROVED FOR RELEASE

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SHEET M-1004 OF

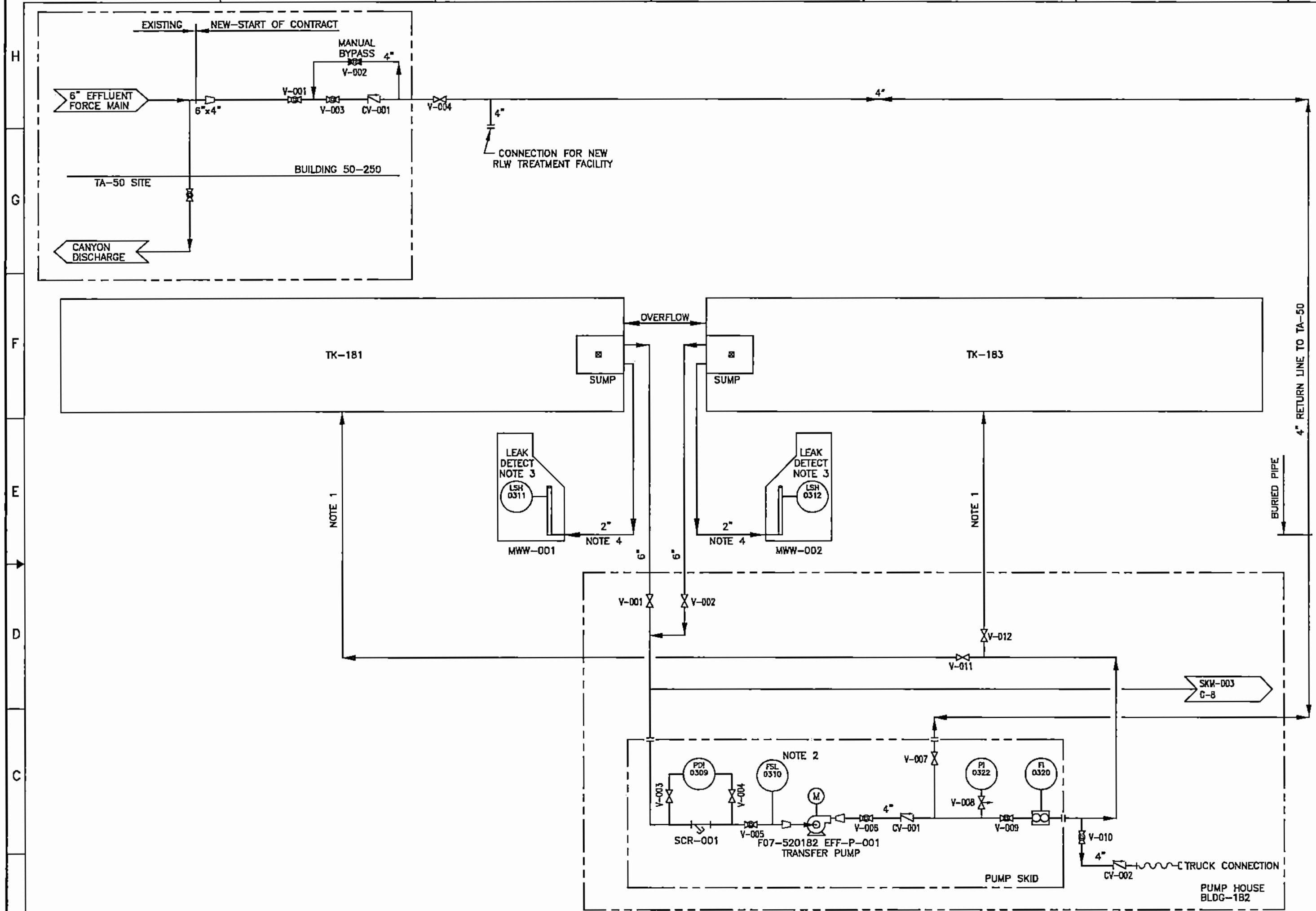
CLASSIFICATION
REVIEWER EDWARD ARTIGUA
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: Plot Date: 6/30/2011
FILE NAME: C55751-M-1004-RA.DWG

Appendix B

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 3



TA-52 SITE

ZERO LIQUID DISCHARGE P&ID

SCALE: NONE

GENERAL NOTES:

1. HEAT TRACE ABOVE GROUND PIPING ONLY.
2. LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY).
3. LEAK DETECTION ALARMS ARE DIRECTED TO A LOCAL ALARM PANEL, WITH FLASHING BEACON, AT THE PUMP ENCLOSURE.
4. 2" CONTAINMENT PIPE WITH ¾" TEFLON HOSE TO MAN HOLE.

SEQUENCE OF OPERATION:

TRANSFER PUMPS:
LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY). THRU VALVE LINEUPS TANK CONTENTS CAN BE TRANSFERRED FROM ONE TANK TO ANOTHER TANK OR RETURNED TO SOURCE BY ONE OR BOTH TRANSFER PUMPS.

MANUAL BYPASS:

LEAK DETECTION:
LEAK DETECTION ALARMS ARE DIRECTED TO A LOCAL ALARM PANEL, WITH FLASHING BEACON, AT THE PUMP ENCLOSURE. TO TANK LEAK DETECTION.

"NOT FOR CONSTRUCTION"

Reserved for Engineer's Stamp

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE P&ID AND SEQUENCE OF OPERATION

BLDG 181,182,183 TA-52

DRAWN: T. HARPER
DESIGN:
CHECKED:
DATE:

SUBMITTED:
APPROVED FOR RELEASE:

SHEET: M-6000 OF

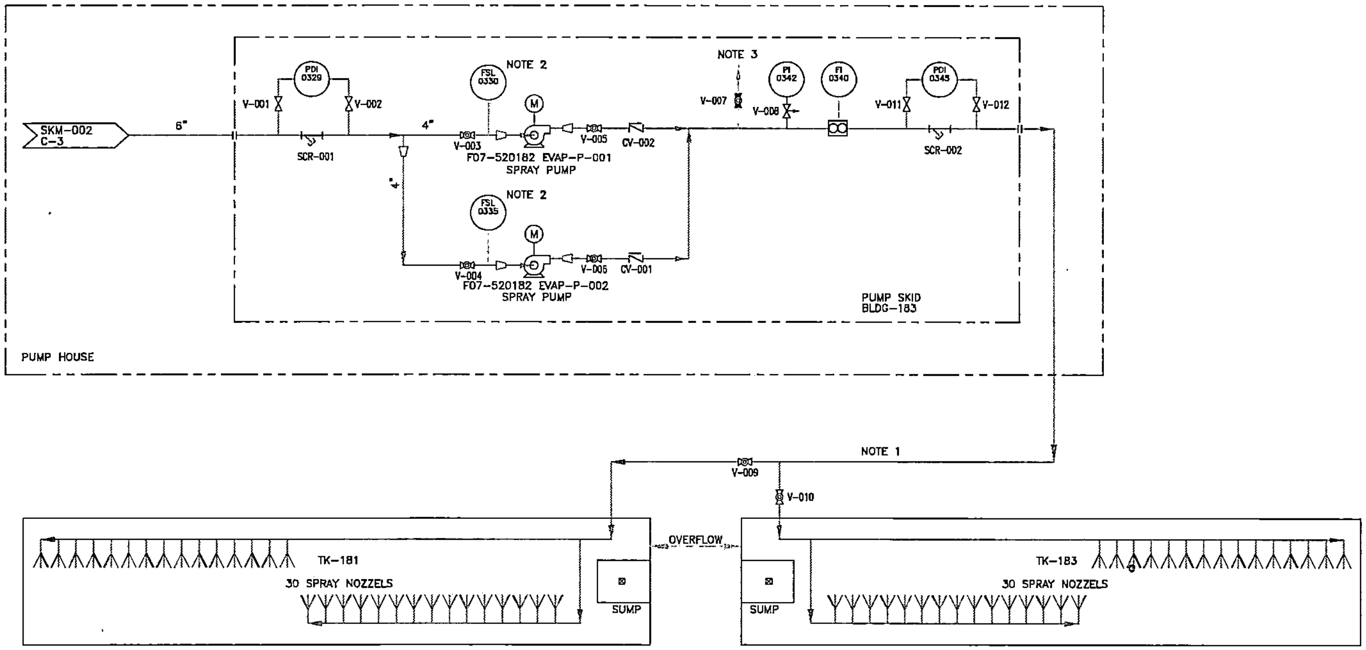
Los Alamos NATIONAL LABORATORY
PO Box 1663 Los Alamos, New Mexico 87545

CLASSIFICATION: Classification
REVIEWER: Reviewer
DATE: Date

PROJECT ID: 100761
DRAWING NO: C-55751
REV: A

GENERAL NOTES:

1. HEAT TRACE ABOVE GROUND PIPING ONLY.
2. LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY).
3. SPRAY NOZZLE HEADERS ARE TO BE SELF DRAINING. LOCATE ¾" VENT WITH GLOBE VALVE AT HIGH POINT OF SPRAY PIPING AND ¾" DRAINS AS REQUIRED ON SPRAY HEADERS AT LOW POINTS. SPRAY PIPING HIGH POINT SHALL BE LOCATED INSIDE THE PUMP HOUSE.



SEQUENCE OF OPERATION:

SPRAY SYSTEM:

NOZZELS:

WHIRL JET SPRAY DRY NOZZLES, HOLLOW CONE AS MANUFACTURED BY SPRAYING SYSTEMS.

SPRAY PUMPS:

LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY). MANUAL OPERATION WHEN SPRAYING IS REQUIRED TO ENHANCE EVAPORATION. ONE PUMP WILL BE UTILIZED FOR SPRAYING ONE TANK. EITHER PUMP CAN BE USED FOR EITHER TANK THROUGH VALVE LINE UPS. SYSTEM IS DESIGNED FOR SPRAYING BOTH TANKS SIMULTANEOUSLY. STARTING AND STOPPING OF ONE OR BOTH SPRAY PUMPS IS A MANUAL OPERATION VIA A LOCAL START/STOP PUSH BUTTON. A LOW FLOW WILL CAUSE A PUMP OR PUMPS TO TRIP IF TANK OR TANKS RUNS DRY (AFTER DELAY).

TA-52 SITE
SPRAY SYSTEM FOR EVAPORATION TANKS

SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE P&ID AND SEQUENCE OF OPERATION

BLDG 181,182,183 TA- 52

DRAWN: T. HARPER
DESIGN:
CHECKED:
DATE:
SUBMITTED:
APPROVED FOR RELEASE:

Los Alamos NATIONAL LABORATORY — PO Box 1663 Los Alamos, New Mexico 87545

SHEET: M-6001 OF

CLASSIFICATION: REVIEWER: DATE:

PROJECT ID: 100761
DRAWING NO: C-55751
REV: A

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-ME-101	Sheet No:	C0	Cont'd on Sht:	C1
Prepared By:	G. Dunn	Date:	6/17/2011	Checked By:		Date:	

Title: **Effluent Transfer System – Effluent Transfer System Discharge Pipe Sizing and Existing Effluent Transfer Pump Check**

APPENDIX __C__ TO CALCULATION (for Computer Analysis Input/Output Sheet)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

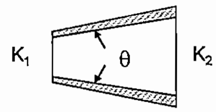
INPUT/OUTPUT PRODUCED ON COMPUTER NO. C1614

CALCULATION OF REDUCER / ENLARGER RESISTANCE COEFFICIENTS

REDUCER / ENLARGER PARAMETERS

Reducer / Enlarger Type: REDUCER

K Factor Referenced to: SMALLER PIPE (K1)



○ STANDARD REDUCER / ENLARGER DIMENSIONS

Pipe Connection	Diameter	Schedule	I.D. (in.)
Smaller Pipe:	3 inches	Steel SCH. 40	3.068
Larger Pipe:	4 inches	Steel SCH. 40	4.026
Reducer / Enlarger Length (Refer to Standard Dimensions table at right), in.:			4.00

◉ USER DEFINED REDUCER / ENLARGER DIMENSIONS

Pipe Connection Internal Diameter	I.D. (in.)
Smaller Pipe:	3.938
Larger Pipe:	5.798
Reducer / Enlarger Length, in.:	1.16

RESULTS

Beta Ratio of Fitting (β): 0.679

Internal Angle of Fitting (θ): 77.4 degrees

RESISTANCE COEFFICIENT (K): **0.213**

INSTRUCTIONS

1. The Reducer / Enlarger Parameters determine which equation is used to calculate the resistance coefficient (K value) of the fitting. Refer to Crane Technical Paper #410 (1998 Ed.) page A-26 for the equations used in this calculation. The equations used are the same regardless of whether the Standard or User Defined Dimensions are used.

2. This spreadsheet will automatically determine whether a fitting is gradual or sudden based on the input diameters and fitting length. The angle (θ) is displayed in the results section for reference. Crane #410 defines a gradual fitting as θ ≤ 45 degrees and a sudden fitting as θ > 45 degrees.

3. Use the "Radio Buttons" to select between the Standard Dimensions and the User Defined Dimensions.

4. The Standard Reducer / Enlarger Dimensions section contains look-up tables that determine pipe internal diameters for steel and stainless steel piping. The fitting length has to be entered manually (shown in **BLUE**) and the table to the right should be used as a guide when selecting standard sizes. Note that pipe couplings (sudden reducers / enlargers) are typically used in piping systems that are 2" and smaller. The fitting length for these couplings should be entered as 0.00".

5. The User Defined Reducer / Enlarger Dimensions section allows the User to specify their own pipe inside diameters and overall fitting length. These inputs are shown in **BLUE**.

6. See the Instructions Sheet, section D-4, on how to incorporate the K value into the Pressure Drop calculation.

STANDARD DIMENSIONS OF STEEL REDUCERS / ENLARGERS

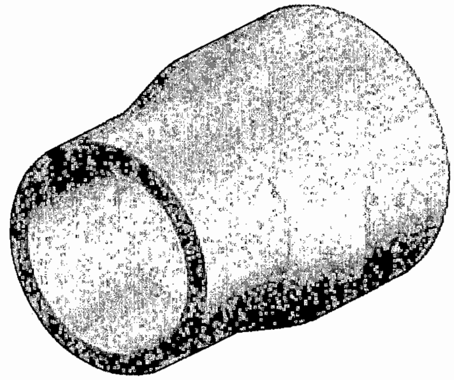
Pipe Size	Length
2.5 X 1	
2.5 X 1.25	3.5"
2.5 X 1.5	
2.5 X 2	
3 X 1.25	
3 X 1.5	3.5"
3 X 2	
3 X 2.5	
4 X 1.5	
4 X 2	4"
4 X 2.5	
4 X 3	
6 X 2.5	
6 X 3	5.5"
6 X 4	
8 X 4	6"
8 X 6	
10 X 4	
10 X 6	7"
10 X 8	
12 X 6	
12 X 8	8"
12 X 10	
14 X 6	
14 X 8	13"
14 X 10	
14 X 12	
16 X 6	
16 X 8	
16 X 10	14"
16 X 12	
16 X 14	
18 X 10	
18 X 12	15"
18 X 14	
18 X 16	
20 X 10	
20 X 12	
20 X 14	20"
20 X 16	
20 X 18	
22 X 14	
22 X 16	20"
22 X 18	
22 X 20	
24 X 16	
24 X 18	20"
24 X 20	
24 X 22	
26 X 18	
26 X 20	
26 X 22	24"
26 X 24	

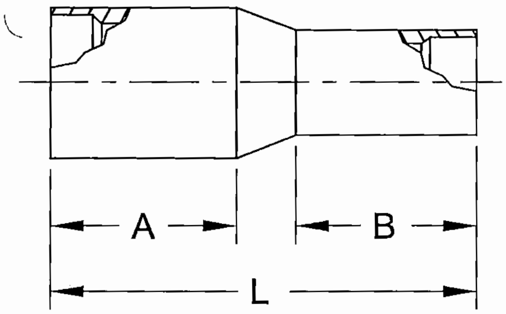
Pipe Size	Length
28 X 18	
28 X 20	
28 X 24	24"
28 X 26	
28 X 26	
30 X 20	
30 X 24	24"
30 X 26	
30 X 28	
32 X 24	
32 X 26	24"
32 X 28	
32 X 30	
34 X 24	
34 X 26	24"
34 X 30	
34 X 32	
36 X 24	
36 X 26	
36 X 30	24"
36 X 32	
36 X 34	
38 X 26	
38 X 28	
38 X 30	24"
38 X 32	
38 X 34	
38 X 36	
40 X 30	
40 X 32	
40 X 34	24"
40 X 36	
40 X 38	
42 X 30	
42 X 32	
42 X 34	24"
42 X 36	
42 X 38	
42 X 40	
44 X 36	
44 X 38	24"
44 X 40	
44 X 42	
46 X 38	
46 X 40	28"
46 X 42	
46 X 44	
48 X 40	
48 X 42	28"
48 X 44	
48 X 46	

Appendix D

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 4

Butt Fittings: Butt Reducers





CTS BUTT REDUCER DIMENSIONS

Nominal Size	A	B	L
1" CTS × ½" CTS	1.79	2.00	4.00
1" IPS × ½" CTS	1.44	1.80	4.50
1" IPS × ¾" CTS	1.50	1.80	4.50
1" IPS × 1" CTS	1.60	2.25	4.50
1¼" CTS × 1" IPS	1.50	2.00	3.84
1¼" IPS × 1¼" CTS	2.50	2.50	5.75
2" IPS × 1¼" CTS	2.49	2.88	6.31
2" IPS × 1½" CTS	2.19	2.29	5.00
2" IPS × 2" CTS	2.75	3.00	6.00
2" IPS × 2" CTS	2.75	3.00	6.00

IPS BUTT REDUCER DIMENSIONS

Nominal Size	A	B	L
1" × ½"	1.50	1.25	4.00
1" × ¾"	1.50	1.75	4.50
1¼" × 1"	1.86	1.92	4.25
1½" × ¾"	2.50	2.40	5.69
1½" × 1"	2.50	2.28	5.75
2" × 1"	2.49	2.88	6.31
2" × 1¼"	3.15	2.56	6.44
2" × 1½"	2.50	2.72	6.00
3" × 2"	3.22	2.50	6.65
4" × 2"	3.00	3.00	11.87
4" × 2"	2.75	2.75	7.16
4" × 3"	3.13	3.13	8.62
6" × 4"	4.22	3.75	9.13
8" × 6"	5.00	4.64	10.78
10" × 8"	6.63	6.25	14.98
12" × 10"	6.63	6.25	14.88

Call for availability of other sizes and dimensions.

Butt Fittings: Butt Reducers

(PE 2406/PE2708) REDUCERS						
Size	SDR	Part Number	Pack Qty.	Wt.	CSA	IAPMO
1" CTS × ½" CTS	.101 WALL × .090 WALL	6911789	100	0.05	-	-
1" IPS × ½" CTS	DR 9.3 × .090 WALL	6911893	100	0.06	-	-
1" IPS × ½" IPS	DR 9.3	6911248	100	0.06	-	-
1" IPS × ¾" CTS	DR 9.3 × .090 WALL	6911234	100	0.07	-	-
1" IPS × ¾" IPS	DR 9.3	6910223	100	0.10	-	-
1" IPS × 1" CTS	DR 9.3 × .090 WALL	6911238	100	0.09	-	-
1" IPS × 1" CTS	DR 9.3 × .101 WALL	6911719	100	0.09	-	-
1¼" CTS × 1" IPS	.090 WALL × DR 9.3	6911245	100	0.07	-	-
1¼" IPS × 1" CTS	DR 10 × .102 WALL	10000725	100	0.10	-	-
1¼" IPS × 1" IPS	DR 10 × DR 11	6910218	100	0.10	-	-
1½" IPS × ¾" IPS	DR 9.3	6910073	100	0.22	-	-
1½" IPS × 1" IPS	DR 11	6910227	100	0.20	YES	-
1½" IPS × 1¼" IPS	DR 11	6911809	100	0.17	-	-
2" IPS × 1" IPS	DR 11	6910081	100	0.29	YES	YES
2" IPS x 1" IPS	DR 11	10009614	100	0.29	-	-
2" IPS × 1¼" CTS	DR 11 × .090 WALL	6912314	100	2.40	-	-
2" IPS × 1¼" IPS	DR 11 × DR 10	6910022	100	0.32	YES	YES
2" IPS × 1½" IPS	DR 11	6910228	50	0.31	YES	-
3" IPS × 2" IPS	DR 11/11.5 × DR 11	691030221000	10	0.68	YES	YES
4" IPS × 2" IPS	DR 11/11.5 × DR 11	6910025	10	1.01	YES	YES
4" IPS × 3" IPS	DR 11/11.5	691040321000	10	0.95	YES	YES
4" IPS × 2" IPS	DR 13.5 × DR 11	6910625	10	1.09	-	-
4" IPS × 3" IPS	DR 13.5 × DR 11	6910646	10	1.03	-	-
6" IPS × 4" IPS	DR 11/11.5	691060421000	5	3.33	YES	YES
6" IPS × 4" IPS	DR 13.5 × DR 11	6911477	5	2.99	-	-
6" IPS × 4" IPS	DR 13.5	6911600	5	3.09	-	-
8" IPS × 6" IPS	DR 11 × DR 11/11.5	6912389	6	5.31	-	-
8" IPS × 6" IPS	DR 11/11.5	691080621000	6	5.86	YES	-
8" IPS × 6" IPS	DR 13.5 × DR 11	6911107	6	6.06	-	-
8" IPS × 6" IPS	DR 13.5	6910451	6	6.20	YES	-

Call for availability of other sizes and dimensions.

Butt Fittings: Butt Reducers

(PE3408/PE4710) CTS & IPS REDUCERS

Size	SDR	Part Number	Pack Qty.	Wt.	AWWA
¾" IPS × ¾" CTS	DR 11 × .090 WALL	10004186	100	0.03	–
1" CTS × ½" CTS	.101 WALL × .090 WALL	10004187	100	0.04	YES
1" IPS × ½" CTS	DR 9.3 × .090 WALL	10004189	50	0.09	YES
1" IPS × ¾" CTS	DR 11 × .090 WALL	10004188	100	0.07	YES
1" IPS × ½" IPS	DR 9.3	10004190	100	0.07	YES
1" IPS × ¾" CTS	DR 9.3 × .090 WALL	10004191	100	0.09	YES
1" IPS × ¾" IPS	DR 9.3	10004192	100	0.09	YES
1" IPS × 1" CTS	DR 9.3 × .090 WALL	10004194	100	0.10	YES
1" IPS × 1" CTS	DR 9.3 × .121 WALL	10004195	100	0.10	YES
1¼" CTS × 1" IPS	.090 WALL × DR 9.3	10003945	100	0.07	YES
1¼" IPS × 1" IPS	DR 11	10004197	100	0.11	YES
1¼" IPS × 1¼" CTS	DR 9.3 × .090 WALL	10003946	100	0.15	YES
1½" IPS × ¾" IPS	DR 9.3	10003947	100	0.18	YES
1½" IPS × 1" IPS	DR 11	10004198	100	0.16	YES
1½" IPS × 1" IPS	DR 9.3	10004199	100	0.19	YES
2" IPS × 1" IPS	DR 11	10007485	100	0.29	YES
2" IPS × 1¼" CTS	DR 11 × .090 WALL	10004200	100	0.30	YES
2" IPS × 1¼" IPS	DR 11	10007479	100	0.33	YES
2" IPS × 1½" IPS	DR 11	10003814	50	0.30	YES
2" IPS × 2" CTS	DR 11 × .193 WALL	10004202	20	0.57	YES
3" IPS × 2" IPS	DR 11	10007480	10	0.65	YES
3" IPS × 2 IPS	DR 9	10004208	10	1.21	YES
3" IPS × 2" IPS	DR 9/9.3	10004209	10	1.15	YES
3" IPS × 2" IPS	DR 7	10007371	10	1.62	YES
4" IPS × 2" IPS	DR 17	10004212	10	0.89	YES
4" IPS × 2" IPS	DR 11	10007481	10	1.02	YES
4" IPS × 2" IPS	DR 9/9.3	10004215	10	0.89	YES
4" IPS × 2" IPS	DR 7	10007372	10	2.38	YES
4" IPS × 3" IPS	DR 17	10004213	10	0.98	YES
4" IPS × 3" IPS	DR 11	10007482	10	1.18	YES
4" IPS × 3" IPS	DR 9/9.3	10004216	10	1.73	YES
4" IPS × 3" IPS	DR 7	10007373	10	2.78	YES
6" IPS × 4" IPS	DR 17	10008769	5	3.30	YES
6" IPS × 4" IPS	DR 11	10007284	5	3.28	YES
6" IPS × 4" IPS	DR 9	10004221	5	3.67	YES
6" IPS × 4" IPS	DR 7	10007374	5	6.00	YES
8" IPS × 6" IPS	DR 17	10004224	5	5.41	YES
8" IPS × 6" IPS	DR 11	10007483	6	6.13	YES
8" IPS × 6" IPS	DR 9	10004227	6	7.69	YES
8" IPS × 6" IPS	DR 7	10007375	6	10.68	YES
10" IPS × 8" IPS	DR 17	10007440	1	15.61	YES
10" IPS × 8" IPS	DR 11	10007439	1	16.40	YES
10" IPS × 8" IPS	DR 9	10000627	1	18.00	YES
12" IPS × 8" IPS	DR 17	10008803	1	17.00	YES
12" IPS × 8" IPS	DR 11	10008804	1	20.20	YES
12" IPS × 8" IPS	DR 9	10008805	1	23.00	YES
12" IPS × 10" IPS	DR 17	10007445	1	21.00	YES
12" IPS × 10" IPS	DR 11	10007444	1	24.20	YES
12" IPS × 10" IPS	DR 9	10000628	1	27.00	YES

Call for availability of other sizes and dimensions.

Appendix E

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

PRESSURE DROP CALCULATION SPREADSHEET - VERSION 1.2, ESI# BRC-MEP-0008-02

This spreadsheet is to be used with Burns and Roe's Technical Procedure P153450M1.
IT IS ESSENTIAL TO HAVE A COMPLETE UNDERSTANDING OF THE PROCEDURE BEFORE USING THIS SPREADSHEET.

USER INSTRUCTIONS:

A) General Notes:

1 Per the Technical Pocedure, the calculations performed by this spreadsheet template are applicable to incompressible fluids and to compressible fluids over a limited pressure drop range.
Limitations of the Darcy Formula (Consult Crane 410 page 3-3 for more information):
Incompressible Fluids - No Restrictions
Compressible Fluids - Do **NOT** use this spreadsheet if the pressure drop is greater than 40% of inlet pressure. The pressure drop may be broken up into multiple smaller pipe calculations to avoid exceeding the 40% rule. Recalculate the inlet conditions for each successive pipe section. V1.1

2 The User should follow Burns and Roe Standard R153450M1, "Maximum Allowable Velocities for Flow of Water and Steam in Pipes", when selecting nominal pipe sizes. "Project specific" velocity requirements may also apply. V1.1

3 Do not alter the format of this spreadsheet. Do NOT add or delete pages from this spreadsheet. Each calculation must be saved under a different file name if you wish to keep it for future use.

4 Do not adjust any of the page settings within this spreadsheet. Although some text lines may appear improperly sized on your screen, they will print properly.

5 A red triangle in the upper right hand corner of a cell indicates that there is a note associate with its contents. Position your mouse over the cell to display the note.

6 Use the drop down boxes to select pipe sizes, pipe material/schedule, and fittings. The selection you make in each of these boxes will cause the spreadsheet to input tabulated piping data into the calculation.

7 This spreadsheet has been protected. Only cells that contain information that is manually input by the User can be modified. Cells which contain formulas or information selected from a drop-down box cannot be modified.

8 Writing in BLUE indicates information that is input by the User.
Writing in BLACK indicates information that is calculated by the spreadsheet.
Writing in RED indicates tabulated information that is supplied by the spreadsheet based on User selections.

B) Piping Materials:

1 The "Radio Buttons" at the top of this section allow the User to select either Standard pipe sizes and materials or User defined pipe sizes and materials. ◉ Sample Radio Button V1.1

Standard Nominal Pipe Sizes and Piping Materials are selected using the two drop down boxes in this section. The pipe internal diameter and roughness factor are then automatically entered into the calculation.

C) Fluid Properties:

1 Flow rate may be entered in either [GPM] or in [lb/hr]. Only one entry for the flow rate should be made. V1.2

2 Average pressure and temperature must be entered by the User. If the calculation is being performed for water or steam, then the User may "check" the box to Enable Water & Steam Properties. This activates the WinSteam add-in which will automatically calculate the specific volume and absoulte viscosity based on the average pressure and temperature. If the calculation is being performed for any other fluid (ie natural gas, oil, brine, etc.) then the box must remain "unchecked" and the User must determine the specific volume and absolute viscosity and enter the values manually.

Note: WinSteam is an add-in function to Excel and is a part of the DeskTop Steam software package. In order to use this program it must be installed locally on the Users computer. Contact the Desktop Steam(WinSteam) Program Advisor for assistance in installing this software.

D) Pressure Drop:

1 Fluid Velocity and Reynolds Number are calculated by the spreadsheet and are updated automatically as information is entered.

2 Friction Factor is ONLY calculated when the Calculate Friction Factor BUTTON is pressed. When the button is pressed, Excel starts an iterative (Goal Seek) calculation to determine the value of the friction factor. The friction factor MUST be recalculated whenever values in the Piping Material or Fluid Properties sections are CHANGED! A warning will be displayed to remind you to recalculate the friction factor when necessary. V1.1

3 Standard resistance coefficients for valves, fittings, etc. have been taken from Crane Technical Paper 410. Crane 410 provides diagrams of the different fittings and should be consulted when making selections. Any selection that results in the word CALC in the (K/f) field must be manually calculated by the User and entered in one of the last three Resistance Coefficient fields.

4 The last three Resistance Coefficient entry fields have been left open to the User. These are for reducers, enlargers, bends, and other non-standard fittings. If the "K" value of the fitting is known, then the following equation should be entered into the K/f column for that fitting: =**[K Value]/F_FACT**. Therefore if the "K" value is 6, then the cell shoud read: =6/F_FACT

~~5 Total straight length of pipe must be entered in feet.~~

6 Static head in the pipe section must be entered in feet. The spreadsheet will automatically convert this value to psi based on the fluid properties. A static head gain should be entered as a negative height.

7 Miscellaneous equipment pressure drops can be manually entered by the User.

E) Reducer Calculations:

1 Refer to the instructions provided on the Reducer Calculation Sheet. V1.2

: 04725

APPENDIX F TO CALCULATION (for Computer Analysis Input/Output Sheet)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

INPUT/OUTPUT PRODUCED ON COMPUTER NO. C1614

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-101	Sheet No:	F1	Cont'd:	G0
Prepared By:	G.Dunn	Date:	6/17/2011	Checked By:		Date:	

Title: Effluent Transfer System – Effluent Transfer System Discharge Pipe Sizing and Existing Effluent Transfer Pump Check

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description:	Water	**Section:**	TA-50 to Evaporation Tanks (TA-52)
Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007 ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938 in
		Inside Diameter (D):	0.328 ft

FLUID PROPERTIES ☐ Check Box to Enable Water & Steam Properties

Fluid:		Average Pressure:	96.10 psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0 F
Flow Rate (Q):	250.0 GPM	Specific Volume (V):	0.01605 ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97570 cP

PRESSURE DROP

Fluid Velocity (Vel):	Vel = 0.0509 W x V / d^2	6.58 ft/sec = 395 ft/min
Reynolds Number (Re):	Re = 6.31 W / (d x μ)	2.05E+05 (= Turbulent Flow)
Friction Factor (f): Turbulent Flow:	$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$	0.0171
Laminar Flow:	f = 64 / Re	

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Gate Valve (Full Port)	3	8	24
Globe Valve (Full Port)	3	340	1020
Stop Check Valve (Y-Pattern)	1	55	55
Tee (Run)	4	20	80
Tee (Branch)	2	60	120
Elbow 90deg. Standard Radius (Small Bore Pipe)	8	30	240
Reducer (6"x4")	1	12.4371	12
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 1551

Equivalent Length of Fittings (L_F):	L_F = D x Sum (nL/D)	509.1 ft
Straight Pipe Length (L_P):		**3600** ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	4109.1 ft
Friction Head Loss (h_L):	h_L = f x (L_{TEL} / D) x (Vel^2 / 2g)	144.1 ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L$ / (144 V)	**62.35 psi**
Static Head:	[psi] = [ft] / (144 V) ___ ft =	**0.00 psi**
Miscellaneous Equipment Pressure Drops:		**psi**
		psi

TOTAL PRESSURE DROP: **62.35 psi**

Appendix G

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 5

GOULDS PUMPS, INC.
SENECA FALLS NEW YORK 13148

DUNS 222-5100

LOAD	ALLOCATION	PAGE	FACTORY NUMBER
	8-5-82	1 OF 2	735522

START	COMPLETE	INVOICE NO.
8-12-82	8-27-82	

DATE SHIPPED SEP 21 1982

PART B/M — TERRITORY

COMP. B/M

TERMS: SUBJECT TO A PENALTY FOR LATE PAYMENT NET 60 DAYS

ON ASSEMBLY

X F.O.B. SENECA FALLS, N.Y. #2 SHOP

ORDER RECEIVED FROM

CUSTOMER'S ORDER NO. AND DATE: 112303 5-13-82 TA

G. P. ORDER NUMBER: 735522

BILL TO:
02597-4197
JAMES S. KONE & CO.
P.O. DRAWER 1109
AMARILLO, TEXAS 79015

SHIP TO:
THE SNOW CO.
2705 PAN AMERICAN FWY N.E.
ALBUQUERQUE, NEW MEXICO 87113

MARK: 112303

VIA: CONSOLIDATED

XX COLLECT ☐ PREPAY

SHIP WITH

APPROX. SCHEDULED SHIPPING DATE: 9-8-82

NO PARTIAL (IF CHECKED)

BRANCH ORDER NO.	DATE ORDER REC'D. IN ORDER DEPT.	DATE ENTERED
TP2-0198	5-14-82 JW	5-17-82

QTY. ORD.	P.O. ITEM NO. / EQUIP. NO. / SERVICE	SERIAL NO.	QTY. SHIPPED	UNIT PRICE	TOTAL PRICE	NET AMOUNT
		735C522-1 THRU 4 MAY 2 0				

	MODEL NO.	SIZE	ROT.	CONST.
4	3996MT	2X3-13	RH	ALL DI

G.P.M.	T.N.H.	LIQUID	TEMP.	SP GR	EFF.
250	140	LOW RADIOACTIVE	AMB	1.0	56

IMPELLER 12½ DIA. DRAWING 100-540 PATT 53973 NPSHR 7

SUCT PRESS

IMPELLER DIA. DRAWING PATT.

MOTOR	H.P.	R.P.M.	PHASE	CYCLES	VOLT	FRAME
	20	1750				256TCV

MOTOR ENCLOSURE — DWG — CODE

MOTOR BY			DATA
CUSTOMER	WILL NOT COME HERE	X	FILE
	WILL COME HERE	☐ ON	

WITH FOLLOWING ADDITIONS, MODIFICATIONS AND/OR REQUIREMENTS

1. MOTOR SUPPORT
2. LESS COUPLING
3. CPLG. GUARD LESS
4. STAINLESS SHAFT 316SS
5. MECHANICAL SEAL PG #2
6. DRILL & TAP FOR OIL MIST CASING SUPPORTS (PURE)
7. UNIT SUBJECT TO INSPECTION. DO NOT SHIP WITHOUT A RELEASE. NOTIFY BILL TO OR BRANCH PRIOR TO SHOP INSPECTION SO THAT CUSTOMER'S REPRESENTATIVE MAY BE PRESENT

FURN. ONLY WHEN CHECKED	TESTS	WIT.	NON-WIT.
	PERFORMANCE		
	NPSH		
	NOISE		
	VIBRATION		
X	HYDROSTATIC		X @ 428 PSIG OPC 551

STANDARD ENG. DATA

WE HEREBY CERTIFY THAT THESE GOODS WERE PRODUCED IN COMPLIANCE WITH ALL APPLICABLE REQUIREMENTS OF SECTIONS 6, 7 & 12 OF THE FAIR LABOR STANDARDS ACT, AS AMENDED AND OF REGULATIONS AND ORDERS OF THE U.S. DEPT. OF LABOR ISSUED UNDER SEC. 14 THEREOF AND THE PRICES CHARGED ARE WITHIN APPLICABLE FEDERAL CEILING PRICE REGULATION AND ORDERS.

REMIT TO: ☐ PITTS ☐ CHI — NO. OF INVOICES — MAILING AND OTHER INSTRUCTIONS

GOULDS PUMPS, INC.
SENECA FALLS, NEW YORK 13148

MECHANICAL SEAL CONT. SHEET

FACTORY ORDER NO. 735522

CUSTOMER'S NAME JAMES S. KONE & CO.

QUANTITY	SEAL MFGR.	TYPE	CODE	SIZE	MFGR. REF. DWG. ☒	STUFFING BOX DWG ☐
	JOHN CRANE DBL	1	NP2C1	1 3/4	F-SP-11604	

STATIONARY SEAT: CLAMPED ☐ "O" RING MOUNTED ☒
DETAILS: 316 SPRING SPACER

ROTARY ORDERED ☒ STOCK ☐ CODE
STATIONARY SEAT ORDERED ☒ STOCK ☐ CODE
SEAL INSTALLATION

GLAND ORDERED ☐ STOCK ☒ PLAIN ☐ VENT AND DRAIN WITH BUSHING ☐ FLUSH ☒ VENT AND DRAIN WITH AUX. BOX ☐ OTHER
GLAND MATERIAL 316

P.O. NO. MS28520
SEAL BY PASS YES ☐ NO ☒

LIP SEAL YES ☐ NO ☒ MFGR. | LIP MATERIAL | EXPANSION COLLAR MATERIAL I.D. AND O.D. | P.O. NO. (LIP SEAL)

	DESCRIPTION	MDL. NO.	SIZE	CODE NUMBER	CLASS.	ITEM	UNIT LIST PRICE	QUAN SHIPPED	TOTAL LIST PRICE	NET AMOUNT

A-834-A-CM

0017681 GOULDS PUMPS, INC. REPLACEMENT PARTS DATA SHEET
ORDER NUMBER 735522 3996MT 2X3-13 CONST. DI
INP. DIAMETER 12-1/2
CUST. P.O. NUMBER 112303 ITEM
SNOW CO
2705 PAN AM N E
ALBUQUERQUE N. 87113

ITEM NO	QTY/ PUMP	PART NAME	GOULDS PART NO.	MATL	NET PRICE EACH	MANUFACTURERS IDENTIFICATION
100	1	CASING	OC00021A06	1012		
101	1*	IMPLR W/O-RG	R100-540	1013		
112A	1*	BALL BRG OTB	8049-30900			BCA-5309A
122	1*	SHAFT	R104-733	2229		
123	1	DEFLECTOR	73519 2			
126	1*	SHAFT SLEEVE	73705X	2229		
132	1	EYE BOLT	49542 5			
134A	1	BRG HOUSING	115- 42	1000		
136	1*	BRG LOCK NUT	8601- C009			MRC N-09
168A	1*	BALL BRG I.B	8050-30960			MRC-309S
184	1	SB COV ASSY	R116-8803	1012		
228A	1	FRAME	B10693 7	1000		
240	1	MT SUPPORT	270- 35	1013		
~~241~~	~~1~~	~~FRAME FOOT~~				
250	1	GLAND MS	077192	1203		
332A	1	OIL SEAL O.B	8690-64324			VICTOR 64324K3
333A	1	OIL SEAL I.B	8690-70175			CRANE175-287-12
351	1	GASKET CASE	70782 28	5128		
353	4	GLAND STUD	27177 607	2229		
355	4	HEX NUT	49507 7	2228		
360D	1	GASKET ADPTR	73078	5130		FRAME-ADAPTR
361A	1	RING RING	58101 393			N5002-393
370	16	H CAP SCREW	49511 252	2210		FR-CASE
370C	3	H TAP BOLT	49521 204	2210		BRG HOUSING
370D	3	H TAP BOLT	49521 204	2210		IMPLR ADJUST
370F	1	DOWEL BOLT	73064	2210		FRAME-FR. FT
370H	2	STUD	27177 626	2228		COVER-ADPTR
382	1*	BRG LOCKWSHR	8910- C009			MRC W-09
383	1*	MECH SEAL	FSP-11604			
412A	1*	O-RING IMPLR	70721 64			ARP568-028
415	3	HEX NUT	49507 57	2210		FOR PART 370D
418	3	H TAP BOLT	49521 204	2228		JACKING BOLT
469B	2	DOWEL PIN	73523 3			FRAME-FR. ADPTR
469D	1	ROLL PIN	80860 5			SHAFT SLEEVE
496	1*	O-RING B.HSG	70721 33			ARP568-245
600		SECTIONAL	248-95			MT PURE OIL W/SLV

* RECOMMENDED SPARE PARTS

Model: 3996	Size: 2X3-13	Group: MT	60Hz	RPM: 1750	Stages: 1

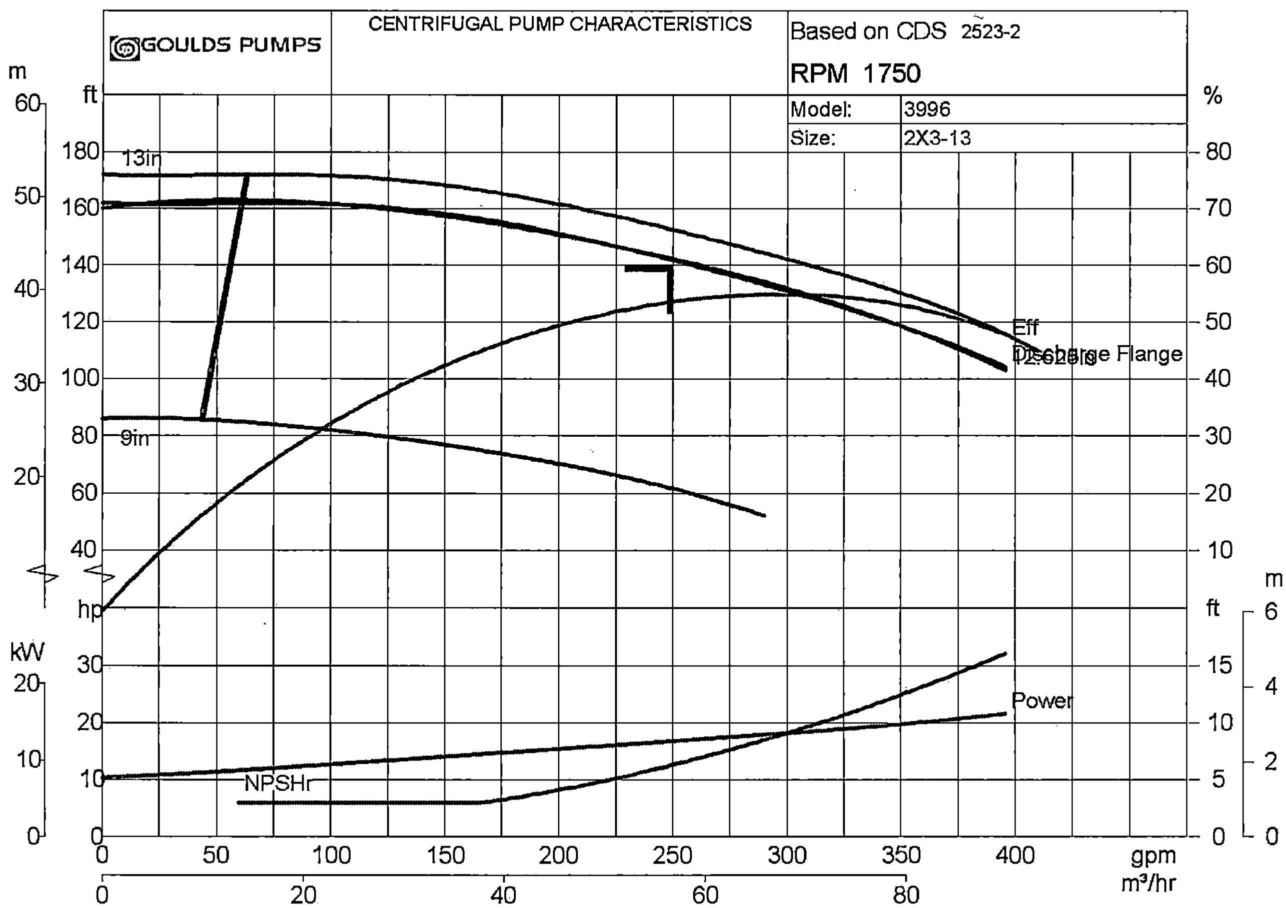
Job/Inq.No. :
Purchaser : UNDEFINED
End User :
Item/Equip.No. : ITEM 001
Service :
Order No. :

Issued by : John Brennan
Quotation No. : NJJB11-06-10 01

Rev. : 0
Date : 06/10/2011

Operating Conditions		Pump Performance			
Liquid:	Water	Published Efficiency:	53.0 %	Suction Specific Speed:	5,501 gpm(US) ft
Temp.:	70.0 deg F	Rated Pump Efficiency:	53.0 %	Min. Hydraulic Flow:	61.2 gpm
S.G./Visc.:	1.000/1.000 cp	Rated Total Power:	16.8 hp	Min. Thermal Flow:	N/A
Flow:	250.0 gpm	Non-Overloading Power:	21.8 hp		
TDH:	140.0 ft	Imp. Dia. First 1 Stg(s):	12.6250 in		
NPSHa:	0.0 ft	NPSHr:	6.3 ft		
Solid size:		Shut off Head:	162.0 ft		
% Susp. Solids (by wtg):		Vapor Press:			
Max. Solids Size:	0.3750 in				

Notes: 1. The Mechanical seal increased drag effect on power and efficiency is not included, unless the correction is shown in the appropriate field above. 2. Magnetic drive eddy current on power and efficiency is not included. 3. Elevated temperature effects on performance are not included. 4. Non Overloading power does not reflect v-belt/gear losses.



Appendix H

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

1. PURPOSE

This Standard establishes the maximum allowable velocities for flow of water and steam in pipes.

2. SCOPE

The maximum allowable velocities presented in this Standard are applicable to the majority of cases involving sizing of piping in conventional power plant piping systems.

This Standard should be used in conjunction with the following Burns and Roe Standards:

P153450M1 - Calculating Pressure Drop

P153450M2 - Estimate of Pipe Sizes and Pressure Drop for Water

3. MAXIMUM VELOCITIES

The following maximum allowable velocities are intended as a guide for designing pipelines.

FLUID	MAXIMUM VELOCITY
Water -	
Feedwater Discharge	20 fps
All Other	12 fps
Steam -	
Superheated	20,000 fpm
Saturated	15,000 fpm

4. DESIGN VELOCITIES

4.1 The determination of the design velocity for a piping system should be based on the available pressure drop from the point of supply to the point of consumption without exceeding the maximum allowable velocities stated above.

4.2 The determination of the design velocities for Condensate, Feedwater, and Circulating Water systems, should be based on the economic analyses of piping, equipment, and pumping costs in addition to the requirement of 4.1.

Burns and Roe Enterprises, Inc.

W.O. No: 03131-001 Calc. 03131-001-ME-102 Sheet No: 1 Cont'd on Sht: 2

Client: Los Alamos National Laboratory Project: Zero Liquid Discharge Project

Title: Effluent Transfer System – New Effluent Transfer Pump Suction Pipe Sizing and Design Check

REVISION RECORD 100761-11-000090

Revision	Status	Description of Revision	Preparer print/sign/date	Checker print/sign/date	Approver print/sign/date
A	Preliminary	Original Issue 60% Submittal	G. Dunn G. Dunn 7/6/2011	S. Stuhrke S Stuhrke 7-6-11	S. Stuhrke

PE Seal (if required)

TABLE OF CONTENTS

PURPOSE

The purpose of this calculation is to size the new Effluent Transfer Pump suction piping, prove the discharge piping size determined in Calculation 03131-001-ME-101 equals the discharge piping size of the new Effluent Transfer Pump, and to prove that the Goulds 3996MT 2X3-13 is sufficient for effluent transfer from Evaporation Tanks at TA-52 back to TA-50.

REFERENCES

1. Website: www.weather.lanl.gov
2. Calculation 03131-001-ME-100
3. Zero Liquid Discharge (ZLD) Sub-Project: Tank Sections 1, C55751-S-3010
4. Zero Liquid Discharge (ZLD) Sub-Project: Pump House Sections, C55751-S-3020
5. Goulds Pump Model: 3996 Specification Sheet
6. Zero Liquid Discharge (ZLD) Sub-Project: Requirements and Criteria Document (Document ID: 100761-ZLD-RCD-0003)
7. ASME B31.3 – 2002 "Process Piping"
8. LANL Radioactive Liquid Waste Treatment Facility (RLWTF): Transfer Piping Plan 1, C55751- M-1000 Rev. A (marked with suction piping lengths)
9. Crane Technical Paper 410
10. Sure Flow Equipment Inc. : Y-Strainers
11. Burns and Roe Engineering Standard, R153450M1, Maximum Allowable Velocities for Flow of Water and Steam in Pipes
12. Heald, C.C., Cameron Hydraulic Data, 19th ed., 1st Printing, Canada, 2002
13. LANL Radioactive Liquid Waste Treatment Facility (RLWTF): Transfer Piping Plan, C55751- M-1000 Rev. A to C55751- M-1004 Rev. A (marked with discharge piping lengths)
14. Georg Fischer Central Plastics – Connector and Equipment Catalog; Butt Fittings: Butt Reducers (p. 20-22) (https://communications.centralplastics.com/pls/portal/docs/PAGE/CENTRAL_PUBLIC/TAB10201/GF%20CENTRAL%20CATALOG%20CONVENTIONAL%20FUSION%20SECTION.PDF)
15. Calculation 03131-001-ME-101
16. LANL Radioactive Liquid Waste Treatment Facility (RLWTF): Zero Liquid Discharge P&ID and Sequence of Operation, C55751- M-6000 Rev. A and C55751- M-6001 Rev. A
17. Goulds Pump Data Sheet; Model: 3996; Size: 2X3-13; Group: MT

DESIGN REQUIREMENTS

1. All Effluent Transfer piping shall conform to ASME B31.3.
2. Design temperature will be equal to the maximum average monthly temperature.
3. Suction design pressure shall be the Evaporation Tanks operating pressure, plus the elevation head from pump inlet to the maximum water level of the Evaporation Tanks during the year, plus 10%.
4. 25% will be added to the total estimated suction pipe length to cover all of the elevation changes of pipe and the pipe routing within the pump house.
5. Discharge design pressure will be equal to the maximum operational pressure, which equals suction side design pressure plus pump shut off head, plus 10%.
6. Design flow rate is equal to the Operating flow rate of the Effluent Transfer System, which is 150 GPM (Ref. 6).
7. High Density Polyethylene (HDPE) piping will be used for the Effluent Transfer piping.
8. Fluid velocity will be less than 12 ft/sec (per Ref. 11)
9. 10% will be added to the pressure drop due to friction in the discharge piping to account for the unknown existing routing upstream of the terminal point (LANL side) and elevation changes in the routing.

UNCONFIRMED ASSUMPTIONS

1. Routing downstream of termination point (LANL side).
2. Finished grade is 6" below the top of the Evaporation Tank wall at the pump house.
3. Effluent Transfer Pump sits on a 3' pedestal.

DESIGN PROCEDURES

1. Calculate the design pressure and temperature of the suction piping of the new Effluent Transfer Pump.
2. Using the calculated design pressure and temperature, select the pipe class for all suction piping from Reference 7.
3. Calculate the pipe length from the Evaporation Tank sump to the new Effluent Transfer Pump inlet. 25% will be added to the total pipe length to cover the elevation changes of the pipe and the pipe routing within the pump house.
4. Input all necessary suction information into the Burns and Roe Standard Pressure Drop Calculation, including pipe lengths, fittings and design conditions.
5. The pressure drop through the suction piping is determined based on the Darcy Formula. The Burns and Roe Standard Pressure Drop Calculation will perform these actions.
6. Per Reference 11, the suction piping velocity shall not exceed 12 ft/sec.
7. Select a suction pipe size based on the Burns and Roe Standard Pressure Drop Calculation output.
8. Calculate the Net Positive Suction Head Available.
9. Calculate Total Suction Lift.
10. Calculate the design pressure and temperature for the discharge piping for the new Effluent Transfer Pump.
11. Using the calculated design pressure and temperature, select the pipe class for all discharge piping from Reference 7.
12. Calculate the discharge pipe length from the new Effluent Transfer Pump outlet to the termination point located at TA-52.
13. Input all necessary discharge information into the Burns and Roe Standard Pressure Drop Calculation, including pipe lengths, fittings and design conditions.
14. The pressure drop through the discharge piping is determined based on the Darcy Formula. The Burns and Roe Standard Pressure Drop Calculation will perform these actions.
15. Per Reference 11, the discharge piping velocity shall not exceed 12 ft/sec.
16. Select a discharge pipe size based on the Burns and Roe Standard Pressure Drop Calculation output.
17. 10% will be added to the calculated Friction Head Loss in the discharge piping to cover all losses that may exist in the unknown piping downstream of the termination point (LANL side) and the effects of elevation changes from TA-52 to TA-50 on pipe length.
18. Calculate Total Discharge Head.
19. Calculate Total System Head.
20. Prove that the existing Effluent Transfer Pump discharge pipe size determined in Calculation 03131-001-ME-101 (Reference 15) is equal to the new Effluent Transfer Pump discharge pipe size.
21. Prove the Goulds 3996MT 2X3-13 is sufficient for effluent transfer from TA-52 to TA-50.

COMPUTER TYPE: Desktop - Dell , OPERATING SYSTEM: Windows

1. COMPUTER PROGRAM: PDCALC - Pressure Drop Calculation (Excel Template) VERSION: 1.2

☒ APPROVED ☐ AUTHORIZED

ESI No. ESI# ME-008-02

CONCLUSIONS

A 6" Polyethylene DR 17 (Piping Specification 502, ASME B31.3 "Process Piping") suction pipe size was selected for the new Effluent Transfer Pump.

The Net Positive Suction Head Available (NPSHa) of the Effluent Transfer System while pumping from the Evaporation Tanks back to TA-50 is 17.24 feet. The Net Positive Suction Head Required (NPSHr) by the Goulds 3996MT 2X3-13 is 6.3 feet (per Reference 17). The NPSHa of the Effluent Transfer System while pumping from the Evaporation Tanks back to TA-50 is sufficient for the NPSHr by the Goulds 3996MT 2X3-13.

A 4" High Density Polyethylene (HDPE) DR 17 (Piping Specification 502, ASME B31.3 "Process Piping") discharge pipe size was selected for the Effluent Transfer Piping while pumping from the Evaporation Tanks back to TA-50. It is the same size and material as the discharge pipe selected in Calculation 03131-001-ME-101 (Reference 15). The same piping may be used in both applications.

The Total System Head calculated for the Effluent Transfer System while pumping from the Evaporation Tanks back to TA-50 is 135.2 ft. Per Reference 6, the Effluent Transfer System shall have a working flow rate of 150 GPM. The pump curve (Appendix I) shows that at 150 GPM, there will be a Total Dynamic Head of 157 feet. The TDH of the Goulds 3996MT 2X3-13 at 150 GPM is sufficient for the Effluent Transfer System while pumping from the Evaporation Tanks back to TA-50.

The Goulds 3996MT 2X3-13 satisfies all Effluent Transfer System criteria and may be used to pump from the Evaporation Tanks back to TA-50

BODY OF CALCULATION

System Boundaries

The new Effluent Transfer Pump takes suction from the Evaporation Tanks and discharges to TA-50. The pipe design downstream of the termination point (LANL side) between new and existing piping is unknown.

SUCTION

Design Temperature

The design temperature is equal to the maximum Mean Monthly Temperature (per Reference 1):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Temperature °F	28.7	32.3	38.3	46.2	55.3	64.9	68.0	65.7	60.0	49.6	37.7	29.9

T_{design} = 68.0 °F

Use 70 °F as the Design Temperature.

Suction Side Design Pressure

The suction side design pressure shall be the Evaporation Tanks operating pressure, plus the elevation head from pump inlet to the maximum water level of the Evaporation Tanks during the year, plus 10%.

The operating pressure of the Evaporation Tanks is atmospheric pressure.

Maximum Evaporation Tank water level during the year will be taken from Calculation 03131-001-ME-100 (Reference 2). Sheet 13 of Calculation 03131-001-ME-100 (Reference 2) states that the Maximum Depth of Water in the Evaporation Tank based on Surface Area during the year is 13.51 inches.

Reference 2 states that the design Maximum Water Level allowed in the tank is 3' – 0". The height between Grade and the Maximum Depth of Water in the Evaporation Tank based on Surface Area is as follows:

Max Water Level (per Reference 2) = 3' – 0" = 36"
Maximum Depth of Water during the year (per Reference 2) = 13.51"
Assumed Finished Grade to top of the Evaporation Tank wall = 6"
Grade to Max Water Level (per Reference 3 and Assumption 2) = 12" – 6" = 6"
Height from Grade to Maximum Depth of Water = 36" – 13.51" + 6" = 28.49"

Reference 4 shows the Enlarged Pumphouse Pad Section view. The pad is located 6" above Finished Grade.

Reference 5 shows the dimensions of the Goulds Model 3996 MT 2X3-13 pump. The height from the base of the pump to the center line of the inlet is 5 ¾". Assuming the pump is sitting on a 3 ft. tall support, the total height from the Pumphouse Pad to the centerline of the pump inlet is 3' – 5 ¾" (which equals 41 ¾").

The total suction static head is as follows:

Total Suction Static Head = Height from Grade to Maximum Depth of Water + Height of Pumphouse Pad + Height from Pumphouse Pad to Centerline of pump inlet

Total Suction Static Head= 28.49" + 6" + 41 ¾" = 76.24" = 6.36' below pump inlet

Atmospheric pressure = 11.10 psia (per Reference 6)
Specific Gravity @ 70 °F = 0.999
Elevation from pump inlet to Evaporation Tank maximum water depth = -6.36 ft.
Since there is a negative suction static head, the maximum pressure in the suction piping will be atmospheric pressure.

$P_{Sdesign}$ = 11.10

Add 10%.
$P_{Sdesign}$ = 11.10 + 1.11 = 12.21 psia
$P_{Sdesign}$ = 12.21 – 11.1 = 1.11 psig

Use 5 psig as Discharge Design Pressure.

Summary of Suction Design Conditions

The new Effluent Transfer Pump Suction design conditions are as follows:

New Effluent Transfer Pump Suction 5 psig / 70 °F

Suction Pipe Class Selection

Piping for the Effluent Transfer System is HDPE, ASME B31.3.

From Reference 7, the following Pipe Class is appropriate:

New Effluent Transfer Pump Suction 502 Polyethylene Piping DR 17, 100 psig and below, ASME B31.3

Routing from Evaporation Tank Sump to New Effluent Transfer Pump Inlet

Using the Transfer Piping Plan drawings (per Reference 8), the length of straight pipe was calculated using the "Measure" ability in AutoCAD. Appendix A shows the piping estimates. The length of pipe used in the calculation of Friction Head Loss in the pipe was the maximum distance, from the Evaporation Tank Sump to the New Effluent Transfer Pump. The total length of pipe is 66' – 11". 25% will be added to the total pipe length to cover all of the elevation changes of pipe and the pipe routing within the pump house, the result is 83.65 feet. 85 feet will be used in the calculation.

Suction Pipe Sizing

Using the Burns and Roe Standard Pressure Drop Calculation, the pressure drop due to friction in the pipe can be calculated. Design Inputs are as follows:

Average Pressure = Design Pressure = 5 psig = 16.1 psia
Average Temperature = Design Temperature = 70 °F
@ 70 °F, Specific Volume of water (per Reference 9) = 0.016045 ft^3/lb
@ 70 °F, Absolute Viscosity of water (per Reference 9) = 0.97570 cP
Flow Rate (per Reference 6) = 150 GPM
Straight Pipe Length = 85 ft.

Using the Process and Instrumentation Diagrams (Appendix B), the pipe fittings were added to the Pressure Drop Calculation. The fitting quantities are as follows:

Gate Valve – 1
Globe Valve – 1
Tee (Run) – 1
Tee (Branch) – 1
Elbows (Standard Radius 90°) – 9

The pressure drop of the inline y-strainer on the suction piping was estimated to be 0.2 psi (per Reference 10).

A 6 inch pipe size was selected for the new Effluent Transfer Pump suction piping after running the Burns and Roe Standard Pressure Drop Calculation. The 6 inch pipe results in a fluid velocity of 1.82 ft/sec, which satisfies the design requirement of a maximum fluid velocity of 12 ft/sec (Reference 11).

The Total Pressure Drop in the suction pipe is 0.53 psi.

The completed Pressure Drop Calculation Sheet is in Appendix C.

NPSHa Calculation (For Suction Lift)

$NPSH_a = h_a - h_{vpa} - h_{st} - h_{fs}$ (per Reference 12)

Where,

h_a = absolute pressure on the surface of the liquid supply level = atmospheric pressure = 11.1 psia (per Reference 6)

h_{vpa} = head in feet corresponding to the vapor pressure of the liquid at the temperature being pumped

h_{st} = static height = 6.36 ft.

h_{fs} = All suction line losses in feet

Converting to feet of head at 70°F water (specific gravity @ 70°F = 0.999)

h_a = 11.1 psia * 2.31/0.999 = 25.67 ft.

Vapor Pressure @ 70°F (per Reference 9) = 0.36292 psia

h_{vpa} = 0.36292 psia * 2.31/0.999 = 0.84 ft.

Suction line pressure drop = 0.53 psi

h_{fs} = 0.53 psi * 2.31/0.999 = 1.23 ft.

NPSHa = 25.67 – 0.84 – 6.36 – 1.23 = 17.24 ft.

Total Suction Lift

Total Suction Lift is equal to the static height in feet plus all friction losses in the suction line (per Reference 12). Total Suction Lift will be used to determine the Total System Head of the Effluent Transfer System.

$h_s = h_{st} + h_{fs}$ = 6.36 ft. + 1.23 ft. = 7.59 ft.

Use 7.6 feet as Total Suction Lift.

DISCHARGE

Design Temperature

The design temperature is equal to the maximum Mean Monthly Temperature (per Reference 1):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Temperature °F	28.7	32.3	38.3	46.2	55.3	64.9	68.0	65.7	60.0	49.6	37.7	29.9

$T_{design} = 68.0$ °F

Use 70 °F as the Design Temperature.

Discharge Side Design Pressure

The discharge side design pressure shall be equal to the suction side design pressure plus the pump shutoff head plus 10%.

$P_{Sdesign}$ = 5psig = 16.1 psia

Pump Shutoff Head (per Reference 17) = 162 ft.
Converting to psi head @ 70 °F = (162 ft. * 0.999) / 2.31 = 70.06 psi

$P_{Sdesign} + P_{ShutoffHead}$ = 16.1 + 70.06 = 86.16 psia

Add 10%.
$P_{Ddesign}$ = 86.16 + 8.62 = 94.78 psia
$P_{Ddesign}$ = 94.78 – 11.1 = 83.68 psig

Use 85 psig as Discharge Design Pressure.

Summary of Design Conditions

The Effluent Transfer System design conditions are as follows:

Effluent Transfer Pump Discharge 85 psig / 70 °F

Pipe Class Selection

Piping for the Effluent Transfer System is HDPE, ASME B31.3.

From Reference 7, the following Pipe Class is appropriate:

Effluent Transfer Pump Discharge 502 Polyethylene Piping DR 17, 100 psig and below, ASME B31.3

Routing from New Effluent Pump Outlet to TA-50

Using the Transfer Piping Plan drawings (per Reference 13), the length of straight pipe was calculated using the "Measure" capability in AutoCAD. Appendix D shows the piping estimates. The length of pipe used in the calculation of Friction Head Loss was the maximum distance, from the pump house located at TA-52 to the terminal point located in TA-50. The total length of pipe is 3387' – 11". 3400 feet will be used in the calculation.

Discharge Pipe Sizing

Using the Burns and Roe Standard Pressure Drop Calculation, the pressure drop due to friction in the pipe can be calculated. Design inputs are as follows:

Average Pressure = Design Pressure = 85 psig = 96.1 psia
Average Temperature = Design Temperature = 70 °F
@ 70 °F, Specific Volume of water (per Reference 9) = 0.016045 ft^3/lb
@ 70 °F, Absolute Viscosity of water (per Reference 9) = 0.97570 cP
Flow Rate (per Reference 6) = 150 GPM
Straight Pipe Length = 3400 ft.

Using the Process and Instrumentation Diagrams (Appendix B), the pipe fittings were added to the Pressure Drop Calculation. The fitting quantities are as follows:

Gate Valve – 2
Globe Valve – 3
Stop Check Valve – 1
Tee (Run) – 1
Tee (Branch) – 3
Enlarger (4"x 6") – 1
Elbows (Standard Radius 90°) – 6

The Resistance Coefficient (K) value for the 4"x6" enlarger was calculated using the Burns and Roe Calculation of Reducer Resistance Coefficients, which is within the Burns and Roe Standard Pressure Drop Calculation file. The Calculation of Enlarger Resistance Coefficients data sheet can be found in Appendix E. Enlarger length can be found using Reference 14 (Appendix F). The inside diameters of the different sized HDPE DR 17 pipe were found in the Burns and Roe Standard Pressure Drop Calculation. The instructions for how to enter the calculated Resistance Coefficient into the Burns and Roe Standard Pressure Drop Calculation can be found in Appendix G. The resulting K factor of the 4"x6" enlarger is 0.290.

A 4 inch discharge pipe size was selected for the Effluent Transfer Piping after running the Burns and Roe Standard Pressure Drop Calculation. The 4 inch pipe results in a fluid velocity of 3.95 ft/sec, which satisfies the design requirement of a maximum fluid velocity of 12 ft/sec (Reference 11).

The Friction Head Loss in the new discharge pipe is 52.8 feet. The completed Pressure Drop Calculation Sheet is in Appendix H.

In order to take into account the unknown existing discharge pipe routing downstream of the terminal point (LANL side) and piping elevation changes from TA-52 to TA-50, a factor of 0.1 is added to the Friction Head Loss of the new discharge piping (52.8 feet). The resulting Total Friction Head Loss in the discharge piping is 58.1 feet.

Total Discharge Head

Total Discharge Head is equal to the static discharge head in feet plus all friction losses in the discharge line (per Reference 12). Total Discharge Head will be used to determine the Total System Head of the Effluent Transfer System.

Per Reference 13, the elevation at the TA-50 terminal point is 7235.5 feet and the elevation at the Evaporation Tank (TA-52) is 7166 feet. The elevation difference (discharge elevation head) from Evaporation Tanks area (TA-52) to terminal point area (TA-52) is 69.5 feet.

$h_d = h_{st} + h_{fs} = 69.5$ ft. + 58.1 ft. = 127.6 ft.

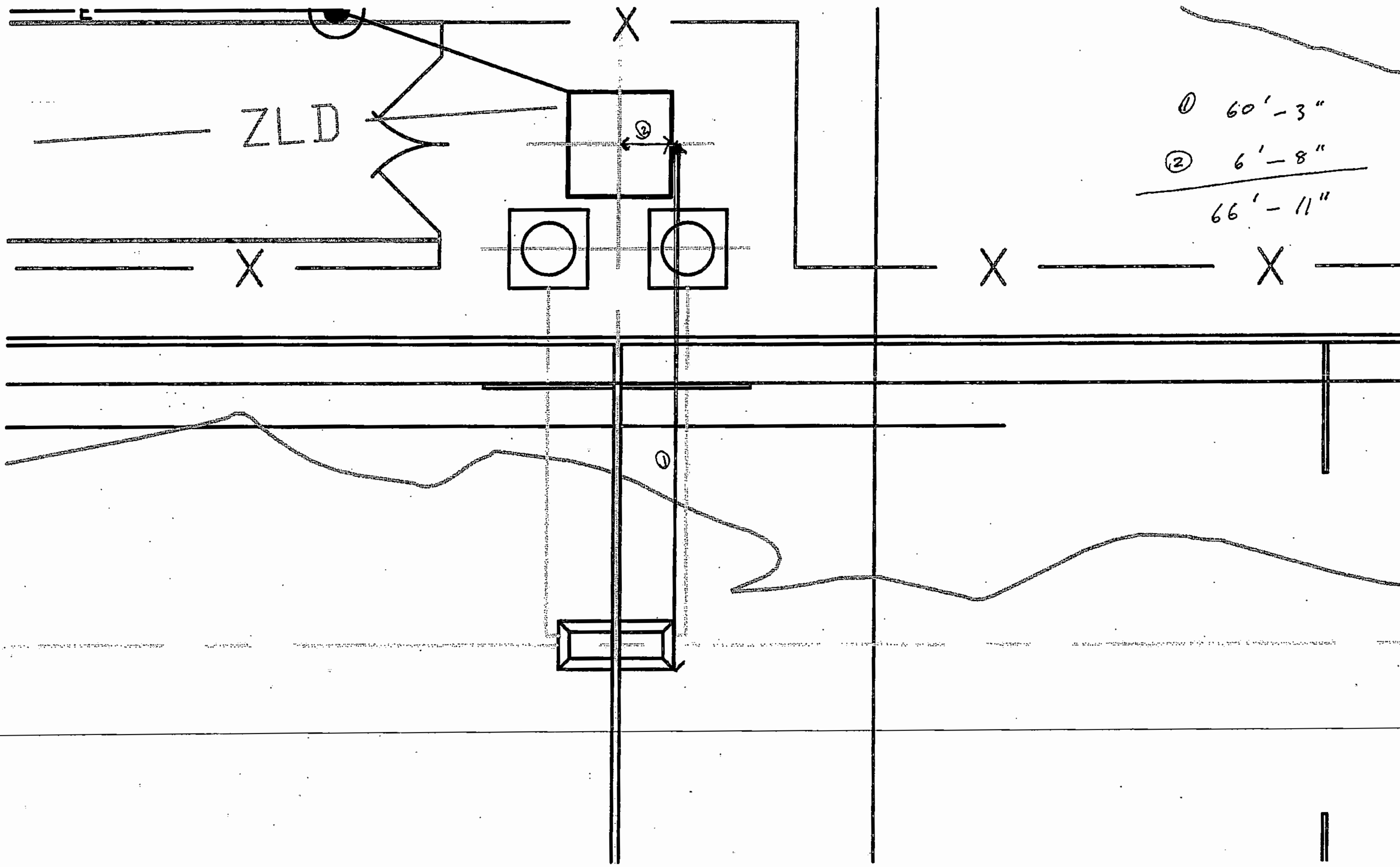
TOTAL SYSTEM HEAD

Total system head, formerly total dynamic head, is the total discharge head (h_d) minus the total suction head (h_s) if positive or plus if a suction lift (per Reference 12).

$H = h_d + h_s = 127.6$ ft. + 7.6 ft. = 135.2 ft.

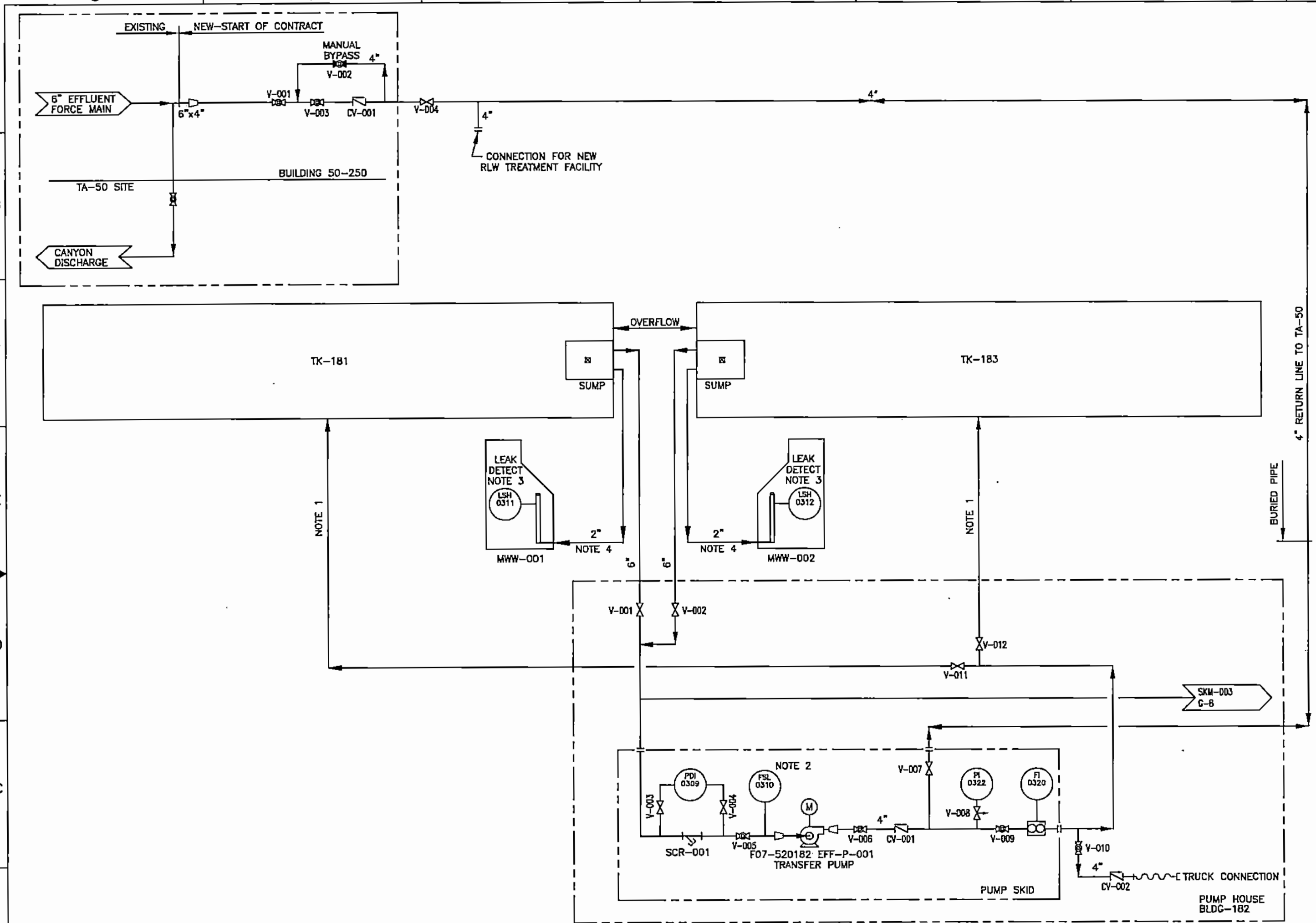
Appendix A

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2


ZLD
①
②
① 60'-3"
② 6'-8"
66'-11"

Appendix B

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 3



TA-52 SITE

ZERO LIQUID DISCHARGE P&ID

SCALE: NONE

GENERAL NOTES:

1. HEAT TRACE ABOVE GROUND PIPING ONLY.
2. LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY).
3. LEAK DETECTION ALARMS ARE DIRECTED TO A LOCAL ALARM PANEL, WITH FLASHING BEACON, AT THE PUMP ENCLOSURE.
4. 2" CONTAINMENT PIPE WITH ¾" TEFLON HOSE TO MAN HOLE.

SEQUENCE OF OPERATION:

TRANSFER PUMPS:
LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY). THRU VALVE LINEUPS TANK CONTENTS CAN BE TRANSFERRED FROM ONE TANK TO ANOTHER TANK OR RETURNED TO SOURCE BY ONE OR BOTH TRANSFER PUMPS.

MANUAL BYPASS:

LEAK DETECTION:
LEAK DETECTION ALARMS ARE DIRECTED TO A LOCAL ALARM PANEL, WITH FLASHING BEACON, AT THE PUMP ENCLOSURE. TO TANK LEAK DETECTION.

"NOT FOR CONSTRUCTION"

Reserved for Engineer's Stamp

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE P&ID AND SEQUENCE OF OPERATION

BLDG 181,182,183 TA-52

DRAWN: T. HARPER
DESIGN
CHECKED
DATE

SUBMITTED
APPROVED FOR RELEASE

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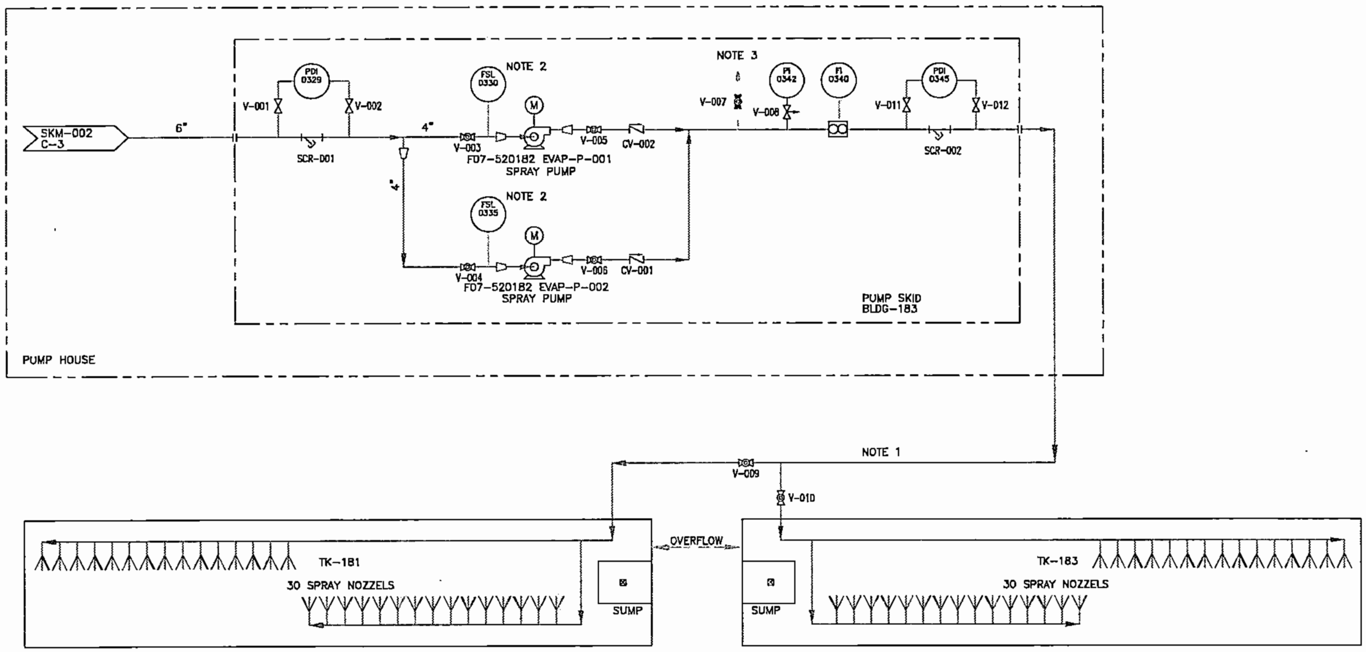
SHEET M-6000 OF

CLASSIFICATION Classification | REVIEWER Reviewer | DATE Date

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: Plot Date: 6/30/2011
FILE NAME: C55751-M-6000-RADWC



GENERAL NOTES:

1. HEAT TRACE ABOVE GROUND PIPING ONLY.
2. LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY).
3. SPRAY NOZZLE HEADERS ARE TO BE SELF DRAINING. LOCATE ¾" VENT WITH GLOBE VALVE AT HIGH POINT OF SPRAY PIPING AND ¾" DRAINS AS REQUIRED ON SPRAY HEADERS AT LOW POINTS. SPRAY PIPING HIGH POINT SHALL BE LOCATED INSIDE THE PUMP HOUSE.

SEQUENCE OF OPERATION:

SPRAY SYSTEM:

NOZZELS:

WHIRL JET SPRAY DRY NOZZLES, HOLLOW CONE AS MANUFACTURED BY SPRAYING SYSTEMS.

SPRAY PUMPS:

LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY). MANUAL OPERATION WHEN SPRAYING IS REQUIRED TO ENHANCE EVAPORATION. ONE PUMP WILL BE UTILIZED FOR SPRAYING ONE TANK. EITHER PUMP CAN BE USED FOR EITHER TANK THROUGH VALVE LINE UPS. SYSTEM IS DESIGNED FOR SPRAYING BOTH TANKS SIMULTANEOUSLY. STARTING AND STOPPING OF ONE OR BOTH SPRAY PUMPS IS A MANUAL OPERATION VIA A LOCAL START/STOP PUSH BUTTON. A LOW FLOW WILL CAUSE A PUMP OR PUMPS TO TRIP IF TANK OR TANKS RUNS DRY (AFTER DELAY).

TA-52 SITE
SPRAY SYSTEM FOR EVAPORATION TANKS

SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE P&ID AND SEQUENCE OF OPERATION

BLDG 181,182,183 — TA-52

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PO Box 1663
Los Alamos, New Mexico 87545

SHEET: M-6001 OF

CLASSIFICATION: — REVIEWER: — DATE:

PROJECT ID: 100761 — DRAWING NO: C-55751 — REV: A

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-ME-102	Sheet No:	C0	Cont'd on Sht:	C1
Prepared By:	G. Dunn	Date:	6/22/2011	Checked By:		Date:	

Title: **Effluent Transfer System – New Effluent Transfer Pump Suction Pipe Sizing and Design Check**

APPENDIX__C__ TO CALCULATION (for Computer Analysis Input/Output Sheet)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

INPUT/OUTPUT PRODUCED ON COMPUTER NO. C1614

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-102	Sheet No:	C1	Cont'd:	D0
Prepared By:	G. Dunn	Date:	6/22/2011	Checked By:		Date:	

Title: Effluent Transfer System – New Effluent Transfer Pump Suction Pipe Sizing and Design Check

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Water **Section:** New Pump Suction

Nominal Size:	**6 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	5.798	in
		Inside Diameter (D):	0.483	ft

FLUID PROPERTIES

☐ Check Box to Enable Water & Steam Properties

Fluid:			Average Pressure:	16.10	psia
Flow Rate (W):		lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	150.0	GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]			Absolute Viscosity (μ):	0.97570	cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 — 1.82 ft/sec = 109 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) — 8.36E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0194

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Gate Valve (Full Port)	1	8	8
Globe Valve (Full Port)	1	340	340
Tee (Run)	1	20	20
Tee (Branch)	1	60	60
Elbow 90deg. Standard Radius (Small Bore Pipe)	9	30	270
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 698

Equivalent Length of Fittings (L_F):	L_F = D x Sum (nL/D)	337.3	ft
Straight Pipe Length (L_P):		**85**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	422.3	ft
Friction Head Loss (h_L):	h_L = f x (L_{TEL} / D) x (Vel^2 / 2g)	0.9	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L$ / (144 V)	**0.38**	**psi**
Static Head:	[psi] = [ft] / (144 V) ____ ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:	Y Strainer	**0.2**	**psi**
			psi
TOTAL PRESSURE DROP:		**0.53**	**psi**

Appendix D

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 6

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

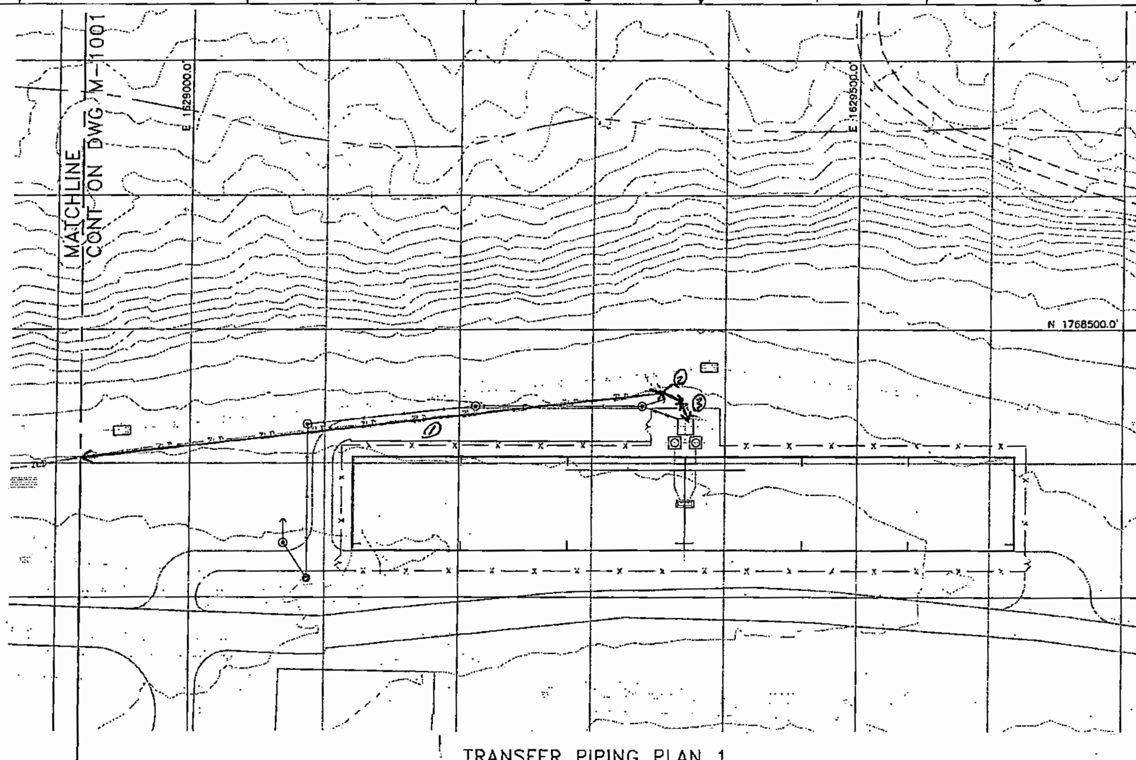
① 435' - 4 5/16"

② 18' - 0 1/16"

③ 10' - 3 11/16"

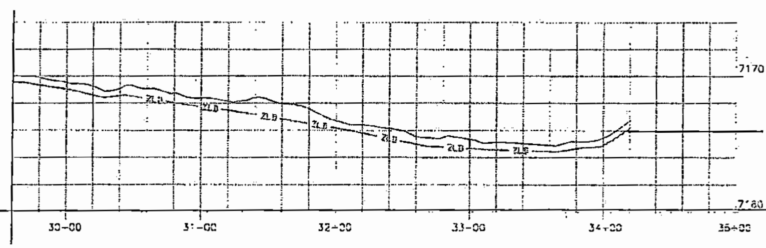
463' - 7 17/16"

= 463' - 8 1/16"



TRANSFER PIPING PLAN 1

1"=40'-0"



PIPING PROFILE

SCALE: NONE

60% REVIEW
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-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 1

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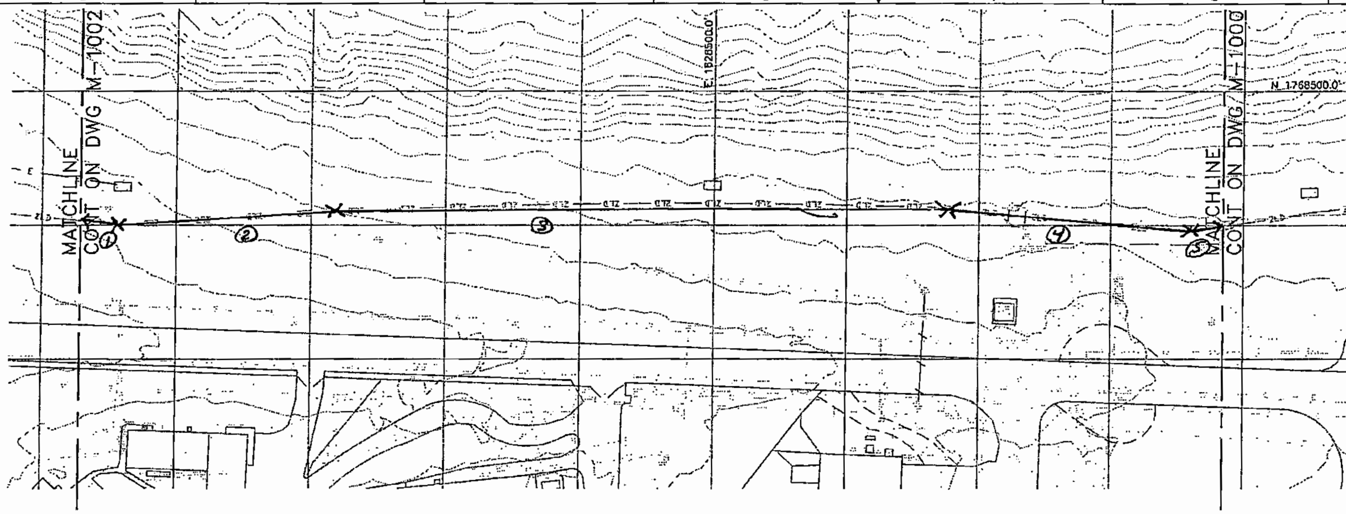
SHEET M-1000 OF

CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: ######## Plot Date: 6/29/2011
FILE NAME: C55751-M-1000-RA.DWG

0540253



TRANSFER PIPING PLAN 2

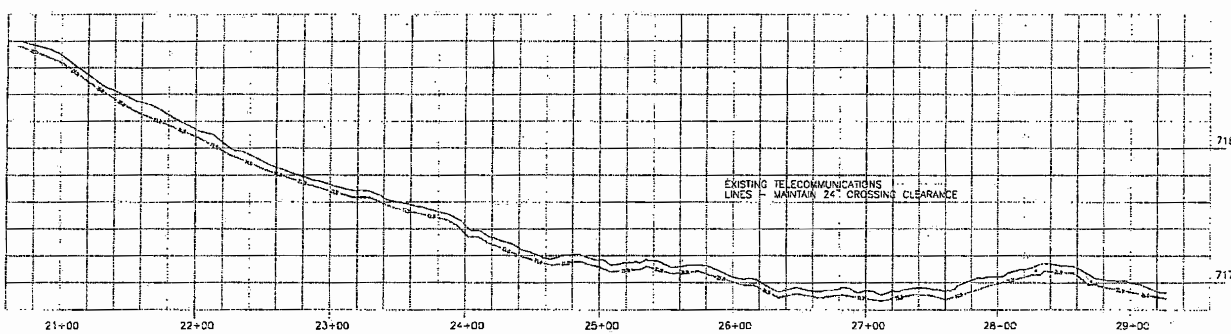
1"=40'-0"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

① 33' - 11 3/8"
② 154' - 11 9/16"
③ 454' - 6 5/16"
④ 190' - 1 15/16"
⑤ 24' - 3 1/16"

855' - 32 36/16"
= 857' - 10 1/4"



PIPING PROFILE
SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 2

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DESIGN: T. HARPER
CHECKED:
DATE:

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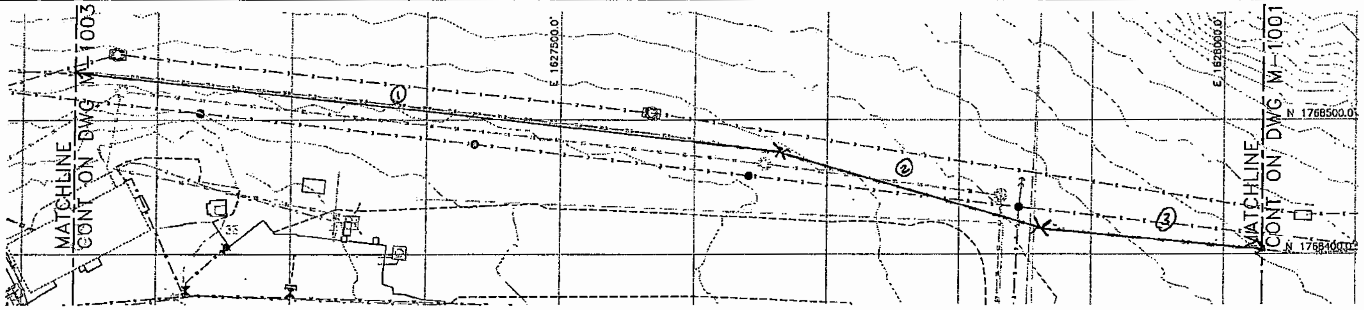
SHEET M-1001 of

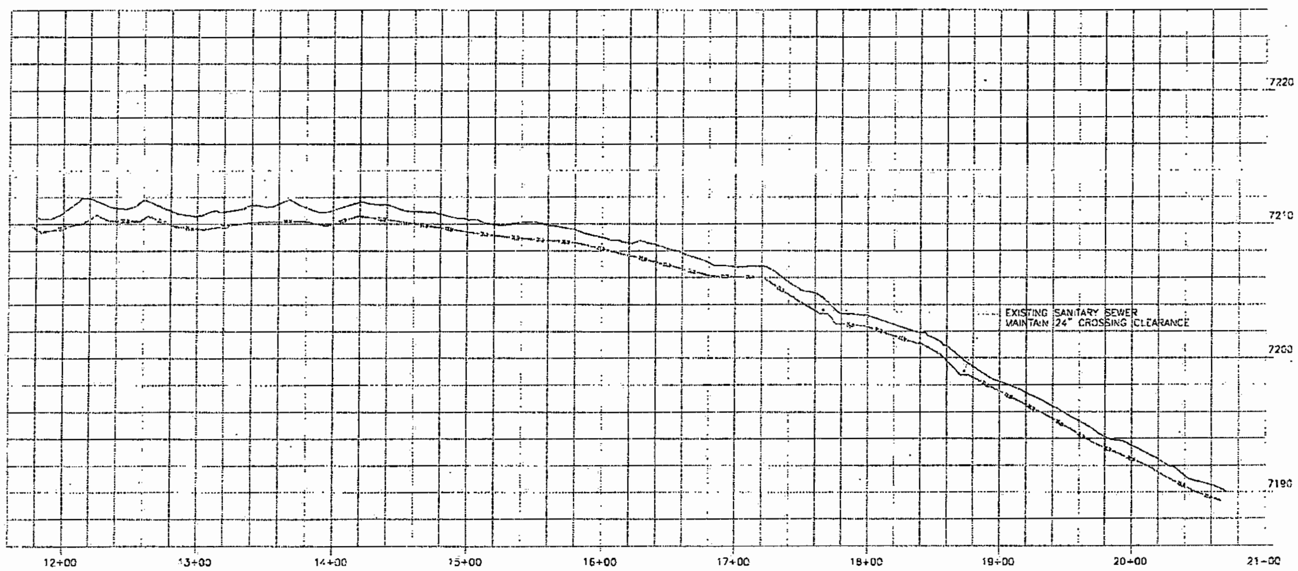
CLASSIFICATION U
REVIEWER EDWARD ARTIGLIA
DATE
PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: Plot Date: 6/29/2011



TRANSFER PIPING PLAN 3

1"=40'-0"



PIPING PROFILE

SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

① 531' - 3 15/16"

② 203' - 2 1/2"

③ 168' - 1 3/16"

902' - 6 26/16"

= 902' - 7 5/8"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 3

DRAWN: T. HARPER
DESIGN: T. HARPER
CHECKED:
DATE:

BLDG 182 TA-52

SUBMITTED

APPROVED FOR RELEASE

SHEET M-1002 OF

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

CLASSIFICATION

REVIEWER EDWARD ARTIGLIA

DATE

PROJECT ID 100761

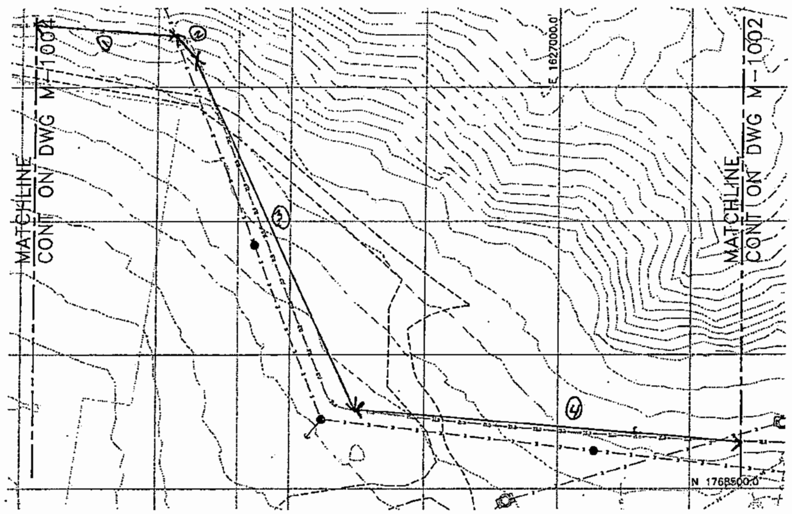
DRAWING NO C-55751

REV A

Plotted By: ######## Plot Date: 6/29/2011
FILE NAME: C55751-M-1002-RA.DWG

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



TRANSFER PIPING PLAN 4

1"=40'-0"

① 101' - 11 5/16"

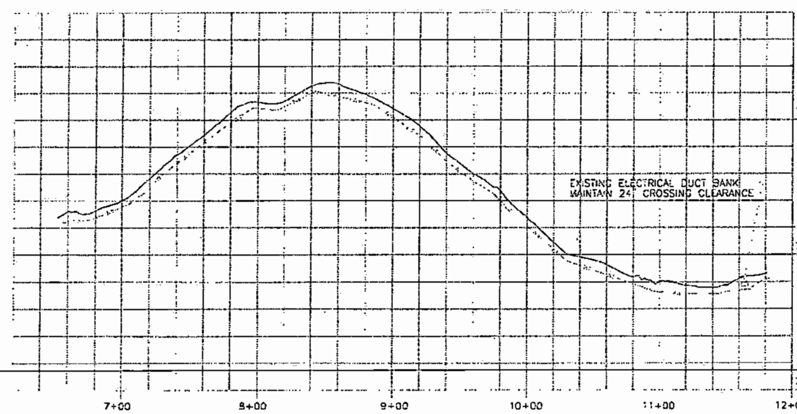
② 20' - 5 3/8"

③ 290' - 3 3/4"

④ 297' - 1 1/8"

708' - 20 25/16"

= 709' - 9 9/16"



PIPING PROFILE

SCALE: NONE

60% REVIEW "NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 4

DRAWN T. HARPER
DESIGN T. HARPER
CHECKED
DATE

BLDG 182 TA-52

SUBMITTED

APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-1003 OF

CLASSIFICATION

REVIEWER EDWARD ARTIGLIA

DATE

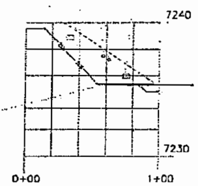
PROJECT ID 100761

DRAWING NO C-55751

REV A

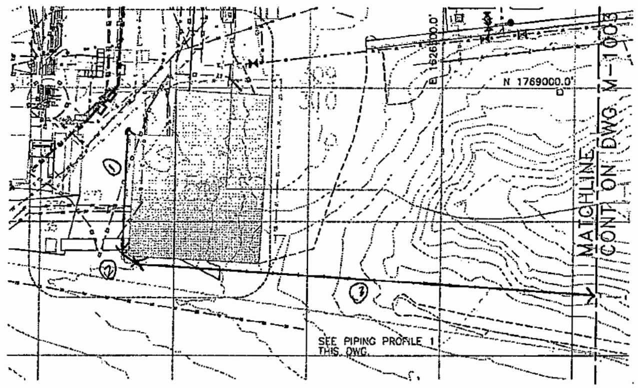
GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



7235.5

PIPING PROFILE 2
SCALE: NONE



TRANSFER PIPING PLAN 5
40' 20' 0 20' 40'
1"=40'-0"

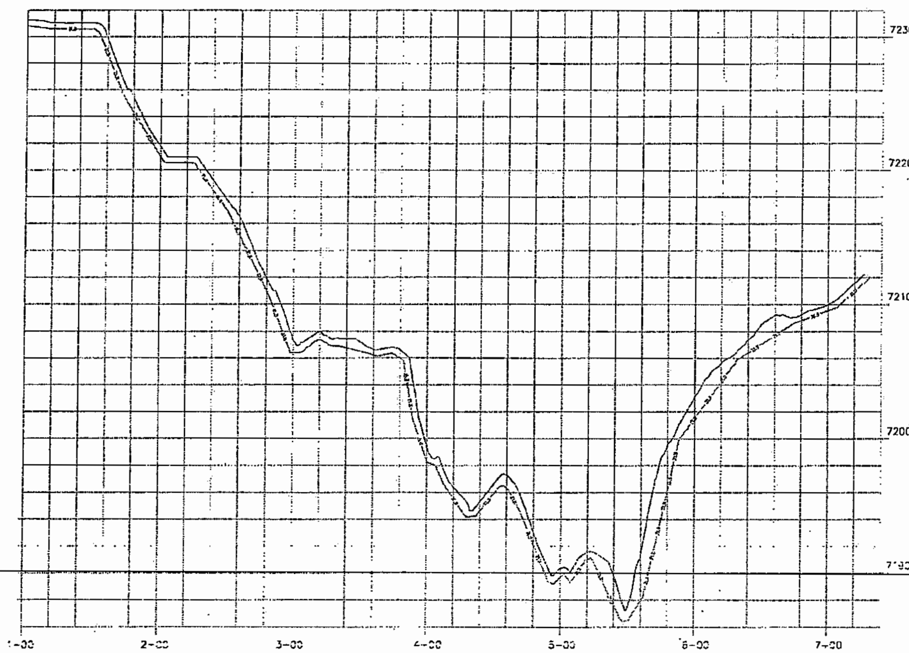
① 95' - 4 7/16"

② 7' - 0 5/8"

③ 351' - 6 7/16"

453' - 10 24/16"

= 453' - 11 1/2"



PIPING PROFILE 1
SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 5

DRAWN: T. HARPER
DESIGN: T. HARPER
CHECKED:
DATE:

BLDG 182 TA-52

SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-1004 OF

CLASSIFICATION | REVIEWER EDWARD ARTIGUA | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: Plot Date: 6/30/2011

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-ME-102	Sheet No:	E0	Cont'd on Sht:	E1
Prepared By:	G. Dunn	Date:	6/22/2011	Checked By:		Date:	

Title: **Effluent Transfer System – New Effluent Transfer Pump Suction Pipe Sizing and Design Check**

APPENDIX__E__ TO CALCULATION (for Computer Analysis Input/Output Sheet)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

INPUT/OUTPUT PRODUCED ON COMPUTER NO. C1614

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-102	Sheet No:	E1	Cont'd:	F0
Prepared By:	G. Dunn	Date:	6/22/2011	Checked By:		Date:	

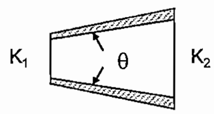
Title: Effluent Transfer System -- New Effluent Transfer Pump Suction Pipe Sizing and Design Check

CALCULATION OF REDUCER / ENLARGER RESISTANCE COEFFICIENTS

REDUCER / ENLARGER PARAMETERS

Reducer / Enlarger Type: ENLARGER

K Factor Referenced to: SMALLER PIPE (K1)



O STANDARD REDUCER / ENLARGER DIMENSIONS

Pipe Connection	Diameter	Schedule		I.D. (in.)
Smaller Pipe:	3 inches	Steel	SCH. 40	3.068
Larger Pipe:	4 inches	Steel	SCH. 40	4.026
Reducer / Enlarger Length (Refer to Standard Dimensions table at right.), in.				4.00

◉ USER DEFINED REDUCER / ENLARGER DIMENSIONS

Pipe Connection Internal Diameter	I.D. (in.)
Smaller Pipe:	3.938
Larger Pipe:	5.798
Reducer / Enlarger Length, in.:	1.16

RESULTS

Beta Ratio of Fitting (β): 0.679

Internal Angle of Fitting (θ): 77.4 degrees

RESISTANCE COEFFICIENT (K): **0.290**

INSTRUCTIONS

1. The Reducer / Enlarger Parameters determine which equation is used to calculate the resistance coefficient (K value) of the fitting. Refer to Crane Technical Paper #410 (1998 Ed.) page A-26 for the equations used in this calculation. The equations used are the same regardless of whether the Standard or User Defined Dimensions are used.

2. This spreadsheet will automatically determine whether a fitting is gradual or sudden based on the input diameters and fitting length. The angle (θ) is displayed in the results section for reference. Crane #410 defines a gradual fitting as θ ≤ 45 degrees and a sudden fitting as θ > 45 degrees.

3. Use the "Radio Buttons" to select between the Standard Dimensions and the User Defined Dimensions.

4. The Standard Reducer / Enlarger Dimensions section contains look-up tables that determine pipe internal diameters for steel and stainless steel piping. The fitting length has to be entered manually (shown in **BLUE**) and the table to the right should be used as a guide when selecting standard sizes. Note that pipe couplings (sudden reducers / enlargers) are typically used in piping systems that are 2" and smaller. The fitting length for these couplings should be entered as 0.00".

5. The User Defined Reducer / Enlarger Dimensions section allows the User to specify their own pipe inside diameters and overall fitting length. These inputs are shown in **BLUE**.

6. See the Instructions Sheet, section D-4, on how to incorporate the K value into the Pressure Drop calculation.

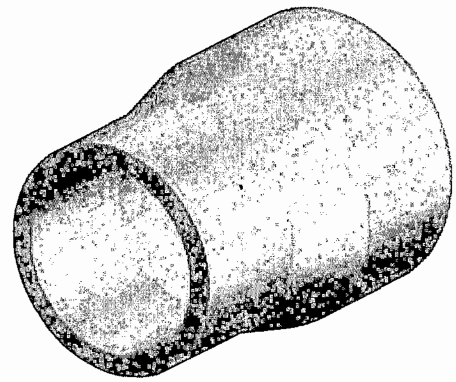
STANDARD DIMENSIONS OF STEEL REDUCERS / ENLARGERS

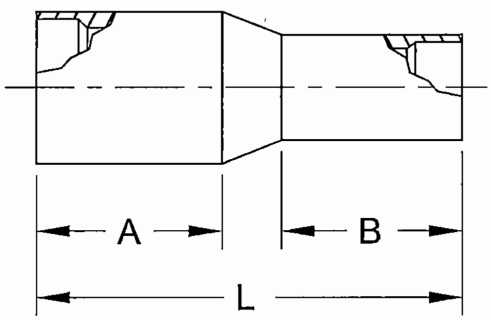
Pipe Size	Length	Pipe Size	Length
2.5 X 1		28 X 18	
2.5 X 1.25	3.5"	28 X 20	
2.5 X 1.5		28 X 24	24"
2.5 X 2		28 X 26	
3 X 1.25		28 X 26	
3 X 1.5		30 X 20	
3 X 2	3.5"	30 X 24	
3 X 2.5		30 X 26	24"
4 X 1.5		30 X 28	
4 X 2	4"	32 X 24	
4 X 2.5		32 X 26	24"
4 X 3		32 X 28	
6 X 2.5		32 X 30	
6 X 3	5.5"	34 X 24	
6 X 4		34 X 26	24"
8 X 4	6"	34 X 30	
8 X 6		34 X 32	
10 X 4		36 X 24	
10 X 6	7"	36 X 26	
10 X 8		36 X 30	24"
12 X 6		36 X 32	
12 X 8	8"	36 X 34	
12 X 10		38 X 26	
14 X 6		38 X 28	
14 X 8	13"	38 X 30	24"
14 X 10		38 X 32	
14 X 12		38 X 34	
16 X 6		38 X 36	
16 X 8		40 X 30	
16 X 10	14"	40 X 32	
16 X 12		40 X 34	24"
16 X 14		40 X 36	
18 X 10		40 X 38	
18 X 12	15"	42 X 30	
18 X 14		42 X 32	
18 X 16		42 X 34	24"
20 X 10		42 X 36	
20 X 12		42 X 38	
20 X 14	20"	42 X 40	
20 X 16		44 X 36	
20 X 18		44 X 38	24"
22 X 14		44 X 40	
22 X 16	20"	44 X 42	
22 X 18		46 X 38	
22 X 20		46 X 40	28"
24 X 16		46 X 42	
24 X 18	20"	46 X 44	
24 X 20		48 X 40	
24 X 22		48 X 42	28"
26 X 18		48 X 44	
26 X 20	24"	48 X 46	
26 X 22			
26 X 24			

Appendix F

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 4

Butt Fittings: Butt Reducers





IPS BUTT REDUCER DIMENSIONS			
Nominal Size	**A**	**B**	**L**
1" × ½"	1.50	1.25	4.00
1" × ¾"	1.50	1.75	4.50
1¼" × 1"	1.86	1.92	4.25
1½" × ¾"	2.50	2.40	5.69
1½" × 1"	2.50	2.28	5.75
2" × 1"	2.49	2.88	6.31
2" × 1¼"	3.15	2.56	6.44
2" × 1½"	2.50	2.72	6.00
3" × 2"	3.22	2.50	6.65
4" × 2"	3.00	3.00	11.87
4" × 2"	2.75	2.75	7.16
4" × 3"	3.13	3.13	8.62
6" × 4"	4.22	3.75	9.13
8" × 6"	5.00	4.64	10.78
10" × 8"	6.63	6.25	14.98
12" × 10"	6.63	6.25	14.88

CTS BUTT REDUCER DIMENSIONS			
Nominal Size	**A**	**B**	**L**
1" CTS × ½" CTS	1.79	2.00	4.00
1" IPS × ½" CTS	1.44	1.80	4.50
1" IPS × ¾" CTS	1.50	1.80	4.50
1" IPS × 1" CTS	1.60	2.25	4.50
1¼" CTS × 1" IPS	1.50	2.00	3.84
1¼" IPS × 1¼" CTS	2.50	2.50	5.75
2" IPS × 1¼" CTS	2.49	2.88	6.31
2" IPS × 1½" CTS	2.19	2.29	5.00
2" IPS × 2" CTS	2.75	3.00	6.00
2" IPS × 2" CTS	2.75	3.00	6.00

Call for availability of other sizes and dimensions.

Butt Fittings: Butt Reducers

(PE 2406/PE2708) REDUCERS						
Size	SDR	Part Number	Pack Qty.	Wt.	CSA	IAPMO
1" CTS × ½" CTS	.101 WALL × .090 WALL	6911789	100	0.05	-	-
1" IPS × ½" CTS	DR 9.3 × .090 WALL	6911893	100	0.06	-	-
1" IPS × ½" IPS	DR 9.3	6911248	100	0.06	-	-
1" IPS × ¾" CTS	DR 9.3 × .090 WALL	6911234	100	0.07	-	-
1" IPS × ¾" IPS	DR 9.3	6910223	100	0.10	-	-
1" IPS × 1" CTS	DR 9.3 × .090 WALL	6911238	100	0.09	-	-
1" IPS × 1" CTS	DR 9.3 × .101 WALL	6911719	100	0.09	-	-
1¼" CTS × 1" IPS	.090 WALL × DR 9.3	6911245	100	0.07	-	-
1¼" IPS × 1" CTS	DR 10 × .102 WALL	10000725	100	0.10	-	-
1¼" IPS × 1" IPS	DR 10 × DR 11	6910218	100	0.10	-	-
1½" IPS × ¾" IPS	DR 9.3	6910073	100	0.22	-	-
1½" IPS × 1" IPS	DR 11	6910227	100	0.20	YES	-
1½" IPS × 1¼" IPS	DR 11	6911809	100	0.17	-	-
2" IPS × 1" IPS	DR 11	6910081	100	0.29	YES	YES
2" IPS x 1" IPS	DR 11	10009614	100	0.29	-	-
2" IPS × 1¼" CTS	DR 11 × .090 WALL	6912314	100	2.40	-	-
2" IPS × 1¼" IPS	DR 11 × DR 10	6910022	100	0.32	YES	YES
2" IPS × 1½" IPS	DR 11	6910228	50	0.31	YES	-
3" IPS × 2" IPS	DR 11/11.5 × DR 11	691030221000	10	0.68	YES	YES
4" IPS × 2" IPS	DR 11/11.5 × DR 11	6910025	10	1.01	YES	YES
4" IPS × 3" IPS	DR 11/11.5	691040321000	10	0.95	YES	YES
4" IPS × 2" IPS	DR 13.5 × DR 11	6910625	10	1.09	-	-
4" IPS × 3" IPS	DR 13.5 × DR 11	6910646	10	1.03	-	-
6" IPS × 4" IPS	DR 11/11.5	691060421000	5	3.33	YES	YES
6" IPS × 4" IPS	DR 13.5 × DR 11	6911477	5	2.99	-	-
6" IPS × 4" IPS	DR 13.5	6911600	5	3.09	-	-
8" IPS × 6" IPS	DR 11 × DR 11/11.5	6912389	6	5.31	-	-
8" IPS × 6" IPS	DR 11/11.5	691080621000	6	5.86	YES	-
8" IPS × 6" IPS	DR 13.5 × DR 11	6911107	6	6.06	-	-
8" IPS × 6" IPS	DR 13.5	6910451	6	6.20	YES	-

Call for availability of other sizes and dimensions.

Butt Fittings: Butt Reducers

(PE3408/PE4710) CTS & IPS REDUCERS

Size	SDR	Part Number	Pack Qty.	Wt.	AWWA
¾" IPS × ¾" CTS	DR 11 × .090 WALL	10004186	100	0.03	-
1" CTS × ½" CTS	.101 WALL × .090 WALL	10004187	100	0.04	YES
1" IPS × ½" CTS	DR 9.3 × .090 WALL	10004189	50	0.09	YES
1" IPS × ¾" CTS	DR 11 × .090 WALL	10004188	100	0.07	YES
1" IPS × ½" IPS	DR 9.3	10004190	100	0.07	YES
1" IPS × ¾" CTS	DR 9.3 × .090 WALL	10004191	100	0.09	YES
1" IPS × ¾" IPS	DR 9.3	10004192	100	0.09	YES
1" IPS × 1" CTS	DR 9.3 × .090 WALL	10004194	100	0.10	YES
1" IPS × 1" CTS	DR 9.3 × .121 WALL	10004195	100	0.10	YES
1¼" CTS × 1" IPS	.090 WALL × DR 9.3	10003945	100	0.07	YES
1¼" IPS × 1" IPS	DR 11	10004197	100	0.11	YES
1¼" IPS × 1¼" CTS	DR 9.3 × .090 WALL	10003946	100	0.15	YES
1½" IPS × ¾" IPS	DR 9.3	10003947	100	0.18	YES
1½" IPS × 1" IPS	DR 11	10004198	100	0.16	YES
1½" IPS × 1" IPS	DR 9.3	10004199	100	0.19	YES
2" IPS × 1" IPS	DR 11	10007485	100	0.29	YES
2" IPS × 1¼" CTS	DR 11 × .090 WALL	10004200	100	0.30	YES
2" IPS × 1¼" IPS	DR 11	10007479	100	0.33	YES
2" IPS × 1½" IPS	DR 11	10003814	50	0.30	YES
2" IPS × 2" CTS	DR 11 × .193 WALL	10004202	20	0.57	YES
3" IPS × 2" IPS	DR 11	10007480	10	0.65	YES
3" IPS × 2 IPS	DR 9	10004208	10	1.21	YES
3" IPS × 2" IPS	DR 9/9.3	10004209	10	1.15	YES
3" IPS × 2" IPS	DR 7	10007371	10	1.62	YES
4" IPS × 2" IPS	DR 17	10004212	10	0.89	YES
4" IPS × 2" IPS	DR 11	10007481	10	1.02	YES
4" IPS × 2" IPS	DR 9/9.3	10004215	10	0.89	YES
4" IPS × 2" IPS	DR 7	10007372	10	2.38	YES
4" IPS × 3" IPS	DR 17	10004213	10	0.98	YES
4" IPS × 3" IPS	DR 11	10007482	10	1.18	YES
4" IPS × 3" IPS	DR 9/9.3	10004216	10	1.73	YES
4" IPS × 3" IPS	DR 7	10007373	10	2.78	YES
6" IPS × 4" IPS	DR 17	10008769	5	3.30	YES
6" IPS × 4" IPS	DR 11	10007784	5	3.28	YES
6" IPS × 4" IPS	DR 9	10004221	5	3.67	YES
6" IPS × 4" IPS	DR 7	10007374	5	6.00	YES
8" IPS × 6" IPS	DR 17	10004224	5	5.41	YES
8" IPS × 6" IPS	DR 11	10007483	6	6.13	YES
8" IPS × 6" IPS	DR 9	10004227	6	7.69	YES
8" IPS × 6" IPS	DR 7	10007375	6	10.68	YES
10" IPS × 8" IPS	DR 17	10007440	1	15.61	YES
10" IPS × 8" IPS	DR 11	10007439	1	16.40	YES
10" IPS × 8" IPS	DR 9	10000627	1	18.00	YES
12" IPS × 8" IPS	DR 17	10008803	1	17.00	YES
12" IPS × 8" IPS	DR 11	10008804	1	20.20	YES
12" IPS × 8" IPS	DR 9	10008805	1	23.00	YES
12" IPS × 10" IPS	DR 17	10007445	1	21.00	YES
12" IPS × 10" IPS	DR 11	10007444	1	24.20	YES
12" IPS × 10" IPS	DR 9	10000628	1	27.00	YES

Call for availability of other sizes and dimensions.

Appendix G

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

PRESSURE DROP CALCULATION SPREADSHEET - VERSION 1.2, ESI# BRC-MEP-0008-02

This spreadsheet is to be used with Burns and Roe's Technical Procedure P153450M1.
IT IS ESSENTIAL TO HAVE A COMPLETE UNDERSTANDING OF THE PROCEDURE BEFORE USING THIS SPREADSHEET.

USER INSTRUCTIONS:

A) General Notes:

1 Per the Technical Pocedure, the calculations performed by this spreadsheet template are applicable to incompressible fluids and to compressible fluids over a limited pressure drop range.
Limitations of the Darcy Formula (Consult Crane 410 page 3-3 for more information):
Incompressible Fluids - No Restrictions
Compressible Fluids - Do **NOT** use this spreadsheet if the pressure drop is greater than 40% of inlet pressure. The pressure drop may be broken up into multiple smaller pipe calculations to avoid exceeding the 40% rule. Recalculate the inlet conditions for each successive pipe section. V1.1

2 The User should follow Burns and Roe Standard R153450M1, "Maximum Allowable Velocities for Flow of Water and Steam in Pipes", when selecting nominal pipe sizes. "Project specific" velocity requirements may also apply. V1.1

3 Do not alter the format of this spreadsheet. Do NOT add or delete pages from this spreadsheet. Each calculation must be saved under a different file name if you wish to keep it for future use.

4 Do not adjust any of the page settings within this spreadsheet. Although some text lines may appear improperly sized on your screen, they will print properly.

5 A red triangle in the upper right hand corner of a cell indicates that there is a note associate with its contents. Position your mouse over the cell to display the note.

6 Use the drop down boxes to select pipe sizes, pipe material/schedule, and fittings. The selection you make in each of these boxes will cause the spreadsheet to input tabulated piping data into the calculation.

7 This spreadsheet has been protected. Only cells that contain information that is manually input by the User can be modified. Cells which contain formulas or information selected from a drop-down box cannot be modified.

8 Writing in BLUE indicates information that is input by the User.
Writing in BLACK indicates information that is calculated by the spreadsheet.
Writing in RED indicates tabulated information that is supplied by the spreadsheet based on User selections.

B) Piping Materials:

1 The "Radio Buttons" at the top of this section allow the User to select either Standard pipe sizes and materials or User defined pipe sizes and materials. ◉ Sample Radio Button V1.1

Standard Nominal Pipe Sizes and Piping Materials are selected using the two drop down boxes in this section. The pipe internal diameter and roughness factor are then automatically entered into the calculation.

C) Fluid Properties:

1 Flow rate may be entered in either [GPM] or in [lb/hr]. Only one entry for the flow rate should be made. V1.2

2 Average pressure and temperature must be entered by the User. If the calculation is being performed for water or steam, then the User may "check" the box to Enable Water & Steam Properties. This activates the WinSteam add-in which will automatically calculate the specific volume and absoulte viscosity based on the average pressure and temperature. If the calculation is being performed for any other fluid (ie natural gas, oil, brine, etc.) then the box must remain "unchecked" and the User must determine the specific volume and absolute viscosity and enter the values manually.

Note: WinSteam is an add-in function to Excel and is a part of the DeskTop Steam software package. In order to use this program it must be installed locally on the Users computer. Contact the Desktop Steam(WinSteam) Program Advisor for assistance in installing this software.

D) Pressure Drop:

1 Fluid Velocity and Reynolds Number are calculated by the spreadsheet and are updated automatically as information is entered.

2 Friction Factor is ONLY calculated when the Calculate Friction Factor BUTTON is pressed. When the button is pressed, Excel starts an iterative (Goal Seek) calculation to determine the value of the friction factor. The friction factor MUST be recalculated whenever values in the Piping Material or Fluid Properties sections are CHANGED! A warning will be displayed to remind you to recalculate the friction factor when necessary. V1.1

3 Standard resistance coefficients for valves, fittings, etc. have been taken from Crane Technical Paper 410. Crane 410 provides diagrams of the different fittings and should be consulted when making selections. Any selection that results in the word CALC in the (K/f) field must be manually calculated by the User and entered in one of the last three Resistance Coefficient fields.

4 The last three Resistance Coefficient entry fields have been left open to the User. These are for reducers, enlargers, bends, and other non-standard fittings. If the "K" value of the fitting is known, then the following equation should be entered into the K/f column for that fitting: **=[K Value]/F_FACT**. Therefore if the "K" value is 6, then the cell shoud read: =6/F_FACT

~~5 Total straight length of pipe must be entered in feet.~~

6 Static head in the pipe section must be entered in feet. The spreadsheet will automatically convert this value to psi based on the fluid properties. A static head gain should be entered as a negative height.

7 Miscellaneous equipment pressure drops can be manually entered by the User.

E) Reducer Calculations: V1.2

1 Refer to the instructions provided on the Reducer Calculation Sheet.

: 04765

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	Calc. No:	03131-001-ME-102	Sheet No:	H0	Cont'd on Sht:	H1
Prepared By:	G. Dunn	Date:	6/22/2011	Checked By:		Date:	
Title:	Effluent Transfer System – New Effluent Transfer Pump Suction Pipe Sizing and Design Check						

APPENDIX__H__ TO CALCULATION (for Computer Analysis Input/Output Sheet)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet):____2______

INPUT/OUTPUT PRODUCED ON COMPUTER NO. ___C1614____

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-102	Sheet No:	H1	Cont'd:	I0
Prepared By:	G. Dunn	Date:	6/22/2011	Checked By:		Date:	

Title: Effluent Transfer System – New Effluent Transfer Pump Suction Pipe Sizing and Design Check

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Water **Section:** New Pump Discharge

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007 ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938 in
		Inside Diameter (D):	0.328 ft

FLUID PROPERTIES

☐ Check Box to Enable Water & Steam Properties

Fluid:		Average Pressure:	96.10 psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0 F
Flow Rate (Q):	150.0 GPM	Specific Volume (V):	0.01605 ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97570 cP

PRESSURE DROP

Fluid Velocity (Vel):	$Vel = 0.0509\ W \times V / d^2$	3.95 ft/sec = 237 ft/min
Reynolds Number (Re):	$Re = 6.31\ W / (d \times \mu)$	1.23E+05 (= Turbulent Flow)
Friction Factor (f): Turbulent Flow:	$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$	0.0184
Laminar Flow:	$f = 64 / Re$	

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Stop Check Valve (Y-Pattern)	1	55	55
Globe Valve (Full Port)	3	340	1020
Tee (Branch)	3	60	180
Tee (Run)	1	20	20
Gate Valve (Full Port)	2	8	16
Elbow 90deg. Standard Radius (Small Bore Pipe)	6	30	180
Enlarger (4"x6")	1	15.7293	16
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 1487

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum\ (nL/D)$	487.9 ft
Straight Pipe Length (L_P):		**3400** ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	3887.9 ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	52.8 ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**22.86 psi**
Static Head:	[psi] = [ft] / (144 V)	**0** ft = **0.00 psi**
Miscellaneous Equipment Pressure Drops:		psi
		psi

TOTAL PRESSURE DROP: **22.86 psi**

Appendix I

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 5

GOULDS PUMPS, INC.
SENECA FALLS NEW YORK 13148

DUNS 222-5100

LOAD	ALLOCATION	PAGE	FACTORY NUMBER
	8-5-82	1 OF 2	735522
START	COMPLETE		INVOICE NO.
8-12-82	8-27-82		

DATE SHIPPED: SEP 21 1982

PART B/M

TERRITORY

COMP. B/M

TERMS:

ON ASSEMBLY

SUBJECT TO A PENALTY FOR LATE PAYMENT
NET 60 DAYS

CUSTOMER'S ORDER NO. AND DATE: 112303 5-13-82 TA

G. P. ORDER NUMBER: 735522

BILL TO:
02597-4197
JAMES S. KONE & CO.
P.O. DRAWER 1109
AMARILLO, TEXAS 79015

SHIP TO:
THE SNOW CO.
2705 PAN AMERICAN FWY N.E.
ALBUQUERQUE, NEW MEXICO 87113

X F.O.B. SENECA FALLS, N.Y. #2 SHOP

ORDER RECEIVED FROM

MARK: 112303
VIA: CONSOLIDATED

XX COLLECT ☐ PREPAY

SHIP WITH

APPROX. SCHEDULED SHIPPING DATE: 9-8-82

NO PARTIAL (IF CHECKED)

BRANCH ORDER NO.	DATE ORDER REC'D. IN ORDER DEPT.	DATE ENTERED
TP2-0198	5-14-82 JW	5-17-82

QTY. ORD. | P.O. ITEM NO. | EQUIP. NO. | SERVICE | SERIAL NO.: 735C522-1 THRU 4 MAY 2 0 | QTY. SHIPPED | UNIT PRICE | TOTAL PRICE | NET AMOUNT

QTY. ORD.	MODEL NO.	SIZE	ROT.	CONST.
4	3996MT	2X3-13	RH	ALL DI

G.P.M.	T.D.H.	LIQUID	TEMP.	SP. GR.	EFF.
250	140	LOW RADIOACTIVE	AMB	1.0	56

IMPELLER 12½ DIA. DRAWING 100-540 PATT 53973 NPSHR 7

SUCT PRESS

IMPELLER DIA. DRAWING PATT.

MOTOR	H.P.	R.P.M.	PHASE	CYCLES	VOLT	FRAME
	20	1750				256 TCV

MOTOR ENCLOSURE DWG CODE

MOTOR BY: CUSTOMER | WILL NOT COME HERE X | WILL COME HERE ☐ ON | DATA: FILE

WITH FOLLOWING ADDITIONS, MODIFICATIONS AND/OR REQUIREMENTS

1. MOTOR SUPPORT
2. LESS COUPLING
3. CPLG. GUARD LESS
4. STAINLESS SHAFT 316SS
5. MECHANICAL SEAL PG #2
6. DRILL & TAP FOR OIL MIST CASING SUPPORTS (PURE)
7. UNIT SUBJECT TO INSPECTION. DO NOT SHIP WITHOUT A RELEASE. NOTIFY BILL TO OR BRANCH PRIOR TO SHOP INSPECTION SO THAT CUSTOMER'S REPRESENTATIVE MAY BE PRESENT

	TESTS	WIT.	NON-WIT.
	PERFORMANCE		
	NPSH		
	NOISE		
	VIBRATION		
X	HYDROSTATIC	X	@ 428 PSIG; OPC 551

STANDARD ENG. DATA
INCLUDES: DIM PRINTS, TDS CURVE, SECTIONALS TYPICAL, SEAL DWGS IF APPLIC., MANUALS
PRINTS
REPRO
MOTOR PRINTS
BILLS OF MATLS

WE HEREBY CERTIFY THAT THESE GOODS WERE PRODUCED IN COMPLIANCE WITH ALL APPLICABLE REQUIREMENTS OF SECTIONS 6, 7 & 12 OF THE FAIR LABOR STANDARDS ACT, AS AMENDED AND OF REGULATIONS AND ORDERS OF THE U.S. DEPT. OF LABOR ISSUED UNDER SEC. 14 THEREOF AND THE PRICES CHARGED ARE WITHIN APPLICABLE FEDERAL CEILING PRICE REGULATION AND ORDERS.

REMIT TO: ☐ PITTS ☐ CHI | NO. OF INVOICES | MAILING AND OTHER INSTRUCTIONS

4567-CM REV 8/1

GOULDS PUMPS, INC.
SENECA FALLS, NEW YORK 13148

MECHANICAL SEAL CONT. SHEET

FACTORY ORDER NO. 735522

CUSTOMER'S NAME JAMES S. KONE & CO.

QUANTITY	SEAL MFGR.	TYPE	CODE	SIZE	MFGR. REF. DWG. ☒	STUFFING BOX DWG ☐
	JOHN CRANE DBL	1	NP2C1	1 3/4	F-SP-11604	

STATIONARY SEAT CLAMPED ☐ "O" RING MOUNTED ☒ | DETAILS 316 SPRING SPACER

ROTARY ORDERED ☒ STOCK ☐ CODE | STATIONARY SEAT ORDERED ☒ STOCK ☐ CODE | SEAL INSTALLATION

GLAND ORDERED ☐ STOCK ☒ | PLAIN ☐ VENT AND DRAIN WITH BUSHING ☐ | FLUSH ☒ VENT AND DRAIN WITH AUX. BOX ☐ | OTHER | GLAND MATERIAL 316

P.O. NO. MS28520 | SEAL BY PASS YES ☐ NO ☒

LIP SEAL MFGR. YES ☐ NO ☒ | LIP MATERIAL | EXPANSION COLLAR MATERIAL I.D. AND O.D. | P.O. NO. (LIP SEAL)

DESCRIPTION	MDL. NO.	SIZE	CODE NUMBER	CLASS.	ITEM	UNIT LIST PRICE	QUAN SHIPPED	TOTAL LIST PRICE	NET AMOUNT

A-834-A-CM

0017681 GOULDS PUMPS, INC. REPLACEMENT PARTS DATA SHEET
ORDER NUMBER 735522 3996MT 2X3-13 CONST. DI
IMP. DIAMETER 12-1/2
CUST. P.O. NUMBER 112303 ITEM
SNOW CO
2705 PAN AM N E
ALBUQUERQUE N. 87113

ITEM NO	QTY/ PUMP	PART NAME	GOULDS PART NO.	MATL	NET PRICE EACH	MANUFACTURERS IDENTIFICATION
100	1	CASING	0C00021A06	1012		
101	1*	IMPLR W/O-RG	R100-540	1013		
112A	1*	BALL BRG OTB	8049-30500			BCA-5309A
122	1*	SHAFT	R104-733	2229		
123	1	DEFLECTOR	73519 2			
126	1*	SHAFT SLEEVE	73705X	2229		
132	1	EYE BOLT	49542 5			
134A	1	BRG HOUSING	115- 42	1000		
136	1*	BRG LOCK NUT	8601- C009			MRC N-09
168A	1*	BALL BRG I.B	8050-30960			MRC-309S
184	1	SB COV ASSY	R116-8803	1012		
228A	1	FRAME	B10493 7	1000		
240	1	MT SUPPORT	270- 35	1013		
~~241~~	~~1~~	~~FRAME FOOT~~				
250	1	GLAND MS	077192	1203		
332A	1	OIL SEAL O.B	8690-64324			VICTOR 64324K3
333A	1	OIL SEAL I.B	8690-70175			CRANE175-287-12
351	1	GASKET CASE	70782 28	5128		
353	4	GLAND STUD	27177 607	2229		
355	4	HEX NUT	49507 7	2228		
360D	1	GASKET ADPTR	73078	5130		FRAME-ADAPTR
361A	1	RING RING	58101 393			N5002-393
370	16	H CAP SCREW	49511 252	2210		FR-CASE
370C	3	H TAP BOLT	49521 204	2210		BRG HOUSING
370D	3	H TAP BOLT	49521 204	2210		IMPLR ADJUST
370F	1	DOWEL BOLT	73064	2210		FRAME-FR. FT
370H	2	STUD	27177 626	2228		COVER-ADPTR
382	1*	BRG LOCKWSHR	8910- C009			MRC W-09
383	1*	MECH SEAL	FSP-11604			
412A	1*	O-RING IMPLR	70721 64			ARP568-028
415	3	HEX NUT	49507 57	2210		FOR PART 370D
418	3	H TAP BOLT	49521 204	2228		JACKING BOLT
469B	2	DOWEL PIN	73523 3			FRAME-FR. ADPTR
469D	1	ROLL PIN	80860 5			SHAFT SLEEVE
496	1*	O-RING B.HSG	70721 33			ARP568-245
600		SECTIONAL	248-95			MT PURE OIL W/SLV

* RECOMMENDED SPARE PARTS

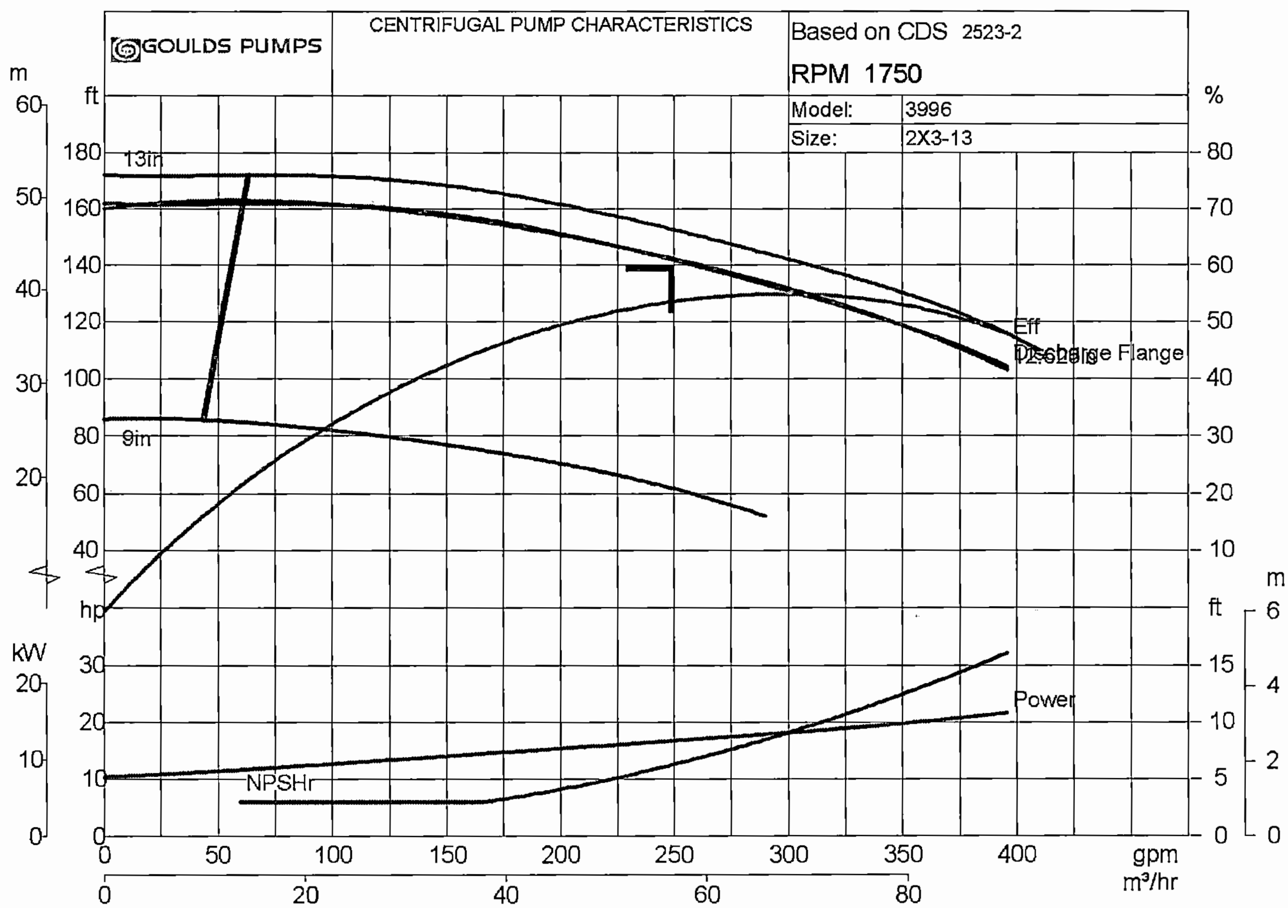
Model: 3996	Size: 2X3-13	Group: MT	60Hz	RPM: 1750	Stages: 1

Job/Inq.No. :					
Purchaser :	UNDEFINED				
End User :		Issued by :	John Brennan	Rev. :	0
Item/Equip.No. :	ITEM 001	Quotation No. :	NJJB11-06-10 01	Date :	06/10/2011
Service :					
Order No. :					

Operating Conditions | **Pump Performance**

Liquid:	Water	Published Efficiency:	53.0 %	Suction Specific Speed:	5,501 gpm(US) ft
Temp.:	70.0 deg F	Rated Pump Efficiency:	53.0 %	Min. Hydraulic Flow:	61.2 gpm
S.G./Visc.:	1.000/1.000 cp	Rated Total Power:	16.8 hp	Min. Thermal Flow:	N/A
Flow:	250.0 gpm	Non-Overloading Power:	21.8 hp		
TDH:	140.0 ft	Imp. Dia. First 1 Stg(s):	12.6250 in		
NPSHa:	0.0 ft	NPSHr:	6.3 ft		
Solid size:		Shut off Head:	162.0 ft		
% Susp. Solids (by wtg):		Vapor Press:			
Max. Solids Size:	0.3750 in				

Notes: 1. The Mechanical seal increased drag effect on power and efficiency is not included, unless the correction is shown in the appropriate field above. 2. Magnetic drive eddy current on power and efficiency is not included. 3. Elevated temperature effects on performance are not included. 4. Non Overloading power does not reflect v-belt/gear losses.



: 04772

Appendix J

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

1. PURPOSE

This Standard establishes the maximum allowable velocities for flow of water and steam in pipes.

2. SCOPE

The maximum allowable velocities presented in this Standard are applicable to the majority of cases involving sizing of piping in conventional power plant piping systems.

This Standard should be used in conjunction with the following Burns and Roe Standards:

P153450M1 - Calculating Pressure Drop

P153450M2 - Estimate of Pipe Sizes and Pressure Drop for Water

3. MAXIMUM VELOCITIES

The following maximum allowable velocities are intended as a guide for designing pipelines.

FLUID	MAXIMUM VELOCITY
Water -	
Feedwater Discharge	20 fps
All Other	12 fps
Steam -	
Superheated	20,000 fpm
Saturated	15,000 fpm

4. DESIGN VELOCITIES

4.1 The determination of the design velocity for a piping system should be based on the available pressure drop from the point of supply to the point of consumption without exceeding the maximum allowable velocities stated above.

4.2 The determination of the design velocities for Condensate, Feedwater, and Circulating Water systems, should be based on the economic analyses of piping, equipment, and pumping costs in addition to the requirement of 4.1.

Approvals				
SP Engineer	— Mgr D&D	BR	MAXIMUM ALLOWABLE VELOCITIES FOR FLOW OF WATER AND STEAM IN PIPES	Engineering Data REV
Mgr Stds	SMPP Chief Engr		Burns and Roe, Inc. - Engineering Standard	R153450M1 Sheet 1 of 1

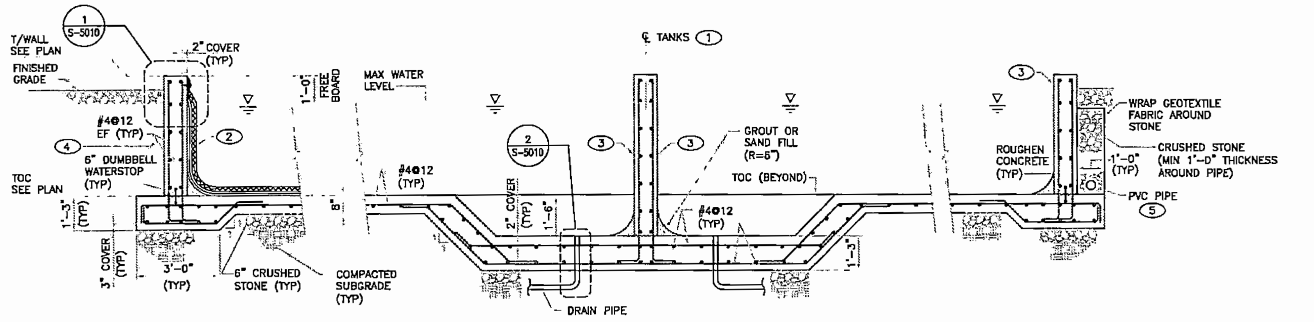
: 04774

Appendix K

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

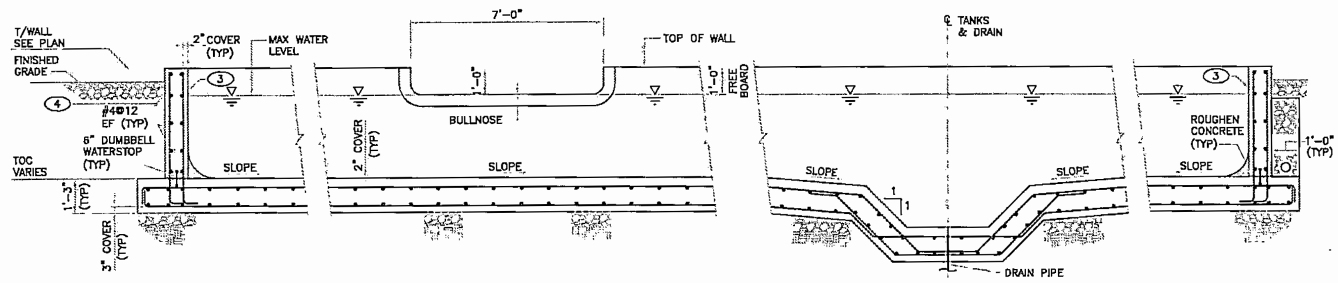
GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. LINER SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S STANDARDS. REFER TO SHEET S-5010 FOR MANUFACTURER.



A S-1010 SECTION

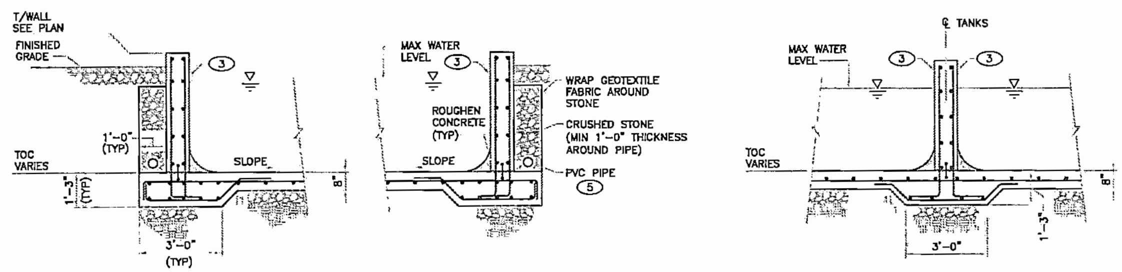
1' 6" 0 1' 2' 3'
1/2"=1'-0"



B S-1010 SECTION–OVERFLOW/SUMP

1' 6" 0 1' 2' 3'
1/2"=1'-0"

NOTE: FOR INFORMATION NOT SHOWN SEE SECTION A



C S-1010 SECTION

1' 6" 0 1' 2' 3'
1/2"=1'-0"

NOTE: FOR INFORMATION NOT SHOWN SEE SECTION B

D S-1010 SECTION

1' 6" 0 1' 2' 3'
1/2"=1'-0"

NOTE: FOR INFORMATION NOT SHOWN SEE SECTION A

KEYED NOTES

1. TANKS ARE SYMMETRICAL ABOUT CENTERLINE UNLESS OTHERWISE NOTED.
2. LINER COMPONENTS SHOWN AT EXAGGERATED SCALE FOR CLARITY.
3. LINER COMPONENTS NOT SHOWN FOR CLARITY.
4. WALL DRAINAGE SYSTEM NOT SHOWN FOR CLARITY.
5. PROVIDE 4"ø PERFORATED PVC PIPE, SLOPED TO DAYLIGHT.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

Burns and Roe Enterprises, Inc.

ZERO LIQUID DISCHARGE SUBPROJECT

TANK SECTIONS 1

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	
DATE	

BLDG N/A — TA-52

SUBMITTED — APPROVED FOR RELEASE: JOSEPH BROPHY

Los Alamos NATIONAL LABORATORY — PO Box 1663 Los Alamos, New Mexico 87545

SHEET S-3010 OF

CLASSIFICATION U — REVIEWER EDWARD ANTIGUA — DATE

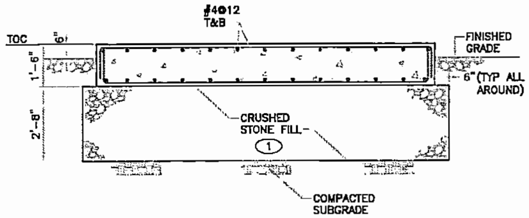
PROJECT ID 100761 — DRAWING NO C-55751 — REV A

STATUS: 8/29/2011

Plotted By: ###### Plot Date: 8/29/2011
FILE NAME: C55751-S-3010-RADWG

Appendix L

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2



A
S-1020
PUMP HOUSE PAD SECTION
1/2"=1"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

KEYED NOTES

(1) STONE FILL SHALL BE NON-FROST SUSCEPTIBLE TYPE IN ACCORDANCE WITH PROJECT SPECIFICATIONS.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

Burns and Roe Enterprises, Inc.

ZERO LIQUID DISCHARGE SUBPROJECT

PUMP HOUSE SECTIONS

BLDG 182 TA-52

DRAWN J. AMICO
DESIGN B. URGO
CHECKED
DATE

SUBMITTED
APPROVED FOR RELEASE JOSEPH BROPHY

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET S-3020
OF

CLASSIFICATION U
REVIEWER EDWARD ARTIGLIA
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: ###### Plot Date: 6/29/2011
FILE NAME: C55751-S-3020-RA.DWG

0178

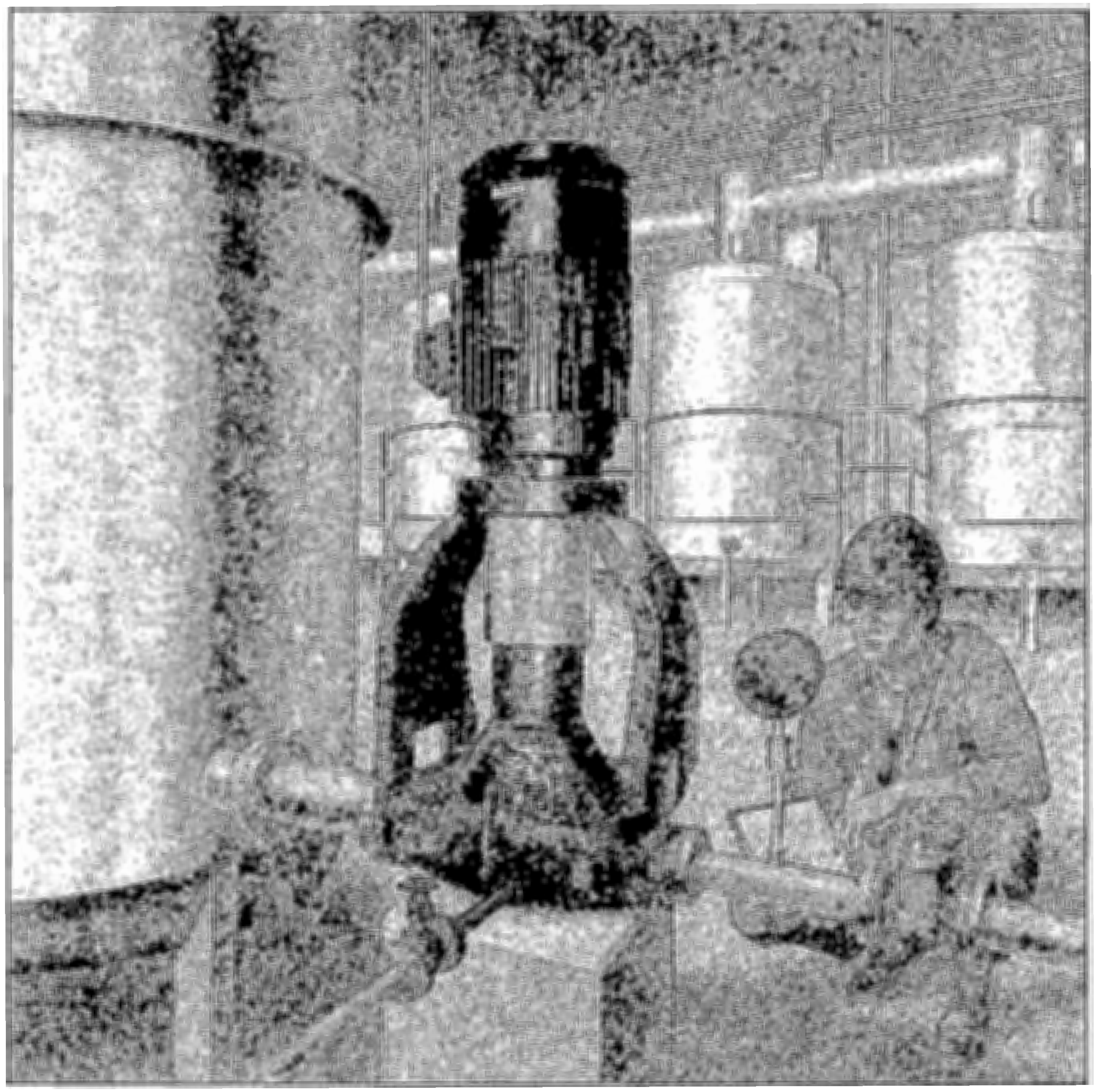
Appendix M

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 11

BULLETIN 725.2
October 2001

GOULDS PUMPS

Goulds Model 3996 In-Line Process Pumps



Goulds Pumps

ITT Industries
Engineered for life

: 04780

Goulds 3996 process pump line is specifically designed to provide superior performance for in-line services of the Chemical Process Industries.

Goulds Model 3996

In-Line Process Pumps Designed for Total Range of Industry Services

- Capacities to 1400 GPM (318 m^3/h)
- Heads to 700 feet (213 m)
- Temperatures to 500° F (260° C)
- Pressures to 375 PSIG (2586 kPa)

Performance Features for In-Line Services

Extended Pump Life

- Integral pump bearings
- TaperBore™ *Plus*/BigBore™ seal chambers
- Precision fits for accurate alignment
- Flexibly coupled

Ease of Maintenance

- In-line mounting
- Field alignment not required
- Back pull-out design
- External impeller adjustment

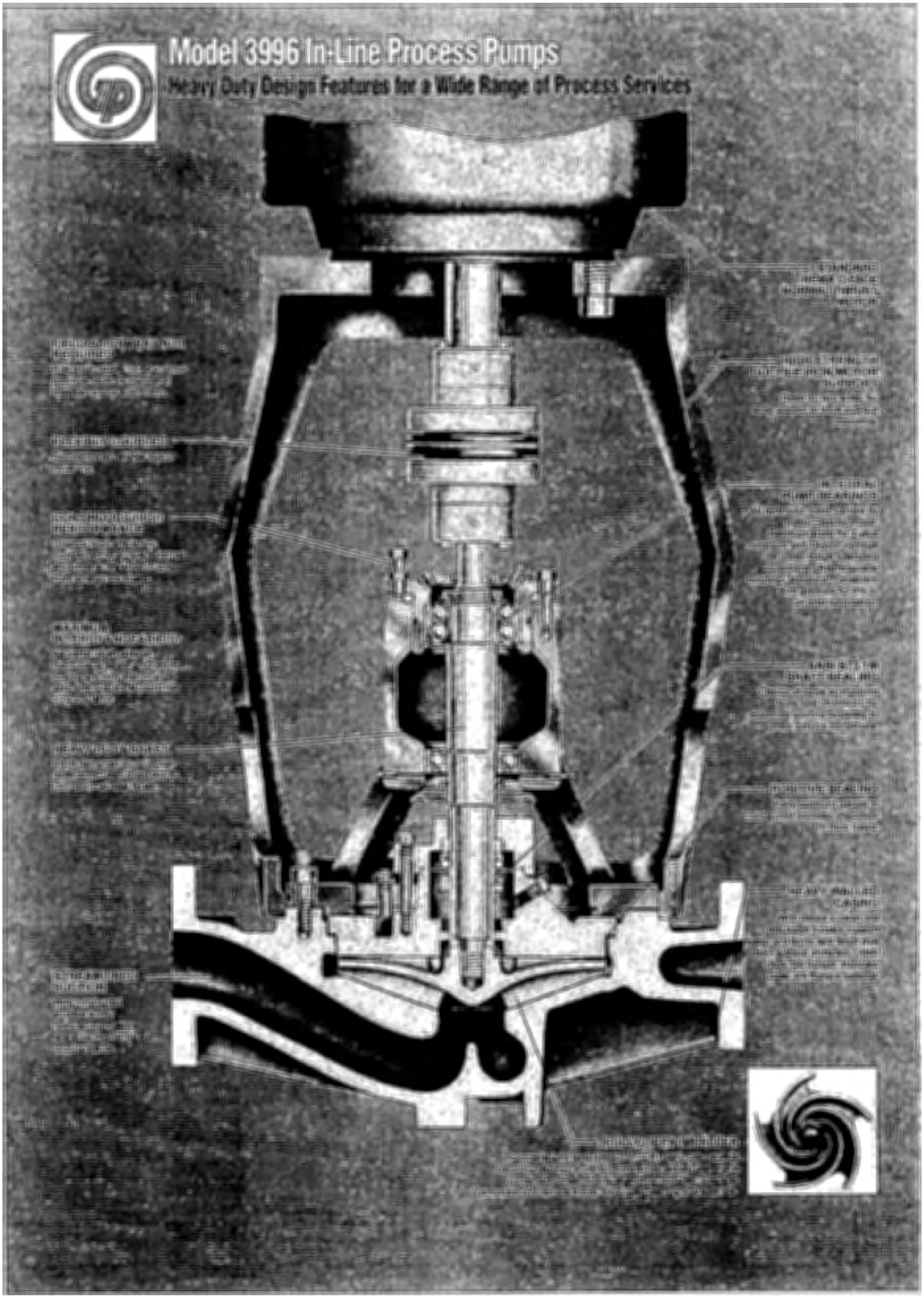
Safety

- ANSI B15.1 coupling guard
- Ductile iron frame and motor support
- Fully serrated flanges

Services

Caustic transfer
Acid unloading
Monomer/Polymer transfer
Liquid nitrogen
Liquid ammonia
Reflux and light tower bottoms
Waste acid recovery
Pickle liquor circulation
Chilled water
Filter feed
Condensate return

: 04781

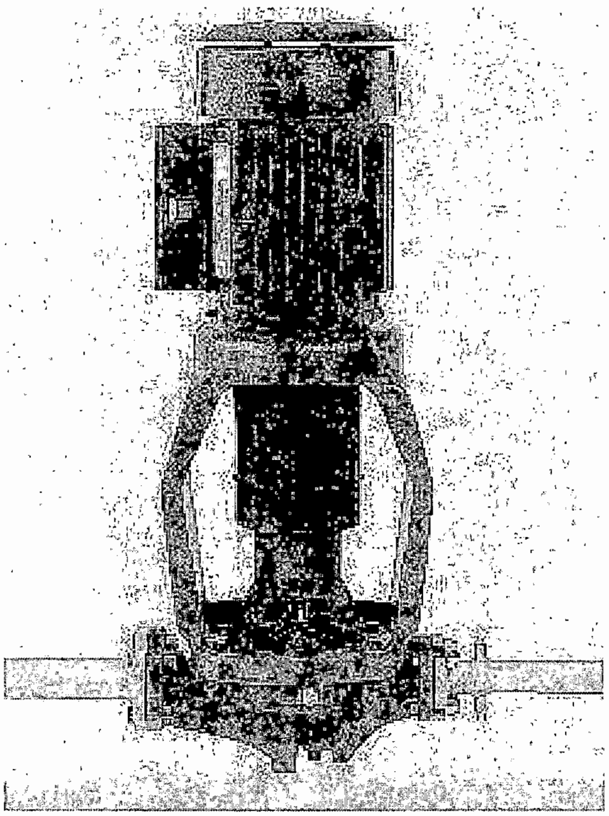


Gutter Fold

: 04782

In-Line Design For Cost Savings

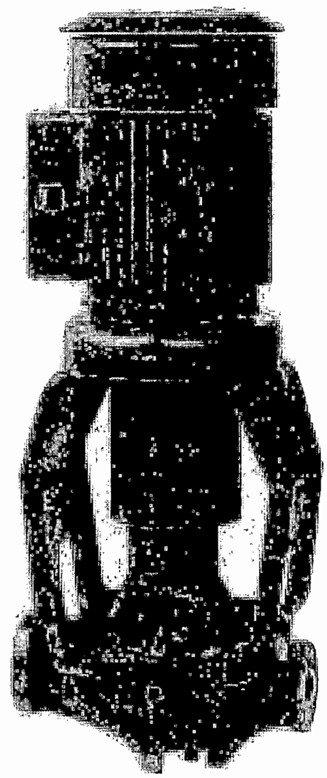
In-line pumps have become increasingly popular with users due to minimal floor space required and reduced installation costs. Installation is simple since the unit is mounted directly in the line like a valve. Field alignment is not required and the unit is not subject to misalignment due to pipe strain or temperature changes.



Setting The Standards For Reliability

The 3996 is designed for optimum reliable service ...shaft size and overhang are optimized to provide maximum seal and bearing life...precision fits provide built-in alignment between pump and motor (field alignment not required). Hydraulic and mechanical loads are carried by the pump, not by special motors (the 3996 uses standard C-face motors).

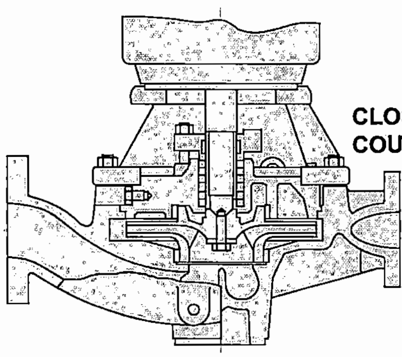
Goulds Model 3996– Designed for Reliable In-line Service



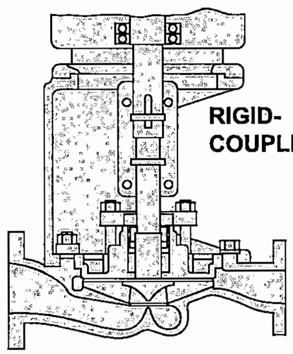
Goulds 3996...The Preferred In-Line Design

A variety of in-line pumps are available including close-coupled, rigid-coupled, and flexibly-coupled/integral bearing designs. Only the flexibly-coupled design such as the 3996 is built without compromise.

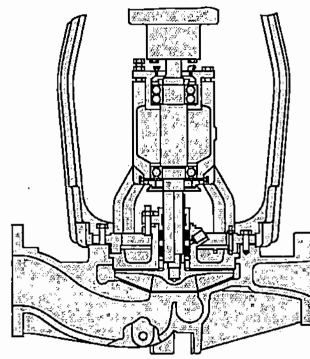
Close-coupled units are difficult to service and rigid-coupled models have long, unsupported shafts which are subject to runout, deflection and imbalance...leading to shortened bearing and seal life.



CLOSE-COUPLED



RIGID-COUPLED



INTEGRAL BEARING FLEXIBLY-COUPLED

: 04783

Parts List and Materials of Construction

Item Number	Part Name	Material: Ductile Iron	316SS	CD4MCu	Alloy 20	Monel	Nickel	Hastelloy B & C	Titanium
100	Casing	Ductile Iron	316SS	CD4MCu	Alloy 20	Monel	Nickel	Hastelloy	Titanium
101	Impeller	Ductile Iron	316SS	CD4MCu	Alloy 20	Monel	Nickel	Hastelloy	Titanium
105	Lantern Ring	Glass-Filled Teflon*							
106	Stuffing Box Packing	Teflon* Impregnated Fibers							
112	Thrust Bearing	Double Row Angular Contact							
119	Bearing End Cover	Steel							
122	Shaft—Less Sleeve (Optional)	SAE4140	316SS		Alloy 20	Monel	Nickel	Hastelloy	Titanium
122	Shaft—With Sleeve	SAE4140				316SS			
126	Shaft Sleeve	316SS		Alloy 20		Monel	Nickel	Hastelloy	Titanium
136	Bearing Locknut and Lockwasher	Steel							
168	Radial Bearing	Single Row Deep Groove							
184	Stuffing Box Cover (Packed Box)	Ductile Iron	316SS	CD4MCu	Alloy 20	Monel	Nickel	Hastelloy	Titanium
184M	Seal Chamber (Mechanical Seal)	Ductile Iron	316SS	CD4MCu	Alloy 20	Monel	Nickel	Hastelloy	Titanium
228	Bearing Frame	Ductile Iron							
240	Motor Support	Ductile Iron							
250	Gland	316SS		CD4MCu	Alloy 20	Monel	Nickel	Hastelloy	Titanium
262	Repeller/Sleeve (Dynamic Seal Option)	CD4MCu			Alloy 20	Monel	Nickel	Hastelloy	Titanium
264	Gasket, Cover to Backplate (Dynamic Seal)	Teflon*							
265A	Stud/Nut, Cover to Frame	304SS							
332A	Grease Seal (Outboard)	Buna Rubber							
333A	Grease Seal (Inboard)	Buna Rubber							
351	Casing Gasket	Aramid Fiber with EPDM Rubber							
358A	Casing Drain Plug (Optional)	Steel	316SS	CD4MCu	Alloy 20	Monel	Nickel	Hastelloy	Titanium
370	Cap Screw, Frame-to-Casing	Steel	304SS						
412A	O-ring, Impeller	Glass-Filled Teflon*							
418	Jacking Bolt	304SS							
444	Backplate (Dynamic Seal Option)	Ductile Iron	316SS	CD4MCu	Alloy 20	Monel	Nickel	Hastelloy	Titanium
469B	Dowel Pin	Steel							
496	O-ring, Bearing Housing	Buna Rubber							

*E.I. DuPont reg. trademark

Construction Details All dimensions in inches and (mm).

		ST	*MT*
Shaft	Diameter at Impeller	.75 (19)	1 (25)
	Diameter in Stuffing Box/Seal Chamber (Less Sleeve) (With Sleeve)	 1.375 (35) 1.125 (29)	 1.75 (45) 1.5 (38)
	Diameter Between Bearings	1.5 (38)	2.125 (54)
	Diameter at Coupling	.875 (22)	1.125 (29)
	Overhang	6.125 (156)	8.375 (213)
	Maximum Shaft Deflection	0.002 (0.05)	
Sleeve	O.D. thru Stuffing Box/Seal Chamber	1.375 (35)	1.75 (45)
Bearings	Radial	SKF 6207	SKF 6309
	Thrust	SKF 5306 A/C3	SKF 5309 A/C3
	Bearing Span	4.125 (105)	6.75 (171)
	Average L'_{10} Bearing Life	87,600 hours	
BigBore™ Seal Chamber	Bore	2.875 (73)	3.5 (89)
Stuffing Box	Bore	2 (51)	2.5 (64)
Power Limits	HP (kW) per 100 RPM	1.1 (.82)	3.4 (2.6)
Maximum Liquid Temperature	Grease Lubrication without Cooling	250° F (121° C)	
	Grease Lubrication with Heat Flinger	450° F (232° C)	
	Oil Mist Lubrication with Heat Flinger and Cooling	500° F (260° C)	
Casing	Corrosion Allowance	.125 (3)	

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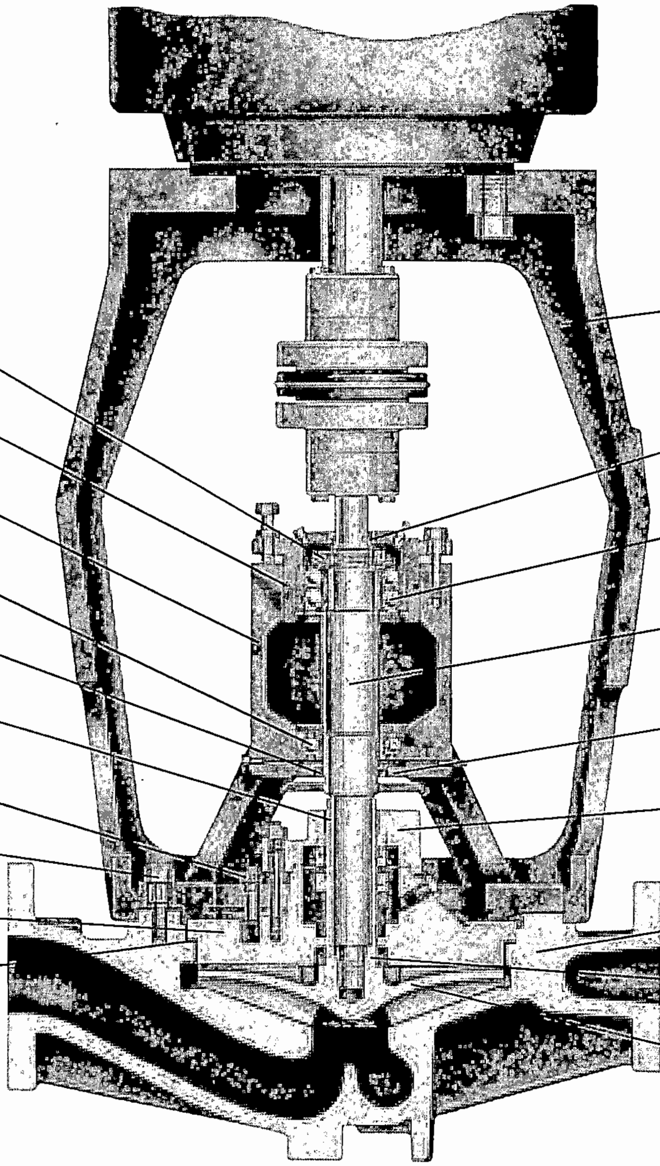
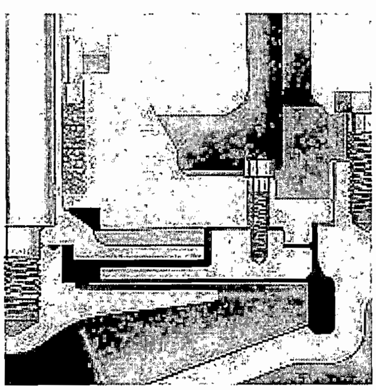
Sectional View Model 3996



Dynamic Seal

For Elimination of Sealing Problems—Reduced Maintenance Costs



On tough pumping services, especially corrosives and slurries, mechanical seals require outside flush and constant, costly attention. Even then, seal failures are common, resulting in downtime.

Goulds offers the ANSI *PLUS*™ Dynamic Seal which, simply by fitting a repeller between the stuffing box and impeller, eliminates the need for a mechanical seal.

Benefits of Goulds Dynamic Seal:

- External seal water not required
- Elimination of pumpage contamination and product dilution
- Reduces utility cost
- No need to treat seal water
- Eliminates problems associated with piping from a remote source

At start-up, the repeller functions like an impeller, and pumps liquid and solids from the stuffing box. When pump is shut down, packing (illustrated) or other type of secondary seal prevents pumpage from leaking.

STUFFING BOX COVER

REPELLER

REPELLER PLATE

Besides being available as a complete unit, any Goulds 3996 can be easily field-converted to Dynamic Seal. Retrofit kits are readily available.

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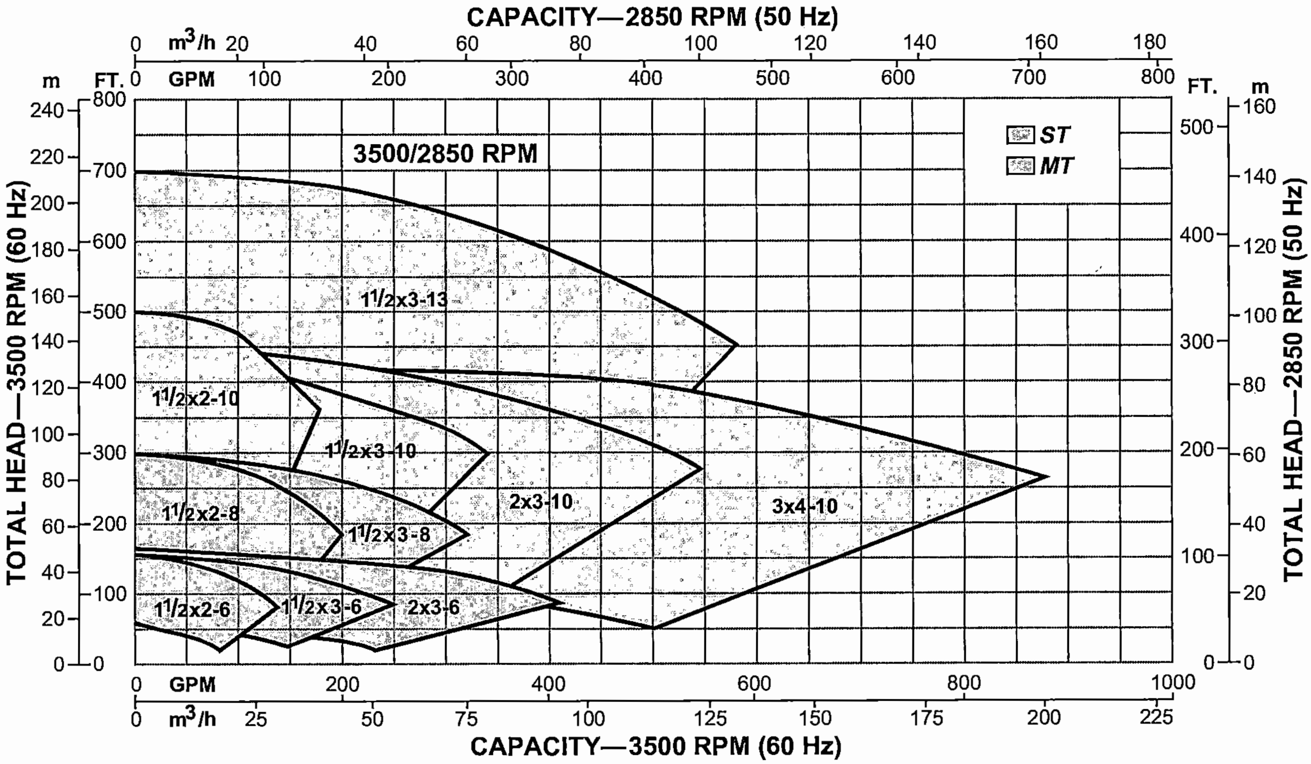
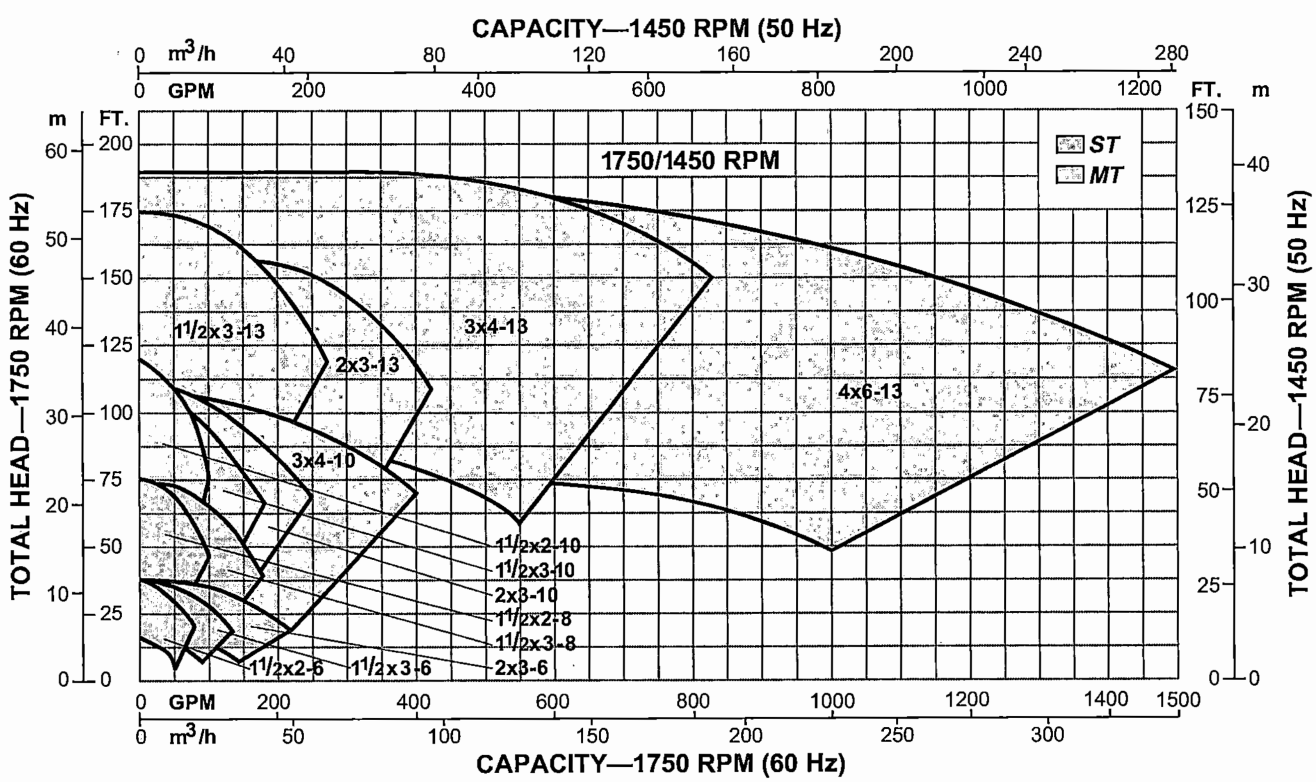
Hydraulic Coverage Model 3996





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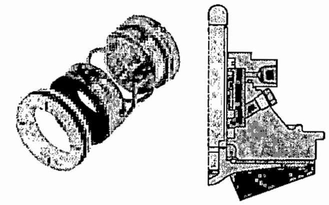
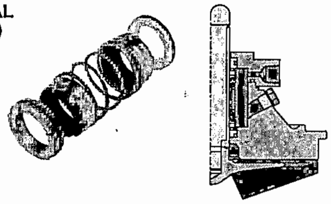
Sealing Solutions

Goulds engineered seal chambers are designed to accept a wide range of sealing arrangements to meet specific user requirements. Your Goulds representative will gladly recommend the best sealing solution for your service...some of which are illustrated here.

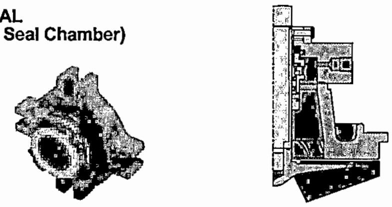
SINGLE INSIDE SEAL
(with BigBore™ Seal Chamber)
- Non-corrosive to moderate corrosive liquids
- Moderate abrasives
- Liquids that have good lubrication qualities



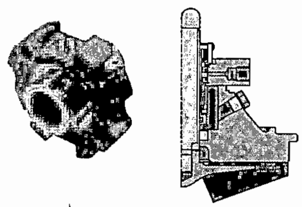
CONVENTIONAL DOUBLE SEAL
(with BigBore™ Seal Chamber)
- Liquids not compatible with single seal
- Toxic, hazardous, abrasive, corrosive
- When pump is operating under cavitation or low flows
- Meet environmental regulations



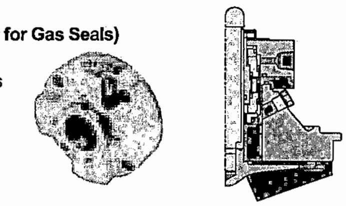
SINGLE CARTRIDGE SEAL
(with TaperBore™ *PLUS* Seal Chamber)
- Same application as conventional single seal
- Ease of maintenance
- No seal setting problems



DOUBLE CARTRIDGE SEAL
(with BigBore™ Seal Chamber)
- Same applications as conventional double seal
- Reduced maintenance costs
- No seal setting errors



DOUBLE GAS BARRIER SEAL
(with BigBore™ Seal Chamber for Gas Seals)
- Toxic or hazardous liquids
- Meet environmental regulations
- When use of seal pot or external flush is not desirable
- When compatible seal flush liquid not available



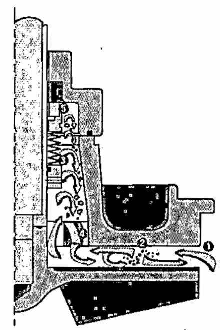
Goulds Patented TaperBore™ *PLUS*

How It Works

The unique flow path created by the patented Vane Particle Ejector directs solids *away* from the mechanical seal, not *towards* the seal as with other tapered bore designs. And, the amount of solids entering the bore is minimized. Air and vapors are also efficiently removed.

On services with or without solids, air or vapors, Goulds TaperBore™ *PLUS* is the effective solution for extended seal and pump life and lower maintenance costs.

1. Solids/liquid mixture flows toward mechanical seal/seal chamber.
2. Turbulent zone. Some solids continue to flow toward shaft. Other solids are forced back out by centrifugal force (generated by back pump-out vanes).
3. Clear liquid continues to move toward mechanical seal faces. Solids, air, vapors flow away from seal.
4. Low pressure zone created by Vane Particle Ejector. Solids, air, vapor liquid mixture exit seal chamber bore.
5. Flow in TaperBore™ *PLUS* seal chamber assures efficient heat removal (cooling) and lubrication. Seal face heat is dissipated. Seal faces are continuously flushed with clean liquid.



Engineered Seal Chamber Selection Guide

A	Ideally Suited
B	Acceptable
C	Not Recommended

Service	**TYPE 1** Standard Bore — *Designed for packing. Also accommodates mechanical seals.*	**TYPE 2** BigBore™ — *Enlarged chamber for increased seal life through improved lubrication and cooling.*	**TYPE 3** TaperBore™ *PLUS* — *Lower seal face temperatures, self- venting and draining. Solids and vapors circulated away from seal faces.*	**TYPE 4** Jacketed TaperBore™ *PLUS* — *Maintains proper temperature control (heating or cooling) of seal environment.*	**TYPE 5** Jacketed BigBore™ — *Maintains proper temperature control (heating or cooling) of seal environment.*
Water-Based Liquids with Flush	A	A	A	A	A
Entrained Air or Vapor	C	B	A	A	B
Solids 0-10%, no Flush	C	C	A	A	C
Solids Greater than 10% with Flush	B	A	C	C	A
Paper Stock 0-5%, no Flush	C	C	A	-	-
Paper Stock 0-5%, with Flush	B	A	-	-	-
Slurries 0-5%, no Flush	C	C	A	A	C
High Boiling Point Liquids, no Flush	C	C	A	A	C
Temperature Control	C	C	C	A	A
Self-Venting and Draining	C	B	A	A	C
Seal Face Heat Removal	C	A	A	A	A
Molten or Polymerized Liquid, no Flush	C	C	C	A	C
Molten or Polymerized Liquid with Flush	C	C	C	A	A

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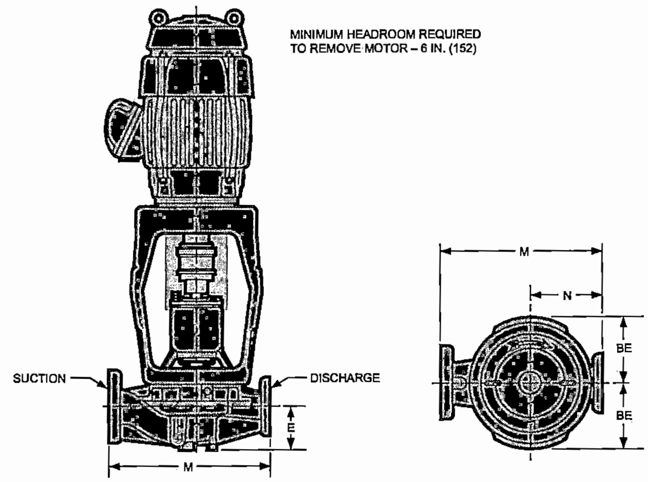
Dimensions Model 3996

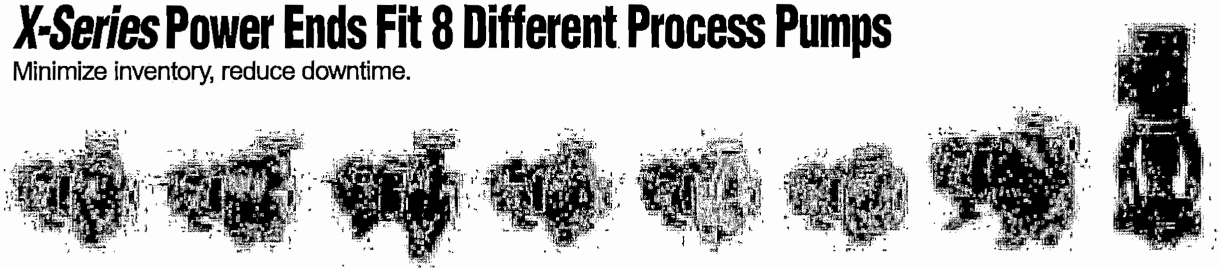
All dimensions in inches and (mm). Not to be used for construction.



DIMENSIONS									
Group	Pump Size	ANSI Designation	Discharge	Suction	E	M	N	BE	Pump Weight (Less Motor) Lbs. (kg)
ST	1$^1/_2$x2-6	2015/15	1$^1/_2$	2	4$^1/_4$ (108)	15 (381)	6$^3/_4$ (171)	6$^3/_8$ (162)	190 (86)
	1$^1/_2$x3-6	3015/15	1$^1/_2$	3	4$^7/_8$ (124)	15 (381)	6$^3/_4$ (171)		200 (91)
	2x3-6	3020/17	2	3	4$^5/_8$ (1118)	17 (432)	7$^1/_2$ (191)		205 (93)
	1$^1/_2$x2-8	2015/17	1$^1/_2$	2	4$^{13}/_{16}$ (122)	17 (432)	8 (203)		200 (91)
	1$^1/_2$x3-8	3015/19	1$^1/_2$	3	5$^1/_4$ (133)	19 (483)	8$^3/_8$ (213)		210 (95)
MT	1$^1/_2$x2-10	2015/19	1$^1/_2$	2	5$^1/_8$ (130)	19 (483)	9$^1/_4$ (235)	10 (254)	370 (168)
	1$^1/_2$x3-10	3015/19	1$^1/_2$	3	5 (127)	19 (483)	9$^1/_4$ (235)		380 (173)
	2x3-10	3020/20	2	3	5$^1/_4$ (133)	20 (508)	9$^1/_2$ (241)		390 (177)
	3x4-10	4030/25	3	4	6 (152)	25 (635)	11$^1/_2$ (292)		430 (195)
	1$^1/_2$x3-13	3015/24	1$^1/_2$	3	5$^5/_8$ (143)	24 (610)	11$^1/_2$ (292)		460 (209)
	2x3-13	3020/24	2	3	5$^3/_4$ (146)	24 (610)	11$^1/_2$ (292)		490 (223)
	3x4-13	4030/28	3	4	6$^7/_8$ (175)	28 (711)	13 (330)		520 (236)
	4x6-13	6040/30	4	6	8$^1/_2$ (216)	30 (762)	14 (356)		610 (277)

X-Series Power Ends Fit 8 Different Process Pumps

Minimize inventory, reduce downtime.



Model 3196 *X-Series* Chemical Process Pumps — **Model CV 3196** *Non-Clog* Process Pumps — **Model HT 3196** High Temperature Chemical Process Pumps — **Model LF 3196** *Low Flow* ANSI Process Pumps — **Model NM 3196** FRP Process Pumps — **Model 3198** PFA TEFLON®-Lined Process Pumps — **Model 3796** Self-Priming Process Pumps — **Model 3996** In-Line Process Pumps

Visit our website at www.gouldspumps.com

Goulds Pumps

ITT Industries
Engineered for life

GOULDS PUMPS ISO 9001 CERTIFIED

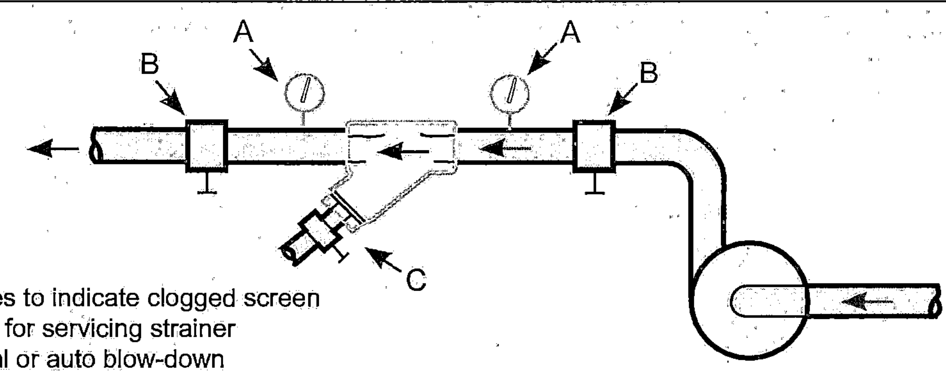
Form No. B725-2 10/01

: 04788

Appendix N

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

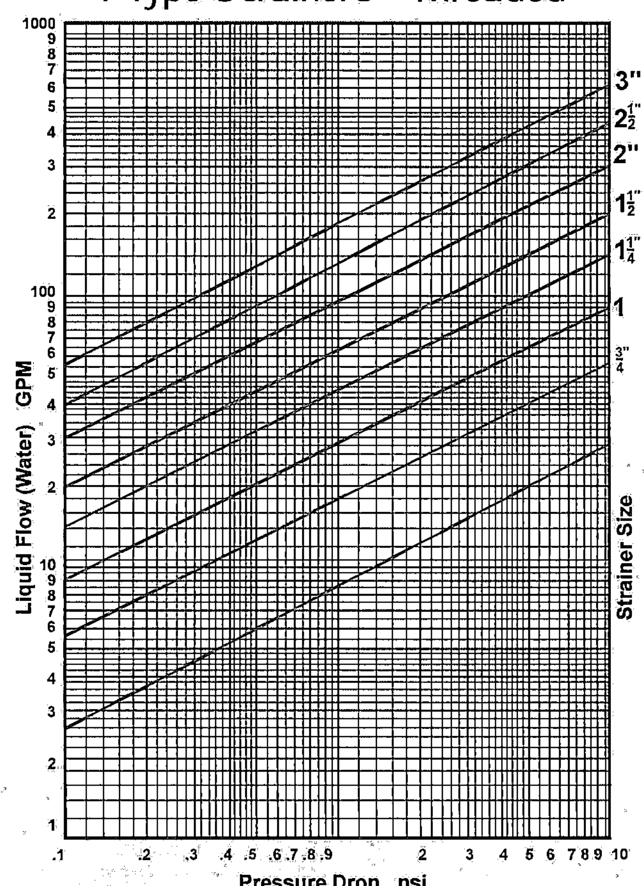
"Y" Strainers take their name from their configuration. They are most commonly used in pressurized lines, gas or liquid, but can also be used in suction or vacuum conditions. They are intended for applications where small amounts of solid particulate are expected, and where clean-out will be infrequent. If solids will flush easily from the screen, and fluid can be exhausted to atmosphere, a blow-down valve on the drain port will allow clean-out without removal of the screen, and without interrupting the process flow.



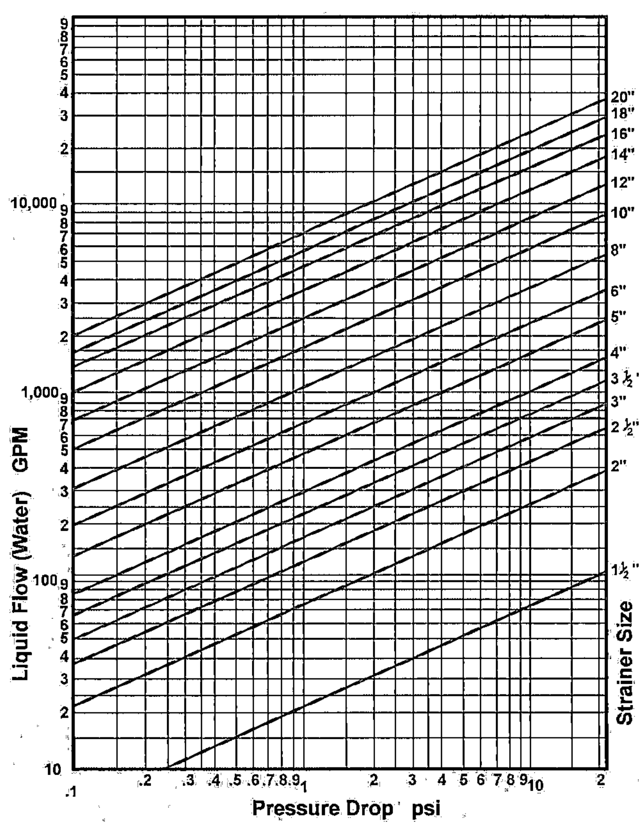
A. Pressure gauges to indicate clogged screen
B. Isolation valves for servicing strainer
C. Optional manual or auto blow-down

Flow Rate vs Pressure Drop

Y-Type Strainers - Threaded



Y-Type Strainers - Flanged



Burns and Roe Enterprises, Inc.

W.O. No: 03131-001 Calc. No: 03131-001-ME-103 Sheet No: 1 Cont'd on Sht: 2

Client: Los Alamos National Laboratory Project: Zero Liquid Discharge Project

Title: Evaporation Spray System – Piping and Pumps Sizing

REVISION RECORD 100761-11-000090

Revision	Status	Description of Revision	Preparer print/sign/date	Checker print/sign/date	Approver print/sign/date
A	Preliminary	Original Issue 60% Submittal	Jerry Dutreuil 7/6/2011	G Dunn 7/6/2011	S. Stuhrke

PE Seal (if required)

04791

TABLE OF CONTENTS

PURPOSE

The purpose of this calculation is to determine the size of the piping and the size of the pumps for the Evaporation Spray System. In addition, the nozzle and the distribution are selected for the Evaporation Spray System.

REFERENCES

1. Website: www.weather.lanl.gov
2. ASME B31.3 – 2002 "Process Piping"
3. Crane Technical Paper 410.
4. Calculation 03131-001-ME-100 and Calculation 03131-001-ME-102.
5. Technical Proposal – Volume 2, Zero Liquid Discharge Sub-Project Los Alamos National Security, LLC RFP No. 117112-RFP-10.
6. Zero Liquid Discharge (ZLD) Sub-Project: Tank Sections 1, C55751-S-3011
7. Zero Liquid Discharge (ZLD) Sub-Project: Pump House Plan, C55751-S-1020
8. LANL Radioactive Liquid Waste Treatment Facility (RLWTF): Transfer Piping Plan 1, C55751-M-1000 Rev. A (marked with suction piping lengths)
9. LANL Radioactive Liquid Waste Treatment Facility (RLWTF): Zero Liquid Discharge P&ID and Sequence of Operation, C55751-M-6000 Rev. A and C55751-M-6001 Rev. A
10. Sure Flow Equipment Inc. Y Strainer Data Sheet page 3.
11. Hayward Y Strainer Data Sheet page 11.
12. Email from Robert Titchenell at Spraying Systems Co. including Data Sheet 36275 and Drawing No. 5100.
13. Burns and Roe Engineering Standard, R153450M1, Maximum Allowable Velocities for Flow of Water and Steam in Pipes.

DESIGN REQUIREMENTS

1. All Evaporation Spray System piping shall conform to ASME B31.3.
2. Design temperature will be equal to the maximum average monthly temperature.
3. Suction design pressure shall be the Evaporation Tanks operating pressure, plus the elevation head from pump inlet to the maximum water level of the Evaporation Tanks during the year, plus 10%.
4. An optimum pressure of 40 psi and 5 gpm is required at each nozzle tip as per Reference 12.
5. Design flow rate is equal to the operating flow rate of the Evaporation Spray System, 150 gpm per pump.
6. Fluid velocity will be less than 12 ft/sec as per Burns and Roe's Standard R153450M1, Reference 13.
7. High Density Polyethylene (HDPE) will be used for the Evaporation Spray System piping.
8. The dimensions of each tank are 248 ft. long, 69 ft. wide and 4ft. high from Calculation 03131-001-ME-100 and drawing C55751-S-3011 Section A, References 4 and 6 respectively.
9. The maximum calculated depth of Water in the Evaporation Tank during the year is 13.51" from Calculation 03131-001-ME-100, Reference 4.

UNCONFIRMED ASSUMPTIONS

1. The average pressure in the discharge piping is 50 psi.
2. The Static Head between the sump of the tanks and the pump inlet is 4.5 ft.
3. The efficiency of the pump is 50%.
4. The spray nozzle is assumed to be at the same level as the pump outlet. Therefore, a zero (0) feet head is used for the piping after the pump.

DESIGN PROCEDURES

1. Calculate the design pressure and temperature of the piping of the new Evaporation Spray System Pump.
2. Using the calculated design pressure and temperature, select the pipe class for all piping from Reference 2.
3. Calculate the pipe length from the Evaporation Tank sump to the new Evaporation Spray System Nozzles. The pipe length for each section is estimated using AutoCAD and other estimation methods.
4. Input all necessary suction information into the Burns and Roe Standard Pressure Drop Calculation, including pipe length, fittings and design conditions.
5. The pressure drop through the piping is determined based on the Darcy Formula. The Burns and Roe Standard Pressure Drop Calculation will perform these actions.
6. Per Reference 13, the suction piping velocity shall not exceed 12 ft/sec.
7. Select pipe size based on the Burns and Roe Standard Pressure Drop Calculation output.
8. Calculate the minimum required pressure at the discharge side of the pump.
9. Calculate the Net Positive Suction Head Available, Total Discharge Head, and Pump size from the Pump Design Sheet.
10. Determine the nozzle layout based on the data sheets given by Spray Systems Co.

COMPUTER TYPE: Dell Optiplex 755, OPERATING SYSTEM: Windows XP

1. COMPUTER PROGRAM: Pressure Drop Calculation VERSION: 1.2

   ☒ APPROVED ☐ AUTHORIZED

   ESI No. ME-0008-02

2. COMPUTER PROGRAM: Pump Design Sheet VERSION: 1.0

   ☒ APPROVED ☐ AUTHORIZED

   ESI No. ME-0027-00

CONCLUSIONS

For the suction side of the pump, a 6" Polyethylene DR 17 (Piping Specification 502, ASME B31.3 "Process Piping") was selected from the Evaporation Tank to the pump skid entrance tee. A 4" High Density Polyethylene (HDPE) DR 17 (Piping Specification 502, ASME B31.3 "Process Piping") pipe was selected from the pump skid entrance tee to the pump inlet.

For the pump discharge, a 4" High Density Polyethylene (HDPE) DR 17 (Piping Specification 502, ASME B31.3 "Process Piping") pipe was selected from the pump exit to the nozzle branch.

The minimum pressure at the discharge side of the Evaporation Spray System Pump is 65 psi.

The pump size required to operate the Spraying System is 8 hp.

Each Evaporation Tank will have an arrangement of thirty (30) Veejet spray nozzles (15 per side) located around the top of the tank wall. The nozzles wii be located at eight (8) ft intervals.

BODY OF CALCULATION

Design Temperature

The design temperature is equal to the maximum Mean Monthly Temperature (per Reference 1):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Monthly Temperature °F	28.7	32.3	38.3	46.2	55.3	64.9	68.0	65.7	60.0	49.6	37.7	29.9

$T_{design} = 68.0$ °F
Use 70 °F as the Design Temperature.

Suction Side Design Pressure

The suction side design pressure shall be the Evaporation Tanks operating pressure, plus the elevation head from pump inlet to the maximum water level of the Evaporation Tanks during the year, plus 10%. From Calculation 03131-001-ME-102, an operating suction pressure of 16.1 psia was used as suction design pressure.

Summary of Suction Design Conditions

The new Evaporation Spray Pump Suction design conditions are as follows:

Pump Suction 5 psig / 70 °F

Suction Pipe Class Selection

Piping for the Evaporation Spray System is HDPE, ASME B31.3. From Reference 2, the following Pipe Class is appropriate: 502 Polyethylene Piping DR 17, 100 psig and below, ASME B31.3.

Pipe Sections

In order to size the Evaporation Spray System piping and pump, the pipe is broken down into sections. Then, the pressure drop for each section is calculated using estimated pipe length and diameter size. The velocity is checked against the maximum velocity from Burns and Roe Engineering Standard, R153450M1, not to exceed 12 ft/s. With the pressure drop for both the suction and discharge side, the pump brake horse power is calculated.

The Evaporation Spray System piping is separated into twenty two (22) sections as per C55751- M-6000 Rev. A and C55751- M-6001 Rev. A, Reference 9. The length of the pipes in the pressure drop calculation is estimated using either the "Measure" ability in AutoCAD, the requirement from manufacturers, and fix distances. The distance between the tank and the pump house is calculated using the following equation:

$$D_{section} = D_{line} \times L_{Factor}$$

D_{line} is the straight length between two locations as per C55751-M-1000 (Reference 8). L_{Factor} is a length factor of 1.25 which, takes into account extra length due to curves in the line. The distances inside the pump house between entrance tee and the pump skid tee is estimated to be 20% more than the length of the pump house (12ft. from C55751-S-1020). Short distances are estimated to be a fix 1 ft. The estimated distances are shown and described in Table 1. The estimated distance in the table includes the length factor. The tag numbers given are specific to this calculation only.

Table 1: Pipe sections and descriptions

Section	Tag	Description	Length	Fittings
1	6"-0001	TK-3001 sump to Pump Encl. Tee	85 ft	Gate valve-Elbow
2	6"-0002	Pump Encl. Tee to Skid Entr. Tee	12 ft	Strainer-Gate valve-Elbow
3	6"-0003	Skid Entr. Tee to Reducer	1 ft	Tee branch-Reducer
4	4"-0004	Reducer to Pump	1 ft	Globe valve-Elbow
5	4"-0005	Pump to Skid Exit Tee	1 ft	Globe valve-Stop check valve-Elbow
6	4"-0006	Skid Exit Tee to Tank Header	85 ft	Strainer-Tee branch-Elbow
7	4"-0007	Tank Header to Nozzle Header	12 ft	Globe valve-Tee branch-Elbow
8	4"-0008	Nozzle Header to Nozzle Tee 1	120 ft	Tee branch
9	4"-0009	Nozzle Tee 1 to Nozzle Tee 2	8 ft	Tee run
10	4"-0010	Nozzle Tee 2 to Nozzle Tee 3	8 ft	Tee run
11	4"-0011	Nozzle Tee 3 to Nozzle Tee 4	8 ft	Tee run
12	4"-0012	Nozzle Tee 4 to Nozzle Tee 5	8 ft	Tee run
13	4"-0013	Nozzle Tee 5 to Nozzle Tee 6	8 ft	Tee run
14	4"-0014	Nozzle Tee 6 to Nozzle Tee 7	8 ft	Tee run
15	4"-0015	Nozzle Tee 7 to Nozzle Tee 8	8 ft	Tee run
16	4"-0016	Nozzle Tee 8 to Nozzle Tee 9	8 ft	Tee run
17	4"-0017	Nozzle Tee 9 to Nozzle Tee 10	8 ft	Tee run
18	4"-0018	Nozzle Tee 10 to Nozzle Tee 11	8 ft	Tee run
19	4"-0019	Nozzle Tee 11 to Nozzle Tee 12	8 ft	Tee run
20	4"-0020	Nozzle Tee 12 to Nozzle Tee 13	8 ft	Tee run
21	4"-0021	Nozzle Tee 13 to Nozzle Tee 14	8 ft	Tee run
22	4"-0022	Nozzle Tee 14 to Nozzle Tee 15	8 ft	Tee run

Pipe Pressure Drop

After separating, the pipe into sections, the pressure drop is calculated using the pipe route with the highest pressure drop. Since the Evaporation Spray System piping is fairly symmetrical, the pipe route with the longest length is selected to have the highest pressure drop. Then, the minimum pressure require for the pump is calculated using the pressure drop calculation sheets.

The Pressure Drop Calculation Sheet and the Pump Design Sheet are Excel sheets approved by Burns and Roe Engineering Software use for calculating the pressure drop in a pipe segments and the design conditions of a pump respectively. Using Pressure Drop calculation Sheets, the pressure drop is calculated for each section using the pipe route from the P&ID. The pressure drop from the strainers and other fittings are shown in the PDcalc Sheets, Appendix A. The pressure drop for both Y strainers is estimated from manufacturer's data sheet. For a 6" diameter pipe and a flow of 300 gpm, the Y-strainer pressure drop is 0.2 psi selected from the Sure Flow Equipment Inc. Catalog page 3; Appendix K. For a 4" diameter pipe and a flow of 300 gpm, the Y-strainer pressure drop is 1.3 psi selected from the Hayward Catalog page 11; Appendix L. Table 2 shows the pressure drop for each section.

Table 2: Pressure Drop and volumetric flow rate for each section

Section	Tag	Description	Flow Rate	Pressure Drop
1	6"-0001	TK-3001 sump to Pump Encl. Tee	150 gpm	2.08 psi
2	6"-0002	Pump Encl. Tee to Skid Entr. Tee	300 gpm	0.51 psi
3	6"-0003	Skid Entr. Tee to Reducer	150 gpm	0.05 psi
4	4"- 0004	Reducer to Pump	150 gpm	0.78 psi
5	4"- 0005	Pump to Skid Exit Tee	150 gpm	1.55 psi
6	4"-0006	Skid Exit Tee to Tank Header	300 gpm	4.38 psi
7	4"-0007	Tank Header to Nozzle Header	150 gpm	0.96 psi
8	4"-0008	Nozzle Header to Nozzle Tee 1	75 gpm	0.23 psi
9	4"-0009	Nozzle Tee 1 to Nozzle Tee 2	70 gpm	0.02 psi
10	4"-0010	Nozzle Tee 2 to Nozzle Tee 3	65 gpm	0.02 psi
11	4"-0011	Nozzle Tee 3 to Nozzle Tee 4	60 gpm	0.02 psi
12	4"-0012	Nozzle Tee 4 to Nozzle Tee 5	55 gpm	0.01 psi
13	4"-0013	Nozzle Tee 5 to Nozzle Tee 6	50 gpm	0.01 psi
14	4"-0014	Nozzle Tee 6 to Nozzle Tee 7	45 gpm	0.01 psi
15	4"-0015	Nozzle Tee 7 to Nozzle Tee 8	40 gpm	0.01 psi
16	4"-0016	Nozzle Tee 8 to Nozzle Tee 9	35 gpm	0.01 psi
17	4"-0017	Nozzle Tee 9 to Nozzle Tee 10	30 gpm	0 psi
18	4"-0018	Nozzle Tee 10 to Nozzle Tee 11	25 gpm	0 psi
19	4"-0019	Nozzle Tee 11 to Nozzle Tee 12	20 gpm	0 psi
20	4"-0020	Nozzle Tee 12 to Nozzle Tee 13	15 gpm	0 psi
21	4"-0021	Nozzle Tee 13 to Nozzle Tee 14	10 gpm	0 psi
22	4"-0022	Nozzle Tee 14 to Nozzle Tee 15	5 gpm	0 psi

The pipe route selected is the combination of sections with the highest pressure drop.

Total Suction Pressure

For the suction side of the pump, the highest pressure drop is calculated using the pipe static head, minus the pipe friction and equipment pressure drop plus the design suction pressure as shown in the following equation:

$P_{Stotal} = \Delta P_{Head} - [\sum \Delta P_{00i} \text{ x Piping Loss Margin}] - \Delta P_{Strainer} + P_{DSuction}$, $i = 1, 2, 3, 4$

The Static pressure is calculated using the fluid head of water, which is 2.31 ft/psi and the static head shown below as per Reference 3:

ΔP_{Head} = (Height x Specific Gravity) / Fluid head of water = (4.5 ft x 0.999)/ 2.31 ft/psi = 1.95 psi
P_{Stotal} = 1.95 psi – [(0.13 psi +0.51 psi +0.05 psi +0.78 psi) x 1.1] + 16.1 psia
P_{Stotal} = 16.23 psia

Total Discharge Pressure

Based on the pressure drop calculation, the total discharge pressure required at the pump is the pipe route with the highest pressure drop for the friction loss including equipment losses, plus the pressure require at the nozzle, plus static head, and atmospheric pressure as shown in the following equation:

$P_{Dtotal} = [\sum \Delta P_{00i} \text{ x Piping Loss Margin}] + P_{Nozzle} + \Delta P_{Strainer} + P_{Static\ Head} + P_{atm}$, $i = 5, 6, \ldots, 22$

The static head after the pump outlet is considered 0 psi since the pump outlet and the spray nozzle are considered to be at the same elevation as per Assumption 4.

P_{Dtotal} = [(1.55 psi +3.08 psi +0.96 psi +0.23 psi +0.02 psi +0.02 psi +0.02 psi +0.01 psi +0.01 psi +0.01 psi +0.01 psi +0.01 psi +0.01 psi) x 1.1] + 40 psi + 1.3 psi + 0 psi+ 11.1 psia = 58.92 psia

Minimum Required Pressure

To calculate the minimum required pressure at the discharge side of the pump, the total discharge pressure is multiplied with a 10% factor of safety.

P_{min} = 58.92 psia x 1.1 = 64.82 psia

The minimum pressure required at the pump discharge is 65 psi.

Pump sizing

To find the pump size, the Total Head is calculated by subtracting the suction pressure from the discharge pressure and multiplying by the fluid head of water (2.31 ft/psi). The equation below shows the required pump size for the Evaporation Spray System using the flow rate, the Total Head, Specific gravity and the efficiency of the pump. Since two one hundred percent capacity (2 x 100%) pumps are used, the required pump power for a flow of one hundred fifty (150) gpm.

P_{pump} = (Q_{Water} x Total Head x Specific Gravity) / (Conversion factor x η_{pump})

The Total Head is calculated as per Reference 3 using:
TH = [(P_{Dtotal} – P_{Stotal}) x 2.31]/ Specific Gravity
TH = (58.92psi – 16.23 psi) x 2.31 ft/psi / 0.999 = 98.7 ft

Use 99 ft for the Total Head.

The conversion factor is used to convert the flow and length unit to brake horsepower.

$$CF = \frac{US\,gallons}{min} \times \frac{0.13368\,ft^3}{1\,US\,gallons} \times \frac{1\,min}{60\,sec} \times ft\ of\ water \times \frac{psi\ of\ water}{2.31\,ft\ of\ water} \times \frac{144\,in^2}{1\,ft^2} \times \frac{1\,bhp}{\frac{ft-lbs}{s}} = 3960\,\frac{gpm \times ft}{bhp}$$

Therefore, the pump brake horsepower is:
P_{pump} = (150 gpm x 99 ft x 1) / (3960 gpm-ft/bhp x 0.50)
P_{pump} = 7.5 bhp

Use an 8 HP motor for each pump.

The Pump Design Sheet takes into account the pipe head (elevation from tank sump to the pump inlet), the strainers in the pipe line, the flow rate and the pressure drop in the pipe for the suction and discharge. Then, the Design Capacity of the pump and the Design NPSHA are calculated as shown Appendix C.

Nozzle Layout

The number of nozzle using an operating flow rate of 150 gpm at 5 gpm per nozzle is 30. The tank is 4ft. high with the maximum level of water of 13.51 inches leaving approximately 3 ft. of height. The recommended forty (40°) degree VeeJet nozzles model 4050 operating at 5 gpm and 40 psi, have a spraying width of 7½" ft. Using 8 ft. spacing between the nozzle amounts to 240 ft., which less than the length of the tank. Therefore, use 8 ft. spacing and 30 nozzles the Spraying System layout.

APPENDIX_A_ TO CALCULATION (for Computer Analysis Input/Output Sheet)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 23

INPUT/OUTPUT PRODUCED ON COMPUTER NO. C1642

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A1	Cont'd:	A2
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: TK-3001 Sump-Pump Encl. Tee **Section:** 1

Nominal Size:	**6 inches**	Absolute Roughness (ε):	0.00007 ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	5.798 in
		Inside Diameter (D):	0.483 ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water	Average Pressure:	16.10 psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0 F
Flow Rate (Q):	150.0 GPM	Specific Volume (V):	0.01605 ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97541 cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ — 1.82 ft/sec = 109 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ — 8.36E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0194

Laminar Flow: $f = 64 / Re$

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Elbow 90deg. Standard Radius (Small Bore Pipe)	4	30	120
Gate Valve (Full Port)	1	8	8
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 128

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum\ (nL/D)$	61.8	ft
Straight Pipe Length (L_P):		**85**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	146.8	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.3	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.13**	psi
Static Head:	[psi] = [ft] / (144 V) — **4.5** ft =	**1.95**	psi
Miscellaneous Equipment Pressure Drops:		**0.0**	psi
		0.0	psi
TOTAL PRESSURE DROP:		**2.08**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A2	Cont'd:	A3
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Pump Encl. Tee-Skid Entr. Tee **Section:** 2

Nominal Size:	**6 inches**	Absolute Roughness (ε):	0.00007 ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	5.798 in
		Inside Diameter (D):	0.483 ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water	Average Pressure:	16.10 psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0 F
Flow Rate (Q):	300.0 GPM	Specific Volume (V):	0.01605 ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97541 cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ 3.64 ft/sec = 218 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ 1.67E+05 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0172

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Branch)	2	60	120
Elbow 90deg. Standard Radius (Small Bore Pipe)	2	30	60
---	2	0	0
---	2	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 180

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum(nL/D)$	87.0	ft
Straight Pipe Length (L_P):		**12**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	99.0	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.7	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.31**	**psi**
Static Head:	[psi] = [ft] / (144 V) **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:	Strainer	**0.2**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.51**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A3	Cont'd:	A4
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description:	Skid Entr. Tee - Reducer	**Section:**	3	
Nominal Size:	**6 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	5.798	in
		Inside Diameter (D):	0.483	ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water	Average Pressure:	16.10	psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	150.0 GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97541	cP

PRESSURE DROP

Fluid Velocity (Vel):	$Vel = 0.0509\ W \times V / d^2$	1.82 ft/sec = 109 ft/min
Reynolds Number (Re):	$Re = 6.31\ W / (d \times \mu)$	8.36E+04 (= Turbulent Flow)
Friction Factor (f):		
Turbulent Flow:	$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$	0.0194
Laminar Flow:	f = 64 / Re	

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Branch)	1	60	60
---	1	0	0
---	2	0	0
---	0	0	0
---	0	0	0
---	0	0	0
Reducer	1	51.7081	52
	0	0	0
	0	0	0
		Sum of nL/D for all Fittings, Valves, Etc.:	112

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum\ (nL/D)$	54.0	ft
Straight Pipe Length (L_P):		**1**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	55.0	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.1	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.05**	**psi**
Static Head:	[psi] = [ft] / (144 V) **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.05**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A4	Cont'd:	A5
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Reducer - Pump **Section:** 4

Nominal Size: **4 inches**

Material and Schedule: **Polyethylene (PE) DR 17.0**

Absolute Roughness (ε): 0.00007 ft

Inside Diameter (d): 3.938 in

Inside Diameter (D): 0.328 ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid: Waste Water

Flow Rate (W): lb/hr

Flow Rate (Q): 150.0 GPM

[Note: W = 8.022 Q / V]

Average Pressure: 16.10 psia

Average Temperature: 70.0 F

Specific Volume (V): 0.01605 ft^3/lb

Absolute Viscosity (μ): 0.97541 cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ — 3.95 ft/sec = 237 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ — 1.23E+05 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0184

Laminar Flow: $f = 64 / Re$

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Globe Valve (Full Port)	1	340	340
Elbow 90deg. Standard Radius (Small Bore Pipe)	2	30	60
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 400

Equivalent Length of Fittings (L_F): $L_F = D \times Sum\ (nL/D)$ — 131.3 ft

Straight Pipe Length (L_P): **1** ft

Total Equivalent Pipe Length (L_{TEL}): $L_{TEL} = L_F + L_P$ — 132.3 ft

Friction Head Loss (h_L): $h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$ — 1.8 ft

Friction Pressure Drop (ΔP): $\Delta P = h_L / (144\ V)$ — **0.78 psi**

Static Head: [psi] = [ft] / (144 V) ___ ft = **0.00 psi**

Miscellaneous Equipment Pressure Drops: **0.0 psi**, **0.0 psi**

TOTAL PRESSURE DROP: 0.78 psi

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A5	Cont'd:	A6
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Pump - Skid Exit Tee **Section:** 5

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938	in
		Inside Diameter (D):	0.328	ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water		Average Pressure:	50.00	psia
Flow Rate (W):		lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	150.0	GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]			Absolute Viscosity (μ):	0.97532	cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ — 3.95 ft/sec = 237 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ — 1.23E+05 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0184

Laminar Flow: $f = 64 / Re$

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Globe Valve (Full Port)	1	340	340
Stop Check Valve (Globe)	1	400	400
Elbow 90deg. Standard Radius (Small Bore Pipe)	2	30	60
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
Sum of nL/D for all Fittings, Valves, Etc.:			800

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum(nL/D)$	262.5	ft
Straight Pipe Length (L_P):		1	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	263.5	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	3.6	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**1.55**	**psi**
Static Head:	[psi] = [ft] / (144 V) — **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**1.55**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A6	Cont'd:	A7
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Skid Exit Tee - Tank Header **Section:** 6

Nominal Size: **4 inches**

Material and Schedule: **Polyethylene (PE) DR 17.0**

Absolute Roughness (ε): 0.00007 ft

Inside Diameter (d): 3.938 in

Inside Diameter (D): 0.328 ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid: Waste Water

Flow Rate (W): ______ lb/hr

Flow Rate (Q): 300.0 GPM

[Note: W = 8.022 Q / V]

Average Pressure: 50.00 psia

Average Temperature: 70.0 F

Specific Volume (V): 0.01605 ft^3/lb

Absolute Viscosity (μ): 0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 — 7.89 ft/sec = 474 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) — 2.46E+05 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0167

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Branch)	1	60	60
Elbow 90deg. Standard Radius (Small Bore Pipe)	4	30	120
---	2	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 180

Equivalent Length of Fittings (L_F): L_F = D x Sum (nL/D) — 59.1 ft

Straight Pipe Length (L_P): **85** ft

Total Equivalent Pipe Length (L_{TEL}): $L_{TEL} = L_F + L_P$ — 144.1 ft

Friction Head Loss (h_L): h_L = f x (L_{TEL} / D) x (Vel^2 / 2g) — 7.1 ft

Friction Pressure Drop (ΔP): $\Delta P = h_L$ / (144 V) — **3.08 psi**

Static Head: [psi] = [ft] / (144 V) — **0** ft = **0.00 psi**

Miscellaneous Equipment Pressure Drops: Strainer — **1.3 psi**

0.0 psi

TOTAL PRESSURE DROP: 4.38 psi

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A7	Cont'd:	A8
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Tank Header - Nozzle Header **Section:** 7

Nominal Size: **4 inches**

Material and Schedule: **Polyethylene (PE) DR 17.0**

Absolute Roughness (ε): 0.00007 ft

Inside Diameter (d): 3.938 in

Inside Diameter (D): 0.328 ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid: Waste Water

Flow Rate (W): ______ lb/hr

Flow Rate (Q): 150.0 GPM

[Note: W = 8.022 Q / V]

Average Pressure: 50.00 psia

Average Temperature: 70.0 F

Specific Volume (V): 0.01605 ft^3/lb

Absolute Viscosity (μ): 0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ — 3.95 ft/sec = 237 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ — 1.23E+05 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0184

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Branch)	1	60	60
Elbow 90deg. Standard Radius (Small Bore Pipe)	2	30	60
Globe Valve (Full Port)	1	340	340
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 460

Equivalent Length of Fittings (L_F): $L_F = D \times Sum\ (nL/D)$ — 151.0 ft

Straight Pipe Length (L_P): **12** ft

Total Equivalent Pipe Length (L_{TEL}): $L_{TEL} = L_F + L_P$ — 163.0 ft

Friction Head Loss (h_L): $h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$ — 2.2 ft

Friction Pressure Drop (ΔP): $\Delta P = h_L / (144\ V)$ — **0.96 psi**

Static Head: [psi] = [ft] / (144 V) — **0** ft = **0.00 psi**

Miscellaneous Equipment Pressure Drops: **0.0 psi**

0.0 psi

TOTAL PRESSURE DROP: 0.96 psi

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A8	Cont'd:	A9
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description:	Nozzle Header - Nozzle Tee 1	**Section:**	8
Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007 ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938 in
		Inside Diameter (D):	0.328 ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water	Average Pressure:	50.00 psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0 F
Flow Rate (Q):	75.0 GPM	Specific Volume (V):	0.01605 ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel):	$Vel = 0.0509\ W \times V / d^2$	1.97 ft/sec = 118 ft/min
Reynolds Number (Re):	$Re = 6.31\ W / (d \times \mu)$	6.16E+04 (= Turbulent Flow)
Friction Factor (f): Turbulent Flow:	$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$	0.0208
Laminar Flow:	f = 64 / Re	

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Branch)	1	60	60
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 60

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum\ (nL/D)$	19.7 ft
Straight Pipe Length (L_P):		**120** ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	139.7 ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.5 ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.23 psi**
Static Head:	[psi] = [ft] / (144 V) **0** ft =	**0.00 psi**
Miscellaneous Equipment Pressure Drops:		**0.0 psi**
		0.0 psi
TOTAL PRESSURE DROP:		**0.23 psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.: 03131-001 Calc.: 03131-001-ME-103 Sheet No: A9 Cont'd: A10
Prepared By: J. Dutreuil Date: 6/29/2011 Checked By: Date:
Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

◉ Standard Pipe Size and Material ○ User-Defined Pipe Size and Material

Line Description: Nozzle Tee 1 - Nozzle Tee 2 **Section:** 9

Nominal Size: **4 inches**
Material and Schedule: **Polyethylene (PE) DR 17.0**

Absolute Roughness (ε): 0.00007 ft
Inside Diameter (d): 3.938 in
Inside Diameter (D): 0.328 ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid: Waste Water
Flow Rate (W): lb/hr
Flow Rate (Q): 70.0 GPM
[Note: W = 8.022 Q / V]

Average Pressure: 50.00 psia
Average Temperature: 70.0 F
Specific Volume (V): 0.01605 ft^3/lb
Absolute Viscosity (μ): 0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 — 1.84 ft/sec = 110 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) — 5.75E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0211

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	1	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 20

Equivalent Length of Fittings (L_F): L_F = D x Sum (nL/D) — 6.6 ft
Straight Pipe Length (L_P): **8** ft
Total Equivalent Pipe Length (L_{TEL}): $L_{TEL} = L_F + L_P$ — 14.6 ft

Friction Head Loss (h_L): h_L = f x (L_{TEL} / D) x (Vel^2 / 2g) — 0.0 ft
Friction Pressure Drop (ΔP): $\Delta P = h_L$ / (144 V) — **0.02 psi**

Static Head: [psi] = [ft] / (144 V) — **0** ft = **0.00 psi**

Miscellaneous Equipment Pressure Drops: **0.0 psi**
0.0 psi

TOTAL PRESSURE DROP: 0.02 psi

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A10	Cont'd:	A11
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description:	Nozzle Tee 2 - Nozzle Tee 3	**Section:**	10	
Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938	in
		Inside Diameter (D):	0.328	ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water		Average Pressure:	50.00	psia
Flow Rate (W):		lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	65.0	GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]			Absolute Viscosity (μ):	0.97532	cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 — 1.71 ft/sec = 103 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) — 5.34E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}}=-2\log_{10}\left(\frac{\varepsilon}{3.7D}+\frac{2.51}{Re\sqrt{f}}\right)$$ 0.0214

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	1	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 20

Equivalent Length of Fittings (L_F):	L_F = D x Sum (nL/D)	6.6	ft
Straight Pipe Length (L_P):		**8**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	h_L = f x (L_{TEL} / D) x (Vel^2 / 2g)	0.0	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L$ / (144 V)	**0.02**	**psi**
Static Head:	[psi] = [ft] / (144 V) — **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.02**	**psi**

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BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A11	Cont'd:	A12
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Nozzle Tee 3 - Nozzle Tee 4 **Section:** 11

Nominal Size: **4 inches**

Material and Schedule: **Polyethylene (PE) DR 17.0**

Absolute Roughness (ε): 0.00007 ft

Inside Diameter (d): 3.938 in

Inside Diameter (D): 0.328 ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid: Waste Water

Flow Rate (W): ______ lb/hr

Flow Rate (Q): 60.0 GPM

[Note: W = 8.022 Q / V]

Average Pressure: 50.00 psia

Average Temperature: 70.0 F

Specific Volume (V): 0.01605 ft^3/lb

Absolute Viscosity (μ): 0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 — 1.58 ft/sec = 95 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) — 4.93E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0217

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 20

Equivalent Length of Fittings (L_F): L_F = D x Sum (nL/D) — 6.6 ft

Straight Pipe Length (L_P): **8** ft

Total Equivalent Pipe Length (L_{TEL}): $L_{TEL} = L_F + L_P$ — 14.6 ft

Friction Head Loss (h_L): $h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$ — 0.0 ft

Friction Pressure Drop (ΔP): $\Delta P = h_L / (144\ V)$ — **0.02 psi**

Static Head: [psi] = [ft] / (144 V) — **0** ft = **0.00 psi**

Miscellaneous Equipment Pressure Drops: **0.0 psi**; **0.0 psi**

TOTAL PRESSURE DROP: 0.02 psi

BURNS AND ROE ENTERPRISES, INC.

W.O. No.: 03131-001 Calc.: 03131-001-ME-103 Sheet No: A12 Cont'd: A13
Prepared By: J. Dutreuil Date: 6/29/2011 Checked By: Date:
Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Nozzle Tee 4 - Nozzle Tee 5 **Section:** 12

Nominal Size: **4 inches** Absolute Roughness (ε): 0.00007 ft
Material and Schedule: **Polyethylene (PE) DR 17.0** Inside Diameter (d): 3.938 in
Inside Diameter (D): 0.328 ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid: Waste Water Average Pressure: 50.00 psia
Flow Rate (W): . lb/hr Average Temperature: 70.0 F
Flow Rate (Q): 55.0 GPM Specific Volume (V): 0.01605 ft^3/lb
[Note: W = 8.022 Q / V] Absolute Viscosity (μ): 0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ 1.45 ft/sec = 87 ft/min
Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ 4.51E+04 (= Turbulent Flow)
Friction Factor (f):
Turbulent Flow: $\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$ 0.0221
Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
Sum of nL/D for all Fittings, Valves, Etc.:			20

Equivalent Length of Fittings (L_F): $L_F = D \times Sum\ (nL/D)$ 6.6 ft
Straight Pipe Length (L_P): **8** ft
Total Equivalent Pipe Length (L_{TEL}): $L_{TEL} = L_F + L_P$ 14.6 ft

Friction Head Loss (h_L): $h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$ 0.0 ft
Friction Pressure Drop (ΔP): $\Delta P = h_L / (144\ V)$ **0.01 psi**

Static Head: [psi] = [ft] / (144 V) **0** ft = **0.00 psi**

Miscellaneous Equipment Pressure Drops: **0.0 psi**
0.0 psi

TOTAL PRESSURE DROP: **0.01 psi**

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Nozzle Tee 5 - Nozzle Tee 6 **Section:** 13

Nominal Size: **4 inches** Absolute Roughness (ε): 0.00007 ft

Material and Schedule: **Polyethylene (PE) DR 17.0** Inside Diameter (d): 3.938 in

Inside Diameter (D): 0.328 ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid: Waste Water Average Pressure: 50.00 psia

Flow Rate (W): ______ lb/hr Average Temperature: 70.0 F

Flow Rate (Q): 50.0 GPM Specific Volume (V): 0.01605 ft^3/lb

[Note: W = 8.022 Q / V] Absolute Viscosity (μ): 0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ 1.32 ft/sec = 79 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ 4.10E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$ 0.0225

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
Sum of nL/D for all Fittings, Valves, Etc.:			20

Equivalent Length of Fittings (L_F): $L_F = D \times Sum\ (nL/D)$ 6.6 ft

Straight Pipe Length (L_P): 8 ft

Total Equivalent Pipe Length (L_{TEL}): $L_{TEL} = L_F + L_P$ 14.6 ft

Friction Head Loss (h_L): $h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$ 0.0 ft

Friction Pressure Drop (ΔP): $\Delta P = h_L / (144\ V)$ **0.01 psi**

Static Head: [psi] = [ft] / (144 V) **0** ft = **0.00 psi**

Miscellaneous Equipment Pressure Drops: 0.0 psi

0.0 psi

TOTAL PRESSURE DROP: 0.01 psi

W.O. No.: 03131-001 Calc.: 03131-001-ME-103 Sheet No: A14 Cont'd: A15
Prepared By: J. Dutreuil Date: 6/29/2011 Checked By: Date:
Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Nozzle Tee 6 - Nozzle Tee 7
Section: 14

Nominal Size: **4 inches**
Material and Schedule: **Polyethylene (PE) DR 17.0**

Absolute Roughness (ε): 0.00007 ft
Inside Diameter (d): 3.938 in
Inside Diameter (D): 0.328 ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid: Waste Water
Flow Rate (W): ______ lb/hr
Flow Rate (Q): 45.0 GPM
[Note: W = 8.022 Q / V]

Average Pressure: 50.00 psia
Average Temperature: 70.0 F
Specific Volume (V): 0.01605 ft^3/lb
Absolute Viscosity (μ): 0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 — 1.18 ft/sec = 71 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) — 3.69E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0230

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 20

Equivalent Length of Fittings (L_F): L_F = D x Sum (nL/D) — 6.6 ft

Straight Pipe Length (L_P): **8** ft

Total Equivalent Pipe Length (L_{TEL}): $L_{TEL} = L_F + L_P$ — 14.6 ft

Friction Head Loss (h_L): $h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$ — 0.0 ft

Friction Pressure Drop (ΔP): $\Delta P = h_L / (144\ V)$ — **0.01 psi**

Static Head: [psi] = [ft] / (144 V) — 0 ft = **0.00 psi**

Miscellaneous Equipment Pressure Drops: **0.0 psi**; **0.0 psi**

TOTAL PRESSURE DROP: 0.01 psi

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A15	Cont'd:	A16
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

(◉) Standard Pipe Size and Material ( ) User Defined Pipe Size and Material

Line Description: Nozzle Tee 7 - Nozzle Tee 8 **Section:** 15

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007 ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938 in
		Inside Diameter (D):	0.328 ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water	Average Pressure:	50.00 psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0 F
Flow Rate (Q):	40.0 GPM	Specific Volume (V):	0.01605 ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ 1.05 ft/sec = 63 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ 3.28E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0236

Laminar Flow: $f = 64 / Re$

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
Sum of nL/D for all Fittings, Valves, Etc.:			20

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum\ (nL/D)$	6.6	ft
Straight Pipe Length (L_P):		**8**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.0	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.01**	**psi**
Static Head:	[psi] = [ft] / (144 V) **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.01**	**psi**

: 04814

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A16	Cont'd:	A17
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description:	Nozzle Tee 8 - Nozzle Tee 9	**Section:**	16	
Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938	in
		Inside Diameter (D):	0.328	ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water		Average Pressure:	50.00	psia
Flow Rate (W):		lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	35.0	GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]			Absolute Viscosity (μ):	0.97532	cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 — 0.92 ft/sec = 55 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) — 2.87E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0243

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
		Sum of nL/D for all Fittings, Valves, Etc.:	20

Equivalent Length of Fittings (L_F):	L_F = D x Sum (nL/D)	6.6	ft
Straight Pipe Length (L_P):		8	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.0	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.01**	**psi**
Static Head:	[psi] = [ft] / (144 V) — 0 ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.01**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A17	Cont'd:	A18
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Nozzle Tee 9 - Nozzle Tee 10 **Section:** 17

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938	in
		Inside Diameter (D):	0.328	ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water		Average Pressure:	50.00	psia
Flow Rate (W):		lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	30.0	GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]			Absolute Viscosity (μ):	0.97532	cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ 0.79 ft/sec = 47 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ 2.46E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0251

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 20

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum\ (nL/D)$	6.6	ft
Straight Pipe Length (L_P):		**8**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.0	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.00**	**psi**
Static Head:	[psi] = [ft] / (144 V) **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.00**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A18	Cont'd:	A19
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS ◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Nozzle Tee 10 - Nozzle Tee 11 **Section:** 18

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938	in
		Inside Diameter (D):	0.328	ft

FLUID PROPERTIES ☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water		Average Pressure:	50.00	psia
Flow Rate (W):		lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	25.0	GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]			Absolute Viscosity (μ):	0.97532	cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ — 0.66 ft/sec = 39 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ — 2.05E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0262

Laminar Flow: $f = 64 / Re$

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
		Sum of nL/D for all Fittings, Valves, Etc.:	20

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum\ (nL/D)$	6.6	ft
Straight Pipe Length (L_P):		**8**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.0	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.00**	**psi**
Static Head:	[psi] = [ft] / (144 V) — **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.00**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.: 03131-001 Calc.: 03131-001-ME-103 Sheet No: A19 Cont'd: A20
Prepared By: J. Dutreuil Date: 6/29/2011 Checked By: Date:
Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

(●) Standard Pipe Size and Material ( ) User Defined Pipe Size and Material

Line Description: Nozzle Tee 11 - Nozzle Tee 12 **Section:** 19

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007 ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938 in
		Inside Diameter (D):	0.328 ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water	Average Pressure:	50.00 psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0 F
Flow Rate (Q):	20.0 GPM	Specific Volume (V):	0.01605 ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97532 cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 0.53 ft/sec = 32 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) 1.64E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0276

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0

Sum of nL/D for all Fittings, Valves, Etc.: 20

Equivalent Length of Fittings (L_F):	L_F = D x Sum (nL/D)	6.6	ft
Straight Pipe Length (L_P):		8	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.0	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.00**	**psi**
Static Head:	[psi] = [ft] / (144 V) **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.00**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A20	Cont'd:	A21
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

◉ Standard Pipe Size and Material ○ User Defined Pipe Size and Material

Line Description: Nozzle Tee 12 - Nozzle Tee 13 **Section:** 20

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938	in
		Inside Diameter (D):	0.328	ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water		Average Pressure:	50.00	psia
Flow Rate (W):		lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	15.0	GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]			Absolute Viscosity (μ):	0.97532	cP

PRESSURE DROP

Fluid Velocity (Vel): Vel = 0.0509 W x V / d^2 — 0.39 ft/sec = 24 ft/min

Reynolds Number (Re): Re = 6.31 W / (d x μ) — 1.23E+04 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0296

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
Sum of nL/D for all Fittings, Valves, Etc.:			20

Equivalent Length of Fittings (L_F):	L_F = D x Sum (nL/D)	6.6	ft
Straight Pipe Length (L_P):		**8**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	h_L = f x (L_{TEL} / D) x (Vel^2 / 2g)	0.0	ft
Friction Pressure Drop (ΔP):	ΔP = h_L / (144 V)	**0.00**	**psi**
Static Head:	[psi] = [ft] / (144 V) — **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.00**	**psi**

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A21	Cont'd:	A22
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

(◉) Standard Pipe Size and Material ( ) User Defined Pipe Size and Material

Line Description: Nozzle Tee 13 - Nozzle Tee 14 **Section:** 21

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938	in
		Inside Diameter (D):	0.328	ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water		Average Pressure:	50.00	psia
Flow Rate (W):		lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	10.0	GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]			Absolute Viscosity (μ):	0.97532	cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ 0.26 ft/sec = 16 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ 8.21E+03 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$ 0.0329

Laminar Flow: f = 64 / Re

Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
		Sum of nL/D for all Fittings, Valves, Etc.:	20

Equivalent Length of Fittings (L_F):	$L_F = D \times Sum\ (nL/D)$	6.6	ft
Straight Pipe Length (L_P):		8	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.0	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.00**	**psi**
Static Head:	[psi] = [ft] / (144 V) **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		**0.0**	**psi**
		0.0	**psi**
TOTAL PRESSURE DROP:		**0.00**	**psi**

: 04820

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	A22	Cont'd:	B0
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

Title: Evaporation Spray System - Piping and Pumps Sizing

PIPING PRESSURE DROP CALCULATION

PIPE CHARACTERISTICS

(●) Standard Pipe Size and Material ( ) User Defined Pipe Size and Material

Line Description: Nozzle Tee 14 - Nozzle 15 **Section:** 22

Nominal Size:	**4 inches**	Absolute Roughness (ε):	0.00007	ft
Material and Schedule:	**Polyethylene (PE) DR 17.0**	Inside Diameter (d):	3.938	in
		Inside Diameter (D):	0.328	ft

FLUID PROPERTIES

☑ Check Box to Enable Water & Steam Properties

Fluid:	Waste Water	Average Pressure:	50.00	psia
Flow Rate (W):	lb/hr	Average Temperature:	70.0	F
Flow Rate (Q):	5.0 GPM	Specific Volume (V):	0.01605	ft^3/lb
[Note: W = 8.022 Q / V]		Absolute Viscosity (μ):	0.97532	cP

PRESSURE DROP

Fluid Velocity (Vel): $Vel = 0.0509\ W \times V / d^2$ — 0.13 ft/sec = 8 ft/min

Reynolds Number (Re): $Re = 6.31\ W / (d \times \mu)$ — 4.10E+03 (= Turbulent Flow)

Friction Factor (f):

Turbulent Flow: $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$ 0.0398

Laminar Flow: f = 64 / Re

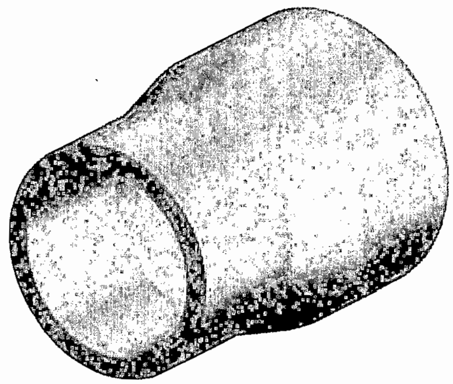
Resistance Coefficients of Fittings, Valves, Etc.	Quantity (n):	L/D or K/f:	nL/D:
Tee (Run)	1	20	20
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
---	0	0	0
	0	0	0
	0	0	0
	0	0	0
Sum of nL/D for all Fittings, Valves, Etc.:			20

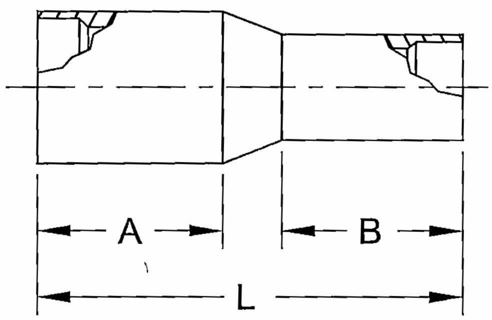
Equivalent Length of Fittings (L_F):	$L_F = D \times Sum(nL/D)$	6.6	ft
Straight Pipe Length (L_P):		**8**	ft
Total Equivalent Pipe Length (L_{TEL}):	$L_{TEL} = L_F + L_P$	14.6	ft
Friction Head Loss (h_L):	$h_L = f \times (L_{TEL} / D) \times (Vel^2 / 2g)$	0.0	ft
Friction Pressure Drop (ΔP):	$\Delta P = h_L / (144\ V)$	**0.00**	**psi**
Static Head:	[psi] = [ft] / (144 V) — **0** ft =	**0.00**	**psi**
Miscellaneous Equipment Pressure Drops:		0.0	psi
		0.0	psi
TOTAL PRESSURE DROP:		**0.00**	**psi**

Appendix B

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 3

Butt Fittings: Butt Reducers





CTS BUTT REDUCER DIMENSIONS			
Nominal Size	**A**	**B**	**L**
1" CTS × ½" CTS	1.79	2.00	4.00
1" IPS × ½" CTS	1.44	1.80	4.50
1" IPS × ¾" CTS	1.50	1.80	4.50
1" IPS × 1" CTS	1.60	2.25	4.50
1¼" CTS × 1" IPS	1.50	2.00	3.84
1¼" IPS × 1¼" CTS	2.50	2.50	5.75
2" IPS × 1¼" CTS	2.49	2.88	6.31
2" IPS × 1½" CTS	2.19	2.29	5.00
2" IPS × 2" CTS	2.75	3.00	6.00
2" IPS × 2" CTS	2.75	3.00	6.00

IPS BUTT REDUCER DIMENSIONS			
Nominal Size	**A**	**B**	**L**
1" × ½"	1.50	1.25	4.00
1" × ¾"	1.50	1.75	4.50
1¼" × 1"	1.86	1.92	4.25
1½" × ¾"	2.50	2.40	5.69
1½" × 1"	2.50	2.28	5.75
2" × 1"	2.49	2.88	6.31
2" × 1¼"	3.15	2.56	6.44
2" × 1½"	2.50	2.72	6.00
3" × 2"	3.22	2.50	6.65
4" × 2"	3.00	3.00	11.87
4" × 2"	2.75	2.75	7.16
4" × 3"	3.13	3.13	8.62
6" × 4"	4.22	3.75	9.13
8" × 6"	5.00	4.64	10.70
10" × 8"	6.63	6.25	14.98
12" × 10"	6.63	6.25	14.88

Call for availability of other sizes and dimensions.

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	B2	Cont'd:	C0
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	

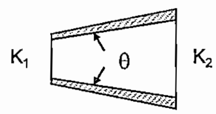
Title: Evaporation Spray System - Piping and Pumps Sizing

CALCULATION OF REDUCER / ENLARGER RESISTANCE COEFFICIENTS

REDUCER / ENLARGER PARAMETERS

Reducer / Enlarger Type: REDUCER

K Factor Referenced to: LARGER PIPE (K2)



○ STANDARD REDUCER / ENLARGER DIMENSIONS

Pipe Connection	Diameter	Schedule	I.D. (in.)
Smaller Pipe	4 inches	Steel SCH. 40	4.026
Larger Pipe	6 inches	Steel SCH. 40	6.065
Reducer / Enlarger Length (Refer to Standard Dimensions table at right), in.			4.00

◉ USER DEFINED REDUCER / ENLARGER DIMENSIONS

Pipe Connection Internal Diameter	I.D. (in.)
Smaller Pipe:	3.938
Larger Pipe:	5.798
Reducer / Enlarger Length, in.:	1.16

RESULTS

Beta Ratio of Fitting (β): 0.679

Internal Angle of Fitting (θ): 77.4 degrees

RESISTANCE COEFFICIENT (K): **1.001**

INSTRUCTIONS

1. The Reducer / Enlarger Parameters determine which equation is used to calculate the resistance coefficient (K value) of the fitting. Refer to Crane Technical Paper #410 (1998 Ed.) page A-26 for the equations used in this calculation. The equations used are the same regardless of whether the Standard or User Defined Dimensions are used.

2. This spreadsheet will automatically determine whether a fitting is gradual or sudden based on the input diameters and fitting length. The angle (θ) is displayed in the results section for reference. Crane #410 defines a gradual fitting as θ ≤ 45 degrees and a sudden fitting as θ > 45 degrees.

3. Use the "Radio Buttons" to select between the Standard Dimensions and the User Defined Dimensions.

4. The Standard Reducer / Enlarger Dimensions section contains look-up tables that determine pipe internal diameters for steel and stainless steel piping. The fitting length has to be entered manually (shown in **BLUE**) and the table to the right should be used as a guide when selecting standard sizes. Note that pipe couplings (sudden reducers / enlargers) are typically used in piping systems that are 2" and smaller. The fitting length for these couplings should be entered as 0.00".

5. The User Defined Reducer / Enlarger Dimensions section allows the User to specify their own pipe inside diameters and overall fitting length. These inputs are shown in **BLUE**.

6. See the Instructions Sheet, section D-4, on how to incorporate the K value into the Pressure Drop calculation.

STANDARD DIMENSIONS OF STEEL REDUCERS / ENLARGERS

Pipe Size	Length	Pipe Size	Length
2.5 X 1		28 X 18	
2.5 X 1.25	3.5"	28 X 20	
2.5 X 1.5		28 X 24	24"
2.5 X 2		28 X 26	
3 X 1.25		28 X 26	
3 X 1.5	3.5"	30 X 20	
3 X 2		30 X 24	
3 X 2.5		30 X 26	24"
4 X 1.5		30 X 28	
4 X 2	4"	32 X 24	
4 X 2.5		32 X 26	24"
4 X 3		32 X 28	
6 X 2.5		32 X 30	
6 X 3	5.5"	34 X 24	
6 X 4		34 X 26	
8 X 4	6"	34 X 30	24"
8 X 6		34 X 32	
10 X 4		36 X 24	
10 X 6	7"	36 X 26	
10 X 8		36 X 30	24"
12 X 6		36 X 32	
12 X 8	8"	36 X 34	
12 X 10		38 X 26	
14 X 6		38 X 28	
14 X 8	13"	38 X 30	
14 X 10		38 X 32	24"
14 X 12		38 X 34	
16 X 6		38 X 36	
16 X 8		40 X 30	
16 X 10	14"	40 X 32	
16 X 12		40 X 34	24"
16 X 14		40 X 36	
18 X 10		40 X 38	
18 X 12	15"	42 X 30	
18 X 14		42 X 32	
18 X 16		42 X 34	
20 X 10		42 X 36	24"
20 X 12		42 X 38	
20 X 14	20"	42 X 40	
20 X 16		44 X 36	
20 X 18		44 X 38	24"
22 X 14		44 X 40	
22 X 16	20"	44 X 42	
22 X 18		46 X 38	
22 X 20		46 X 40	28"
24 X 16		46 X 42	
24 X 18	20"	46 X 44	
24 X 20		48 X 40	
24 X 22		48 X 42	28"
26 X 18		48 X 44	
26 X 20	24"	48 X 46	
26 X 22			
26 X 24			

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	**Calc. No:**	03131-001-ME-103	**Sheet No:**	C0	**Cont'd on**	C1
Prepared By:	J. Dutreuil	**Date:**	6/29/2011	**Checked By:**		**Date:**	

Title: **Evaporation Spray System – Piping and Pumps Sizing**

APPENDIX__C__ TO CALCULATION (for Computer Analysis Input/Output Sheet)

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

INPUT/OUTPUT PRODUCED ON COMPUTER NO. C1642

BURNS AND ROE ENTERPRISES, INC.

W.O. No.:	03131-001	Calc.:	03131-001-ME-103	Sheet No:	C1	Cont'd:	D0
Prepared By:	J. Dutreuil	Date:	6/29/2011	Checked By:		Date:	
Title:	Evaporation Spray System - Piping and Pumps Sizing						

PUMP DESIGN SHEET

PUMP INFORMATION

Service:	Spraying System	Equipment Tag(s):	Later
Location:	TA-52 Site	Quantity Required:	Two (2) Pumps

SYSTEM SKETCH

See Drawings: C55751-M-6000 Rev. A and C55751-M-6001 Rev. A in Appendix J

FLUID PROPERTIES

(1) Fluid Pumped	Waste Water	(5) Specific Gravity @ Temperature	0.999
(2) Pump Capacity	150 gpm	(6) Viscosity @ Temperature	0.975 cP
(3) Margin for Capacity	5 %	(7) Vapor Pressure @ Temperature	0.36 psia
(4) Pumping Temperature	70 F	(8) Feet of Fluid Head	2.31 ft/psi

HYDRAULIC SUMMARY

SUCTION SIDE:			DISCHARGE SIDE:		
(9) Terminal Pressure		16.10 psia	(18) Terminal Pressure		51.10 psia
(10) Static Head	4.5 ft =	1.95 psi	(19) Static Head	0 ft =	0.00 psi
(11) Equipment Loss		0.20 psi	(20) Equipment Loss		1.30 psi
(12) Piping Friction Loss		1.47 psi	(21) Piping Friction Loss		5.93 psi
(13) Margin for Piping Loss		10.00 %	(22) Margin for Piping Loss		10.00 %
(14) Total Piping Loss with Margin		1.62 psi	(23) Total Piping Loss with Margin		6.52 psi
(15) Total Suction Pressure		16.23 psia	(24) Control Valve Loss (Confirm with I&C)		0.00 psi
(16) NPSHA in psi		15.87 psi	(25) Pump Wear		0.00 psi
(17) NPSHA in feet		36.69 ft	(26) Total Discharge Pressure		58.92 psia

DESIGN CONDITIONS

(27) Total Differential Pressure	43 psi
(28) **Total Head (TH or TDH)**	**99 ft**
(29) **Design Capacity**	**158 gpm**
(30) **Design NPSHA**	**37 ft**
(31) User Estimated Pump Efficiency	50 %
(32) **Estimated Pump Horsepower**	**8 bhp**

CONSTRUCTION FEATURES

(33) Packing/Mechanical Seal/Flushing Liquid:

(34) Suggested Materials of Construction:

Casing

Impeller

Shaft

Remarks:

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	**Calc. No:**	03131-001-ME-103	**Sheet No:**	D0	**Cont'd on**	D1
Prepared By:	J. Dutreuil	**Date:**	6/29/2011	**Checked By:**		**Date:**	

Title: **Evaporation Spray System – Piping and Pumps Sizing**

Appendix D

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

Based on the Maximum Cumulative Evaporation Tank Volume, the Maximum Depth of Water in the Evaporation Tank is 13.51 inches, which is less than the design requirement of 36 inches.

Burns and Roe Enterprises, Inc.

W.O. No:	03131-001	**Calc. No:**	03131-001-ME-103	**Sheet No:**	E0	**Cont'd on**	E1
Prepared By:	J. Dutreuil	**Date:**	6/29/2011	**Checked By:**		**Date:**	

Title: **Evaporation Spray System – Piping and Pumps Sizing**

Appendix E

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

Total Suction Static Head = Height from Grade to Maximum Depth of Water + Height of Pumphouse Pad + Height from Pumphouse Pad to Centerline of pump inlet

Total Suction Static Head= 28.49" + 6" + 41 ¾" = 76.24" = 6.36' below pump inlet

Atmospheric pressure = 11.10 psia (per Reference 6)
Specific Gravity @ 70 °F = 0.999
Elevation from pump inlet to Evaporation Tank maximum water depth = -6.36 ft.
Since there is a negative suction static head, the maximum pressure in the suction piping will be atmospheric pressure.

$P_{Sdesign} = 11.10$

Add 10%.
$P_{Sdesign} = 11.10 + 1.11 = 12.21$ psia
$P_{Sdesign} = 12.21 - 11.1 = 1.11$ psig

Use 5 psig as Discharge Design Pressure.

Summary of Suction Design Conditions

The new Effluent Transfer Pump Suction design conditions are as follows:

New Effluent Transfer Pump Suction 5 psig / 70 °F

Suction Pipe Class Selection

Piping for the Effluent Transfer System is HDPE, ASME B31.3.

From Reference 7, the following Pipe Class is appropriate:

New Effluent Transfer Pump Suction 502 Polyethylene Piping DR 17, 100 psig and below, ASME B31.3

Routing from Evaporation Tank Sump to New Effluent Transfer Pump Inlet

Using the Transfer Piping Plan drawings (per Reference 8), the length of straight pipe was calculated using the "Measure" ability in AutoCAD. Appendix A shows the piping estimates. The length of pipe used in the calculation of Friction Head Loss in the pipe was the maximum distance, from the Evaporation Tank Sump to the New Effluent Transfer Pump. The total length of pipe is 66' – 11". 25% will be added to the total pipe length to cover all of the elevation changes of pipe and the pipe routing within the pump house, the result is 83.65 feet. 85 feet will be used in the calculation.

Suction Pipe Sizing

Using the Burns and Roe Standard Pressure Drop Calculation, the pressure drop due to friction in the pipe can be calculated. Design Inputs are as follows:

Average Pressure = Design Pressure = 5 psig = 16.1 psia
Average Temperature = Design Temperature = 70 °F
@ 70 °F, Specific Volume of water (per Reference 9) = 0.016045 ft^3/lb
@ 70 °F, Absolute Viscosity of water (per Reference 9) = 0.97570 cP
Flow Rate (per Reference 6) = 150 GPM
Straight Pipe Length = 85 ft.

Appendix F

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

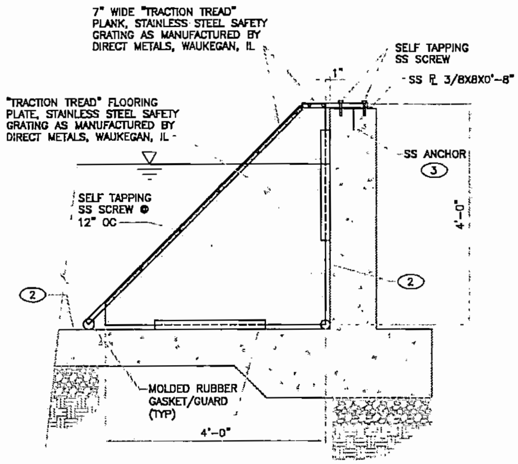
Summary of RFP Requirements	ECC Team Technical Strategy
	of ancillary equipment meets all standards for physical and seismic protection. The geology and seismology of the site are integrated into the design approach to ensure excessive stress does not develop in the system.
Double liner of Resource Conservation and Recovery Act (RCRA) approved fabric, drained to a sump with leak detection between the two liners.	Liner system installed sequentially, entailing: 12-ounce density geotextile layer, 40-mil HDPE secondary liner, 220-mil integrated geomesh leak detection system, and 60-mil HDPE primary liner. The leak detection system will have warning light alarms.
High-density polyethylene (HDPE) transfer piping to and from the point of connection at TA-50 to and from the zero liquid discharge evaporation tanks. Includes ability to transfer from the basins back to the existing facility and any required ancillary equipment. The same single line may be used for transfer both directions.	Four-inch diameter HDPE piping has been selected for transfer from the point of connection at TA-50 to and from the zero liquid discharge evaporation tanks. The design accommodates the retransfer of liquids back to TA-50. New effluent lines direct fluids to a pump house, where fluids are transferred through pumps to maintain desired flow rates and retain capacity for incoming fluids.
Tanks sized to handle 5 million liters of treated effluent from the Radioactive Liquid Waste Treatment Facility at TA-50. Incorporate weather data (TA-53 precipitation and Santa Fe pan evaporation data) and monthly quantities of treatment effluent in design.	Calculation of evaporation rates and required basin capacities will be prepared by the Engineer of Record to meet these criteria. Preliminary calculations are provided. Tank capacity design has taken into consideration the provided weather data.
The tank or tanks shall be designed to fit within the area indicated on the site area map.	Our concept plan shows how we will utilize the allocated area, taking advantage of natural grade, and integrating existing features and tie-in points.
Effluent transfer system shall be designed to allow the transfer of 150 gallons per minute. Transfer line shall be capable of year round transfer. Water will be transferred ina batch-type operation.	The design of the transfer line will accommodate the stated discharge rate and head pressure of the transfer and retransfer pumps. The line will be buried at depth for frost protection and/or be heat traced to allow for year round transfer.
The tanks shall be designed and installed with a minimum of eight (8) wildlife escape ramps. Ramps are to be 45 degree incline, a minimum of 4 ½" wide, and must be made of materials that will not contaminate the water in case it is sent back to RLWTF for retreatment.	Eight (8) wildlife escape ramps have been incorporated into the design. The ramps are of sufficient incline and minimum width to facility wildlife escape. Ramp materials will not contaminate the water in the case of retransfer back to the RLWTF.
Mechanical assistance equipment (e.g. fountains and / or heaters) can be included in the design to achieve the evaporation of the treated effluent.	Mechanical assistance equipment has been incorporated into the design to facility evaporation and will be capable of operation at least 7 months out of the year.
Overfill prevention controls can be considered, such as visual beacon alarm that indicates when the water level in the tank gets too high and a valve system that automatically close when overfill is likely.	Level indicator and alarms are provided triggering shutoff of flow, if needed, and transfer for liquids to other basins.
The minimum freeboard for the tank(s) is 12 inches between the surface of the water and the top of the tank.	A proposed freeboard of 12 inches is provided in the ECC team concept design.
The tank(s) may be placed partially below grade to maximize the cut and fill requirements for placing the tank/s at the project site.	Portions of the tank are below grade as shown in the provided design drawings. The proposed positioning of the tank(s) minimizes cut and fill

Appendix G

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

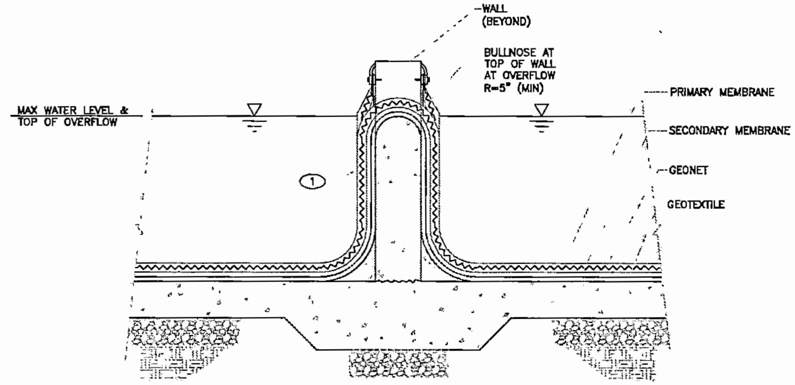
GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FOR INFORMATION NOT SHOWN REFER TO SHEET S-3010.



A S-4010 SECTION–ANIMAL EGRESS RAMP

1'=1'-0"



B S-1010 SECTION–OVERFLOW

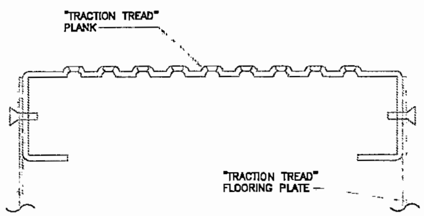
1"=1'-0"

KEYED NOTES

1. LINER COMPONENTS SHOWN AT EXAGGERATED SCALE FOR CLARITY.
2. LINER COMPONENTS NOT SHOWN FOR CLARITY.
3. POST INSTALLED ANCHORS SHALL BE OF THE KWIK BOLT TZ SYSTEM AS MANUFACTURED BY HILTI AND INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS. TOTAL BOLT LENGTH SHALL BE 3 3/4" WITH A BOLT DIAMETER OF 3/8".
4. LEVEL INDICATOR SHALL BE 60 MIL HDPE MEMBRANE TO MATCH PRIMARY MEMBRANE, COLORED WHITE, WITH BLACK LEVEL LINES AND NUMERALS, AS MANUFACTURED BY GSE, CORONA, CA. INDICATOR SHALL BE BONDED TO PRIMARY MEMBRANE IN FIELD IN ACCORDANCE WITH MANUFACTURER'S STANDARDS. LEVEL LINES FOR FOOT INTERVALS SHALL BE 4" LONG, NUMERALS SHALL BE 3" HIGH.

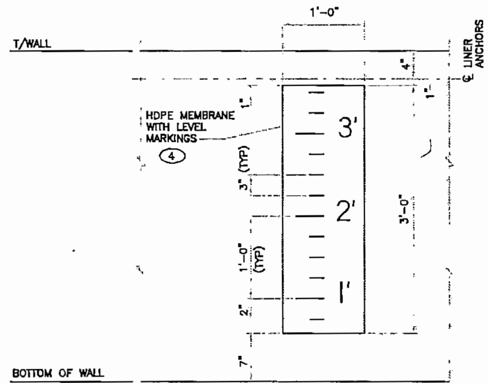
PRODUCT OPTIONS AND SUBSTITUTIONS

"OR APPROVED EQUAL" IS ALWAYS IMPLIED AFTER A BRAND NAME, PATENTED PROCESS OR CATALOG NUMBER. THE SUBCONTRACTOR MAY SUBSTITUTE ANY BRAND OR PROCESS APPROVED AS AN EQUAL BY THE SPECIFYING ARCHITECT/ENGINEER THROUGH THE SUBMITTAL PROCESS. THE ONLY EXCEPTION IS WHERE "NO SUBSTITUTION" IS SPECIFIED. SEE GENERAL PROVISION "MATERIAL AND WORKMANSHIP".



C S-4010 SECTION–TRACTION TREAD PLANK

1 1/2"=1'-0"



D S-1010 SECTION–LEVEL INDICATOR SIGN

1 1/2"=1'-0"

60% REVIEW "NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK SECTIONS 2

DRAWN J. AMICO
DESIGN B. URGO
CHECKED
DATE

BLDG N/A TA-52
SUBMITTED
APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET S-3011 OF

CLASSIFICATION U
REVIEWER
DATE

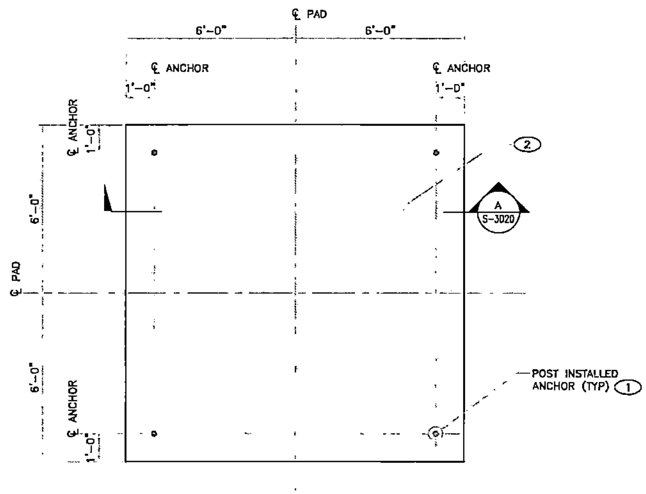
PROJECT ID 100761
DRAWING NO C-55751
REV A

STATUS: 6/29/2011

Plotted By: ###### Plot Date: 7/6/2011
FILE NAME: C55751-S-3011-RA.DWG

Appendix H

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2



NOTE: FOR LOCATION SEE SHEET C-4001

PLAN-PUMP HOUSE PAD

1/2"=1'-0"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

KEYED NOTES

1. POST INSTALLED ANCHORS SHALL BE OF THE KWIK BOLT TZ SYSTEM AS MANUFACTURED BY HILTI AND INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS. TOTAL BOLT LENGTH SHALL BE 8 1/2" WITH PROJECTION OF 2" AND MINIMUM EMBEDMENT OF 6 1/2".
2. PUMP SKIDS, PIPE AND CONDUIT PENETRATIONS NOT SHOWN.

PRODUCT OPTIONS AND SUBSTITUTIONS

"OR APPROVED EQUAL" IS ALWAYS IMPLIED AFTER A BRAND NAME, PATENTED PROCESS OR CATALOG NUMBER. THE SUBCONTRACTOR MAY SUBSTITUTE ANY BRAND OR PROCESS APPROVED AS AN EQUAL BY THE SPECIFYING ARCHITECT/ENGINEER THROUGH THE SUBMITTAL PROCESS. THE ONLY EXCEPTION IS WHERE "NO SUBSTITUTION" IS SPECIFIED. SEE GENERAL PROVISION "MATERIAL AND WORKMANSHIP".

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

PUMP HOUSE PLAN

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	
DATE	

BLDG 182 TA-52

SUBMITTED

APPROVED FOR RELEASE JOSEPH BROPHY

SHEET S-1020 OF

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

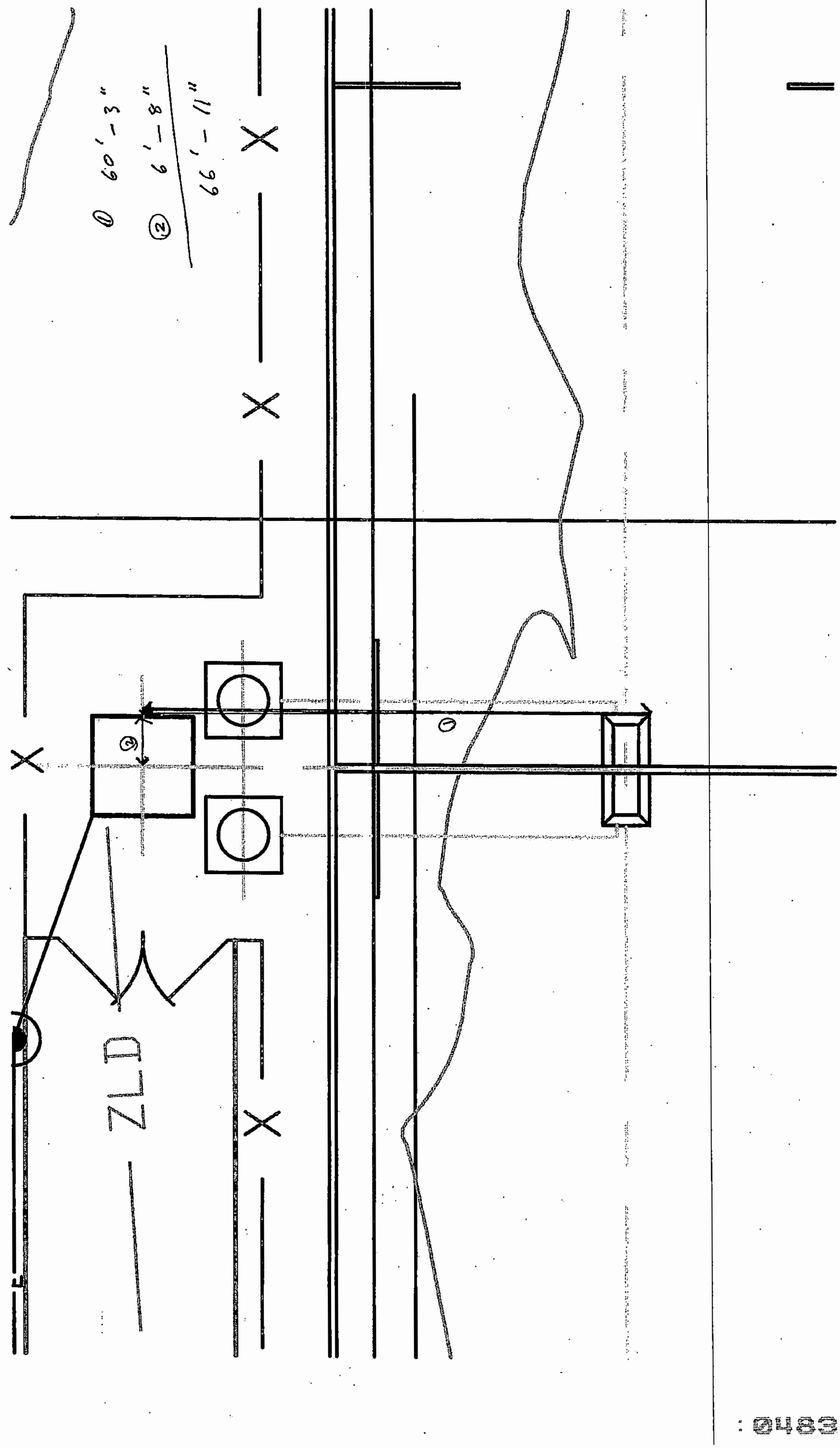
CLASSIFICATION U | REVIEWER EDWARD ARTIGLIA | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: ###### Plot Date: 7/6/2011
FILE NAME: C55751-S-1020-RA.DWG

Appendix I

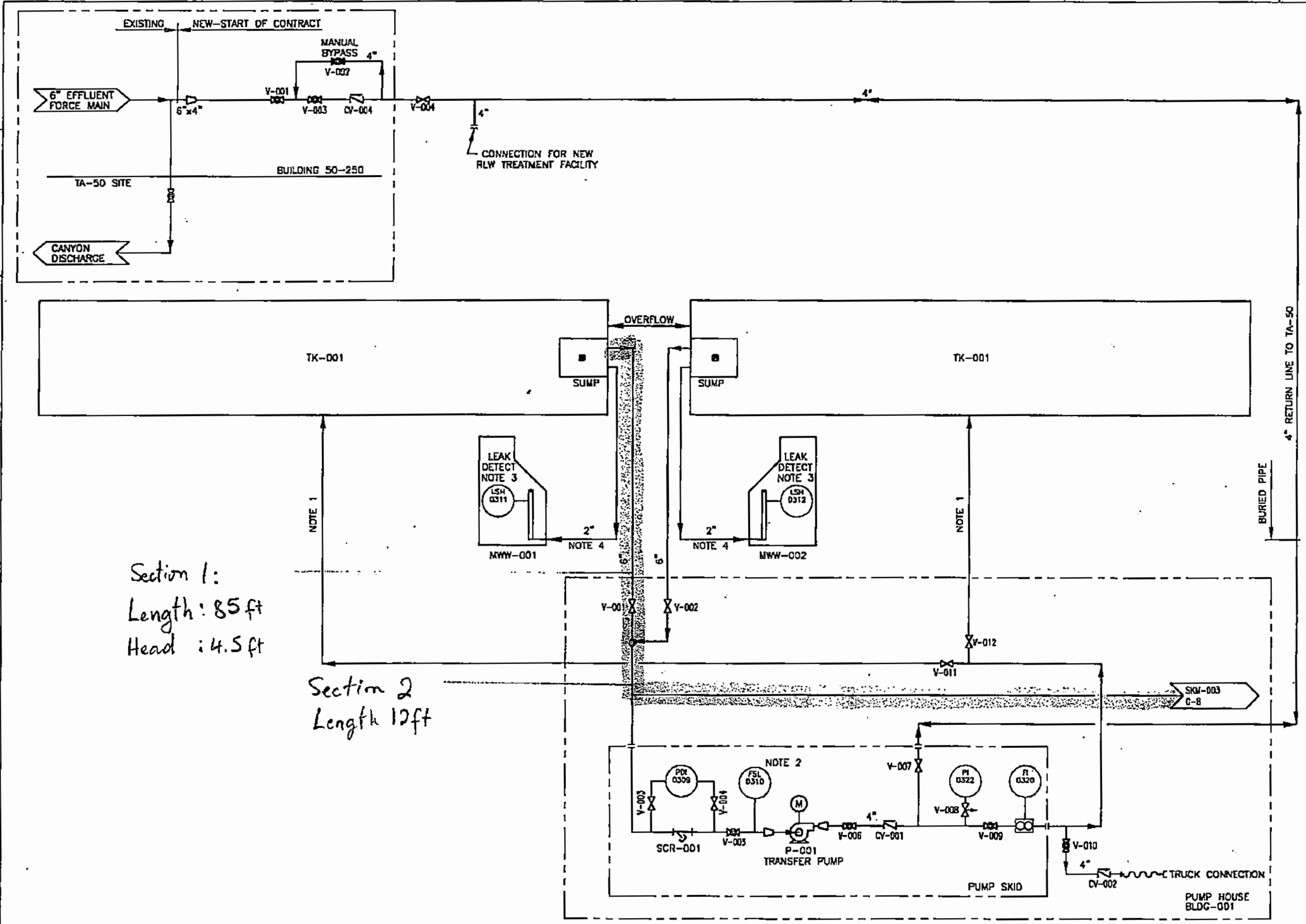
TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2



: 04838

Appendix J

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 3



TA-52 SITE

ZERO LIQUID DISCHARGE P&ID

SCALE: NONE

GENERAL NOTES:

1. HEAT TRACE ABOVE GROUND PIPING ONLY.
2. LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY).
3. LEAK DETECTION ALARMS ARE DIRECTED TO A LOCAL ALARM PANEL, WITH FLASHING BEACON, AT THE PUMP ENCLOSURE.
4. 2" CONTAINMENT PIPE WITH ¾" TEFLON HOSE TO MAN HOLE.

SEQUENCE OF OPERATION:

TRANSFER PUMPS:
LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY). THRU VALVE LINEUPS TANK CONTENTS CAN BE TRANSFERRED FROM ONE TANK TO ANOTHER TANK OR RETURNED TO SOURCE BY ONE OR BOTH TRANSFER PUMPS.

MANUAL BYPASS:

LEAK DETECTION:
LEAK DETECTION ALARMS ARE DIRECTED TO A LOCAL ALARM PANEL, WITH FLASHING BEACON, AT THE PUMP ENCLOSURE. TO TANK LEAK DETECTION.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

Burns and Roe Enterprises, Inc.

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE P&ID AND SEQUENCE OF OPERATION

DRAWN T. HARPER
DESIGN
CHECKED
DATE

BLDG 181,182,183 TA-52

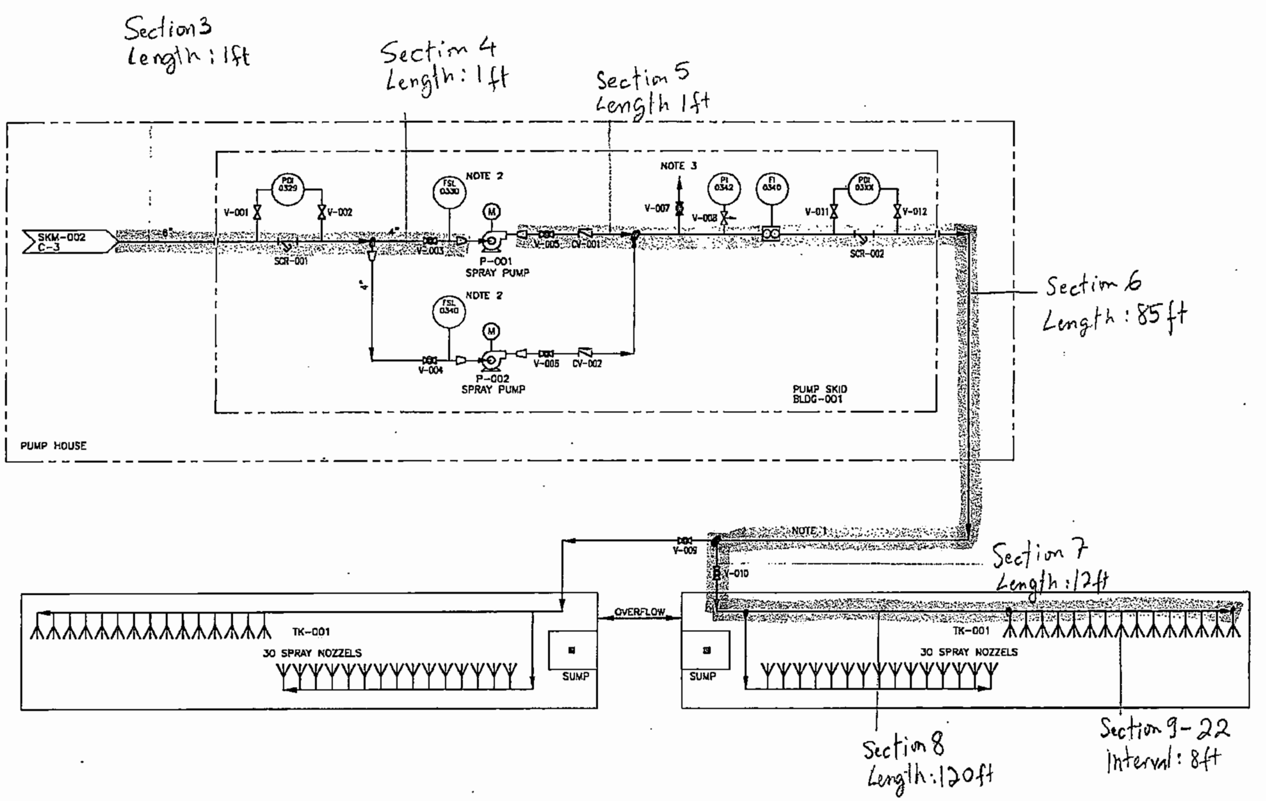
SUBMITTED PROJ_ENGR
APPROVED FOR RELEASE PROJ_TEAM_LEADER

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-6000 OF

CLASSIFICATION Classification REVIEWER Reviewer DATE Date

PROJECT ID 100761 DRAWING NO C-55751 REV A



TA-52 SITE

SPRAY SYSTEM FOR EVAPORATION TANKS

SCALE: NONE

GENERAL NOTES:

1. HEAT TRACE ABOVE GROUND PIPING ONLY.
2. LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY).
3. SPRAY NOZZLE HEADERS ARE TO BE SELF DRAINING. LOCATE ¾" VENT WITH GLOBE VALVE AT HIGH POINT OF SPRAY PIPING AND ¾" DRAINS AS REQUIRED ON SPRAY HEADERS AT LOW POINTS. SPRAY PIPING HIGH POINT SHALL BE LOCATED INSIDE THE PUMP HOUSE.

SEQUENCE OF OPERATION:

SPRAY SYSTEM:

NOZZELS:

WHIRL JET SPRAY DRY NOZZLES, HOLLOW CONE AS MANUFACTURED BY SPRAYING SYSTEMS.

SPRAY PUMPS:

LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF IT RUNS DRY (AFTER DELAY). MANUAL OPERATION WHEN SPRAYING IS REQUIRED TO ENHANCE EVAPORATION. ONE PUMP WILL BE UTILIZED FOR SPRAYING ONE TANK. EITHER PUMP CAN BE USED FOR EITHER TANK THROUGH VALVE LINE UPS. SYSTEM IS DESIGNED FOR SPRAYING BOTH TANKS SIMULTANEOUSLY. STARTING AND STOPPING OF ONE OR BOTH SPRAY PUMPS IS A MANUAL OPERATION VIA A LOCAL START/STOP PUSH BUTTON. A LOW FLOW WILL CAUSE A PUMP OR PUMPS TO TRIP IF TANK OR TANKS RUNS DRY (AFTER DELAY).

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
A	–	–	–	FOR INFORMATION ONLY	TJH	–	–	–	–

Burns and Roe Enterprises, Inc.

ZERO LIQUID DISCHARGE
SUBPROJECT

ZERO LIQUID DISCHARGE P&ID AND
SEQUENCE OF OPERATION

DRAWN T. HARPER
DESIGN
CHECKED
DATE

BLDG 181,182,183 TA-52

SUBMITTED PROJ_ENGIN
APPROVED FOR RELEASE PROJ_TEAM_LEADER

Los Alamos NATIONAL LABORATORY
PO Box 1663
Los Alamos, New Mexico 87545

SHEET M-6001
OF

CLASSIFICATION U
REVIEWER
DATE

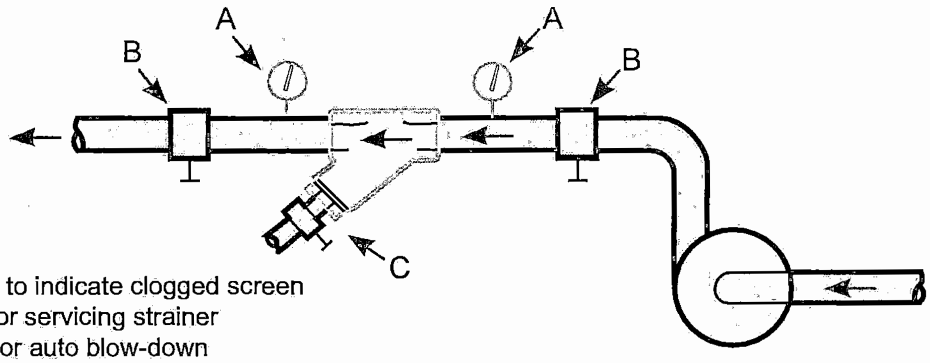
PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: HARPER Plot Date: 8/27/2011

Appendix K

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

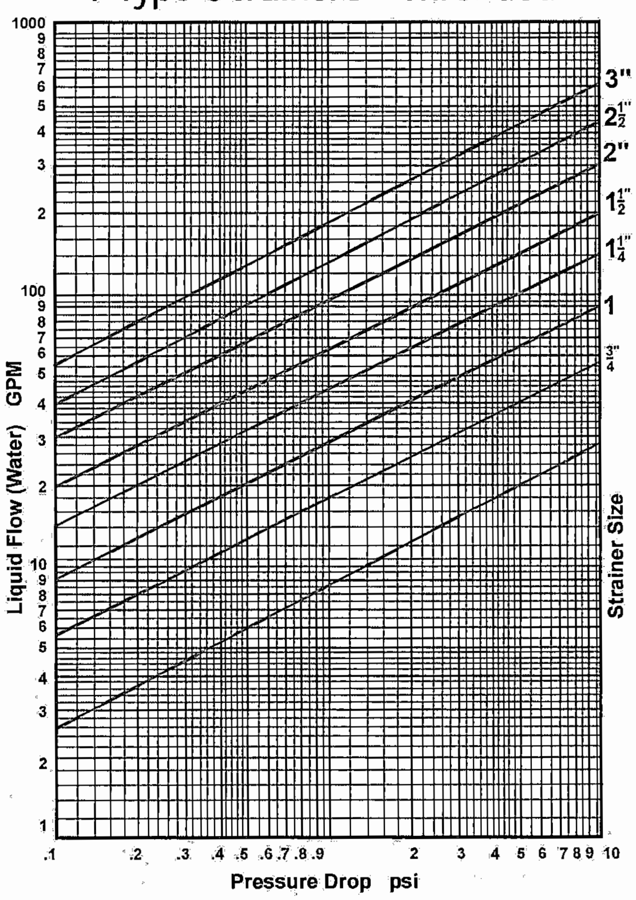
"Y" Strainers take their name from their configuration. They are most commonly used in pressurized lines, gas or liquid, but can also be used in suction or vacuum conditions. They are intended for applications where small amounts of solid particulate are expected, and where clean-out will be infrequent. If solids will flush easily from the screen, and fluid can be exhausted to atmosphere, a blow-down valve on the drain port will allow clean-out without removal of the screen, and without interrupting the process flow.



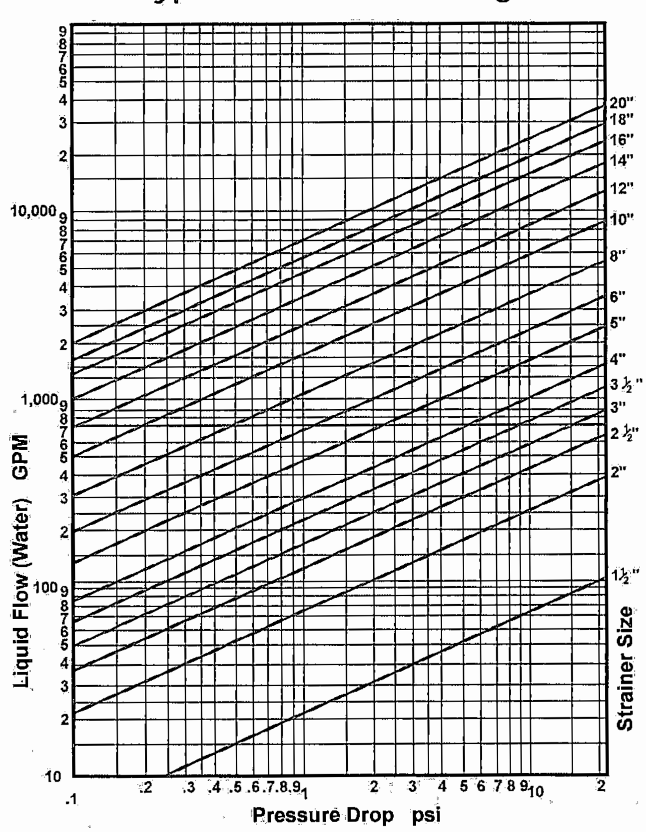
A. Pressure gauges to indicate clogged screen
B. Isolation valves for servicing strainer
C. Optional manual or auto blow-down

Flow Rate vs Pressure Drop

Y-Type Strainers - Threaded



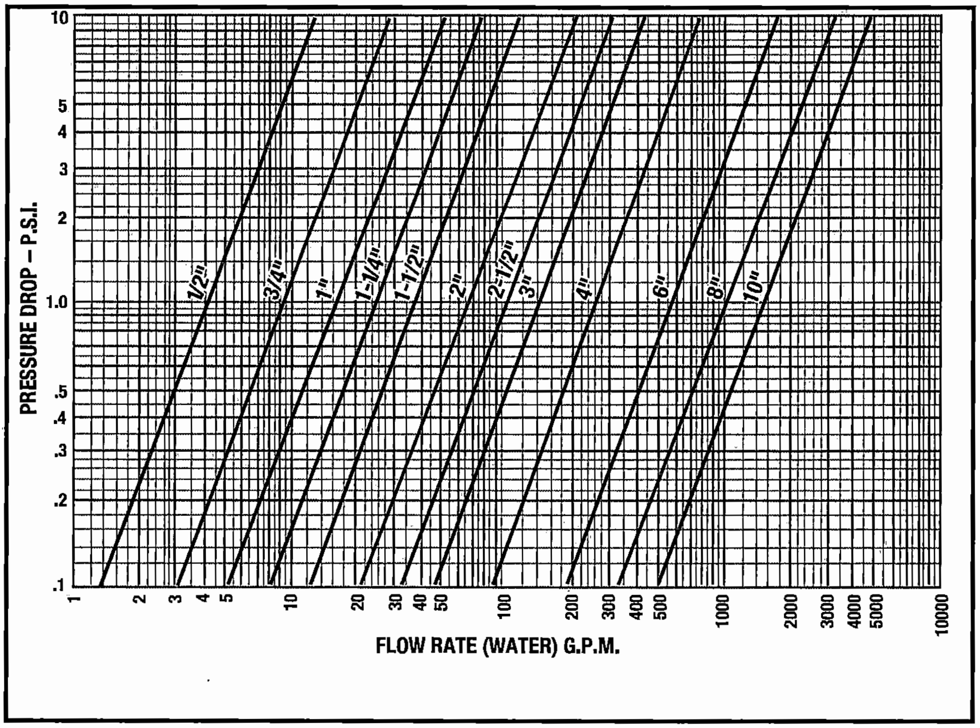
Y-Type Strainers - Flanged



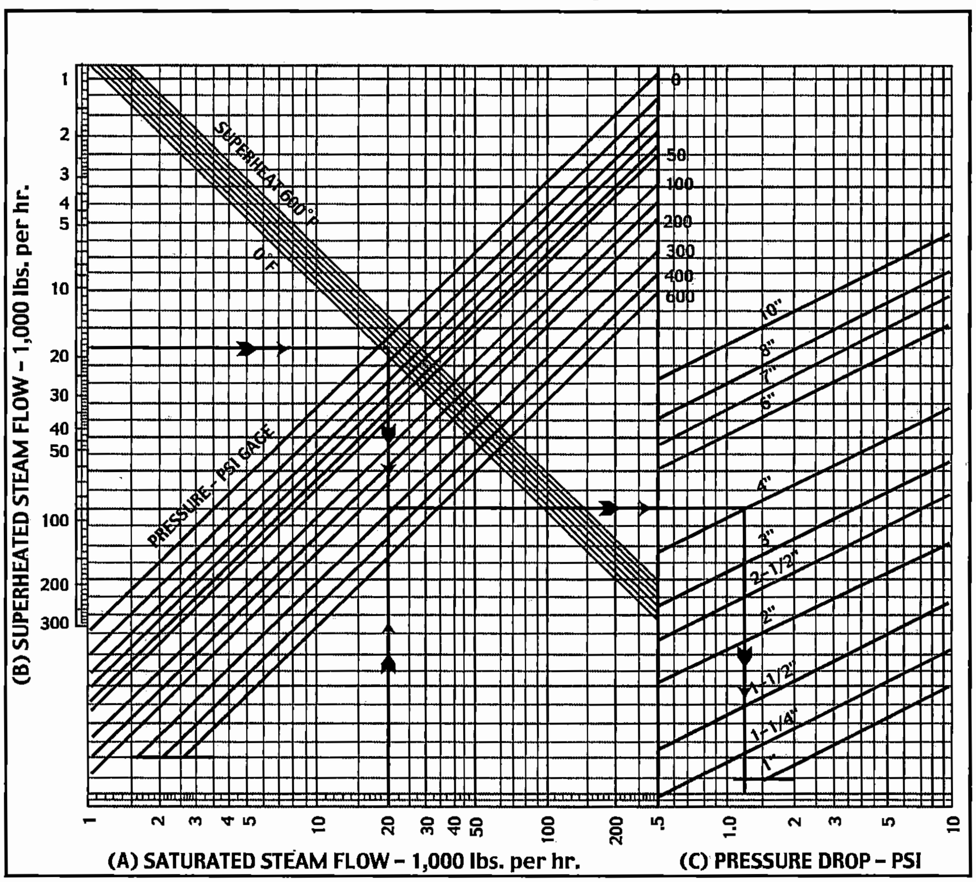
Appendix L

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

Water Pressure Drops



Steam Pressure Drops



Calculating Saturated Steam Pressure Drop

Example:

Pressure = 300 psig
Flow Rate = 20,000 lb/hr
Strainer Size = 4 inches

1. Locate steam flow on Scale A.
2. Follow vertical line to required pressure.
3. Follow horizontal line to strainer size.
4. Follow vertical line downward and read pressure drop on Scale C.
5. Pressure drop equals 1.25 psi.

Calculating Superheated Steam Pressure Drop

Example:

Pressure = 300 psig
Flow Rate = 18,000 lb/hr
Strainer Size = 4 inches

1. Locate steam flow on Scale B.
2. Follow horizontal line to superheat.
3. Follow vertical line to pressure.
4. Follow horizontal line to strainer size.
5. Follow vertical line downward and read pressure drop on Scale C.
6. Pressure drop equals 1.25 psi.

Note: Use the superheat temperature value above the saturated steam temperature to obtain the point on this graph.

Appendix M

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 2

1. PURPOSE

This Standard establishes the maximum allowable velocities for flow of water and steam in pipes.

2. SCOPE

The maximum allowable velocities presented in this Standard are applicable to the majority of cases involving sizing of piping in conventional power plant piping systems.

This Standard should be used in conjunction with the following Burns and Roe Standards:

P153450M1 - Calculating Pressure Drop

P153450M2 - Estimate of Pipe Sizes and Pressure Drop for Water

3. MAXIMUM VELOCITIES

The following maximum allowable velocities are intended as a guide for designing pipelines.

FLUID	MAXIMUM VELOCITY
Water -	
Feedwater Discharge	20 fps
All Other	12 fps
Steam -	
Superheated	20,000 fpm
Saturated	15,000 fpm

4. DESIGN VELOCITIES

4.1 The determination of the design velocity for a piping system should be based on the available pressure drop from the point of supply to the point of consumption without exceeding the maximum allowable velocities stated above.

4.2 The determination of the design velocities for Condensate, Feedwater, and Circulating Water systems, should be based on the economic analyses of piping, equipment, and pumping costs in addition to the requirement of 4.1.

Appendix N

TOTAL NUMBER OF SHEETS CONTAINED IN THIS APPENDIX (including this sheet): 4

Dutreuil, Jerry

From: Titchenell, Robert <Bob.Titchenell@spray.com>
Sent: Wednesday, June 22, 2011 8:52 AM
To: Stuhrke, Stephen
Cc: Dutreuil, Jerry; Tarr, Lisa
Subject: RE: Zero Liquid Discharge Project - Los Alamos, New Mexico
Attachments: 5100-3.pdf; 36275.pdf

Steve,
Per our conversation, attached is a coverage data sheet for the 25 & 40 degree VeeJet nozzles. The 2550 or 4050 will give you 5 gpm @ 40 psi. Also, I am including pricing and a data sheet for our 36275 adjustable ball fitting.

P/n H1/4U-4050 (or 2550), Brass veejet (flat fan pattern), ¼" NPT (M) inlet
Cost...Qty: 36-99...$3.77 ea

P/n 36275-1/4x1/4, Brass adjustable ball fitting 1/4Fx!1/4M
Cost...Qty: 36-99...$12.37 ea

Delivery: 2 wks.

Who will be placing the order?

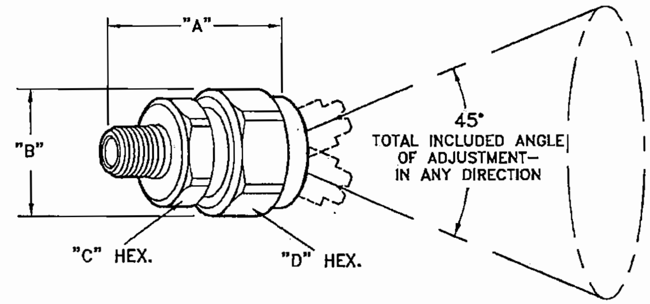
15 psi is on the low side. The pattern is not well defined. I would like to see a minimum of 30 psi. Optimum is 40. The equivalent orifice diameter is .172". I suggest using a minimum of 50 mesh filter.

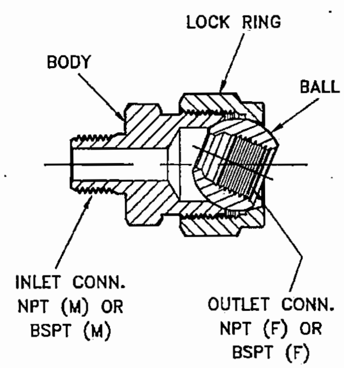
Regards,

Bob Titchenell
cell #610-505-3404
Bob.Titchenell@spray.com

From: Stuhrke, Stephen [mailto:SStuhrke@roe.com]
Sent: Tuesday, June 21, 2011 6:20 PM
To: Titchenell, Robert
Cc: Dutreuil, Jerry
Subject: Zero Liquid Discharge Project - Los Alamos, New Mexico

ADJUSTABLE BALL FITTING No.	MATERIAL	INLET CONN.	OUTLET CONN.	DIMENSIONS "A"	"B"	"C" HEX.	"D" HEX.	NET WEIGHT
36275-1/8x1/8	BRASS	1/8" NPT (M)	1/8" NPT (F)	1 3/8" (34.9 mm)	31/32" (24.6 mm)	3/4" (19.1 mm)	7/8" (22.2 mm)	2 oz. (0.057 kg)
36275-1/8x1/8-SS	STAINLESS STEEL							
B36275-1/8x1/8	BRASS	1/8" BSPT (M)	1/8" BSPT (F)					
B36275-1/8x1/8-SS	STAINLESS STEEL							
36275-1/4x1/4	BRASS	1/4" NPT (M)	1/4" NPT (F)	1 9/16" (39.7 mm)	1 3/32" (27.8 mm)	7/8" (22.2 mm)	1" (25.4 mm)	3 oz. (0.085 kg)
36275-1/4x1/4-SS	STAINLESS STEEL							
B36275-1/4x1/4	BRASS	1/4" BSPT (M)	1/4" BSPT (F)					
B36275-1/4x1/4-SS	STAINLESS STEEL							
36275-1/4x1/8	BRASS	1/4" NPT (M)	1/8" NPT (F)	1 9/16" (39.7 mm)	1 3/32" (27.8 mm)	7/8" (22.2 mm)	1" (25.4 mm)	3.1 oz. (0.088 kg)
36275-1/4x1/8-SS	STAINLESS STEEL							
B36275-1/4x1/8	BRASS	1/4" BSPT (M)	1/8" BSPT (F)					
B36275-1/4x1/8-SS	STAINLESS STEEL							
36275-3/8x3/8	BRASS	3/8" NPT (M)	3/8" NPT (F)	1 25/32" (45.2 mm)	1 3/8" (34.9 mm)	1 1/8" (28.6 mm)	1 1/4" (31.8 mm)	5.5 oz. (0.156 kg)
36275-3/8x3/8-SS	STAINLESS STEEL							
B36275-3/8x3/8	BRASS	3/8" BSPT (M)	3/8" BSPT (F)					
B36275-3/8x3/8-SS	STAINLESS STEEL							
36275-3/8x1/4	BRASS	3/8" NPT (M)	1/4" NPT (F)	1 25/32" (45.2 mm)	1 3/8" (34.9 mm)	1 1/8" (28.6 mm)	1 1/4" (31.8 mm)	5.7 oz. (0.162 kg)
36275-3/8x1/4-SS	STAINLESS STEEL							
B36275-3/8x1/4	BRASS	3/8" BSPT (M)	1/4" BSPT (F)					
B36275-3/8x1/4-SS	STAINLESS STEEL							
36275-1/2x1/2	BRASS	1/2" NPT (M)	1/2" NPT (F)	2 7/32" (56.4 mm)	1 21/32" (42.1 mm)	1 3/8" (34.9 mm)	1 1/2" (38.1 mm)	10 oz. (0.283 kg)
36275-1/2x1/2-SS	STAINLESS STEEL							
B36275-1/2x1/2	BRASS	1/2" BSPT (M)	1/2" BSPT (F)					
B36275-1/2x1/2-SS	STAINLESS STEEL							
36275-1/2x1/4	BRASS	1/2" NPT (M)	1/4" NPT (F)	1 7/8" (47.6 mm)	1 3/8" (34.9 mm)	1 1/8" (28.6 mm)	1 1/4" (31.8 mm)	5.7 oz. (0.162 kg)
36275-1/2x1/4-SS	STAINLESS STEEL							
B36275-1/2x1/4	BRASS	1/2" BSPT (M)	1/4" BSPT (F)					
B36275-1/2x1/4-SS	STAINLESS STEEL							
36275-1/2x3/8	BRASS	1/2" NPT (M)	3/8" NPT (F)	1 7/8" (47.6 mm)	1 3/8" (34.9 mm)	1 1/8" (28.6 mm)	1 1/4" (31.8 mm)	5.3 oz. (0.151 kg)
36275-1/2x3/8-SS	STAINLESS STEEL							
B36275-1/2x3/8	BRASS	1/2" BSPT (M)	3/8" BSPT (F)					
B36275-1/2x3/8-SS	STAINLESS STEEL							
36275-3/4x3/4	BRASS	3/4" NPT (M)	3/4" NPT (F)	2 13/32" (61.1 mm)	1 29/32" (48.4 mm)	1 3/4" (44.5 mm)	1 7/8" (47.6 mm)	17 oz. (0.483 kg)
36275-3/4x3/4-SS	STAINLESS STEEL							
B36275-3/4x3/4	BRASS	3/4" BSPT (M)	3/4" BSPT (F)					
B36275-3/4x3/4-SS	STAINLESS STEEL							





FEATURES:

- PROVIDES ADJUSTABLE POSITIONING OF SPRAY NOZZLES FOR PRECISE CONTROL OF SPRAYING DIRECTION.
- LOCK RING HOLDS THE NOZZLE IN POSITION EVEN WHEN JARRED OR SUBJECTED TO VIBRATION.
- MAXIMUM PRESSURE – 300 PSI (21 bar).
- NOZZLE REMOVAL FOR CLEANING AND READJUSTMENT IS QUICK AND SIMPLE.
- AVAILABLE IN BRASS, 303 STAINLESS STEEL AND OTHER MATERIALS.

HOW TO ORDER: SPECIFY ADJUSTABLE BALL FITTING No.
EXAMPLE: 36275-1/8x1/8

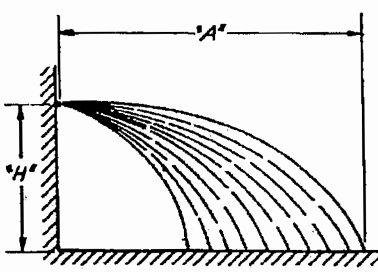
DESCRIPTION:
NO. 36275--- LOCK RING ADJUSTABLE BALL FITTINGS

Spraying Systems Co.®
Spray Nozzles and Accessories
P.O. Box 7900 - Wheaton, Il. 60189-7900

Rev. No.	Data Sheet No. 36275
Ref.	SHEET OF

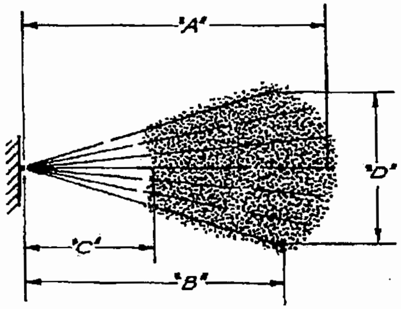
NOZZLE NO.	"H"	10 p.s.i. "A"	10 p.s.i. "B"	10 p.s.i. "C"	10 p.s.i. "D"	20 p.s.i. "A"	20 p.s.i. "B"	20 p.s.i. "C"	20 p.s.i. "D"	40 p.s.i. "A"	40 p.s.i. "B"	40 p.s.i. "C"	40 p.s.i. "D"	80 p.s.i. "A"	80 p.s.i. "B"	80 p.s.i. "C"	80 p.s.i. "D"
-- 4002	3'	8	7½	5	3	8½	7½	5	3½	9	8	4½	4½	10	8	4½	4½
	5'	9	8	5	3½	9½	8	4½	4	9½	8	4½	4½	10½	8½	4½	5
	7'	9½	9	5	3½	9½	9	4½	4½	10	9	4½	5	10½	9	4½	5
	10'	9½	9	5	4	9½	9	4½	4½	10	9	4½	5	10½	9	4½	5
-- 4004	3'	9½	9	5	3½	10	9	5	4	11	9	5	5	12½	10½	5	5
	5'	11	10	5	3½	11½	10½	5	4½	12½	10½	5	5½	13½	11½	5	5½
	7'	12	11	5	4	12½	11	5	4½	13½	11½	5	5½	16	12	5	5½
	10'	12½	11	5	4½	13½	11	5	5	14	12	5	5½	16½	13	5	5½
-- 4008	3'	11	9½	6	4½	12½	10½	6	5½	14	11½	6	6	15½	13	6	6
	5'	12	10	6½	5½	13½	12	6½	6	16	13½	6	6½	18½	14	6	6½
	7'	13½	11	6½	5½	14½	12	6½	6	16½	13½	6	6½	19	14	6	6½
	10'	14	11½	6½	5½	16	12	6½	6	18½	13½	6	6½	19½	14	6	6½
-- 4015	3'	11½	10	7	4½	13	11½	6½	6	16	13½	6½	6½	18½	14	6	6½
	5'	13½	12½	7½	4½	15	13	7½	6	18	14½	7	6½	20	15	6	6½
	7'	14½	13½	7½	4½	16½	14	7½	6	19½	15	7	6½	22½	17	6	7
	10'	16	15	8	5	19½	15	7½	6½	23½	17	7	7	25	18½	7	7½
-- 4030	3'	13½	12	7½	4½	16	14½	7	6½	20	16	7	7½	23	16	7	8
	5'	15	13	7½	5½	18	16	7	6½	22	17½	7	8	25	19	7	8
	7'	17	15½	8	6	20	18	7½	7	24	19	7	8½	27	21	7	8½
	10'	18	16½	8½	6½	23	20	8	8	27	21	8	9½	30½	22	7½	8½
-- 4050	3'	13½	12	8	4½	16½	14	8	7	20½	16	8	7½	24½	18	8	8½
	5'	16	14½	8½	5½	20	17	8½	7½	24	18	8	8	28	20	8	9
	7'	17	15½	8½	6	21	18	8½	7½	26½	20	8½	8½	30½	21½	8½	9½
	10'	19	17	9	6½	26	20	9	8½	30	22	9	10	34	24	9	10
-- 40100	3'	14½	13	8½	6½	18	16	8	7½	22	18	8½	8	26	20	8½	9
	5'	17	15	8½	7	21½	18	8½	8	26	20	8½	8½	29	23	8½	9½
	7'	18	16	9	8	24	20	9	8½	30	22	9	9	33	26	9	10
	10'	21	19	9½	8½	28	23	9	9	33	25	10	10½	37½	29	10	11
-- 40200	3'	15	13½	8½	7	20	17½	8	8½	27	21	8½	9	29	22	9	9½
	5'	18	15½	8½	8½	25½	19	9	9½	30	22	9½	10½	31	24	9½	10½
	7'	19½	16	9	9½	26½	21½	9½	10½	33	26	9½	10½	35	27	10	10½
	10'	29	20	10	10	30	25	10½	11	36½	28	11	11	39	30	11	11

NOZZLE NO.	"H"	10 p.s.i. "A"	10 p.s.i. "B"	10 p.s.i. "C"	10 p.s.i. "D"	20 p.s.i. "A"	20 p.s.i. "B"	20 p.s.i. "C"	20 p.s.i. "D"	40 p.s.i. "A"	40 p.s.i. "B"	40 p.s.i. "C"	40 p.s.i. "D"	80 p.s.i. "A"	80 p.s.i. "B"	80 p.s.i. "C"	80 p.s.i. "D"
-- 2502	3'	11	10	8½	1	11½	10½	8	1½	12	11	7½	2	12½	11½	7	3
	5'	12½	11½	9	1½	12½	11½	8	2	13	11½	7½	3	13½	12½	7	3
	7'	13½	12½	9	1½	13½	12	8	2½	13½	11½	7	3	14	12½	6	3
	10'	15½	13	9	2	15½	12	8	2½	15½	12	7	3	15½	12½	6	3½
-- 2504	3'	11½	10	8	1½	12	11	7	2½	13	11½	6½	3	14½	13	6	3½
	5'	12½	11	8	2½	12½	11	7½	3	14½	12	7	3½	16	14	7	4
	7'	14	12	8½	2½	14½	12½	8	3½	15½	13	7	4	17	15	7	4
	10'	15½	14	8½	2½	15½	14	8	3½	16	14	7½	4	19	16	7½	4
-- 2508	3'	12	11	8½	2	14	13	7½	2½	15½	14	7	3½	18½	16	6	4
	5'	14½	12	8½	2½	16	13	8	3	17	15	7	3½	19	17	6	4
	7'	16	14	8½	2½	16½	14	8	3	19	17	7½	3½	21	19	6½	4
	10'	17	15	8	3	18½	17	8	3½	19½	17½	7½	4	22½	20	6½	4½
-- 2515	3'	13	11½	7½	2½	15½	14	7½	3½	19	17	7	4	21	18	6	4½
	5'	15½	14	8	3	17	15	7½	4	20½	18	7	5	24	19	6	5
	7'	16½	14½	8½	3½	19	16	8	4	22	19	8	5	25½	19½	7	5½
	10'	18	15	8½	3½	20	17½	8	4½	23½	19	8	5½	27	21	7	5½
-- 2530	3'	13½	12	8	3½	16½	15	7½	4½	20	18	7	5	23	18½	7	5½
	5'	16	14	8½	4	19	17	8	5	24	19	7	6	26½	19	7	6
	7'	17½	15	8½	4	21	18	8	5½	26	20	7½	6½	28	20	7½	6½
	10'	19	17	8½	4½	23	20	8	6	27½	22	7½	7	30	23	7½	7
-- 2550	3'	14	13	8	4	18	17	8	5½	23	18	7½	6½	25	18	7½	6½
	5'	16½	15	8	4	21	19	8	5½	26	20	8	7	30	21	8	7
	7'	19	18	8½	4½	22½	20½	8½	6	27½	22	8½	7	32	23	8½	7
	10'	20	18	9	5	24	22	9	6½	30	23	8½	7½	34½	24	8½	7½
-- 25100	3'	15½	13½	8½	4	19	17	8	5½	25	19½	8	6½	26½	21	8	6½
	5'	17½	15½	8½	4	22	20	8½	6	28	22	8½	7	31	26	8½	6½
	7'	19½	18	9	4½	24	20½	9	6½	31	25	9	7	34	29	9	7
	10'	22	19	9½	5	27	22	9½	6½	35	26	9½	7½	39	30	9½	7½
-- 25200	3'	15½	14	9	4	20	17	8½	5½	28	24	8½	6½	30	25	8½	6½
	5'	18½	16½	10	4	24	22	10	6	30	26	9½	6½	33	28	9½	6½
	7'	20½	18	10½	5	28	23	10½	6½	34	28	10	7	37	32	10	7
	10'	24½	22	11½	5	30	25	11	7	35	29	11	7½	40	35	11	7½



SIDE VIEW OF SPRAY

5100-3



TOP VIEW OF SPRAY PATTERN

DIMENSIONS "A", "B", "C", "D" AND "H" ARE GIVEN IN FEET

TABULATION IS BASED ON WATER AT TEMPERATURE OF 70°F.

WHEN A WETTING AGENT IS USED, DECREASING THE SURFACE TENSION TO 30 DYNES/CM., DIMENSIONS "A", "B", AND "C" ARE REDUCED APPROX. 5%. "D" REMAINS APPROX. SAME AS LISTED ABOVE.

COVERAGES OF FLAT SPRAY NOZZLES NOT LISTED ABOVE CAN BE DETERMINED BY INTERPOLATING IN THE TABULATION.

DESCRIPTION

SPRAY PATTERN DIMENSIONS FOR FLAT SPRAY UNIJET AND VEEJET NOZZLES -SPRAYING HORIZONTALLY-

SPRAYING SYSTEMS CO.
Engineers and Manufacturers
NORTH AVENUE AT SCHMALE ROAD • WHEATON, ILLINOIS 60187

DATE 4-22-68

DWG. NO. 5100
SHEET 3 OF 4

13851

2 of 4

ENCLOSURE 3
Radioactive Liquid Waste Treatment Facility
Project 100761 (RLWTF-UP)
ZLD Subproject
July 13, 22011

ENV-RCRA-11-0136
LAUR-11-11041

Los Alamos
NATIONAL LABORATORY
Los Alamos NM 87545

60% Design Package: Drawings, Specifications, Calculations

UNCLASSIFIED

"Enclosure 3_CD_Design Drawings" file

RADIOACTIVE LIQUID WASTE TREATMENT FACILITY (RLWTF)

BLDG 181,182,183 TA-50,52,63

LIST OF DRAWINGS

GENERAL DRAWINGS

REVISION NUMBER	SHEET NUMBER	DRAWING NUMBER	DRAWING TITLE
A		G-0001	TITLE SHEET AND LIST OF DRAWINGS

CIVIL/STRUCTURAL DRAWINGS

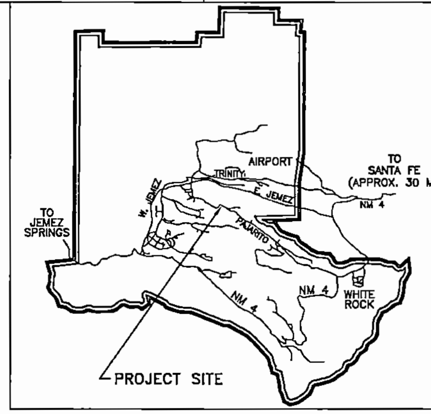
REVISION NUMBER	SHEET NUMBER	DRAWING NUMBER	DRAWING TITLE
A	C-0001	C-55751	LEGENDS AND SYMBOLS
A	C-0002	C-55751	CIVIL NOTES
A	C-1010	C-55751	PROJECT SITE PLAN
A	C-1020	C-55751	TANK AREA SITE PLAN
A	C-1025	C-55751	TANK AREA BORING LOCATION PLAN
A	C-1030	C-55751	TANK AREA GRADING PLAN
A	C-1040	C-55751	TANK AREA CUT & FILL PLAN
A	C-1050	C-55751	TANK AREA USE PLAN
A	C-1151	C-55751	TRANSFER PIPE AREA USE PLAN 1
A	C-1152	C-55751	TRANSFER PIPE AREA USE PLAN 2
A	C-1153	C-55751	TRANSFER PIPE AREA USE PLAN 3
A	C-3001	C-55751	TANK AREA SECTION 1
A	C-4001	C-55751	TANK AREA ENLARGED PLOT PLAN
A	C-5001	C-55751	TYPICAL DETAILS SITE DETAILS 1
A	C-5002	C-55751	TYPICAL DETAILS SITE DETAILS 2
A	C-5003	C-55751	TYPICAL DETAILS SITE DETAILS 3
A	C-5004	C-55751	TYPICAL DETAILS SITE DETAILS 4
A	C-5101	C-55751	TRANSFER PIPE TYPICAL DETAILS
A	S-0001	C-55751	STRUCTURAL NOTES
A	S-1010	C-55751	TANK PLAN
A	S-1011	C-55751	TANK JOINT PLAN
A	S-1020	C-55751	PUMP HOUSE PLAN
A	S-3010	C-55751	TANK SECTIONS 1
A	S-3011	C-55751	TANK SECTIONS 2
A	S-3020	C-55751	PUMP HOUSE SECTIONS
A	S-4010	C-55751	TANK ENLARGED PLAN
A	S-5001	C-55751	TYPICAL DETAILS STRUCTURAL DETAILS 1
A	S-5010	C-55751	TANK DETAILS 1

ELECTRICAL DRAWINGS

REVISION NUMBER	SHEET NUMBER	DRAWING NUMBER	DRAWING TITLE
A	E-0001	C-55751	ELECTRICAL SYMBOL LEGEND AND GENERAL NOTES
A	E-1000	C-55751	TANK AREA POLE PLAN
A	E-1001	C-55751	DISTRIBUTION – NEW 3 WAY TAP ON EXISTING POLE 2903 – DETAIL
A	E-1002	C-55751	DISTRIBUTION – NEW 3 WAY TAP ON EXISTING POLE 2903 – BILL OF MATERIAL
A	E-1003	C-55751	DISTRIBUTION SINGLE ARM POLE 2903B – DETAIL
A	E-1004	C-55751	DISTRIBUTION SINGLE ARM POLE 2903B – BILL OF MATERIAL
A	E-1005	C-55751	3-PHASE TRANSFORMER BANK ON DEAD END POLE 2903C WITH UNDERGROUND SECONDARY DETAIL
A	E-1006	C-55751	DISTRIBUTION 60°-90° ANGLE POLE 2903A – DETAIL
A	E-1007	C-55751	DISTRIBUTION 60°-90° ANGLE POLE 2903A – BILL OF MATERIAL
A	E-1008	C-55751	PUMP HOUSE UNDERGROUND GROUNDING AND CONDUIT PLAN
A	E-1009	C-55751	GUY POLE DETAILS
A	E-6000	C-55751	ELECTRICAL ONE LINE DIAGRAM
A	E-7000	C-55751	ELECTRICAL PANEL SCHEDULE
A	E-7001	C-55751	ELECTRICAL NAMEPLATE SCHEDULE
A	E-7002	C-55751	ELECTRICAL BILL OF MATERIALS

MECHANICAL/INSTRUMENT AND CONTROL DRAWINGS

REVISION NUMBER	SHEET NUMBER	DRAWING NUMBER	DRAWING TITLE
A	M-0001	C-55751	P&ID – LEGENDS AND SYMBOLS
A	M-0002	C-55751	P&ID – LEGENDS AND SYMBOLS
A	M-0003	C-55751	P&ID – LEGENDS AND SYMBOLS
A	M-1000	C-55751	TRANSFER PIPING PLAN & PROFILE 1
A	M-1001	C-55751	TRANSFER PIPING PLAN & PROFILE 2
A	M-1002	C-55751	TRANSFER PIPING PLAN & PROFILE 3
A	M-1003	C-55751	TRANSFER PIPING PLAN & PROFILE 4
A	M-1004	C-55751	TRANSFER PIPING PLAN & PROFILE 5
A	M-1005	C-55751	PUMP HOUSE GA & COMPOSITE PIPING
A	M-1006	C-55751	ZLD SPRAY PIPING COMPOSITE PLAN
A	M-1007	C-55751	ZLD SPRAY PIPING COMPOSITE PLAN
A	M-1008	C-55751	ZLD SPRAY PIPING COMPOSITE PLAN
A	M-1009	C-55751	ZLD SPRAY PIPING COMPOSITE PLAN
A	M-1010	C-55751	ZLD SPRAY PIPING COMPOSITE PLAN
A	M-1011	C-55751	ZLD SPRAY PIPING COMPOSITE PLAN
A	M-1012	C-55751	ZLD SPRAY PIPING COMPOSITE PLAN
A	M-1013	C-55751	ZLD SPRAY PIPING COMPOSITE PLAN
A	M-1014	C-55751	ZLD TRANSFER PIPING COMPOSITE PLAN AT TANKS
A	M-3000	C-55751	PIPING SECTIONS
A	M-4000	C-55751	TERMINAL POINTS ENLARGED PLAN VIEWS
A	M-5000	C-55751	TYPICAL PIPING DETAILS
A	M-5006	C-55751	INSTRUMENT INSTALLATION DETAILS
A	M-5007	C-55751	INSTRUMENT INSTALLATION DETAILS
A	M-6000	C-55751	ZLD P&ID AND SEQUENCE OF OPERATION
A	M-6001	C-55751	ZLD P&ID AND SEQUENCE OF OPERATION
A	M-7000	C-55751	INSTRUMENT INDEX
A	M-7001	C-55751	MECHANICAL BILL OF MATERIALS
A	M-7002	C-55751	VALVE SCHEDULE



LOCATION PLAN
SCALE: NONE

DISTRIBUTION LIMITATION STATEMENT
FURTHER DISSEMINATION AUTHORIZED TO THE DEPARTMENT OF ENERGY AND DOE CONTRACTORS ONLY; OTHER REQUESTS SHALL BE APPROVED BY THE ORIGINATING FACILITY OR HIGHER DOE PROGRAMMATIC AUTHORITY.

100761-11-000090_Drawings

"NOT FOR CONSTRUCTION" 60% REVIEW

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TITLE SHEET AND LIST OF DRAWINGS
SHEET 1
BLDG 181,182,183 TA-50 TA-52 TA-63

DRAWN: E. NEMCEK
DESIGN: E. NEMCEK
CHECKED: S. STUHRKE
DATE:

SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY
PO Box 1663
Los Alamos, New Mexico 87545

SHEET G-0001 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-G-0001-RA.DWG

8	7	6	5	4	3	2	1

CIVIL SYMBOLS

SYMBOL	DESCRIPTION
	PROPERTY LINE INDICATOR
	SURFACE DRAINAGE
EL	EXISTING CONTOUR
EL	FINISHED CONTOUR
	UNDISTURBED EARTH OR TUFF
	SELECT COMPACT FILL
	ROCK
	COURSE POROUS FILL
	FINE POROUS FILL
	TOP OF SLOPE
	TOE OF SLOPE
BM	BENCHMARK INDICATOR
EL	CONTROL ELEVATION INDICATOR
NO EL	MONUMENT NO=SEQUENTIAL DESIGNATION EL=ELEVATION
NO EL	BORING INDICATOR NO=SEQUENTIAL DESIGNATION EL=ELEVATION
EL	EXISTING ELEVATION INDICATOR
EL	FINISH ELEVATION INDICATOR
SC	STEAM/COMMUNICATIONS MANHOLE
	STORM DRAIN GRATE
X	C – PRECAST CONCRETE, COMMUNICATION VAULT
	E – PRECAST CONCRETE, ELECTRICAL VAULT
	F – PRECAST CONCRETE, FUEL OIL VAULT
	G – PRECAST CONCRETE, NATURAL GAS VAULT
	T – PRECAST CONCRETE, TELEPHONE VAULT
	THRUST BLOCK
	TEE FITTING
	VALVE
	NOT USED
X	G – UTILITY, METER, NATURAL GAS
	S – UTILITY, METER, SANITARY
	W – UTILITY, METER, WATER
	CULVERT/END SECTION
	DRAINAGE ARROW

SYMBOL	DESCRIPTION
X	C – COMMUNICATION MANHOLE
	D – STORM DRAIN MANHOLE
	E – ELECTRICAL MANHOLE
	G – NATURAL GAS MANHOLE
	S – SEWER MANHOLE
	T – TELEPHONE MANHOLE
	W – WATER MANHOLE
	FIRE HYDRANT
W	UTILITY–WATER REGULATOR VALVE
TV	PRECAST CONCRETE, MANHOLE, TRANSFORMER VAULT
PB	PULL BOX
MH	MANHOLE
TP	TURNING POINT
℄	CENTERLINE
	PROPERTY LINE
	FLOW LINE
	HANDICAP DESIGNATION
25	INTERSTATE ROUTE
66	U.S. ROUTE
50	STATE ROUTE
	EXISTING PROPERTY CORNER INDICATOR
	NEW PROPERTY CORNER INDICATOR
MATERIAL	VAULT
CO	CLEANOUT
CO	DOUBLE CLEANOUT
CB	CATCH BASIN
	SITE UTILITIES (PIPING)
—PW—	POTABLE WATER
—C—	CONDENSATE
—S—	STEAM
—G—	NATURAL GAS HIGH PRESSURE (>5 PSI)
—SS—	SANITARY SEWER
— STS —	STORM SEWER
—F—	FIRE PROTECTION WATER
—SWTE—	SANITARY WASTEWATER TREATED EFFLUENT
—E—	ELECTRICAL
—T—	TELECOMMUNICATION
—ZLD—	ZERO LIQUID DISCHARGE

LINE TYPES

SYMBOL	DESCRIPTION
	CENTER LINE
	DIMENSION LINE
	LEADER LINE
	FUTURE CONSTRUCTION
	EXISTING CONSTRUCTION
	HIDDEN LINE
	NEW CONSTRUCTION AND REVISION CLOUD
	NEW CONST. BACKGROUND
	MATCH LINE
	EXISTING TO BE REMOVED
	BREAK LINE

ABBREVIATIONS

BOT	BOTTOM
B/WALL	BOTTOM OF WALL
℄	CENTERLINE
DIA, ⌀	DIAMETER
EA	EACH
EF	EACH FACE
EL	ELEVATION
EXP	EXPANSION
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
LG	LONG
LP	LOW POINT
MAX	MAXIMUM
MIN	MINIMUM
OC	ON CENTER
℘	PLATE
R	RADIUS
REQD	REQUIRED
SYM	SYMMETRICAL
SS	STAINLESS STEEL
T	THICKNESS
TOC	TOP OF CONCRETE
T/WALL	TOP OF WALL
TYP	TYPICAL

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

LEGENDS AND SYMBOLS

TA–50 TA–52 TA–63

BLDG 181,182,183

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

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SHEET C–0001 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C–55751 | REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-0001-RA.DWG

GENERAL NOTES

1. ALL CONSTRUCTION WORK SHALL BE DONE IN ACCORDANCE WITH THE PROPERTY OWNER'S, STANDARD PROCEDURES AND SITE SAFETY REQUIREMENTS UNLESS NOTED OTHERWISE ON PLANS AND/OR PROJECT SPECIFICATIONS.
2. THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM HIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS AND OTHER AREAS. THE CONTRACTOR SHALL OBSERVE AND COMPLY WITH ALL FEDERAL, STATE AND LOCAL LAWS REQUIRED FOR THE PROTECTION OF PUBLIC HEALTH AND SAFETY AND ENVIRONMENTAL QUALITY. THE COST INCURRED FOR ANY NECESSARY REMEDIAL ACTION ORDERED BY THE DIRECTOR OF PUBLIC WORKS SHALL BE PAID BY THE CONTRACTOR.
3. CONSTRUCTION DEBRIS AND WASTES SHALL BE REMOVED AND DISPOSED OF AT AN APPROPRIATE SITE.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DAMAGE DUE TO CONSTRUCTION ACTIVITIES, AND FOR THE MAINTENANCE AND PROTECTION OF EXISTING UTILITIES FROM ANY DAMAGE.
5. A PRE-CONSTRUCTION MEETING WITH REPRESENTATIVES FROM THE OWNER, AND THE CONTRACTOR SHALL BE HELD PRIOR TO COMMENCEMENT OF CONSTRUCTION.
6. THE CONTRACTOR SHALL PROVIDE VEHICLE ACCESS TO AND FROM ADJACENT STREETS AT ALL TIMES.
7. ALL EXCAVATION WORK SHALL INCLUDE EXCAVATION CALLED FOR ON THE PLANS AND ANY OTHER INCIDENTAL EXCAVATION WORK NOT CALLED FOR BUT REQUIRED FOR THE CONSTRUCTION OF THIS PROJECT.
8. CONTRACTOR SHALL TAKE EVERY PRECAUTION TO PREVENT VEHICLES FROM TRACKING MUD ONTO PAVED SURFACES, AND OFF THE PROJECT SITE. IN THE EVENT THAT MUD IS PRESENT ON PAVED SURFACES, CONTRACTOR SHALL CLEAN THE AREA IMMEDIATELY.
9. VERIFY AND CHECK ALL DIMENSIONS AND DETAILS SHOWN ON THE DRAWINGS PRIOR TO START OF CONSTRUCTION. ANY DISCREPANCY SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE ENGINEER FOR DIRECTION.
10. THE CONTRACTOR SHALL NOTIFY ALL AGENCIES TO VERIFY THE ACTUAL LOCATIONS OF ALL UTILITIES IN THE PROJECT AREA PRIOR TO EXCAVATING. THE CONTRACTOR SHALL COORDINATE ALL WORK.
11. THE CONTRACTOR SHALL RELOCATE, REMOVE, AND/OR REPLACE ALL EXISTING UTILITIES, ROADWAY PAVEMENT, FENCES, IRRIGATION, AND LANDSCAPING DISTURBED DUE TO WORK RELATED TO THIS PROJECT AS DIRECTED BY THE OWNER.
12. THE CONTRACTOR SHALL RESTORE ALL EXISTING IMPROVEMENTS THAT ARE DAMAGED AS A RESULT OF THE CONSTRUCTION TO THEIR ORIGINAL CONDITION OR BETTER, INCLUDING PAVEMENTS, EMBANKMENTS, CURBS, SIGNS, LANDSCAPING, STRUCTURES, UTILITIES, WALLS, FENCES, ETC.
13. ALL WORK IN THIS PROJECT SHALL INCLUDE THE WORK CALLED FOR ON THE PLANS AND ANY OTHER INCIDENTAL WORK NOT CALLED FOR BUT REQUIRED FOR THE CONSTRUCTION OF THIS PROJECT.
14. CONTRACTOR SHALL FIELD-VERIFY ALL EXISTING CONDITIONS PRIOR TO CONSTRUCTION.
15. WHEN TRENCH EXCAVATION IS ADJACENT TO OR UNDER EXISTING STRUCTURES OR FACILITIES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROPERLY SHEETING AND BRACING THE EXCAVATION AND STABILIZING THE EXISTING GROUND PER OSHA STANDARDS, TO RENDER IT SAFE AND SECURE FROM POSSIBLE SLIDES, CAVE-INS AND SETTLEMENT. THE CONTRACTOR SHALL PROPERLY SUPPORT EXISTING STRUCTURES AND FACILITIES WITH BEAMS, STRUTS OR UNDER-PINNING TO FULLY PROTECT THEM FROM DAMAGE.
16. THE UNDERGROUND PIPES, CABLES OR DUCTLINES KNOWN TO EXIST BY THE ENGINEER FROM HIS SEARCH OF RECORDS ARE INDICATED ON THE PLANS. THE CONTRACTOR SHALL VERIFY THE LOCATIONS AND DEPTHS OF THE FACILITIES AND ANY OTHER FACILITIES NOT SHOWN ON PLAN, AND EXERCISE PROPER CARE IN EXCAVATING IN THE AREA. WHENEVER CONNECTIONS OF NEW UTILITIES TO EXISTING UTILITIES ARE SHOWN ON THE PLANS, THE CONTRACTOR SHALL EXPOSE THE EXISTING LINES AT THE PROPOSED CONNECTIONS TO VERIFY THEIR LOCATIONS AND DEPTHS PRIOR TO EXCAVATION FOR NEW LINES. ALL DAMAGED PORTIONS SHALL BE REPLACED IN ACCORDANCE WITH THE STANDARDS AND SPECIFICATIONS OF THE AFFECTED UTILITY COMPANY AND SHALL BE THE CONTRACTOR'S RESPONSIBILITY.
17. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONFORMANCE WITH THE PROJECT SWPPP. BEST MANAGEMENT PRACTICES SHALL BE EMPLOYED AT ALL TIMES DURING CONSTRUCTION.
18. EXISTING UNDERGROUND UTILITIES AND STRUCTURES AS SHOWN ON THE PLANS ARE FROM THE LATEST AVAILABLE DATA BUT ARE NOT GUARANTEED AS TO THE LOCATION SHOWN OR THAT OTHER OBSTACLES MAY NOT BE ENCOUNTERED IN THE COURSE OF THE WORK. THE CONTRACTOR SHALL NOT ASSUME THAT WHERE NO UTILITIES ARE SHOWN THAT NONE EXISTS.
19. THE CONTRACTOR SHALL SURVEY ALL EXISTING UNDERGROUND UTILITIES AND STRUCTURES AT CROSSINGS TO VERIFY INVERT ELEVATIONS PRIOR TO EXCAVATION OF PIPELINE TRENCH.
20. THE CONTRACTOR, AT THEIR EXPENSE, SHALL KEEP THE PROJECT AND SURROUNDING AREAS FREE FROM DUST NUISANCE AND SHALL TAKE SUPPLEMENTARY MEASURES AS NECESSARY.
21. IT IS THE INTENT OF THESE DRAWINGS AND SPECIFICATIONS TO PROVIDE A COMPLETE INSTALLATION. SHOULD THERE BE OMISSIONS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER. THE CONTRACTOR SHALL PROVIDE AND INSTALL FITTINGS, APPURTENANCES AND MATERIALS AS REQUIRED TO PROVIDE A COMPLETE FUNCTIONABLE UTILITY SYSTEM CONFORMING TO ALL APPLICABLE STANDARDS AND REQUIREMENTS.

GRADING NOTES

1. ALL GRADING WORK SHALL BE DONE IN ACCORDANCE WITH PROJECT SPECIFICATIONS.
2. NO CONTRACTOR SHALL PERFORM ANY GRADING OPERATION SO AS TO CAUSE FALLING ROCKS, SOIL OR DEBRIS IN ANY FORM TO FALL, SLIDE OR FLOW ONTO ADJOINING PROPERTIES, STREETS OR NATURAL WATERCOURSES. SHOULD SUCH VIOLATIONS OCCUR, THE CONTRACTOR MAY BE CITED AND THE CONTRACTOR SHALL IMMEDIATELY MAKE ALL REMEDIAL ACTIONS NECESSARY.
3. ADEQUATE PROVISIONS SHALL BE MADE TO PREVENT SURFACE WATERS FROM DAMAGING THE CUT FACE OF AN EXCAVATION OR THE SLOPED SURFACES OF A FILL. FURTHERMORE, ADEQUATE PROVISIONS SHALL BE MADE TO PREVENT SEDIMENT-LADEN RUNOFF FROM LEAVING THE SITE.
4. ALL SLOPES AND EXPOSED AREAS SHALL BE SODDED OR PLANTED AS SOON AS FINAL GRADES HAVE BEEN ESTABLISHED. PLANTING SHALL NOT BE DELAYED UNTIL ALL GRADING WORK HAS BEEN COMPLETED. GRADING TO FINAL GRADE SHALL BE CONTINUOUS, AND ANY AREA WITHIN WHICH WORK HAS BEEN INTERRUPTED OR DELAYED SHALL BE PLANTED.
5. THE LOCATION OF THE BORROW/DISPOSAL SITE FOR THE PROJECT SHALL BE COORDINATED WITH THE OWNER.
6. THE LIMITS OF THE AREA TO BE GRADED SHALL BE FLAGGED BEFORE THE COMMENCEMENT OF THE GRADING WORK.
7. ALL GRADING OPERATIONS SHALL BE PERFORMED IN CONFORMANCE WITH THE APPLICABLE PROJECT SWPPP, AND IF APPLICABLE, THE NPDES PERMIT FOR THE PROJECT.
8. WHERE APPLICABLE AND FEASIBLE THE MEASURES TO CONTROL EROSION AND OTHER POLLUTANTS SHALL BE IN PLACE BEFORE ANY EARTH MOVING PHASE OF THE GRADING IS INITIATED.
9. TEMPORARY EROSION CONTROLS SHALL NOT BE REMOVED BEFORE PERMANENT EROSION CONTROLS ARE IN-PLACE AND ESTABLISHED.
10. IF THE GRADING WORK INVOLVES CONTAMINATED SOIL, THEN ALL GRADING WORK SHALL BE DONE IN CONFORMANCE WITH APPLICABLE OWNER, STATE AND FEDERAL REQUIREMENTS.
11. ALL GRADING AND CONSTRUCTION WORK SHALL IMPLEMENT MEASURES TO ENSURE THAT THE DISCHARGE OF POLLUTANTS FROM THE CONSTRUCTION SITE WILL BE REDUCED TO THE MAXIMUM EXTENT PRACTICABLE AND WILL NOT CAUSE OR CONTRIBUTE TO AN EXCEEDANCE OF WATER QUALITY STANDARDS.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE - SUBPROJECT

CIVIL NOTES

BLDG 181,182,183

TA-50
TA-52
TA-63

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

SUBMITTED

APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY
PO Box 1663
Los Alamos, New Mexico 87545

SHEET C-0002

OF

CLASSIFICATION U

REVIEWER

DATE

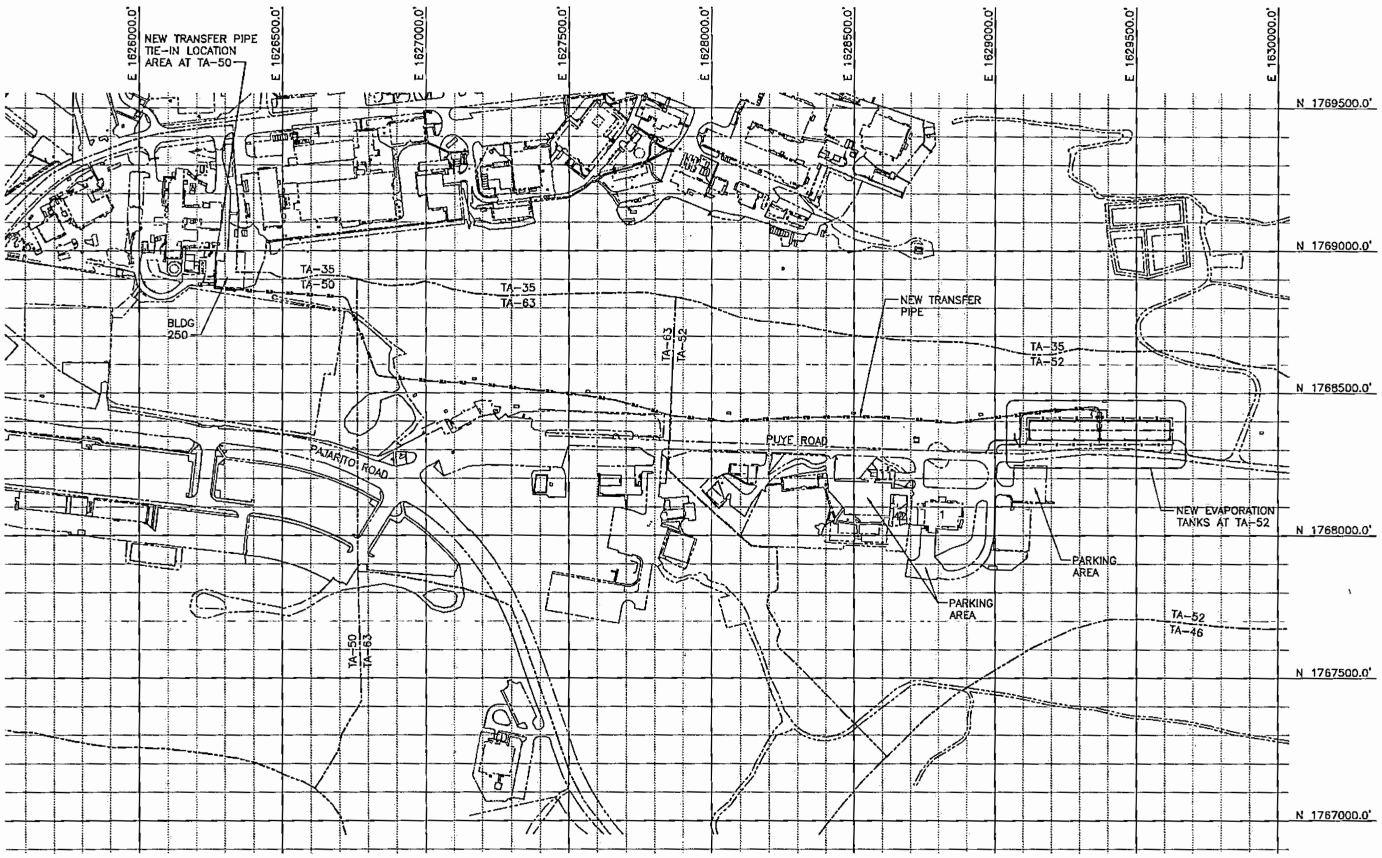
PROJECT ID 100761

DRAWING NO C-55751

REV A

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. TOPOGRAPHIC MAP IS AS PROVIDED BY OWNER, LOS ALAMOS NATIONAL LABORATORY (LANL). COORDINATE GRID SHOWN IS BASED UPON TOPOGRAPHIC MAP FILE PROVIDED, WITH PLAN NORTH AS INDICATED.



SITE PLAN

0 200' 400'

1"=200'-0"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

PROJECT SITE PLAN

TA-50
TA-52
TA-63

BLDG 181,182,183

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

SUBMITTED

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Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET C-1010 OF

CLASSIFICATION U

REVIEWER

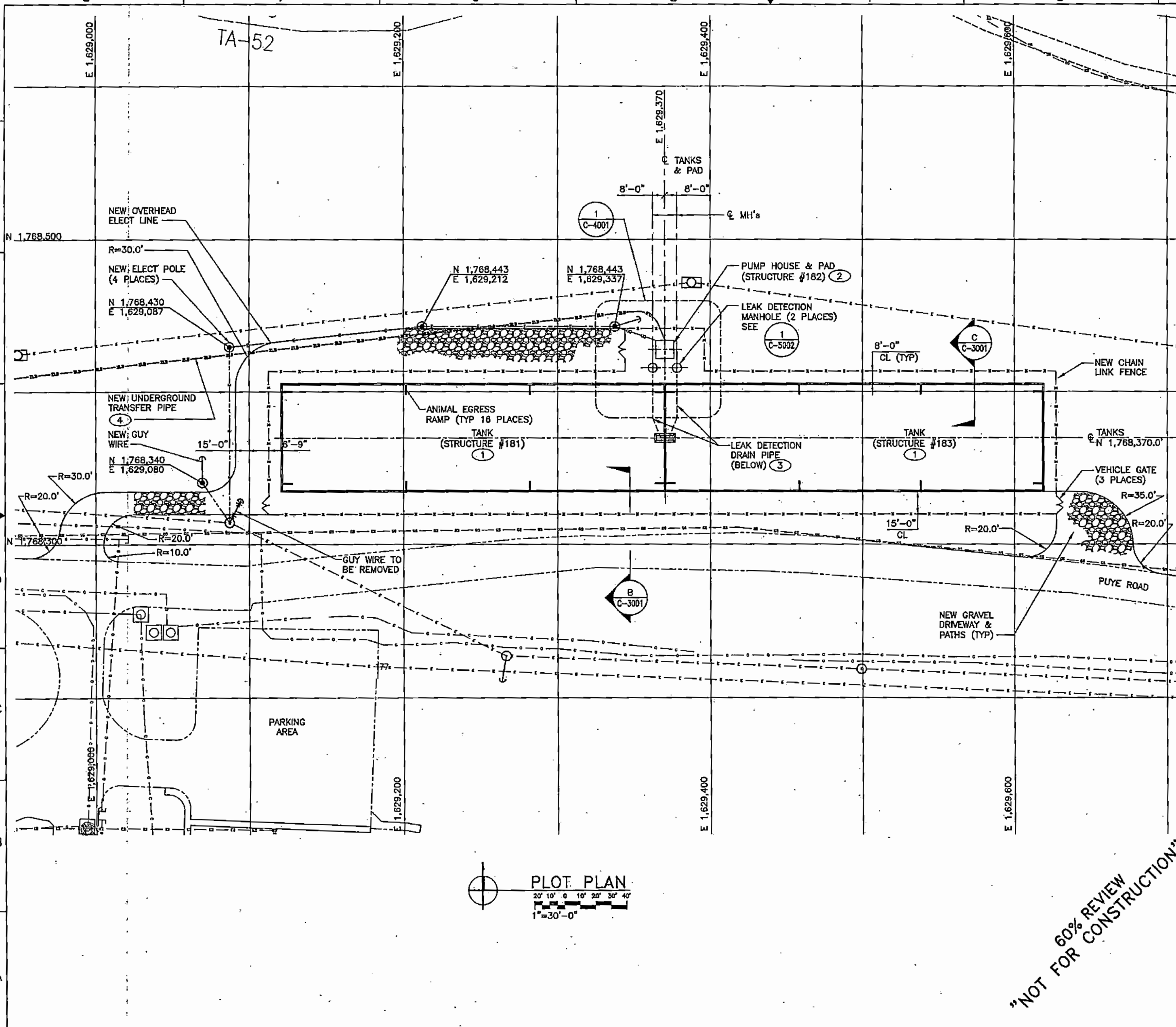
DATE

PROJECT ID 100761

DRAWING NO C-55751

REV A

Plotted By: DMYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-1010-RA.DWG



60% REVIEW
"NOT FOR CONSTRUCTION"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. TOPOGRAPHIC MAP IS AS PROVIDED BY OWNER, LOS ALAMOS NATIONAL LABORATORY (LANL). COORDINATE GRID SHOWN IS BASED UPON TOPOGRAPHIC MAP FILE PROVIDED, WITH PLAN NORTH AS INDICATED. ELEVATIONS PER NAVD 88 AND OTHER DATA PER NGVD 29.
3. EXISTING UTILITIES ARE SHOWN PER DRAWING "UTILITY COMPOSITE MAP" AS PRODUCED BY UTILITIES AND INFRASTRUCTURE DATED 10-19-2010. CONTRACTOR SHALL VERIFY LOCATIONS OF UTILITIES IN FIELD AT TIME OF CONSTRUCTION.

KEYED NOTES

1. FOR TANKS REFER TO SHEET S-1010
2. FOR PUMP HOUSE PAD REFER TO SHEET S-1020
3. DRAIN PIPE SHALL BE ROUTED IN FIELD
4. REFER TO MECHANICAL DRAWINGS FOR TRANSFER PIPE ROUTING

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK AREA PLOT PLAN

BLDG 181,182,183 TA-52

DRAWN J. AMICO
DESIGN B. URGO
CHECKED J. COOK
DATE

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SHEET C-1020 OF

CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: DWYERRAY Plot Date: 7/11/2011
FILE NAME: C55751-C-1020-RA.DWG

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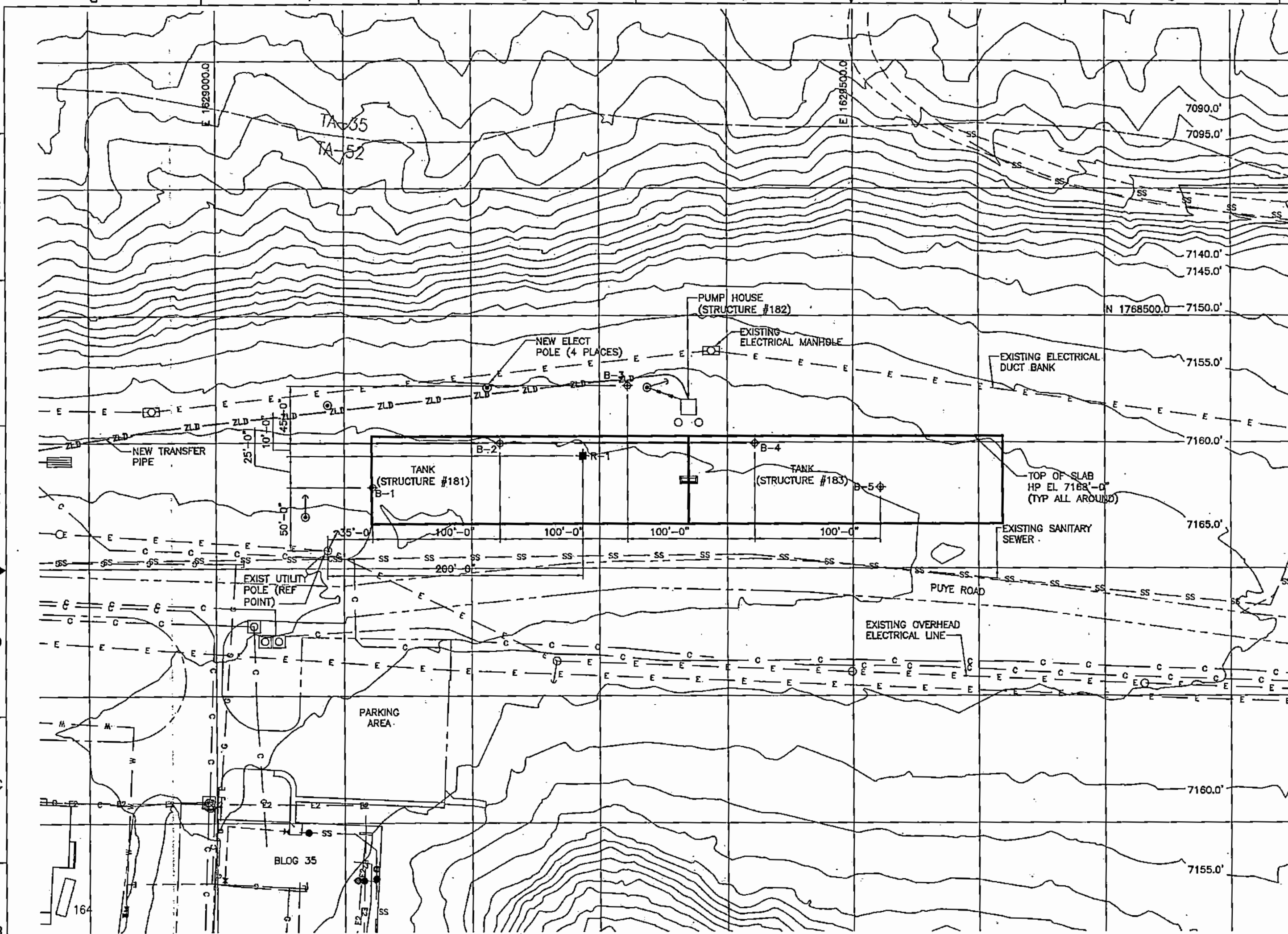

BORING LOCATION PLAN

1"=40'-0"

TABLE 1		
MARK	EAST	NORTH
POLE	1629086.98'	1768314.28'
B-1	1629121.98'	1768364.28'
B-2	1629221.98'	1768399.28'
B-3	1629321.98'	1768444.28'
B-4	1629421.98'	1768399.28'
B-5	1629521.98'	1768364.28'
R-1	1629286.98'	1768389.28'

60% REVIEW
"NOT FOR CONSTRUCTION"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FIELD WORK OF SUBSURFACE INVESTIGATION SHALL CONSIST OF ADVANCING BORINGS AND PERFORMING RESISTIVITY TESTS.
3. CONTRACTOR SHALL LOCATE BORINGS AND RESISTIVITY TESTS PRIOR TO INVESTIGATION AND SHALL DETERMINE GROUND SURFACE ELEVATION AT EACH TEST LOCATION.
4. CONTRACTOR SHALL VERIFY LOCATION OF UNDERGROUND UTILITIES ON-SITE, PRIOR TO START OF DRILLING OPERATIONS.
5. CONTRACTOR SHALL PERFORM SITE CLEARING, IF NECESSARY, IN ORDER TO ACCESS THE TEST LOCATIONS.
6. CONTRACTOR SHALL PROVIDE A FIELD GEOTECHNICAL ENGINEER OR ENGINEERING GEOLOGIST FOR OVERSIGHT OF FIELD OPERATIONS.
7. FOR TEST BORINGS, CONTRACTOR SHALL UTILIZE DRILLING METHODOLOGY THAT ALLOWS FOR OBTAINING GROUND WATER MEASUREMENT (HOLLOW STEM AUGER). PIEZOMETERS SHALL BE INSTALLED PER SPECIFICATION SHOULD WATER BE ENCOUNTERED IN ANY BORING.
8. BORINGS SHALL EXTENO TO A MINUMUM DEPTH OF 25' AND MAXIMUM DEPTH OF 35'. IF REFUSAL OTHER THAN OBSTRUCTIONS IS ENCOUNTERED AT SHALLOWER DEPTH, ROCK CORING IN ACCORDANCE WITH SPECIFICATION REQUIREMENTS SHALL BEGIN AT THAT DEPTH. OTHER BORINGS SHALL BE TERMINATED AT REFUSAL. REFUSAL IS DEFINED AS 50 BLOWS ON THE SPLIT-SPOON SAMPLER (ASTM D1586) RESULTING IN LESS THAN ONE INCH OF PENETRATION. BORING DEPTH MAY BE ALTERED IN THE FIELD BY OWNER'S REPRESENTATIVE.
9. SAMPLING SHALL BE CONTINUOUS FROM EXISTING GRADE TO A DEPTH OF TEN FEET (I.E. 0-2', 2-4', 4-6', 6-8', 8-10') AND THEREAFTER AT 5-FOOT INTERVALS STARTING FROM A DEPTH OF 10 FEET, CONTINUING TO THE BOTTOM OF EACH BORING (I.E. 10-12', 15-17', 20-22', ETC.). FOR GRANULAR SOILS, SAMPLING SHALL BE OBTAINED WITH A SPLIT-BARREL SAMPLER. FOR COHESIVE SOILS, SAMPLING SHALL CONSIST OF ADVANCING SHELBY TUBES. THE UNCONFINED COMPRESSIVE STRENGTH OF ALL RECOVERED COHESIVE SOIL SAMPLES SHALL BE DETERMINED IN FIELD WITH A POCKET PENETROMETER.
10. RESISTIVITY TESTING SHALL BE PERFORMED IN ACCORDANCE WITH THE WENNER FOUR-ELECTRODE METHOD. RESISTIVITY TEST PROBE SPACING SHALL BE AS INDICATED IN SOIL RESISTIVITY PROCEDURE OF SPECIFICATION. RESISTIVITY TEST SHALL BE PERFORMED IN BOTH NORTH-SOUTH AND EAST-WEST DIRECTIONS.
11. REFER TO TABLE 1 FOR REFERENCE UTILITY POLE, BORING AND RESISTIVITY TEST LOCATIONS.
12. FOR ADDITIONAL NOTES SEE SHEET C-1020.

LEGEND

B-1 BORING LOCATION
R-1 RESISTIVITY TEST LOCATION

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK AREA
BORING LOCATION PLAN

BLDG 181,182,183 TA-52

DRAWN J. AMICO
DESIGN B. URGO
CHECKED J. COOK
DATE

SUBMITTED
APPROVED FOR RELEASE

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PO Box 1663
Los Alamos, New Mexico 87545

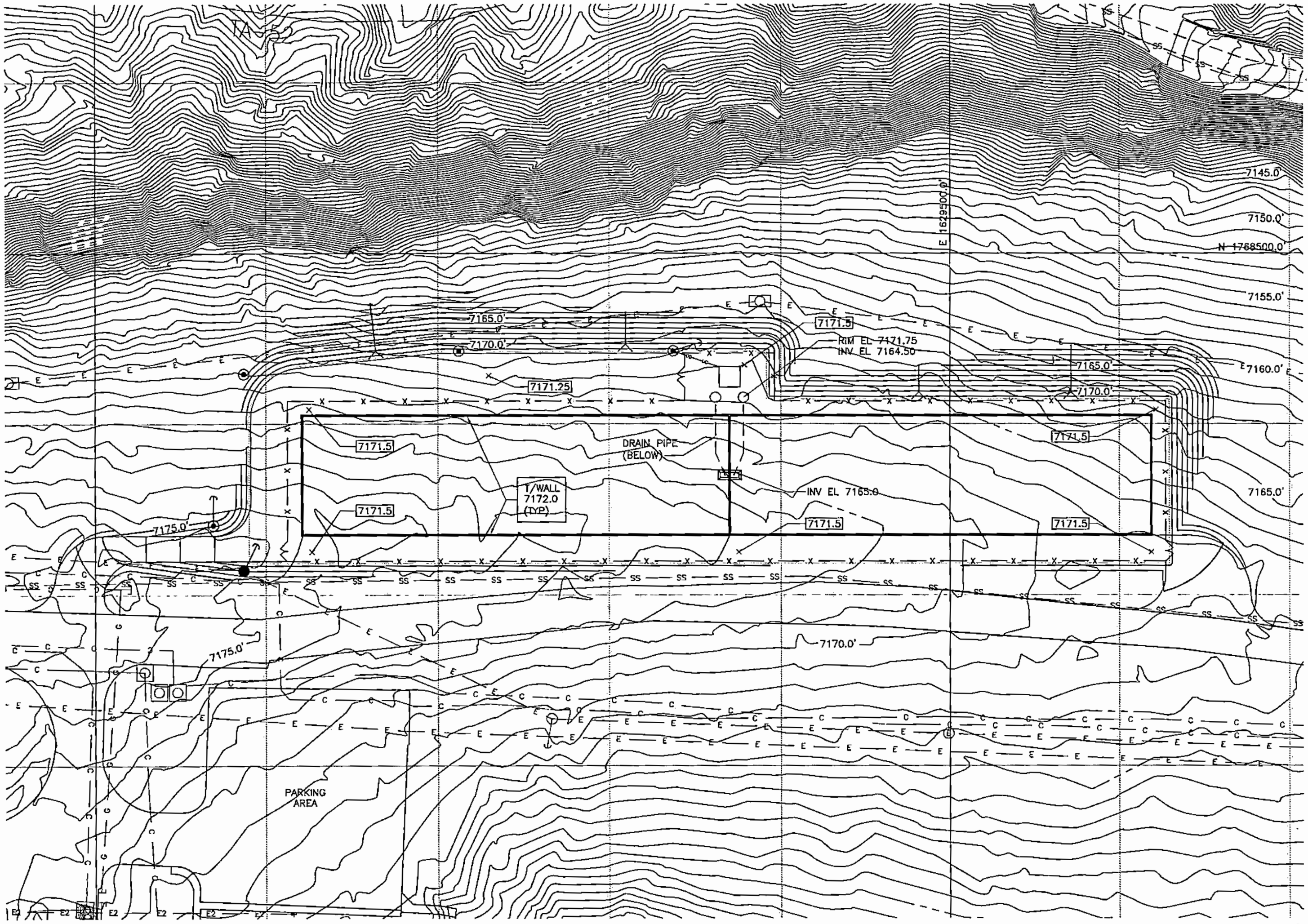
SHEET C-1025
OF

CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FOR ADDITIONAL NOTES SEE SHEET C-1020.



GRADING PLAN

20' 10' 0 10' 20' 30' 40'

1"=30'-0"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK AREA
GRADING PLAN

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

BLDG 181,182,183 TA-52

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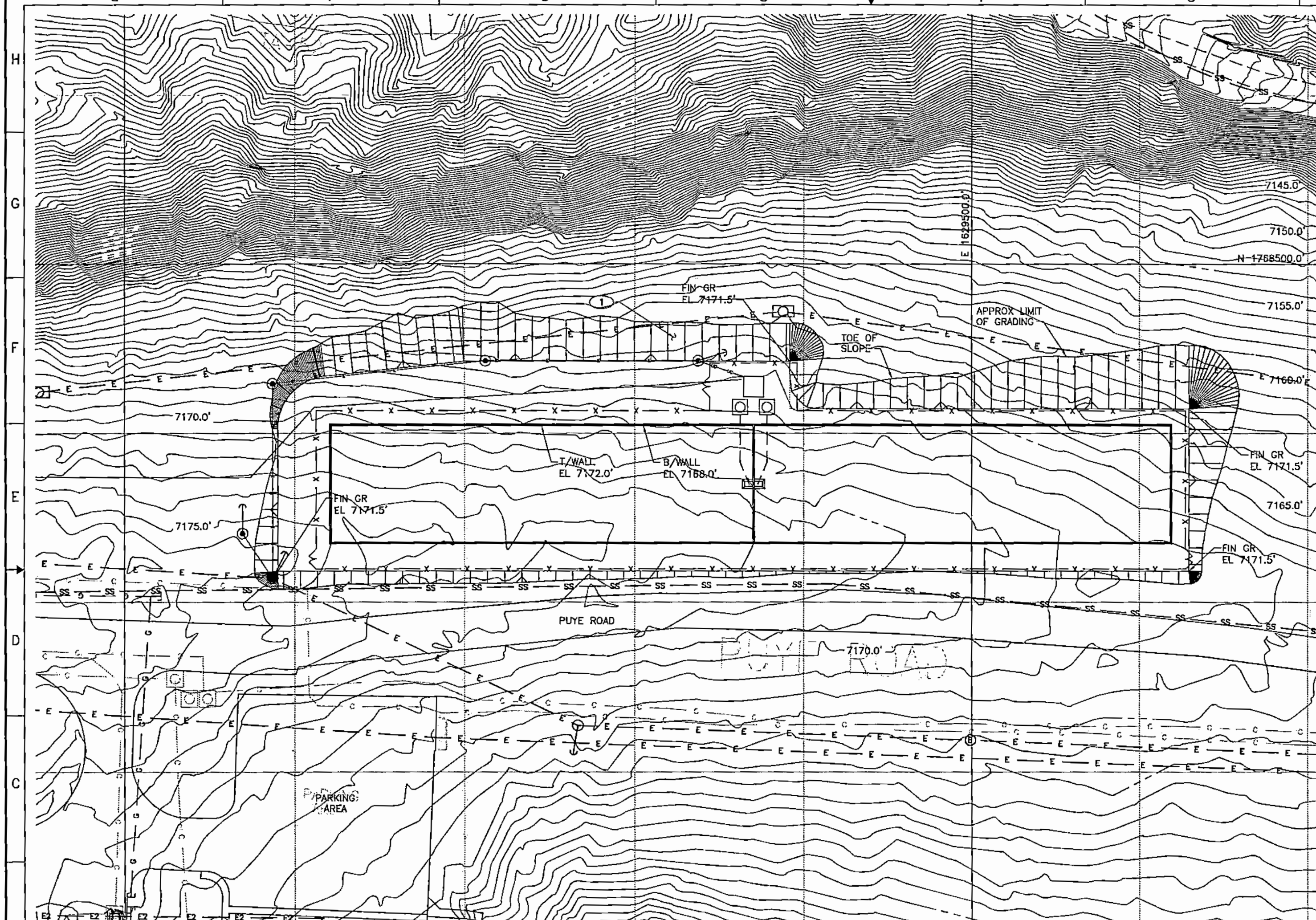
SHEET C-1030 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: DMYERRAY Plot Date: 7/11/2011
FILE NAME: C55751-C-1030-RA.DWG



CUT & FILL PLAN

20' 10' 0 10' 20' 30' 40'
1"=30'-0"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. APPROXIMATE CUT & FILL QUANTITIES ARE AS SHOWN IN TABLE 1.
3. CUT & FILL QUANTITIES ARE SHOWN FOR DIFFERENCE BETWEEN EXIST GRADE AND FINAL FINISHED GRADE. WASTE AND FINISHED SURFACE TYPES ARE NOT CONSIDERED.

TABLE 1

CUT & FILL QUANTITY

TRIANGLE VOLUME	
TRIANGLE VOLUME REPORT	
ORIGINAL SURFACE:	EXIST
DESIGN SURFACE:	TANK (EL 7171.5)
MODE:	ENTIRE SURFACE
CUT FACTOR:	1.0
FILL FACTOR:	0.8
CUT:	130171.2 cu ft
FILL:	88734.4 cu ft
NET:	41436.8 cu ft
CUT:	4821.2 cu yd
FILL:	3286.5 cu yd
NET:	1534.7 cu yd

4. FOR ADDITIONAL NOTES SEE SHEET C-1020.

KEYED NOTES

1 SIDES SLOPES TO MEET EXIST GRADE ARE 3H:1V, TYPICAL.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK AREA
CUT & FILL PLAN

BLDG 181,182,183 TA-52

DRAWN J. AMICO
DESIGN J. HULT
CHECKED J. COOK
DATE

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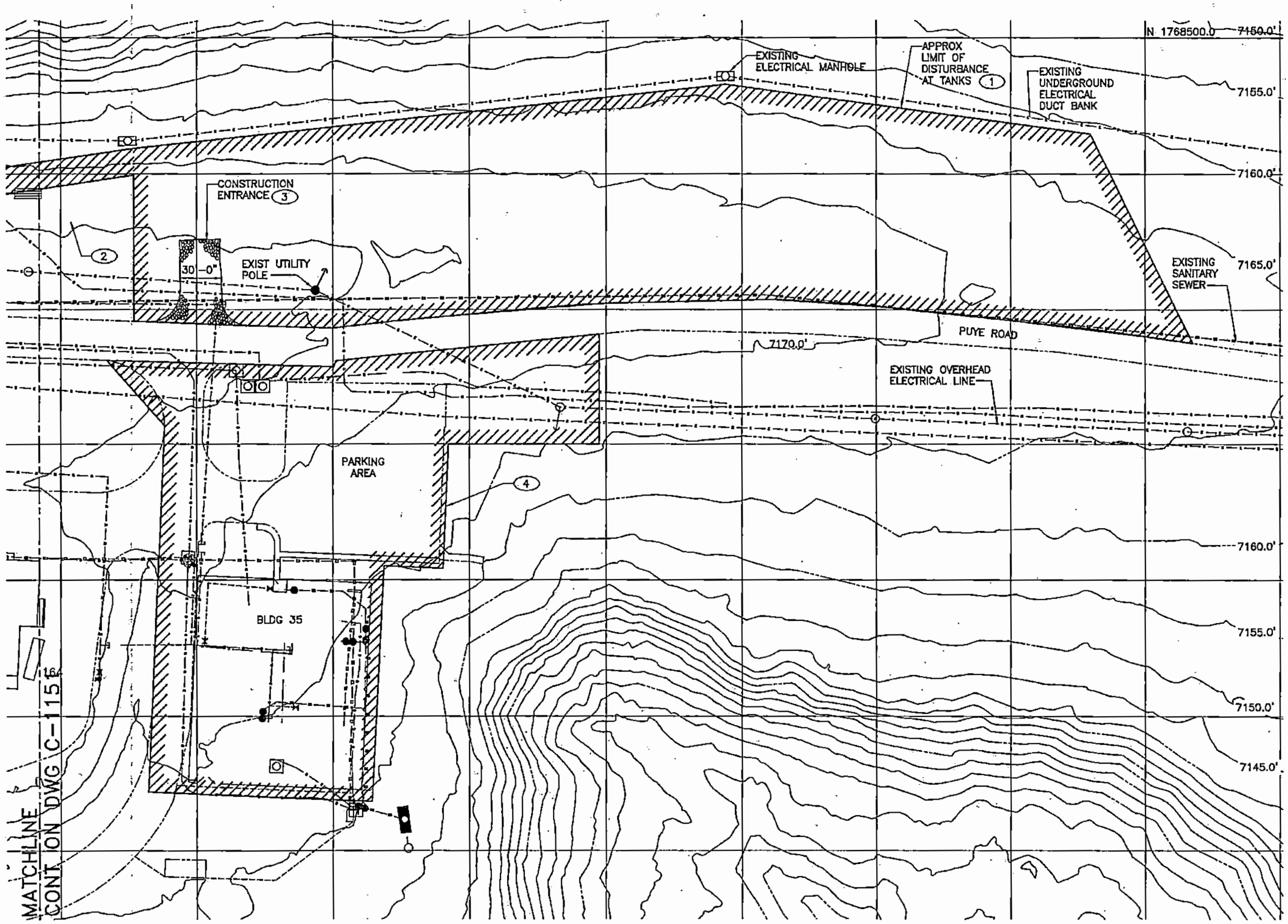
PO Box 1663
Los Alamos, New Mexico 87545

SHEET C-1040 OF

CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME C55751-C-1040-RA.DWG



AREA USE PLAN

40' 20' 0 20' 40'

1"=40'-0"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. TOPOGRAPHIC MAP IS AS PROVIDED BY OWNER, LOS ALAMOS NATIONAL LABORATORY (LANL). COORDINATE GRID SHOWN IS BASED UPON TOPOGRAPHIC MAP FILE PROVIDED, WITH PLAN NORTH AS INDICATED, ELEVATIONS PER NAVD 88 AND OTHER DATA PER NGVD 29.
3. EXISTING UTILITIES ARE SHOWN PER DRAWING "UTILITY COMPOSITE MAP" AS PRODUCED BY UTILITIES AND INFRASTRUCTURE DATED 10-19-2010. CONTRACTOR SHALL VERIFY LOCATIONS OF UTILITIES IN FIELD AT TIME OF CONSTRUCTION.

KEYED NOTES

1. APPROXIMATE AREA OF DISTURBANCE FOR TANK AREA CONSTRUCTION = 109650.0 SF.
2. LIMIT OF DISTURBANCE FOR INSTALLATION OF TRANSFER PIPE SHALL BE APPROXIMATELY 20 FEET WIDE OVER LENGTH OF PIPE.
3. A 50 FOOT (MINIMUM) STABILIZED CONSTRUCTION ENTRANCE SHALL BE INSTALLED AT POINTS OF INGRESS AND EGRESS. ENTRANCE SHALL BE 12" THICK OF 4" TO 8" CRUSHED STONE.
4. APPROXIMATE LIMIT OF CONSTRUCTION LAYDOWN AREA AS PROVIDED BY LANL.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK AREA
AREA USE PLAN

BLDG 181,182,183 TA-52

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

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SHEET C-1050 OF

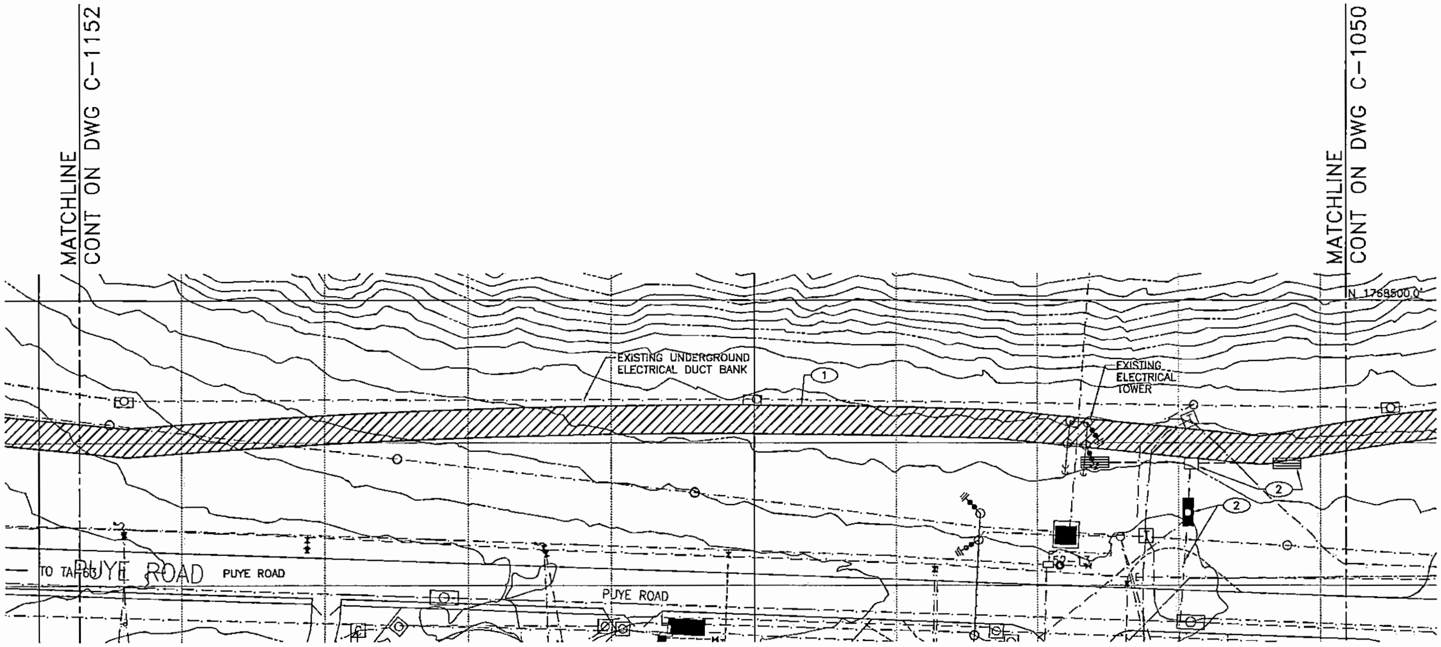
CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: DWYERRAY Plot Date: 7/11/2011
FILE NAME: C55751-C-1050-RA.DWG

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FOR ADDITIONAL NOTES SEE SHEET C-1050.



AREA USE PLAN
40' 20' 0 20' 40'
1"=40'-0"

KEYED NOTES

1. LIMIT OF DISTURBANCE FOR INSTALLATION OF TRANSFER PIPE SHALL BE APPROXIMATELY 20 FEET WIDE OVER LENGTH OF PIPE.
2. ABANDONED SEPTIC SYSTEM AND SANITARY SEWER PER OWNER FIELD NOTES (RFI-005). CONTRACTOR SHALL VERIFY IN FIELD DURING CONSTRUCTION.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPE
AREA USE PLAN 1

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

BLDG 181,182,183 — TA-52

SUBMITTED — APPROVED FOR RELEASE

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SHEET C-1151 OF

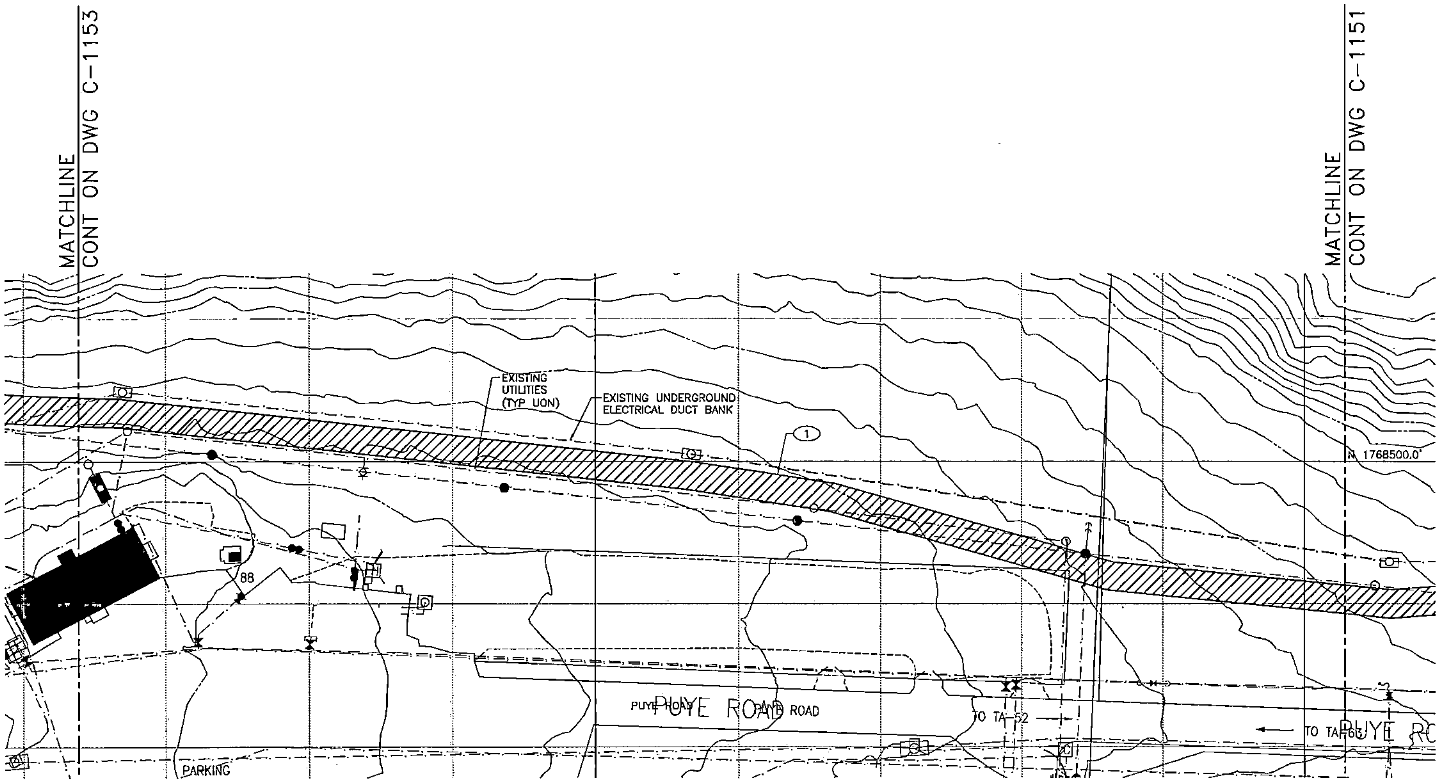
CLASSIFICATION U — REVIEWER — DATE

PROJECT ID 100761 — DRAWING NO C-55751 — REV A

Plotted By: DWYERGAY Plot Date: 7/8/2011
FILE NAME: C55751-C-1151-RA.DWG

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FOR ADDITIONAL NOTES SEE SHEET C-1050.



AREA USE PLAN

40' 20' 0 20' 40'
1"=40'-0"

KEYED NOTES

1. LIMIT OF DISTURBANCE FOR INSTALLATION OF TRANSFER PIPE SHALL BE APPROXIMATELY 20 FEET WIDE OVER LENGTH OF PIPE.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPE
AREA USE PLAN 2

BLDG 181,182,183 TA-52 TA-63

DRAWN: J. AMICO
DESIGN: B. URGO
CHECKED: J. COOK
DATE:

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Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET C-1152 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: DWYEKRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-1152-RA.DWG

AREA USE PLAN

40' 20' 0 20' 40'

1"=40'-0"

60% REVIEW "NOT FOR CONSTRUCTION"

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FOR ADDITIONAL NOTES, SEE SHEET C-1050.

KEYED NOTES

1. LIMIT OF DISTURBANCE FOR INSTALLATION OF TRANSFER PIPE SHALL BE APPROXIMATELY 20 FEET WIDE OVER LENGTH OF PIPE.

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPE
AREA USE PLAN 3

BLDG 181,182,183 — TA-50, TA-63

DRAWN: J. AMICO
DESIGN: B. URGO
CHECKED: J. COOK
DATE:

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SHEET: C-1153 OF

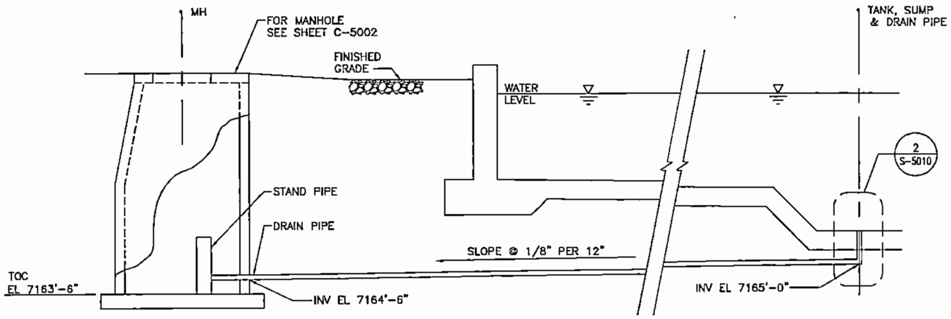
CLASSIFICATION: U
REVIEWER
DATE

PROJECT ID: 100761
DRAWING NO: C-55751
REV: A

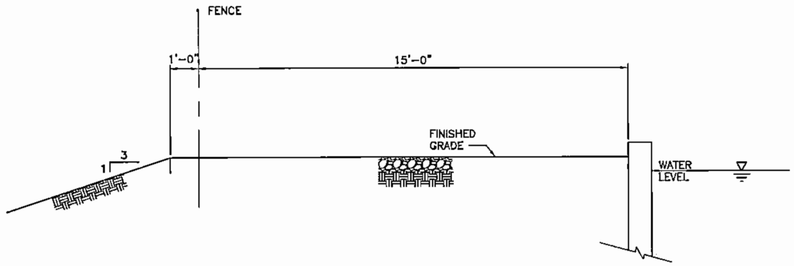
Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-1153-RA.DWG

GENERAL NOTES:

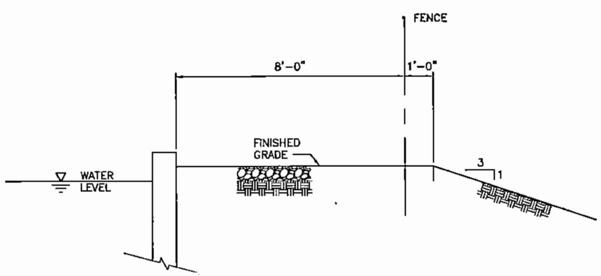
1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



A C-4001 SECTION–LEAK DETECTION DRAIN PIPE
1/2"=1'-0"



B C-1020 SECTION–DRIVEWAY
1/2"=1'-0"



C C-1020 SECTION–ACCESS PATH
1/2"=1'-0"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK AREA SECTIONS 1

BLDG 181,182,183 TA-52

DRAWN J. AMICO
DESIGN B. URGO
CHECKED J. COOK
DATE

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SHEET C-3001 OF

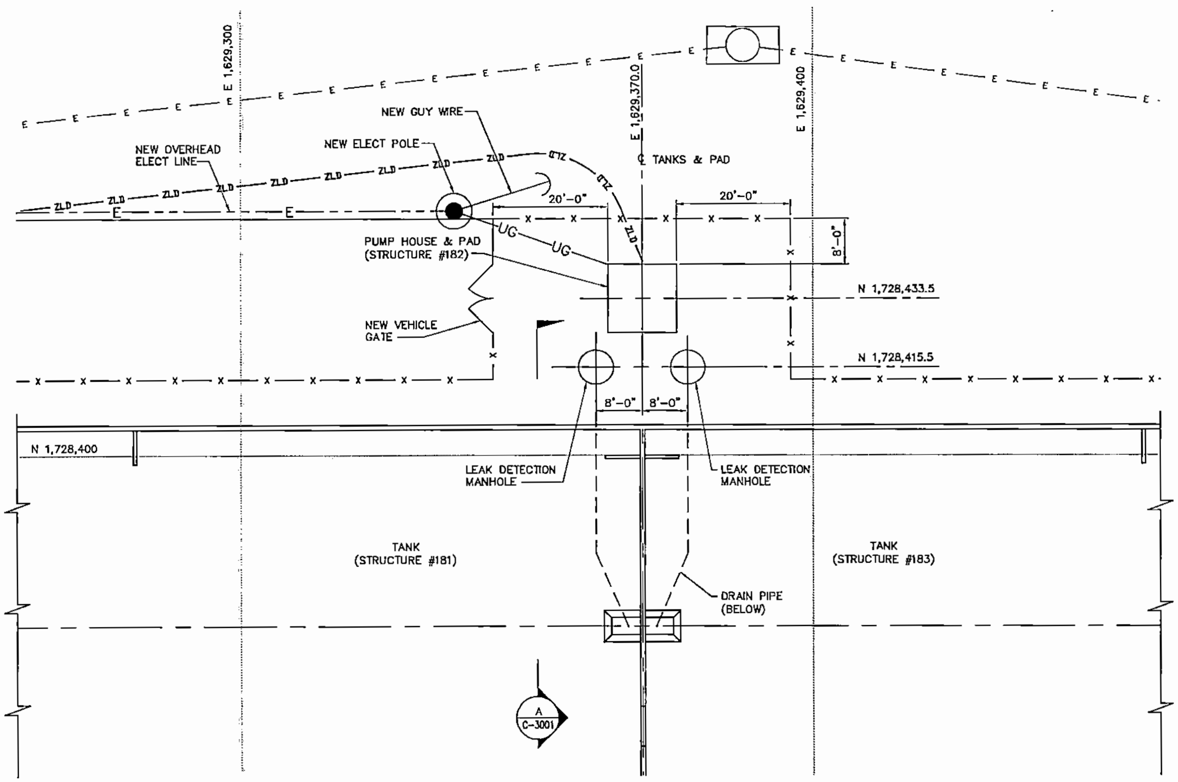
CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-3001-RA.DWG

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



1 C-1020 ENLARGED PLOT PLAN

10' 5' 0 10' 20'

1"=10'-0"

60% REVIEW "NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK AREA ENLARGED PLOT PLAN

BLDG 181,182,183 TA-52

DRAWN	R. DWYER
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

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SHEET C-4001 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

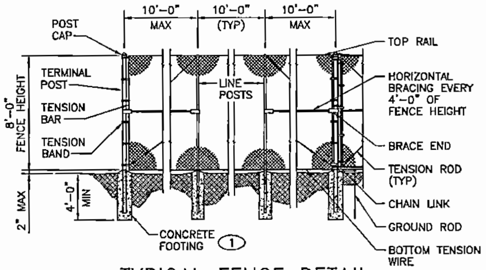
Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-4001-RA.DWG

GENERAL NOTES:

1. STRUCTURE IDENTIFICATION SIGNS SHALL BE FABRICATED AND SUPPLIED BY LANL AS GFE. SIGNS SHALL BE FABRICATED IN ACCORDANCE WITH LANL STANDARD DRAWING ST-GS040-4, SHEET 8 WITH THE FOLLOWING TEXT:

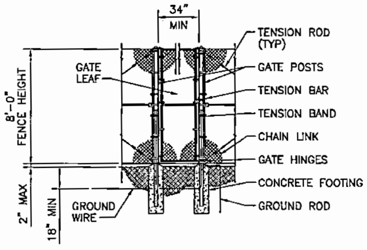
   SIGN 1: TA-52-181
   SIGN 2: TA-52-182
   SIGN 3: TA-52-183

2. CONTRACTOR SHALL INSTALL SIGNS UNDER DIRECTION OF LANL STR AND IN ACCORDANCE WITH PROJECT SPECIFICATIONS.



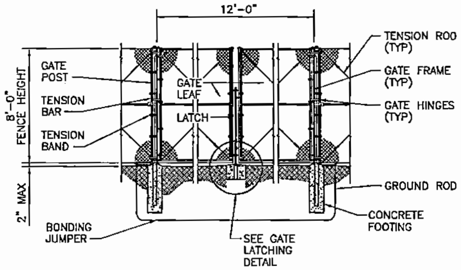
TYPICAL FENCE DETAIL

SCALE: NONE



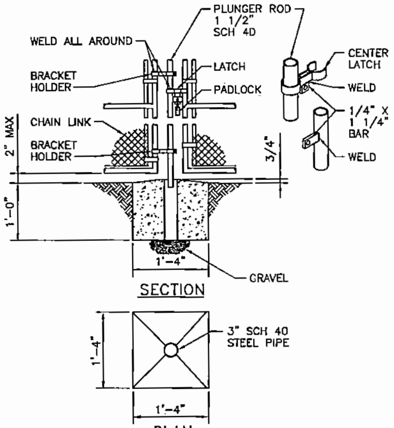
PEDESTRIAN GATE DETAIL

SCALE: NONE



VEHICLE GATE DETAIL

SCALE: NONE



GATE LATCHING DETAIL

SCALE: NONE

KEYED NOTES

(1) CONCRETE FOOTING FOR FENCE POST SHALL BE SIZED IN ACCORDANCE WITH SPECIFICATIONS.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TYPICAL DETAILS
SITE DETAILS 1

BLDG 181,182,183 TA-52

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

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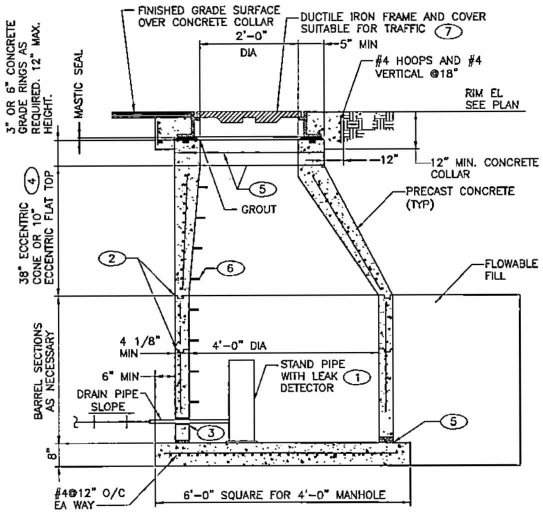
SHEET C-5001 OF

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

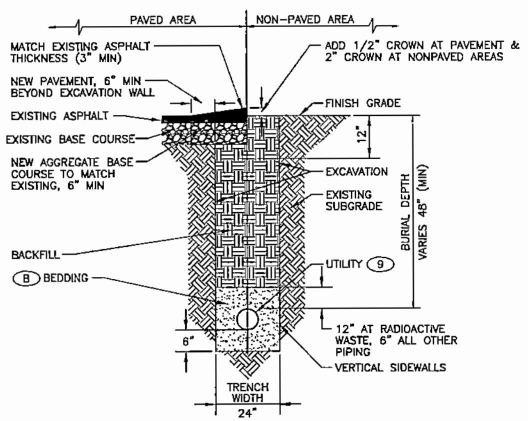
CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

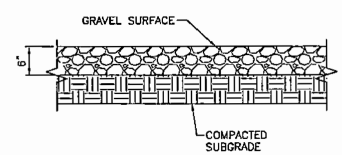
Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-5001-RA.DWG



1 C-1020 MANHOLE DETAIL
SCALE: NONE



SINGLE TRENCH DETAIL-LEAK DRAIN PIPE
SCALE: NONE



SURFACING DETAIL
SCALE: NONE

KEYED NOTES

1. REFER TO INSTRUMENTATION SHEETS FOR DETAILS OF DRAIN PIPE AND STAND PIPE WITHIN MANHOLE.
2. CLEAN ALL JOINTS AND INSTALL SEALING GASKETS.
3. GROUT WATER STOP OR GASKET WATER STOP FOR PLASTIC PIPE (TYP).
4. DO NOT USE FLAT TOPS IN PARKING LOTS OR ROADWAYS.
5. MASTIC AND/OR GROUT FOR WATER TIGHT SEAL AND PREVENTION OF DISPLACEMENT OF RINGS AND COVER.
6. PROVIDE STEPS OVER FULL HEIGHT OF MANHOLE, LOCATED TO CLEAR INLET DRAIN PIPE.
7. COVER SHALL BE SELF SEALING WITH INTEGRATED GASKET, AS MANUFACTURED BY NEENAH FOUNDRY.
8. PROVIDE A MINIMUM OF 6" OF SAND BEDDING BETWEEN PIPE AND VERTICAL SIDEWALLS.
9. NEW UTILITY SHALL BE 2"ø PIPE PER MECHANICAL SPECIFICATIONS AND DRAWINGS.

PRODUCT OPTIONS AND SUBSTITUTIONS

"OR APPROVED EQUAL" IS ALWAYS IMPLIED AFTER A BRAND NAME, PATENTED PROCESS OR CATALOG NUMBER. THE SUBCONTRACTOR MAY SUBSTITUTE ANY BRAND OR PROCESS APPROVED AS AN EQUAL BY THE SPECIFYING ARCHITECT/ENGINEER THROUGH THE SUBMITTAL PROCESS. THE ONLY EXCEPTION IS WHERE "NO SUBSTITUTION" IS SPECIFIED. SEE GENERAL PROVISION "MATERIAL AND WORKMANSHIP".

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TYPICAL DETAILS
SITE DETAILS 2

DRAWN: J. AMICO
DESIGN: B. URGO
CHECKED: J. COOK
DATE:

BLDG 181,182,183 TA-52

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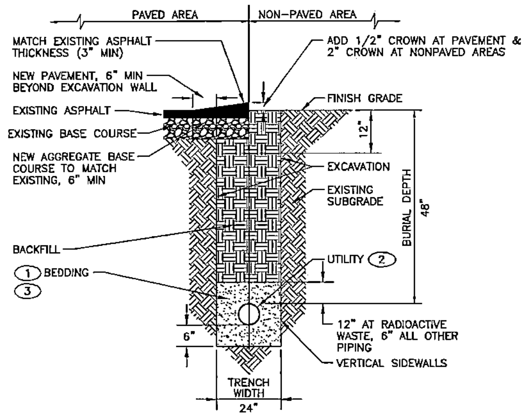
SHEET C-5002 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: DMYCRRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-5002-RA.DWG



SINGLE TRENCH DETAIL

SCALE: NONE

KEYED NOTES

1. PROVIDE A MINIMUM OF 6" OF SAND BEDDING BETWEEN PIPE AND VERTICAL SIDEWALLS.
2. NEW UTILITY SHALL BE 4"ø HDPE PIPE PER MECHANICAL SPECIFICATIONS AND DRAWINGS.
3. BEDDING MATERIAL SHALL BE AS SPECIFIED IN PROJECT SPECIFICATIONS OR AS RECOMMENDED BY MANUFACTURER, WITH APPROVAL OF LANL STR.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPE TYPICAL DETAILS

BLDG 181,182,183 TA-52

DRAWN	J. AMICO
DESIGN	B. URGO
CHECKED	J. COOK
DATE	

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SHEET C-5101 OF

CLASSIFICATION U REVIEWER DATE

PROJECT ID 100761 DRAWING NO C-55751 REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-C-5101-RA.DWG

69865

8	7	6	5	4	3	2	1

CONCRETE NOTES

1. DESIGN AND CONSTRUCTION SHALL CONFORM TO THE AMERICAN CONCRETE INSTITUTE, "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE", ACI 318, 2005 EDITION.
2. CONCRETE SHALL BE NORMAL WEIGHT WITH AN ULTIMATE COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS.
3. CONCRETE PROTECTION FOR REINFORCEMENT SHALL BE 3 INCH CLEAR COVER FOR CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH; 2 INCH FOR #6 AND LARGER BARS (1 1/2 INCH FOR #5 AND SMALLER BARS) EXPOSED TO EARTH OR WEATHER AFTER REMOVAL OF FORMS; 1 1/2 INCH FOR PRINCIPAL REINFORCEMENT TIES, STIRRUPS, AND SPIRALS IN BEAMS, GIRDERS, AND COLUMNS, NOT EXPOSED TO EARTH OR WEATHER; 3/4 INCH FOR #11 AND SMALLER BARS IN SLABS, WALLS, AND JOISTS NOT EXPOSED TO EARTH OR WEATHER; OR AS INDICATED ON THE CONTRACT DRAWINGS AND SPECIFICATIONS, THE MORE STRINGENT REQUIREMENTS SHALL APPLY.
4. REINFORCING BARS SHALL BE DEFORMED BARS CONFORMING TO ASTM A615, GRADE 60.
5. CONTINUOUS REINFORCING #11 AND SMALLER, SHALL BE LAPPED AT SPLICES. LAP LENGTH OF SPLICES SHALL NOT BE LESS THAN CLASS B SPLICE. WELDING OF REINFORCEMENT WILL NOT BE PERMITTED.
6. UNLESS OTHERWISE INDICATED, ANCHOR BOLTS SHALL CONFORM TO ASTM F1554 GRADE 36.
7. ALL DOWELS, ANCHOR BOLTS, EMBEDDED STEEL, ELECTRICAL CONDUITS, PIPE SLEEVES, PIPING, WATERSTOPS, INSERTS, GROUNDS, AND ALL OTHER EMBEDDED ITEMS AND FORMED DETAILS SHALL BE IN PLACE PRIOR TO START OF CONCRETE PLACEMENT. ALL EMBEDDED ITEMS SHALL BE SUPPORTED AND SECURELY TIED TO PREVENT DISPLACEMENT AND/OR DAMAGE DURING PLACEMENT OF CONCRETE.
8. ALL EXPOSED CONCRETE EDGES SHALL HAVE A 1 INCH CHAMFER.

ABBREVIATIONS

BOT	BOTTOM
B/WALL	BOTTOM OF WALL
•	CENTERLINE
DIA, ø	DIAMETER
EA	EACH
EF	EACH FACE
EL	ELEVATION
EXP	EXPANSION
HDPE	HIGH DENSITY POLYETHYLENE
HP	HIGH POINT
LG	LONG
LP	LOW POINT
MAX	MAXIMUM
MIN	MINIMUM
OC	ON CENTER
•	PLATE
R	RADIUS
REQD	REQUIRED
SYM	SYMMETRICAL
SS	STAINLESS STEEL
T	THICKNESS
TOC	TOP OF CONCRETE
T/WALL	TOP OF WALL
TYP	TYPICAL

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NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

STRUCTURAL NOTES

BLDG 181,182,183 TA-52

DRAWN	J. AMICO
DESIGN	J. COOK
CHECKED	B. URGO
DATE	

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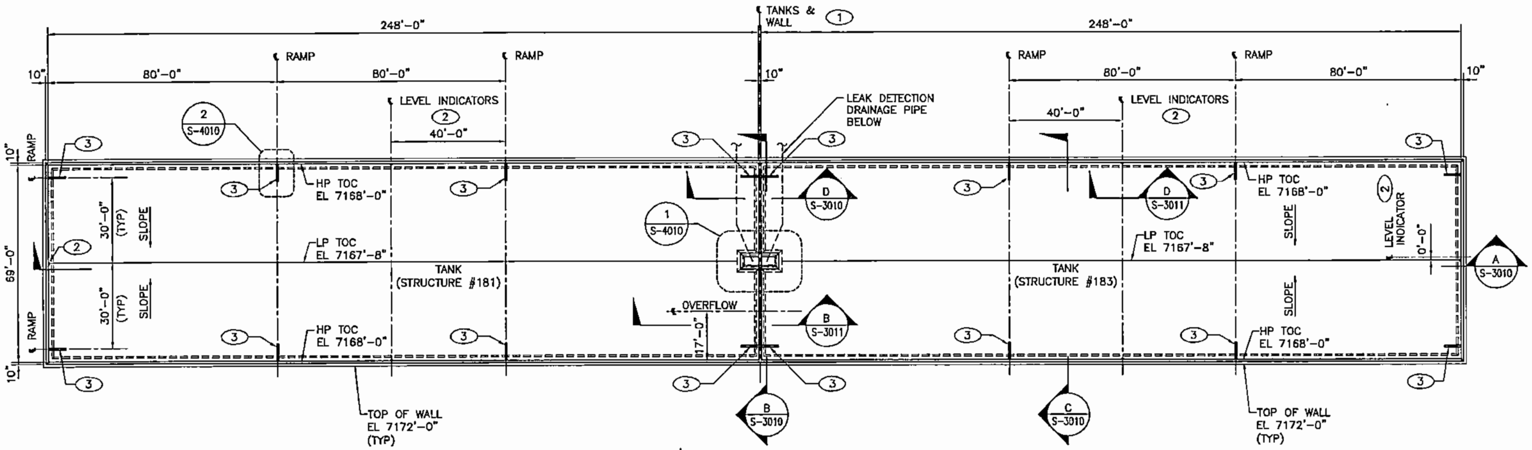
SHEET S-0001 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-0001-RA.DWG



TANK PLAN
20' 10' 0 10' 20'
1"=20'-0"

GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

KEYED NOTES

(1) TANKS ARE SYMMETRICAL ABOUT CENTERLINE UNLESS OTHERWISE NOTED.

(2) LEVEL INDICATOR SIGN SHALL BE LOCATED AND ATTACHED IN FIELD, WITH 3 SIGNS PER TANK, 6 SIGNS TOTAL.

(3) ANIMAL EGRESS RAMP (16 TOTAL)

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK PLAN

BLDG 181,183 TA-52

DRAWN	J. AMICO
DESIGN	J. COOK
CHECKED	B. URGO
DATE	

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PO Box 1663
Los Alamos, New Mexico 87545

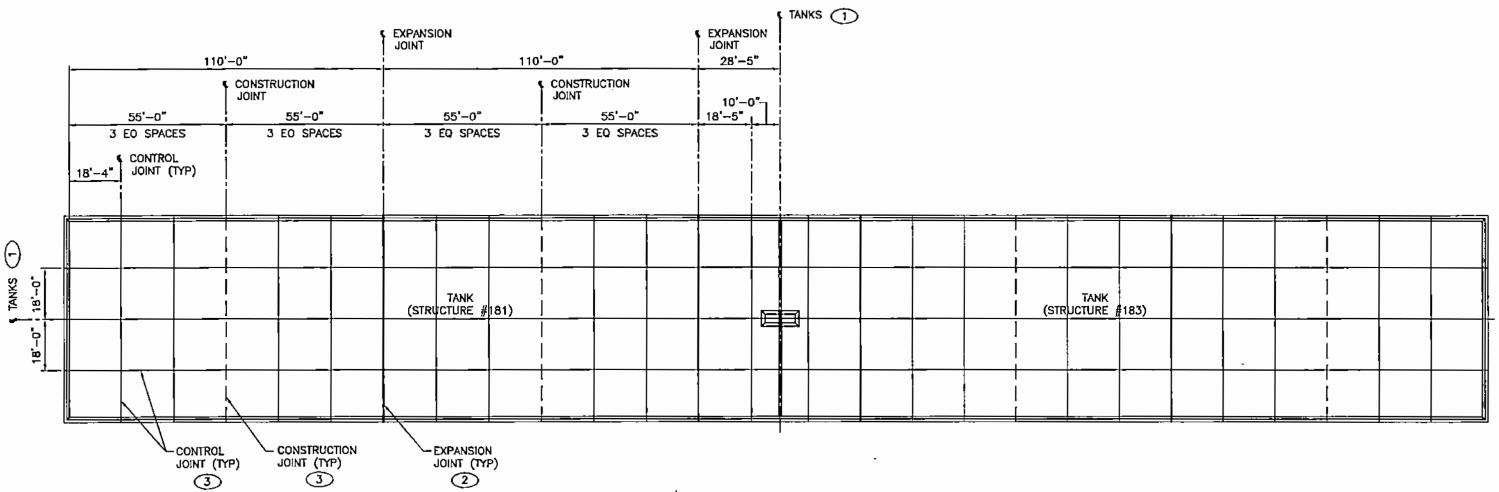
SHEET S-1010 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



TANK JOINT PLAN

20' 10' 0 10' 20'
1"=20'-0"

KEYED NOTES

1. TANKS ARE SYMMETRICAL ABOUT CENTERLINE UNLESS OTHERWISE NOTED.
2. EXPANSION JOINTS SHALL BE CONTINUOUS THROUGH SLAB AND WALL.
3. CONTROL AND CONSTRUCTION JOINT LOCATIONS MAY DIFFER BETWEEN SLAB AND WALL.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK JOINT PLAN

BLDG 181,183 TA-52

DRAWN	J. AMICO
DESIGN	J. COOK
CHECKED	B. URGO
DATE	

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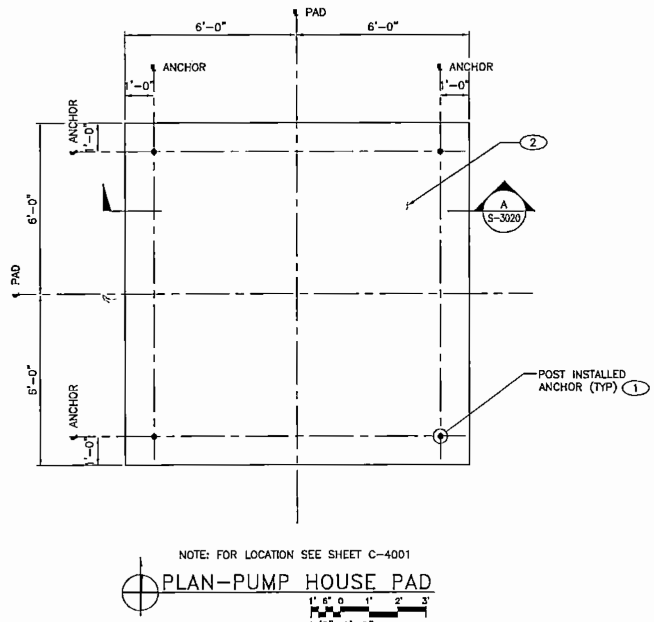
SHEET S-1011 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-1011-RA.DWG



NOTE: FOR LOCATION SEE SHEET C-4001

PLAN-PUMP HOUSE PAD

1/2"=1'-0"

HOLD

PUMP ENCLOSURE DIMENSIONS AND DETAILS REQUIRED FROM VENDOR

GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

KEYED NOTES

1. POST INSTALLED ANCHORS SHALL BE OF THE KWIK BOLT TZ SYSTEM AS MANUFACTURED BY HILTI AND INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS. TOTAL BOLT LENGTH SHALL BE 8 1/2" WITH PROJECTION OF 2" AND MINIMUM EMBEDMENT OF 6 1/2".
2. PUMP SKIDS, PIPE AND CONDUIT PENETRATIONS NOT SHOWN.

PRODUCT OPTIONS AND SUBSTITUTIONS

"OR APPROVED EQUAL" IS ALWAYS IMPLIED AFTER A BRAND NAME, PATENTED PROCESS OR CATALOG NUMBER. THE SUBCONTRACTOR MAY SUBSTITUTE ANY BRAND OR PROCESS APPROVED AS AN EQUAL BY THE SPECIFYING ARCHITECT/ENGINEER THROUGH THE SUBMITTAL PROCESS. THE ONLY EXCEPTION IS WHERE "NO SUBSTITUTION" IS SPECIFIED. SEE GENERAL PROVISION "MATERIAL AND WORKMANSHIP".

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

PUMP HOUSE PLAN

DRAWN	J. AMICO
DESIGN	J. COOK
CHECKED	B. URGO
DATE	

BLDG 182 TA-52

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SHEET S-1020 OF

CLASSIFICATION U

REVIEWER

DATE

PROJECT ID 100761

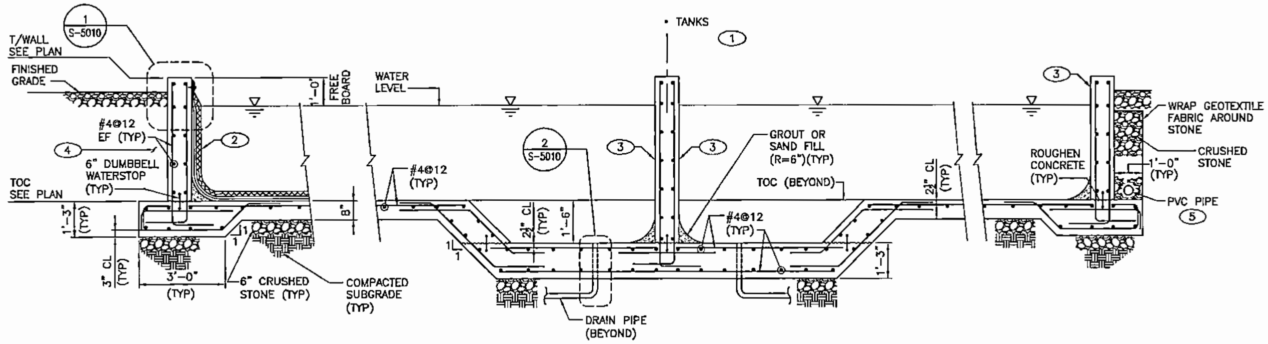
DRAWING NO C-55751

REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-1020-RA.DWG

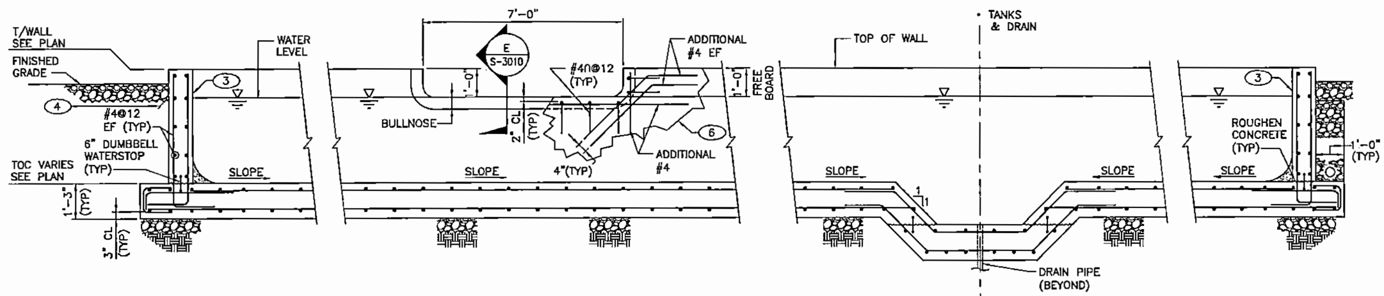
GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. LINER SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S STANDARDS. REFER TO SHEET S-5010 FOR MANUFACTURER.



A SECTION (S-1010)

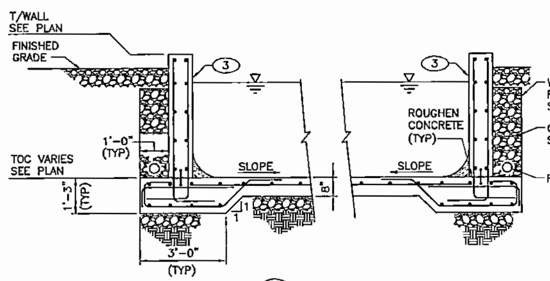
1/2"=1'-0"



B SECTION–OVERFLOW/SUMP (S-1010, S-4010)

1/2"=1'-0"

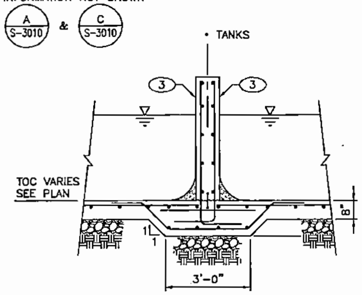
NOTE: FOR INFORMATION NOT SHOWN SEE A (S-3010) & C (S-3010)



C SECTION (S-1010)

1/2"=1'-0"

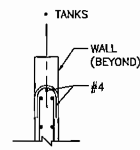
NOTE: FOR INFORMATION NOT SHOWN SEE B (S-3010)



D SECTION (S-1010)

1/2"=1'-0"

NOTE: FOR INFORMATION NOT SHOWN SEE A (S-3010)



E SECTION (S-3010)

1/2"=1'-0"

60% REVIEW
"NOT FOR CONSTRUCTION"

KEYED NOTES

1. TANKS ARE SYMMETRICAL ABOUT CENTERLINE UNLESS OTHERWISE NOTED.
2. LINER COMPONENTS SHOWN AT EXAGGERATED SCALE FOR CLARITY.
3. LINER COMPONENTS NOT SHOWN.
4. WALL DRAINAGE SYSTEM NOT SHOWN FOR CLARITY.
5. PROVIDE 4"φ PERFORATED PVC PIPE, SLOPED TO DAYLIGHT.
6. FOR REINFORCEMENT NOT SHOWN, REFER TO SECTION D (S-3010)

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK SECTIONS 1

DRAWN	J. AMICO
DESIGN	J. COOK
CHECKED	B. URGO
DATE	

BLDG 181,182,183 TA-52

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SHEET S-3010 OF

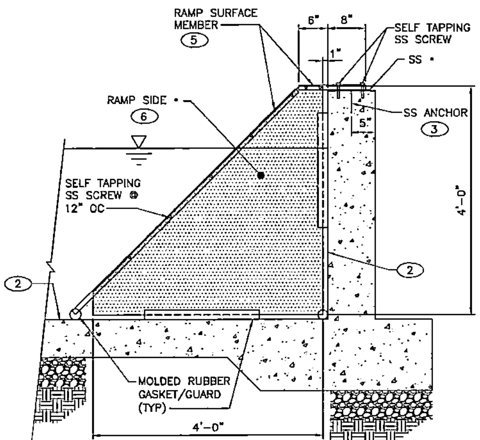
CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: DMYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-3010-RA.DWG

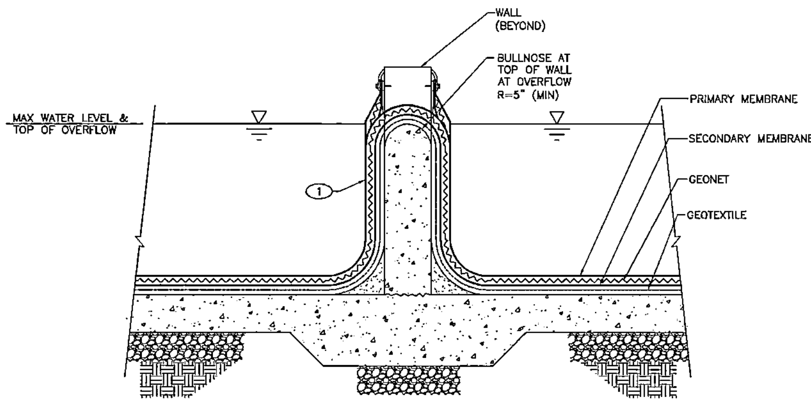
GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FOR INFORMATION NOT SHOWN REFER TO SHEET S-3010.



A S-4010 SECTION-ANIMAL EGRESS RAMP

1"=1'-0"



B S-1010 SECTION-OVERFLOW

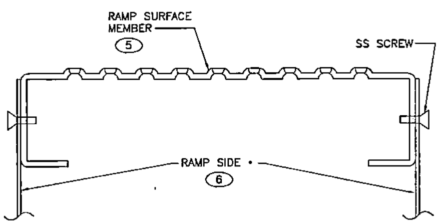
1"=1'-0"

KEYED NOTES

1. LINER COMPONENTS SHOWN AT EXAGGERATED SCALE FOR CLARITY.
2. LINER COMPONENTS NOT SHOWN FOR CLARITY.
3. POST INSTALLED ANCHORS SHALL BE STAINLESS STEEL, OF THE KWIK BOLT TZ SYSTEM AS MANUFACTURED BY HILTI AND INSTALLED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS. TOTAL BOLT LENGTH SHALL BE 3 3/4" WITH A BOLT DIAMETER OF 3/8".
4. LEVEL INDICATOR SHALL BE 60 MIL HDPE MEMBRANE TO MATCH PRIMARY MEMBRANE, COLORED WHITE, WITH BLACK LEVEL LINES AND NUMERALS, AS MANUFACTURED BY GSE, CORONA, CA. INDICATOR SHALL BE BONDED TO PRIMARY MEMBRANE IN FIELD IN ACCORDANCE WITH MANUFACTURER'S STANDARDS. LEVEL LINES FOR FOOT INTERVALS SHALL BE 4" LONG, NUMERALS SHALL BE 3" HIGH.
5. 7" WIDE "TRACTION TREAD" PLANK, STAINLESS STEEL SAFETY GRATING AS MANUFACTURED BY DIRECT METALS, WAUKEGAN, IL.
6. "TRACTION TREAD" FLOORING PLATE, STAINLESS STEEL SAFETY GRATING AS MANUFACTURED BY DIRECT METALS, WAUKEGAN, IL.

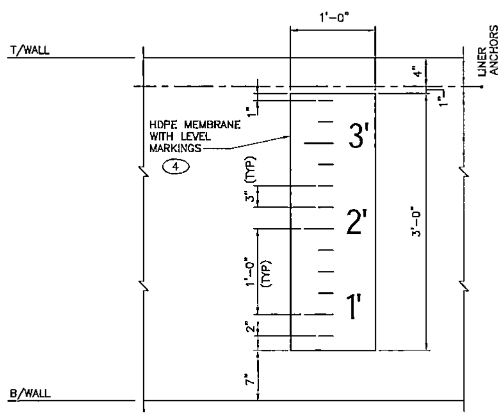
PRODUCT OPTIONS AND SUBSTITUTIONS

"OR APPROVED EQUAL" IS ALWAYS IMPLIED AFTER A BRAND NAME, PATENTED PROCESS OR CATALOG NUMBER. THE SUBCONTRACTOR MAY SUBSTITUTE ANY BRAND OR PROCESS APPROVED AS AN EQUAL BY THE SPECIFYING ARCHITECT/ENGINEER THROUGH THE SUBMITTAL PROCESS. THE ONLY EXCEPTION IS WHERE "NO SUBSTITUTION" IS SPECIFIED. SEE GENERAL PROVISION "MATERIAL AND WORKMANSHIP".



C S-4010 SECTION-TRACTION TREAD PLANK

1 1/2"=1'-0"



D S-1010 SECTION-LEVEL INDICATOR SIGN

1 1/2"=1'-0"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK SECTIONS 2

BLDG 181,182,183 TA-52

DRAWN J. AMICO
DESIGN J. COOK
CHECKED B. URGO
DATE

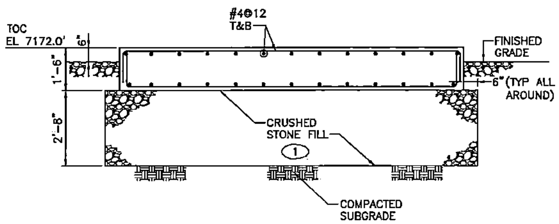
SUBMITTED
APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET S-3011 OF

CLASSIFICATION U
REVIEWER
DATE
PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-3011-RA.DWG



A S-1020 SECTION—PUMP HOUSE PAD

1/2"=1'-0"

GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

KEYED NOTES

(1) STONE FILL SHALL BE NON-FROST SUSCEPTIBLE TYPE IN ACCORDANCE WITH PROJECT SPECIFICATIONS.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

PUMP HOUSE SECTIONS

BLDG 182 TA-52

DRAWN J. AMICO
DESIGN J. COOK
CHECKED B. URGO
DATE

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APPROVED FOR RELEASE

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SHEET S-3020 OF

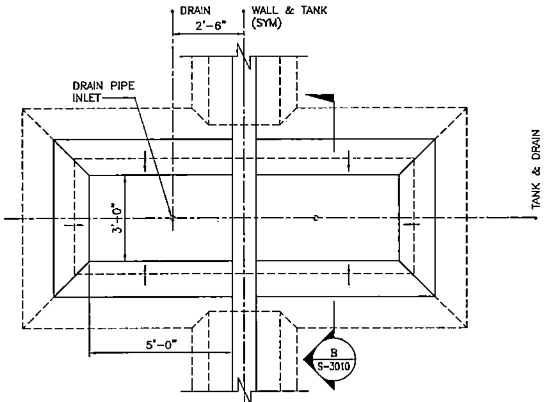
CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: DMYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-3020-RA.DWG

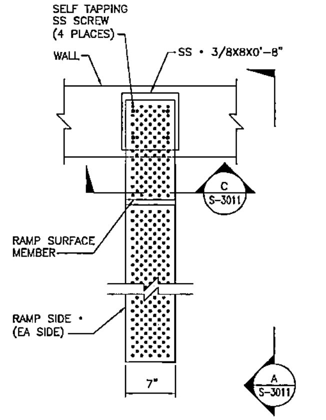
GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



1 S-1010 ENLARGED PARTIAL PLAN–SUMP

1/2"=1'-0"



2 S-1010 ENLARGED PARTIAL PLAN–ANIMAL EGRESS RAMP

1 1/2"=1'-0"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK
ENLARGED PLAN

BLDG 181,183 TA-52

DRAWN	J. AMICO
DESIGN	J. COOK
CHECKED	B. URGO
DATE	

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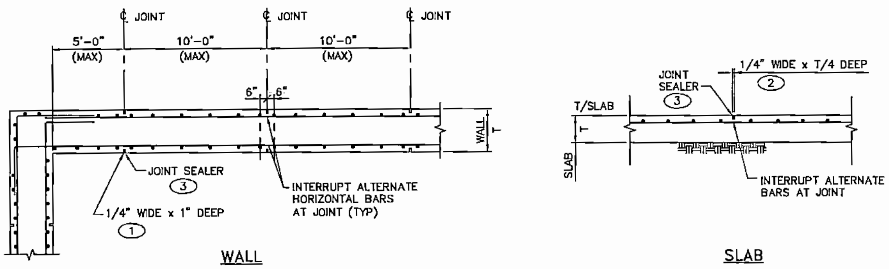
SHEET S-4010 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

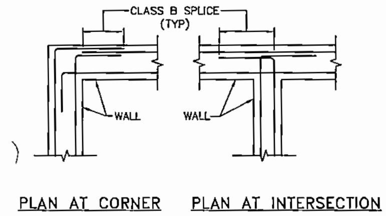
Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-4010-RA.DWG

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



TYPICAL CONTROL JOINT DETAILS

SCALE: NONE

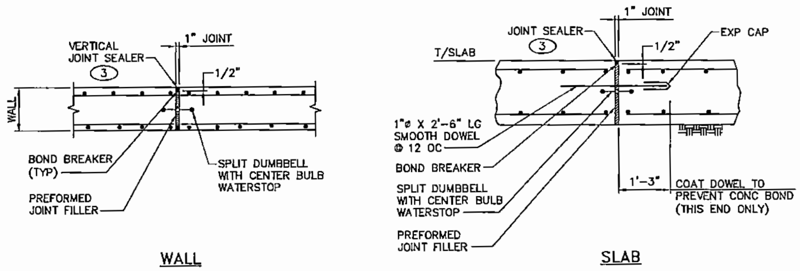


TYPICAL CORNER REINFORCING DETAIL

SCALE: NONE

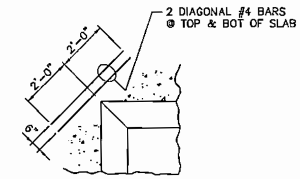
GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FOR ADDITIONAL NOTES, SEE SHEET S-0001.
3. CONTRACTOR SHALL PREPARE A DRAWING SHOWING LOCATIONS OF CONTROL, EXPANSION, AND CONSTRUCTION JOINTS. THIS DRAWING SHALL BE PROVIDED TO DETAILER AND ENGINEER OF RECORD BEFORE SHOP DRAWINGS ARE PREPARED.
4. PROVISIONS FOR CURING SHALL BE MADE IN ADVANCE OF CONCRETE PLACEMENT. CURING MEASURES SHALL BE IMPLEMENTED AS EARLY AS CONCRETE HARDENING AND FINISHING OPERATIONS WILL ALLOW. AT NO TIME SHALL THE CONCRETE BE PERMITTED TO BECOME SURFACE DRY.
5. IMMEDIATELY AFTER PLACEMENT, CONCRETE SHALL BE PROTECTED FROM PREMATURE DRYING AND EXCESSIVELY HOT OR COLD TEMPERATURES; AND, SHALL BE MAINTAINED WITH MINIMAL MOISTURE LOSS FOR A PERIOD OF AT LEAST TEN DAYS NECESSARY FOR HYDRATION OF CEMENT AND HARDENING OF CONCRETE.
6. SURFACES NOT IN CONTACT WITH FORMS SHALL BE CURED BY EITHER PONDING OR CONTINUOUS SPRINKLING; OR, BY APPLICATION OF A MEMBRANE CURING COMPOUND. CURING COMPOUND SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.
7. MOISTURE LOSS FROM SURFACES PLACED AGAINST WOOD OR METAL FORMS SHALL BE MINIMIZED BY KEEPING THE FORMS WET UNTIL REMOVAL. AFTER FORM REMOVAL, CONCRETE SHALL CONTINUE TO BE CURED, AS PROVIDED ABOVE, FOR AT LEAST TEN DAYS.



TYPICAL EXPANSION JOINT DETAILS

SCALE: NONE

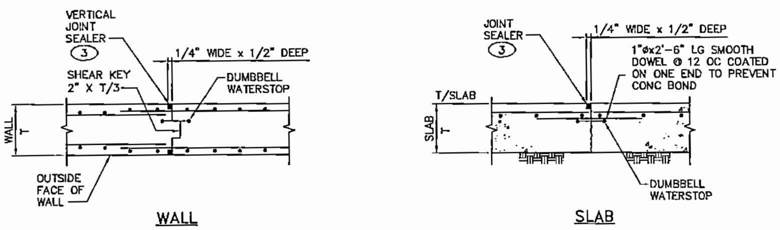


TYPICAL RE-ENTRANT CORNER REINFORCING DETAIL

SCALE: NONE

KEYED NOTES

1. CONTROL JOINTS IN WALL SHALL BE MADE BY PROVIDING FORMING STRIPS IN THE FORMWORK. STRIPS SHALL BE IN-PLACE BEFORE CONCRETE PLACEMENT. CONTRACTOR MAY SUBMIT AN ALTERNATE CROSS SECTION FOR THE JOINT FOR OWNER APPROVAL PRIOR TO CONSTRUCTION.
2. CONTROL JOINTS IN SLAB SHALL BE FORMED AS SOON AS POSSIBLE AFTER CONCRETE PLACEMENT. JOINTS SHALL BE FORMED AFTER A SUFFICIENT TIME TO PREVENT RAVELING AT THE JOINTS, BUT NO LONGER THAN SIX HOURS AFTER PLACEMENT.
3. AFTER CURING, ALL JOINTS IN WALLS AND SLAB SHALL BE SEALED WITH JOINT SEALER, AS INDICATED.



TYPICAL CONSTRUCTION JOINT DETAILS

SCALE: NONE

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NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TYPICAL DETAILS
STRUCTURAL DETAILS 1

BLDG 181,182,183 TA-52

DRAWN	J. AMICO
DESIGN	J. COOK
CHECKED	B. URGO
DATE	

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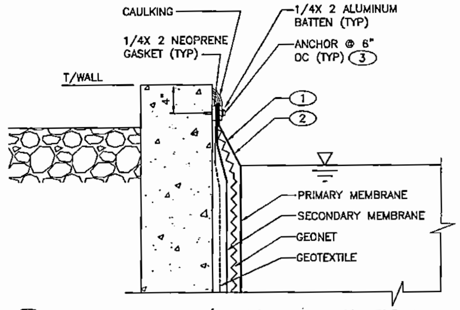
SHEET S-5001 OF

CLASSIFICATION U | REVIEWER | DATE

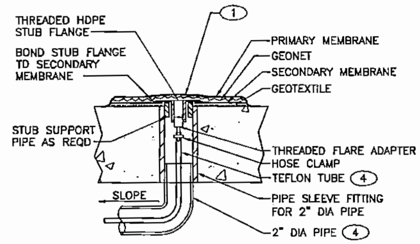
PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-5001-RA.DWG



1 S-3010 DETAIL–LINER/WALL CONNECTION

1 1/2"=1'-0"



2 S-3010 DETAIL–PIPE

3"=1'-0"

GENERAL NOTES

1. IF THIS SHEET IS NOT 36"X24" THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

KEYED NOTES

1 LINER COMPONENTS SHOWN AT EXAGGERATED SCALE FOR CLARITY.

2 LINER COMPONENTS SHALL BE AS MANUFACTURED BY GSE, CORONA, CA AS FOLLOWS:

- PRIMARY MEMBRANE SHALL BE 60 MIL HDPE, CONDUCTIVE SMOOTH
- GEONET SHALL BE 250 MIL HDPE, HYPERNET HF
- SECONDARY MEMBRANE SHALL BE 40 MIL HDPE CONDUCTIVE SMOOTH
- GEOTEXTILE SHALL BE 12 OZ/YD², GSE NW 12

3 POST INSTALLED ANCHORS SHALL BE SELECTED AND INSTALLED IN ACCORDANCE WITH LINER MANUFACTURER'S STANDARDS.

4 REFER TO MECHANICAL DRAWINGS FOR PIPE INFORMATION.

PRODUCT OPTIONS AND SUBSTITUTIONS

"OR APPROVED EQUAL" IS ALWAYS IMPLIED AFTER A BRAND NAME, PATENTED PROCESS OR CATALOG NUMBER. THE SUBCONTRACTOR MAY SUBSTITUTE ANY BRAND OR PROCESS APPROVED AS AN EQUAL BY THE SPECIFYING ARCHITECT/ENGINEER THROUGH THE SUBMITTAL PROCESS. THE ONLY EXCEPTION IS WHERE "NO SUBSTITUTION" IS SPECIFIED. SEE GENERAL PROVISION "MATERIAL AND WORKMANSHIP".

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TANK
DETAILS 1

BLDG 181,182,183 TA-52

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DESIGN J. COOK
CHECKED B. URGO
DATE

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Los Alamos, New Mexico 87545

SHEET S-5010 OF

CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: DWYERRAY Plot Date: 7/8/2011
FILE NAME: C55751-S-5010-RA.DWG

8	7	6	5	4	3	2	1

PROCESS FLOW DIAGRAMS AND P&ID SYMBOLS (GENERAL INSTRUMENT OR FUNCTION SYMBOLS)

LINE TYPES

SYMBOL	LINE TYPE	DESCRIPTION
	CONTINUOUS	PRIMARY PROCESS FLOW LINE
	CONTINUOUS	SECONDARY PROCESS FLOW LINE
	CONTINUOUS	INSTRUMENT SUPPLY OR CONNECTION TO PROCESS
	CONTINUOUS	UNDEFINED SIGNAL
	CONTINUOUS	PNEUMATIC SIGNAL *
	HIDDENX2	ELECTRIC SIGNAL
L L	CONTINUOUS	HYDRAULIC SIGNAL
	CONTINUOUS	CAPILLARY TUBE
	CONTINUOUS	ELECTROMAGNETIC OR SONIC SIGNAL ** (GUIDED)
∿ ∿	CONTINUOUS	ELECTROMAGNETIC OR SONIC SIGNAL ** (NOT GUIDED)
	CONTINUOUS	INTERNAL SYSTEM LINK (SOFTWARE OR DATA LINK
	CONTINUOUS	MECHANICAL LINK
OPTIONAL BINARY (ON-OFF) SYMBOLS		
	CONTINUOUS	PNEUMATIC BINARY SIGNAL
	DASHED2	ELECTRIC BINARY SIGNAL
E E	CONTINUOUS	ELECTRICAL HEAT TRACING
S S	CONTINUOUS/DASHED2	STEAM HEAT TRACING
	DASHED2	BURIED LINES
	PHANTOM	EXISTING
XX	CENTER	FP – FLOOR PENETRATION RP – ROOF PENETRATION WP – WALL PENETRATION SB – SYSTEM BREAK

NOTES:
"OR" MEANS USER CHOICE. CONSISTENCY IS RECOMMENDED.

- * THE PNEUMATIC SIGNAL SYMBOL APPLIES TO A SIGNAL USING ANY GAS AS THE SIGNAL MEDIUM. IF GAS OTHER THAN AIR IS USED, THE GAS MAY BE IDENTIFIED BY A NOTE ON THE SIGNAL SYMBOL OR OTHERWISE.
- ** ELECTROMECHANIC PHENOMENA INCLUDE HEAT, RADIO WAVES, NUCLEAR RADIATION, AND LIGHT.

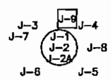
SYMBOL	DESCRIPTION
◇	P =PURGE OR FLUSHING DEVICE R =RESET FOR LATCH-TYPE ACTUATOR I =UNDEFINED INTERLOCK LOGIC
X	S=SOLENOID D=DIGITAL P=PILOT T=TRAP M=MAGNETIC FLOWMETER SP=SET POINT
√	ROOT EXTRACTION
±	BIAS
X	MULTIPLY
>	HIGH SELECTING
<	LOW SELECTING
≯	HIGH LIMITING
≮	LOW LIMITING
K	PROPORTIONAL
-K	REVERSE PROPORTIONAL
+	SUMMING
÷	DIVIDING
CA-1	EQUIPMENT TAG
X Y-#	PIPE OR WIRE IS CONTINUED ON DRAWING X (INCLUDING SHEET NUMBER), GRID COORDINATE (Y-#); FLOW IS TO THAT DRAWING.
X Y-#	PIPE OR WIRE IS CONTINUED ON DRAWING X (INCLUDING SHEET NUMBER), GRID COORDINATE (Y-#); FLOW IS FROM THAT DRAWING.
X Y-#	PIPE OR WIRE IS CONTINUED ON DRAWING X (INCLUDING SHEET NUMBER), GRID COORDINATE (Y-#); FLOW IS IN BOTH DIRECTIONS

INSTRUMENT/FUNCTION SYMBOLS

	PRIMARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	FIELD MOUNTED	AUXILIARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	AUXILIARY LOCATION NORMALLY INACCESSIBLE TO OPERATOR
DISCRETE INSTRUMENTS	J1 J2 J2A	J1 J2 J2A	J1 J2 J2A	J1 J2 J2A
SHARED DISPLAY, SHARED CONTROL	J1 J2 J2A	J1 J2 J2A	J1 J2 J2A	J1 J2 J2A
COMPUTER FUNCTION	J1 J2 J2A	J1 J2 J2A	J1 J2 J2A	J1 J2 J2A
PROGRAMMABLE LOGIC CONTROL	J1 J2 J2A	J1 J2 J2A	J1 J2 J2A	J1 J2 J2A

SYMBOL	DESCRIPTION
	FLOW INDICATOR TO BE USED IN CONJUNCTION WITH P016
J1 J2 J2A J1 J2 J2A	INSTRUMENTS SHARING COMMON HOUSING
J1 J2 J2A	PANEL MOUNTED PATCHBOARD POINT 12

INSTRUMENTATION IDENTIFICATION TABLE



J-1 COMPONENT FUNCTION NUMBER
J-2 COMPONENT SEQUENCE NUMBER
J-2A COMPONENT SEQUENCE # CONT'D
J-3 VENDOR DESIGNATION
J-4 PANEL NUMBER
J-5 APPLICABLE NOTES
J-6 SYSTEM ACRONYM
J-7 ASME TEST SYMBOL FOR TEST ONLY OR TEST PLUS NORMAL USE
J-8 SET-POINT(S)
J-9 FUNCTION (SEE INSTRUMENT/FUNCTION SYMBOLS)

NOTE:
INSTRUMENTATION FUNCTION IDENTIFIERS (J-1) AND FUNCTION SYMBOLS PER ANSI/ISA S5.1.

ACRONYMS

EQUIPMENT

AHU – AIR HANDLING UNIT
ASV – AIR SWITCH VALVE
CA – AIR COMPRESSOR
CAE – COOLER, AIR EVAPORATIVE
D – DAMPER
DAD – DESICCANT AIR DRYER
DAMD – DUCT AIR MONITOR DEVICE
ES – EXHAUST STACK
FAB – FILTER AIR BOX
FANE – FAN EVALUATOR
FAR – FILTER AIR REPLACEABLE
FC – FAN CIRCULATING
FD – FIRE DAMPER
FE – FAN EXHAUST
FRA – FAN, RETURN AIR
FRL – FILTER AIR ROLL
FS – FAN SUPPLY
HEPA – HIGH EFFICIENCY PARTICULATE AIR FILTER
HX – HEAT EXCHANGER
MT – MOISTURE TRAP
OIM – OPERATOR INTERFACE MODULE
SST – SYSTEM STATIC TOTALIZER
TCA – TANK COMPRESSED AIR
TK – TANK
T – TRAP
V – VALVE
VFD – VARIABLE FREQUENCY DRIVE/MOTOR CONTROLLER
YS – PLC CONTROL OUTPUT

MINOR EQUIPMENT

OPEN DRAIN ANNOTATIONS
RD – RADIOACTIVE DRAIN TO DRAIN HEADER
ND – NON-RADIOACTIVE DRAIN
AW – ACID WASTE
NW – NORMAL WASTE
OW – OIL WASTE
SW – SANITARY WASTE

LINE VALVE STATUS SYMBOLS

TYPICAL VALVE ANNOTATIONS
FO – FAIL OPEN
FC – FAIL CLOSED
FL – FAIL LOCKED (POSITION DOES NOT CHANGE)
FI – FAIL INDETERMINATE
FAI – FAIL AS IS
NO – NORMALLY OPEN
NC – NORMALLY CLOSED
LO – LOCKED OPEN
LC – LOCKED CLOSED

MISCELLANEOUS ACRONYMS

WP – WALL PENETRATION
FP – FLOOR PENETRATION
RP – ROOF PENETRATION
AO – ANALOG OUTPUT
AI – ANALOG INPUT
DI – DIGITAL INPUT
RO – RELAY OUTPUT

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE
P&ID – LEGENDS & SYMBOLS TA-50 TA-52 TA-63
BLDG 181,182,183

DRAWN T. HARPER
DESIGN T. HARPER
CHECKED S. STUHRKE
DATE
SUBMITTED
APPROVED FOR RELEASE

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SHEET M-0001 OF
CLASSIFICATION U
REVIEWER
DATE
PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-0001-RADWG

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

REVISION 1, DATE 9-16-2004

VALVE & INSTRUMENTATION FUNCTION IDENTIFIERS (SELECTED)

FIRST-LETTERS	INDICATING MEASURED OR CONTROLLED VARIABLE	CONTROLLERS			VALVES	READOUT DEVICE		SWITCHES AND * ALARM DEVICES			TRANSMITTERS			SOLENOIDS RELAYS COMPUTING DEVICES	PRIMARY ELEMENT	TEST POINT	WELL OR PROBE	VIEWING DEVICE GLASS	SAFETY DEVICE	FINAL ELEMENT
		RECORDING	INDICATING	BLIND		RECORDING	INDICATING	HIGH**	LOW	COMB	RECORDING	INDICATING	BLIND							
A	ANALYSIS	ARC	AIC	AC		AR	AI	ASH	ASL	ASHL	ART	AIT	AT	AY	AE	AP	AW			AV
B	BURNER/ COMBUSTION	BRC	BIC	BC		BR	BI	BSH	BSL	BSHL	BRT	BIT	BT	BY	BE		BW	BG		BZ
C	CONDUCTIVITY		CIC	CC											CE					
D	USER'S CHOICE																			
E	VOLTAGE	ERC	EIC	EC		ER	EI	ESH	ESL	ESHL	ERT	EIT	ET	EY	EE					EZ
F	FLOW RATE	FRC	FIC	FC	FCV FICV	FR	FI	FSH	FSL	FSHL	FRT	FIT	FT	FY	FE	FP		FG		FV
FQ	FLOW QUANTITY	FQRC	FQIC			FQR	FQI	FQSH	FQSL			FQIT	FQT	FQY	FQE					FQV
FF	FLOW RATIO	FFRC	FFIC	FFC		FFR	FFI	FFSH	FFSL						FE					FFV
G	USER'S CHOICE																			
H	HAND		HIC	HC	HV					HS										HV
I	CURRENT	IRC	IIC			IR	II	ISH	ISL	ISHL	IRT	IIT	IT	IY	IE					IZ
J	POWER	JRC	JIC	ARC		JR	JI	JSH	JSL	JSHL	JRT	JIT	JT	JY	JE					JV
K	TIME	KRC	KIC	KC	KCV	KR	KI	KSH	KSL	KSHL	KRT	KIT	KT	KY	KE					KV
L	LEVEL	LRC	LIC	LC	LCV	LR	LI	LSH	LSL	LSHL	LRT	LIT	LT	LY	LE		LW	LG		LV
M	MOISTURE/ HUMIDITY						MI						MT							
N	USER'S CHOICE																			
O	USER'S CHOICE																			
P	PRESSURE VACUUM	PRC	PIC	PC	PCV	PR	PI	PSH	PSL	PSHL	PRT	PIT	PT	PY	PE	PTP			PSV PSE	PV
PD	PRESSURE DIFFERENTIAL	PDRC	PDIC	PDC	PDCV	PDR	PDI	PDSH	PDSL		PDRT	PDIT	PDT	PDY	PE	PTP				PDV
Q	QUALITY	QRC	QIC			QR	QI	QSH	QSL	QSHL	QRT	QIT	QT	QY	QE					QZ
R	RADIATION	RRC	RIC	RC		RR	RI	RSH	RSL	RSHL	RRT	RIT	RT	RY	RE		RW			RZ
S	SPEED	SRC	SIC	SC	SCV	SR	SI	SSH	SSL	SSHL	SRT	SIT	ST	SY	SE					SV
T	TEMPERATURE	TRC	TIC	TC	TCV	TR	TI	TSH	TSL	TSHL	TRT	TIT	TT	TY	TE	TP	TW		TSE	TV
T	TEMPERATURE DIFFERENTIAL	TDRC	TDIC	TDC	TDCV	TDR	TDI	TDSH	TDSL		TDRT	TDIT	TDT	TDY	TDE	TDP TP	TDW TW			TDV
U	MULTIVARIABLE					UR	UI							UY						UV
V	MACHINERY VIBRATION ANALYSIS					VR	VI	VSH	VSL	VSHL	VRT	VIT	VT	VY	VE					VZ
W	WEIGHT FORCE	WRC	WIC	WC	WCV	WR	WI	WSH	WSL	WSHL	WRT	WIT	WT	WY	WE					WZ
WD	WEIGHT FORCE DIFFERENTIAL	WDRC	WDIC	WDC	WDCV	WDR	WDI	WDSH	WDSL		WDRT	WDIT	WDT	WDY	WDE WE					WDZ
X	USER'S CHOICE																			
Y	EVENT STATE PRESENCE		YIC	YC		YR	YI	YSH	YSL				YT	YY	YE					YZ
Z	POSITION DIMENSION	ZRC	ZIC	ZC	ZCV	ZR	ZI	ZSH	ZSL	ZSHL	ZRT	ZIT	ZT	ZY	ZE					ZV
ZD	GAUGING DEVIATION	ZDRC	ZDIC	ZDC	ZDCV	ZDR	ZDI	ZDSH	ZDSL		ZDRT	ZDIT	ZDT	ZDY	ZDE					ZDV

NOTE:
THIS TABLE IS NOT ALL-INCLUSIVE, SEE LEM CH. 1, SECTION 230

*A, ALARM, THE ANNUNCIATING DEVICE, MAY BE USED IN THE SAME FASHION AS, SWITCH, THE ACTING DEVICE.

** THE LETTERS H AND L MAY BE OMITTED IN THE UNDEFINED CASE.

OTHER POSSIBLE COMBINATIONS:

FO	(RESTRICTION ORIFICE)	PFR	(RATIO)
FRK, HIK	(CONTROL STATIONS)	KQI	(RUNNING TIME INDICATOR)
FX	(ACCESSORIES)	QQI	(INDICATING COUNTER)
TJR	(SCANNING RECORDER)	WKIC	(RATE-OF-WEIGHT-LOSS CONTROLLER)
LLH	(PILOT LIGHT)	HMS	(HAND MOMENTARY SWITCH)

"60% REVIEW "NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE
P&ID -- LEGENDS & SYMBOLS TA-50 TA-52 TA-63
BLDG 181,182,183

DRAWN T. HARPER
DESIGN T. HARPER
CHECKED S. STUHRKE
DATE

SUBMITTED | APPROVED FOR RELEASE

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SHEET M-0002 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPER Plot Date: 7/8/2011
FILE NAME: C55751-M-0002-RA.DWG

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

H G F E D C B A

PROCESS FLOW DIAGRAMS AND P&ID SYMBOLS (GENERAL INSTRUMENT OR FUNCTION SYMBOLS)

SYMBOL	DESCRIPTION
	ANGLE VALVE
	BUTTERFLY VALVE
	ROTARY VALVE
	3-WAY VALVE
	4-WAY VALVE
	OS & Y VALVE
	DIAPHRAGM VALVE
	PRESSURE RELIEF
	DIAPHRAGM ACTUATOR
	TWO-WAY VALVE, FAIL CLOSED
	TWO-WAY VALVE, FAIL OPEN
	3-WAY VALVE W/DIAPHRAM ACTUATOR
	4-WAY VALVE W/DIAPHRAM ACTUATOR
	SPRING-OPPOSED SINGLE-ACTING ACTUATOR
	SPRING-OPPOSED DOUBLE-ACTING ACTUATOR
	ELECTROHYDRAULIC ACTUATOR
	HAND ACTUATOR OR HANDWHEEL
	RESTRICTION ORIFICE IN PROCESS LINE
	RESTRICTION ORIFICE DRILLED IN VALVE
	FLOW STRAIGHTING VANE
	DIAPHRAGM PRESSURE-BALANCED
	PRESSURE-REDUCING REGULATOR, SELF-CONTAINED, WITH HANDWHEEL ADJUSTABLE SET POINT
	PRESSURE REDUCING REGULATOR WITH EXTERNAL PRESSURE TAP
	DIFFERENTIAL-PRESSURE-REDUCING REGULATOR WITH INTERNAL AND EXTERNAL TAPS
	BACKPRESSURE REGULATOR, SELF-CONTAINED
	BACKPRESSURE REGULATOR WITH EXTERNAL PRESSURE TAP
	PRESSURE-REDUCING REGULATOR WITH INTEGRAL OUTLET PRESSURE RELIEF VALVE, AND OPTIONAL PRESSURE INDICATOR
PI	PRESSURE INDICATOR
	FLOW DIRECTION
	PRESSURE RELIEF OR SAFETY VALVE
	VACUUM RELIEF VALVE
	PRESSURE RELIEF OR SAFETY VALVE, STRAIGHT-THROUGH PATTERN, SPRING- OR WEIGHT-LOADED, OR WITH INTEGRAL PILOT
	RUPTURE DISK OR SAFETY HEAD FOR VACUUM RELIEF

SYMBOL	DESCRIPTION
	RUPTURE DISK OR SAFETY HEAD FOR PRESSURE RELIEF
	PILOT LIGHT X=COLOR R=RED G=GREEN
	FLEX CONNECTION (RUBBER)
	FLEX CONNECTION (STEEL BRAIDED)
	SINGLE PITOT TUBE OR PITOT VENTURI TUBE
	FLOW METER
	FLOW NOZZLE OR VENTURI
	REDUCER
	SCREWED CAP
	PIPE CAP
	HOSE CONNECTION
	FLANGED CONNECTION (PIPING OR EQUIP)
	FLOW ORIFICE FIXED
	STRAINER WITH VALVE
	Y-STRAINER
	COMPRESSED AIR
	DUCTED AIR FLOW FROM SPACE
	CAPPED AIR DUCT
	GATE VALVE (OPEN)
	GATE VALVE (CLOSED)
	GLOBE VALVE (OPEN)
	GLOBE VALVE (CLOSED)
	NEEDLE VALVE (OPEN)
	NEEDLE VALVE (CLOSED)
	PLUG VALVE (OPEN)
	PLUG VALVE (CLOSED)
	BALL VALVE (OPEN)
	BALL VALVE (CLOSED)
	CHECK VALVE
	SPRING CHECK VALVE
	ANGLE VALVE (OPEN)
	ANGLE VALVE (CLOSED)
	SAFETY OR RELIEF VALVE (INLET PORT SHOWN CLOSED)
	THREE-WAY VALVE (CLOSED PORT DARKENED)
	FOUR-WAY VALVE (ARROWS INDICATE FLOW DIRECTION)
	BALL-CHECK VALVE
	DUAL PURGE VALVE
	ALARM VALVE
	AIR INTAKE FILTER
	ALARM
	BUBBLE GAUGE

SYMBOL	DESCRIPTION
	IN-LINE FILTER
	ATMOSPHERIC FILTER
	DOUBLE BASKET STRAINER
	HOSE REEL
	OPEN DRAIN (SHOWN)
XX	XX- DRAIN SYSTEM ANNOTATIONS
	DRAIN (PLAN VIEW)
	CLEANOUT (PLAN VIEW)
	SANITARY VENT
	SILENCER/MUFFLER
	SPACE PENETRATIONS
	FIXED LOUVERS
XX	TRAP XX ANNOTATES FUNCTION
L	LUBRICATOR
	55 GALLON DRUM
	THERMOSTATIC VENT
	SPRINKLER ALARM (WATER MOTOR GONG)
	FLOW ALARM VALVE
	COOLING TOWER
	CHILLER
	HORIZONTAL CENTRIFUGAL PUMP
	CENTRIFUGAL FAN WITH VARIABLE INLET VANES
	BLOWER/CENTRIFUGAL FAN
	ROTARY PUMP
	VERTICAL WET PIT PUMP
	PROGRESSIVE CAVITY PUMP
	VERTICAL SUMP PUMP
	HEATER
	HEAT EXCHANGER

SYMBOL	DESCRIPTION
	AXIAL FAN
	AXIAL FAN WITH VARIABLE INLET VANES
	2-STAGE RECIPROCATING AIR COMPRESSOR
	SINGLE STAGE RECIPROCATING AIR COMPRESSOR
	2-STAGE ROTARY SCREW AIR COMPRESSOR
	RECIPROCATING PUMP
	PRESSURE VESSELS, VERTICAL (SHOWN) OR HORIZONTAL (TANKS, RECEIVERS, SEPARATORS, SUMPS ETC.)
	TANK
A / B	HVAC COIL (A) HW HEATING WATER DX DIRECT EXPANSION CH CHILLED WATER STM STEAM (B) HCL HEATING COIL CCL COOLING COIL
A / B	UNIT HEATER (A) HW HEATING WATER DX DIRECT EXPANSION STM STEAM (B) HCL HEATING COIL
	PRESSURIZED GAS BOTTLE
	DOUBLE CONTAINMENT TANK
H	HUMIDIFIER
	MANUAL BALANCE DAMPER
	MULTI POINT PITOT TUBE ARRAY
NO/NC	DAMPER (NORMALLY OPEN) OR NORMALLY CLOSED
	EVAPORATIVE AIR COOLER
	OPPOSED BLADE DAMPER FOR HVAC EQUIPMENT
	BACKDRAFT DAMPER

SYMBOL	DESCRIPTION
	SINGLE DUCT VARIABLE VOLUME BOX
A / B	WING TYPE FACE AND BYPASS DAMPER (A) HW HEATING WATER DX DIRECT EXPANSION CH CHILLED WATER STM STEAM (B) HCL HEATING COIL CCL COOLING COIL
	COLLECTION BIN
	CYCLONE SEPARATOR
	FLUID RECOVERY PUMP
	DUAL SERVICE HEAT EXCHANGER
	MULTI BLADE DAMPER
	SINGLE BLADE DAMPER
M	MOTOR
	TEST PORT
	PILOT LIGHT
	SEPARATOR
	MIST ELIMINATOR
	HEPA FILTER
	CARBON ABSORBER FILTER
	FILTER
SD	SUCTION DIFFUSER

60% REVIEW "NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE P&ID - LEGENDS & SYMBOLS TA-50 TA-52 TA-63

BLDG 181,182,183

DRAWN T. HARPER
DESIGN T. HARPER
CHECKED S. STUHRKE
DATE
SUBMITTED
APPROVED FOR RELEASE

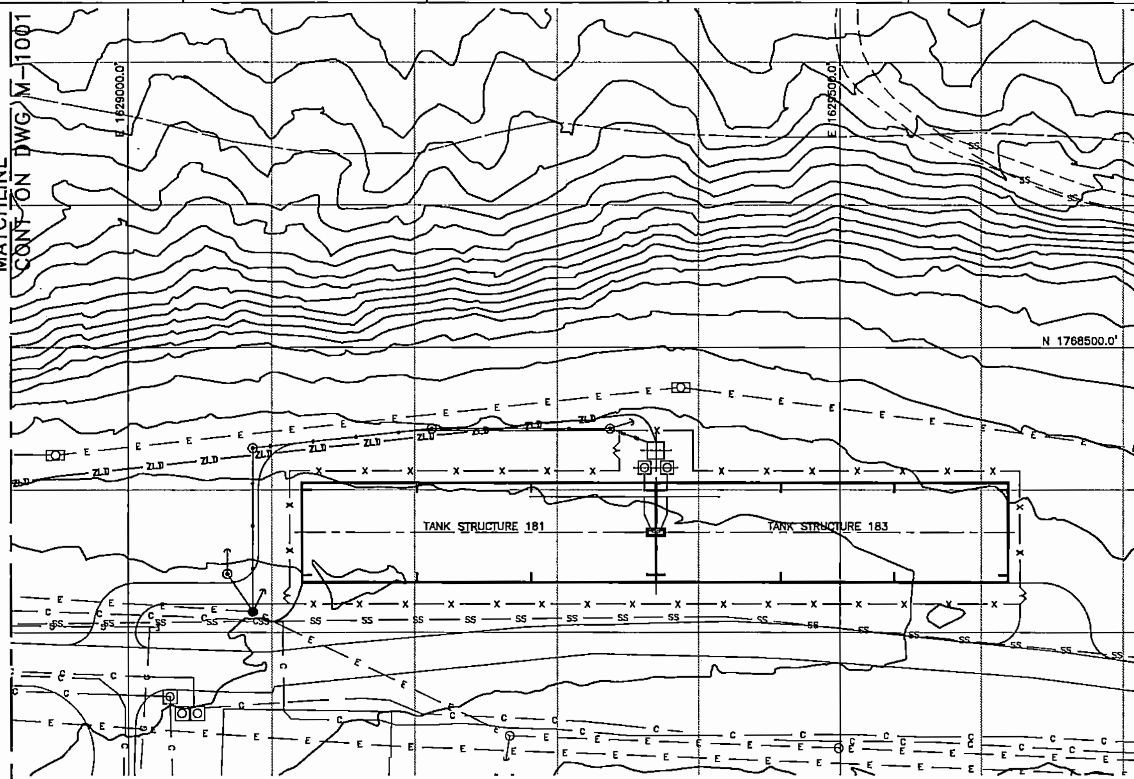
Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-0003 OF

CLASSIFICATION U | REVIEWER | DATE

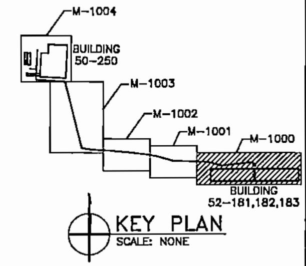
PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPER Plot Date: 7/8/2011
FILE NAME: C55751-M-0003-RA.DWG



TRANSFER PIPING PLAN 1

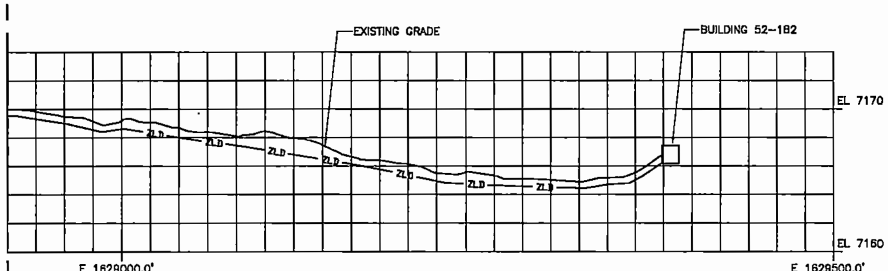
40' 20' 0 20' 40'
1"=40'-0"



KEY PLAN
SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. MINIMUM BURIAL DEPTH (COVER) OF THE ZLD TRANSFER PIPING SHALL BE 4 FEET.
3. TOPOGRAPHIC MAP IS AS PROVIDED BY OWNER, LOS ALAMOS NATIONAL LABORATORY (LANL). COORDINATE GRID SHOWN IS BASED UPON TOPOGRAPHIC MAP FILE PROVIDED, WITH PLAN NORTH AS INDICATED, ELEVATIONS PER NAVD 88 AND OTHER DATA PER NGVD 29.
4. EXISTING UTILITIES ARE SHOWN PER DRAWING "UTILITY COMPOSITE MAP" AS PRODUCED BY UTILITIES AND INFRASTRUCTURE DATED 10-19-2010. CONTRACTOR SHALL VERIFY LOCATIONS OF UTILITIES IN FIELD AT TIME OF CONSTRUCTION.



PIPING PROFILE
SCALE: HORIZONTAL 1"=40.0'
VERTICAL 1"=4.0'

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 1

DRAWN: T. HARPER
DESIGN: T. HARPER
CHECKED: S. STUHRKE
DATE:

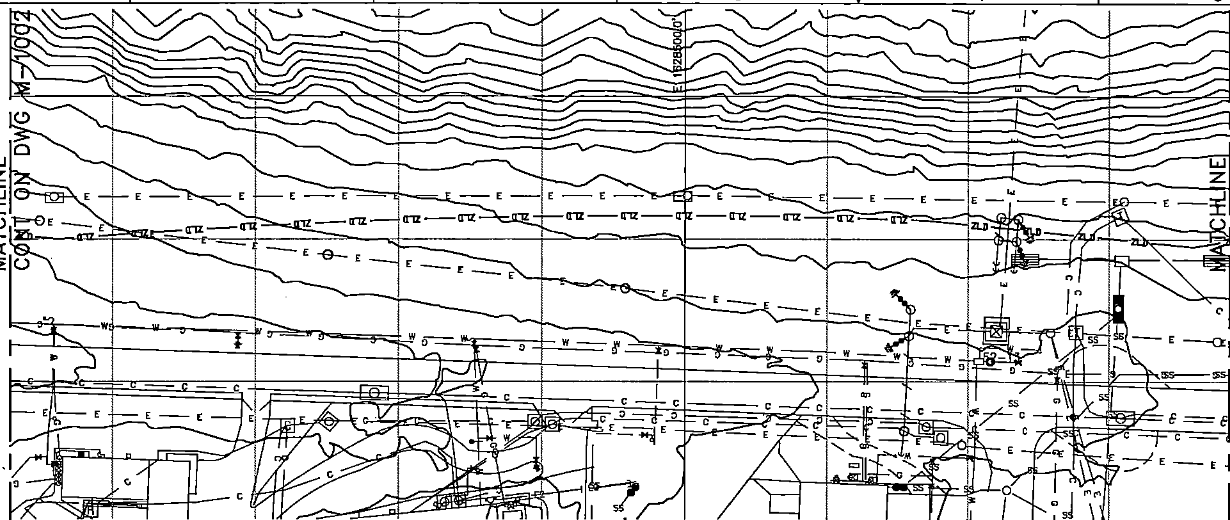
BLDG N/A | TA-52
SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY
PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-1000 OF

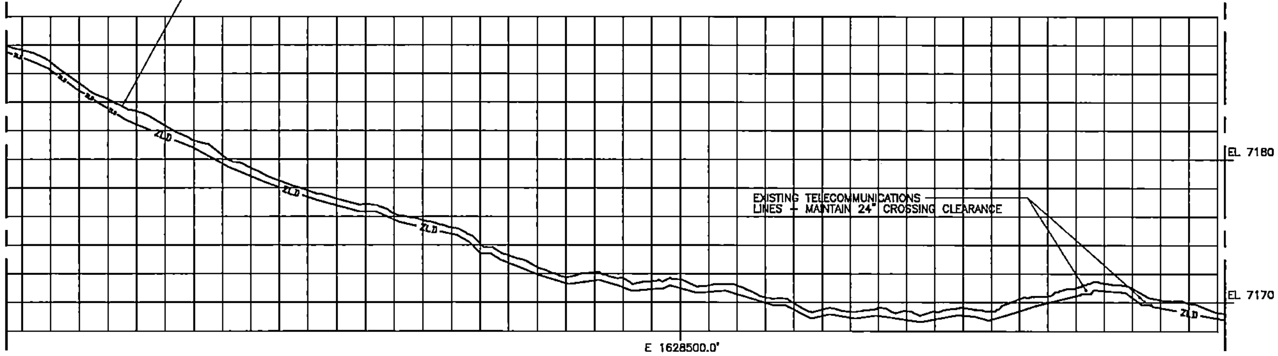
CLASSIFICATION U | REVIEWER | DATE
PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPER Plot Date: 7/6/2011
FILE NAME: C55751-M-1000-RA.DWG



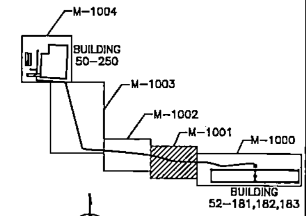
TRANSFER PIPING PLAN 2

40' 20' 0 20' 40'
1"=40'-0"



PIPING PROFILE

SCALE: HORIZONTAL 1"=40.0'
VERTICAL 1"=4.0'



KEY PLAN

SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. MINIMUM BURIAL DEPTH (COVER) OF THE ZLD TRANSFER PIPING SHALL BE 4 FEET.
3. CARE AND HAND EXCAVATION WILL BE REQUIRED NEAR AND WHEN CROSSING UTILITIES OR OTHER PIPELINES WITH THE ZLD TRANSFER PIPING. MAINTAIN AT LEAST THE MINIMUM CLEARANCE NOTED ON THE PIPING PROFILE.
4. FOR ADDITIONAL NOTES SEE SHEET M-1000.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 2

DRAWN T. HARPER
DESIGN T. HARPER
CHECKED S. STUHRKE
DATE

BLDG N/A TA-52
SUBMITTED
APPROVED FOR RELEASE

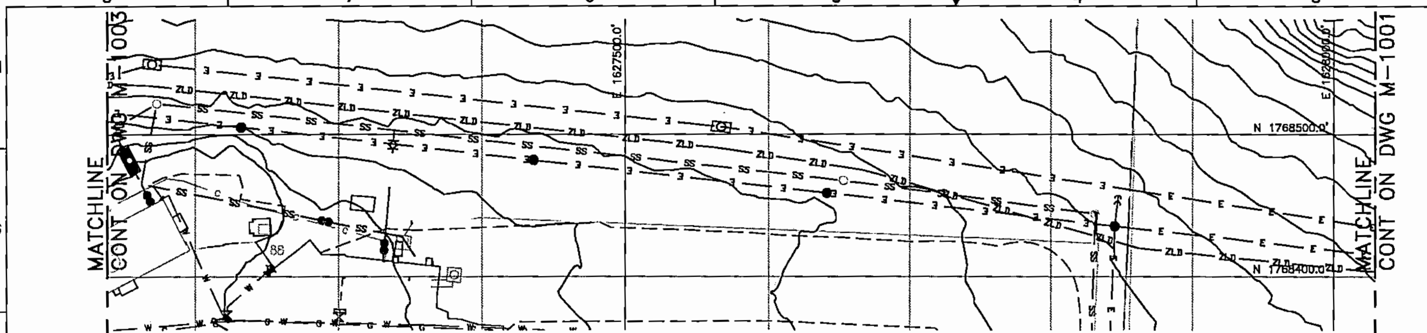
Los Alamos NATIONAL LABORATORY
PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-1001 OF

CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: HARPER Plot Date: 7/8/2011
FILE NAME: C55751-M-1001-RA.DWG

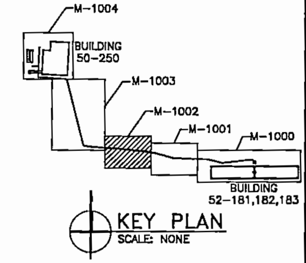


TRANSFER PIPING PLAN 3

40' 20' 0 20' 40'
1"=40'-0"

PIPING PROFILE

SCALE: HORIZONTAL 1"=40.0'
VERTICAL 1"=4.0'



KEY PLAN

SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. MINIMUM BURIAL DEPTH (COVER) OF THE ZLD TRANSFER PIPING SHALL BE 4 FEET.
3. CARE AND HAND EXCAVATION WILL BE REQUIRED NEAR AND WHEN CROSSING UTILITIES OR OTHER PIPELINES WITH THE ZLD TRANSFER PIPING. MAINTAIN AT LEAST THE MINIMUM CLEARANCE NOTED ON THE PIPING PROFILE.
4. FOR ADDITIONAL NOTES SEE SHEET M-1000.

"NOT FOR CONSTRUCTION"
60% REVIEW

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 3

BLDG N/A
TA-52
TA-63

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

SUBMITTED
APPROVED FOR RELEASE

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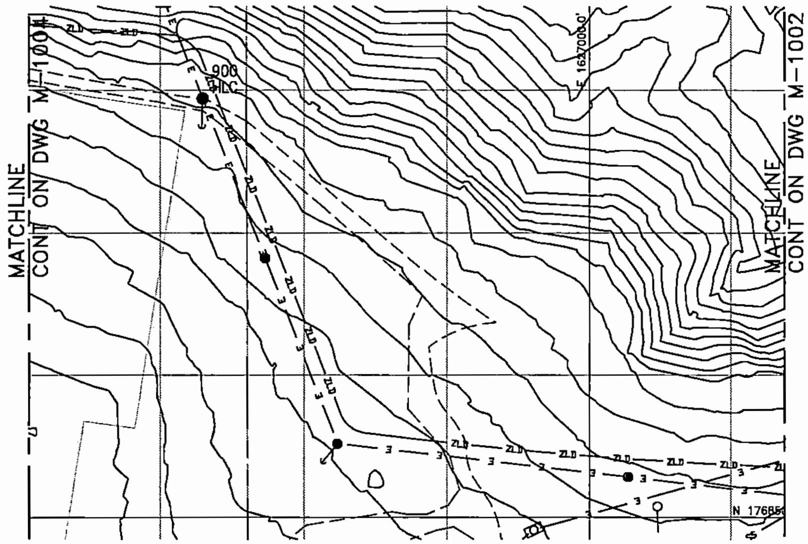
PO Box 1663
Los Alamos, New Mexico 87545

SHEET M-1002
OF

CLASSIFICATION U
REVIEWER
DATE

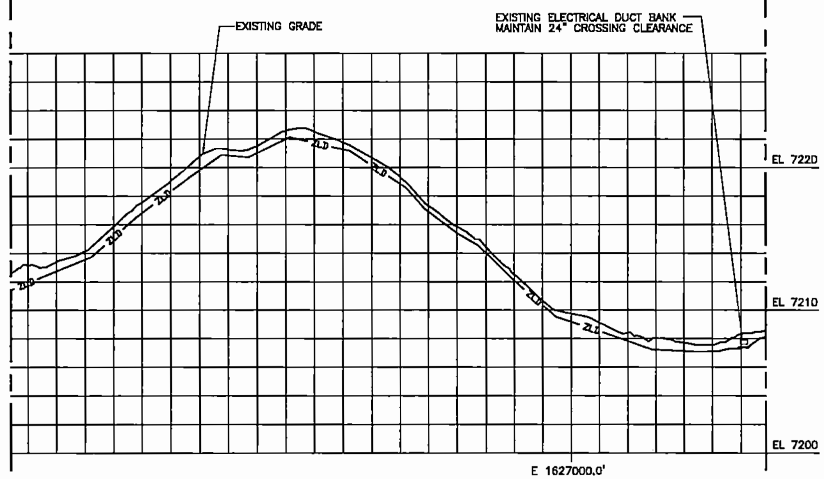
PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: HARPER Plot Date: 7/8/2011
FILE NAME: C55751-M-1002-RA.DWG



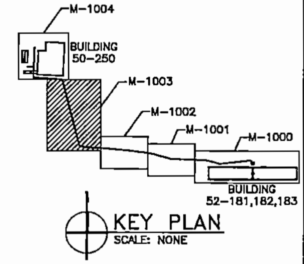
TRANSFER PIPING PLAN 4

40' 20' 0 20' 40'
1"=40'-0"



PIPING PROFILE

SCALE: HORIZONTAL 1"=40.0'
VERTICAL 1"=4.0'



KEY PLAN

SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. MINIMUM BURIAL DEPTH (COVER) OF THE ZLD TRANSFER PIPING SHALL BE 4 FEET.
3. CARE AND HAND EXCAVATION WILL BE REQUIRED NEAR AND WHEN CROSSING UTILITIES OR OTHER PIPELINES WITH THE ZLD TRANSFER PIPING. MAINTAIN AT LEAST THE MINIMUM CLEARANCE NOTED ON THE PIPING PROFILE.
4. FOR ADDITIONAL NOTES SEE SHEET M-1000.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 4

BLDG N/A — TA-50, TA-63

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

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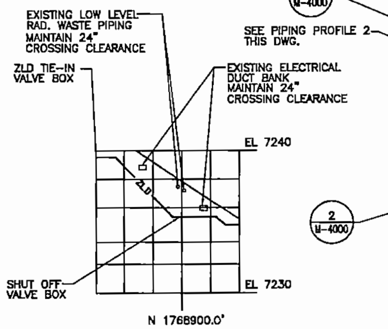
SHEET M-1003 OF

CLASSIFICATION U — REVIEWER — DATE

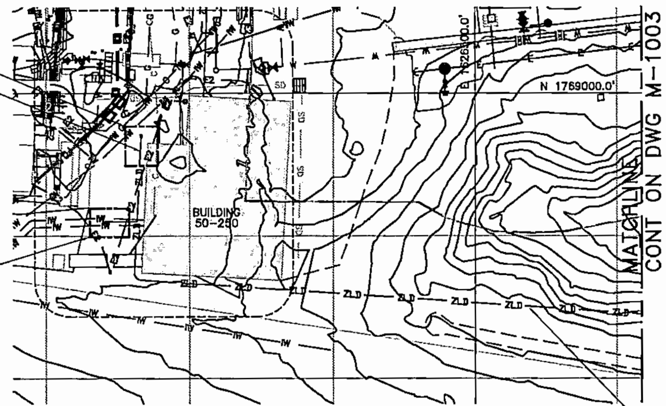
PROJECT ID 100761 — DRAWING NO C-55751 — REV A

Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-1003-RA.DWG



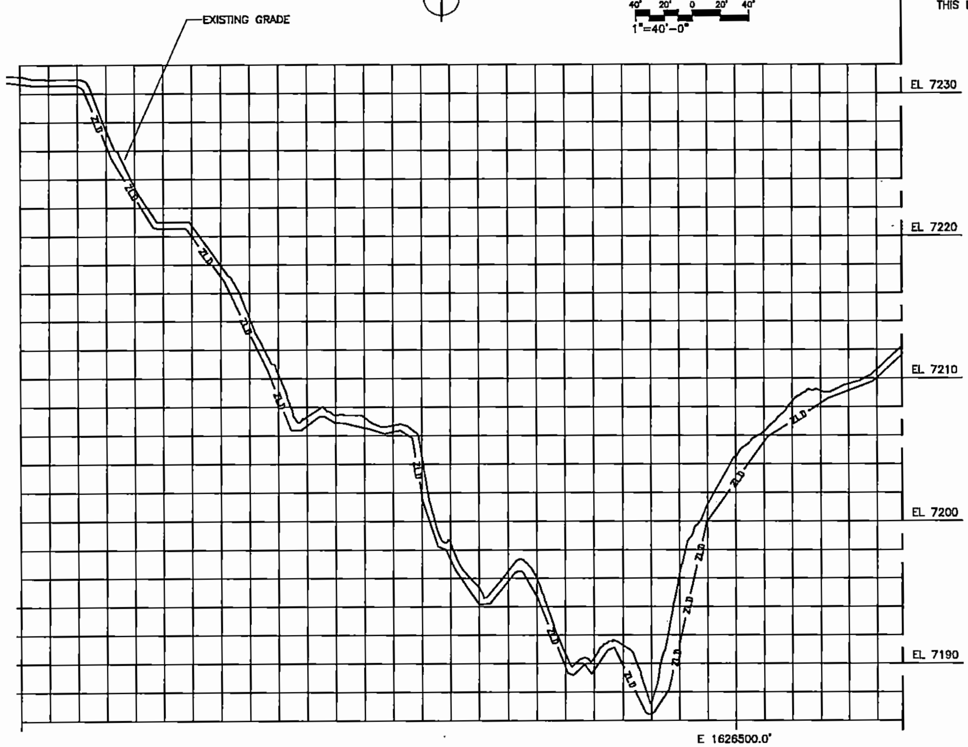
PIPING PROFILE 2-LOOKING EAST

SCALE: HORIZONTAL 1"=40.0'
VERTICAL 1"=4.0'



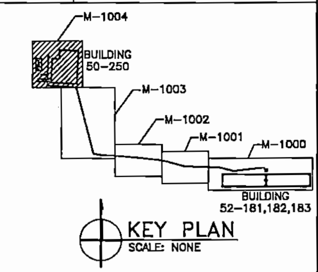
TRANSFER PIPING PLAN 5

40' 20' 0 20' 40'
1"=40'-0"



PIPING PROFILE 1

SCALE: HORIZONTAL 1"=40.0'
VERTICAL 1"=4.0'



KEY PLAN

SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. MINIMUM BURIAL DEPTH (COVER) OF THE ZLD TRANSFER PIPING SHALL BE 4 FEET.
3. CARE AND HAND EXCAVATION WILL BE REQUIRED NEAR AND WHEN CROSSING UTILITIES OR OTHER PIPELINES WITH THE ZLD TRANSFER PIPING. MAINTAIN AT LEAST THE MINIMUM CLEARANCE NOTED ON THE PIPING PROFILES.
4. FOR ADDITIONAL NOTES SEE SHEET M-1000.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TRANSFER PIPING PLAN & PROFILE 5

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

BLDG N/A TA-50

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SHEET M-1004 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPER Plot Date: 7/8/2011
FILE NAME: C55751-M-1004-RA.DWG

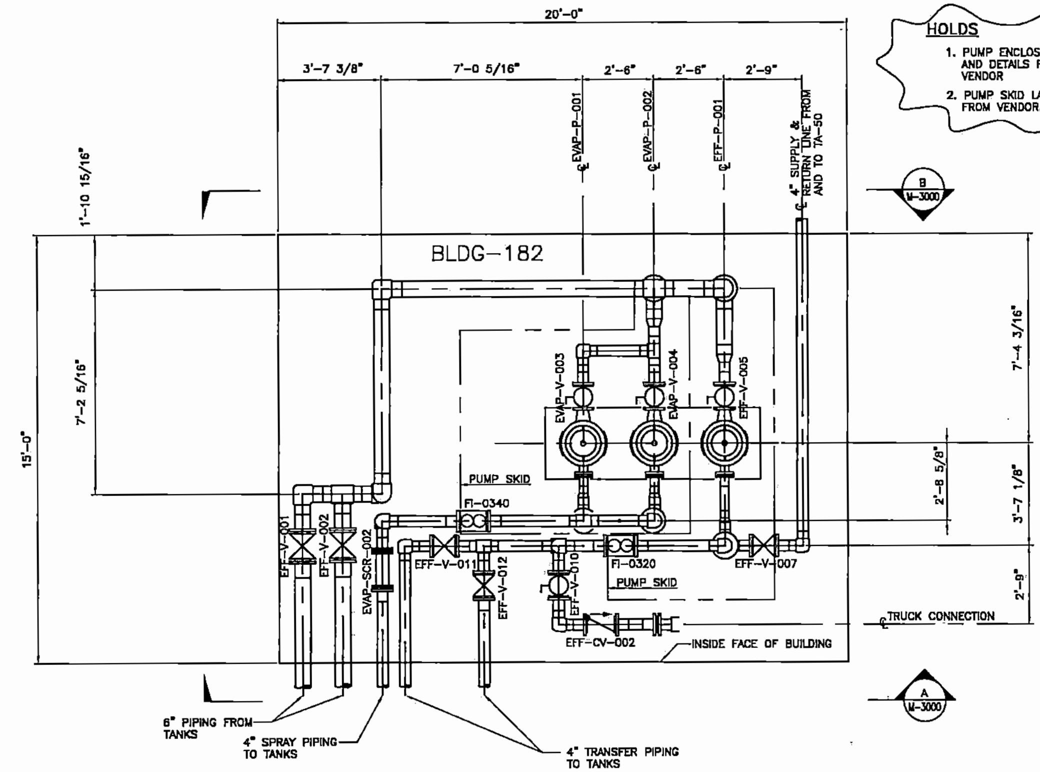
8 7 6 5 4 3 2 1
H G F E D C B A

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

HOLDS

1. PUMP ENCLOSURE DIMENSIONS AND DETAILS REQUIRED FROM VENDOR
2. PUMP SKID LAYOUT REQUIRED FROM VENDOR.



PUMP HOUSE GENERAL ARRANGEMENT AND COMPOSITE PIPING

1/2"=1'-0"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

PUMP HOUSE GENERAL ARRANGEMENT & COMPOSITE PIPING

BLDG 182 TA-52

DRAWN T. HARPER
DESIGN T. HARPER
CHECKED S. STUHRKE
DATE

SUBMITTED
APPROVED FOR RELEASE

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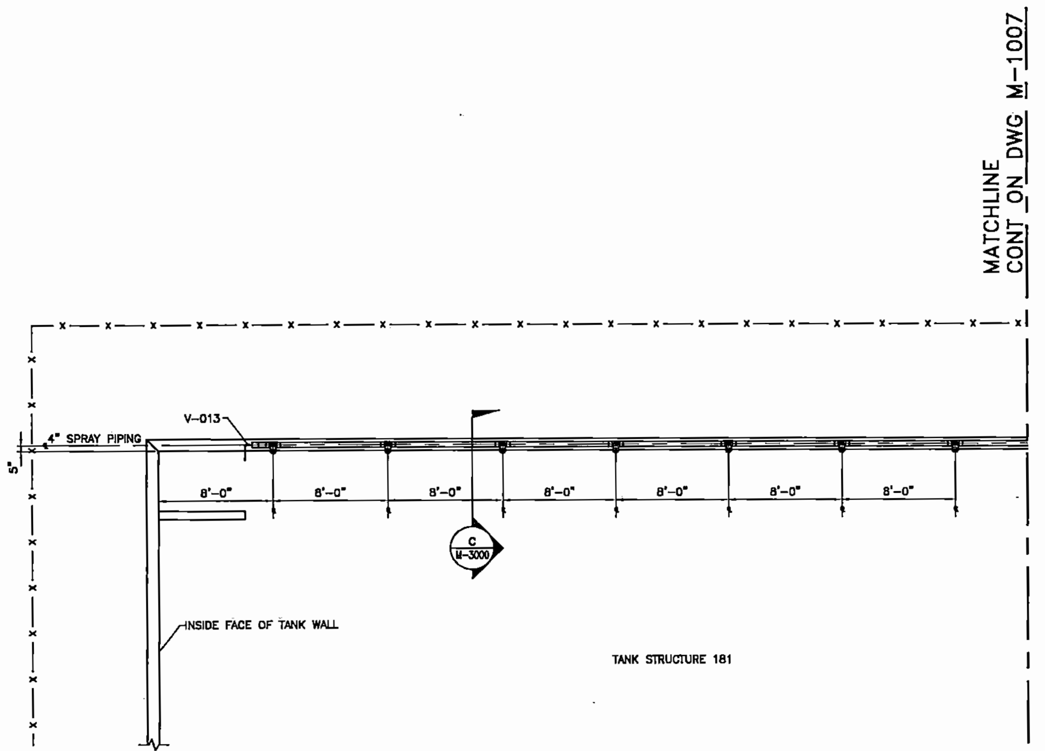
PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-1005
OF

CLASSIFICATION U
REVIEWER
DATE

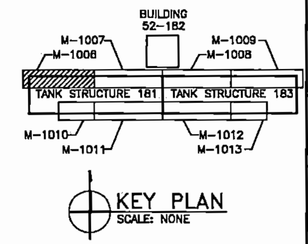
PROJECT ID 100761
DRAWING NO C-55751
REV A

Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-1005-RADWG



SPRAY PIPING COMPOSITE PLAN 1

1/4"=1'-0"



KEY PLAN
SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

"NOT FOR CONSTRUCTION"
60% REVIEW

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD SPRAY PIPING COMPOSITE PLAN

BLDG 181 TA-52

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

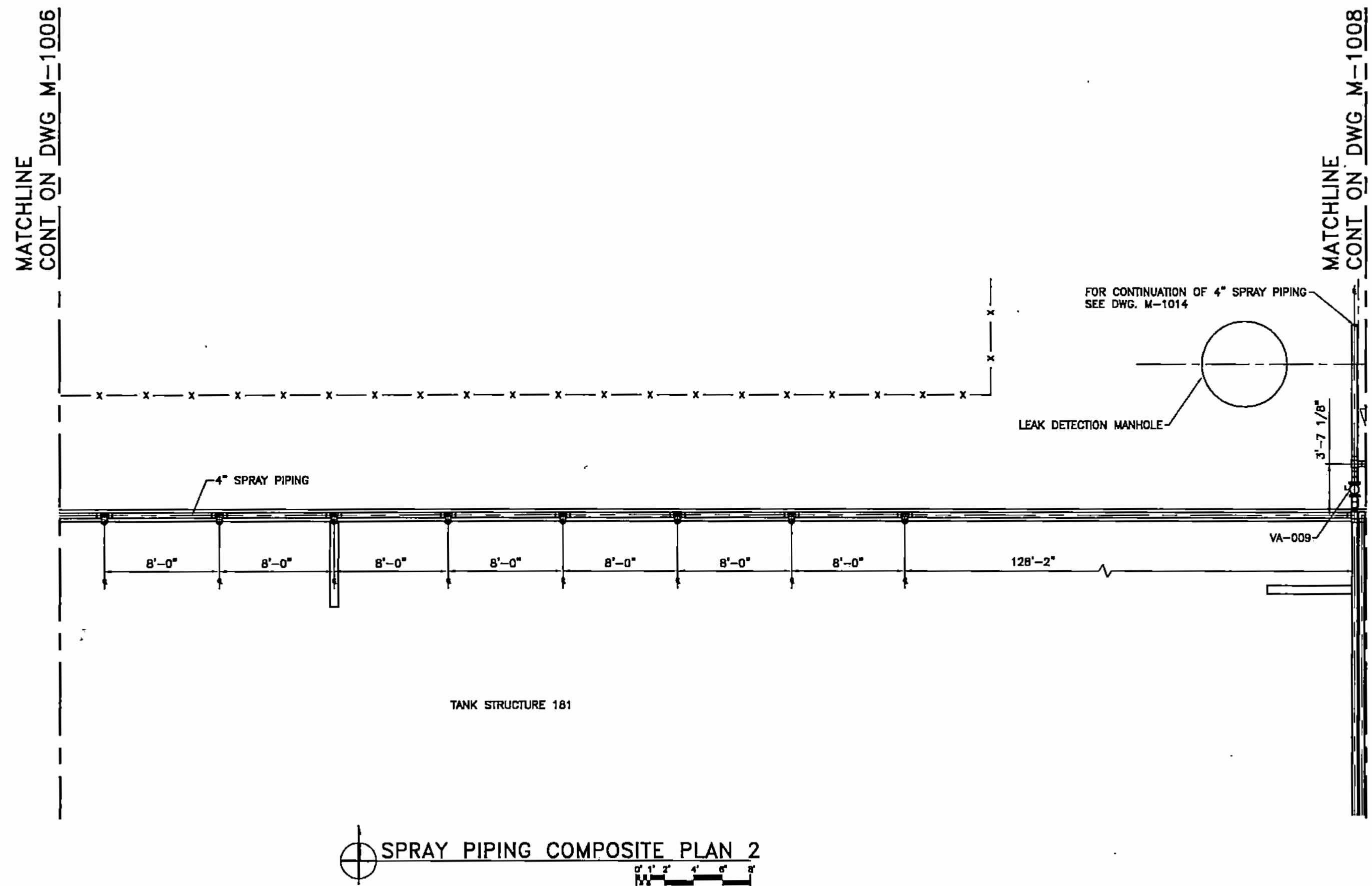
SHEET M-1006 OF

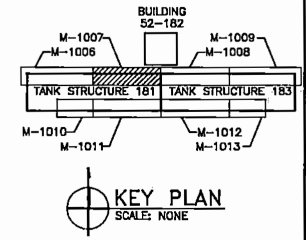
CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPER Plot Date: 7/8/2011
FILE NAME: C55751-M-1006-RA.DWG

64883





GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD SPRAY PIPING COMPOSITE PLAN

BLDG 181,183 TA-52

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

SUBMITTED — APPROVED FOR RELEASE

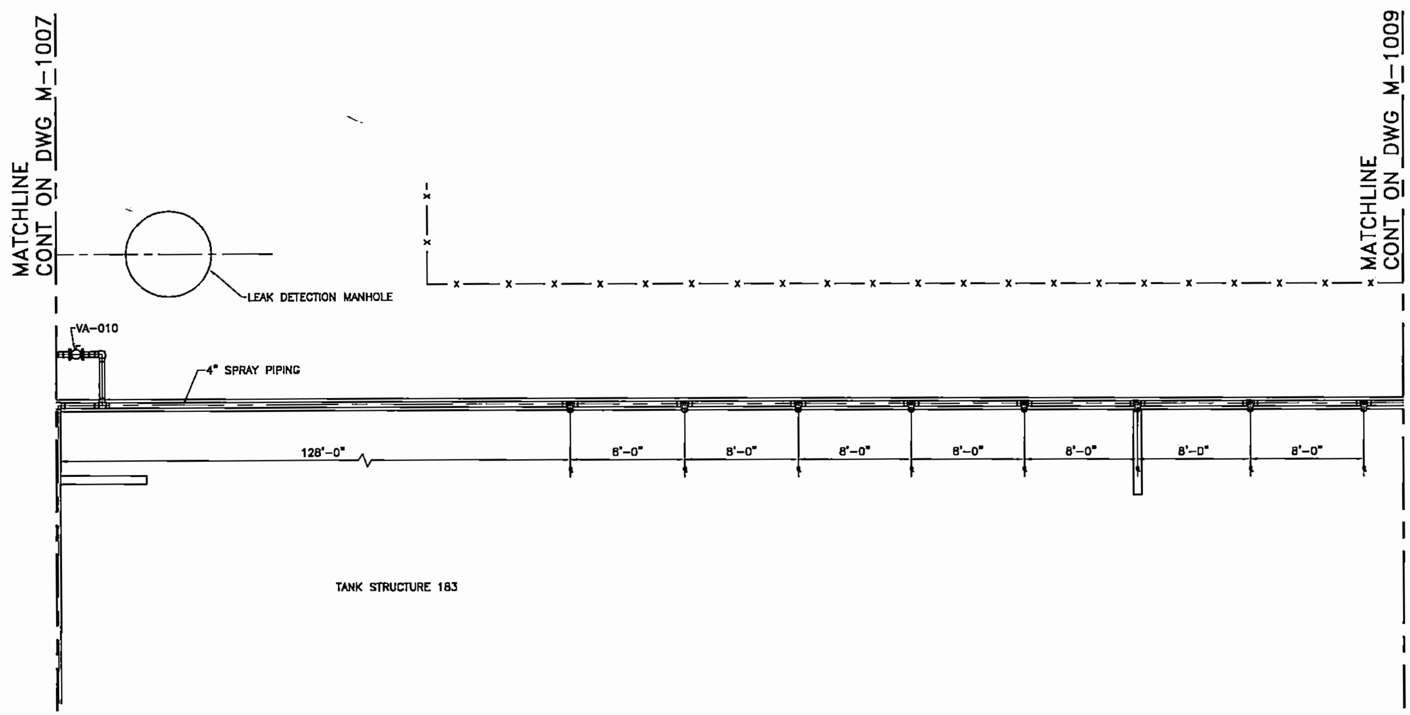
Los Alamos NATIONAL LABORATORY — PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-1007 OF

CLASSIFICATION U — REVIEWER — DATE

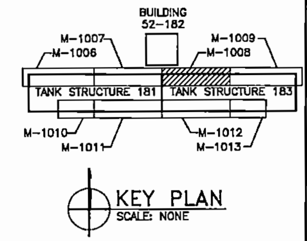
PROJECT ID 100761 — DRAWING NO C-55751 — REV A

Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-1007-RA.DWG



SPRAY PIPING COMPISTE PLAN 3

1/4"=1'-0"



KEY PLAN
SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD SPRAY PIPING COMPOSITE PLAN

BLDG 183 TA-52

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

SUBMITTED | APPROVED FOR RELEASE

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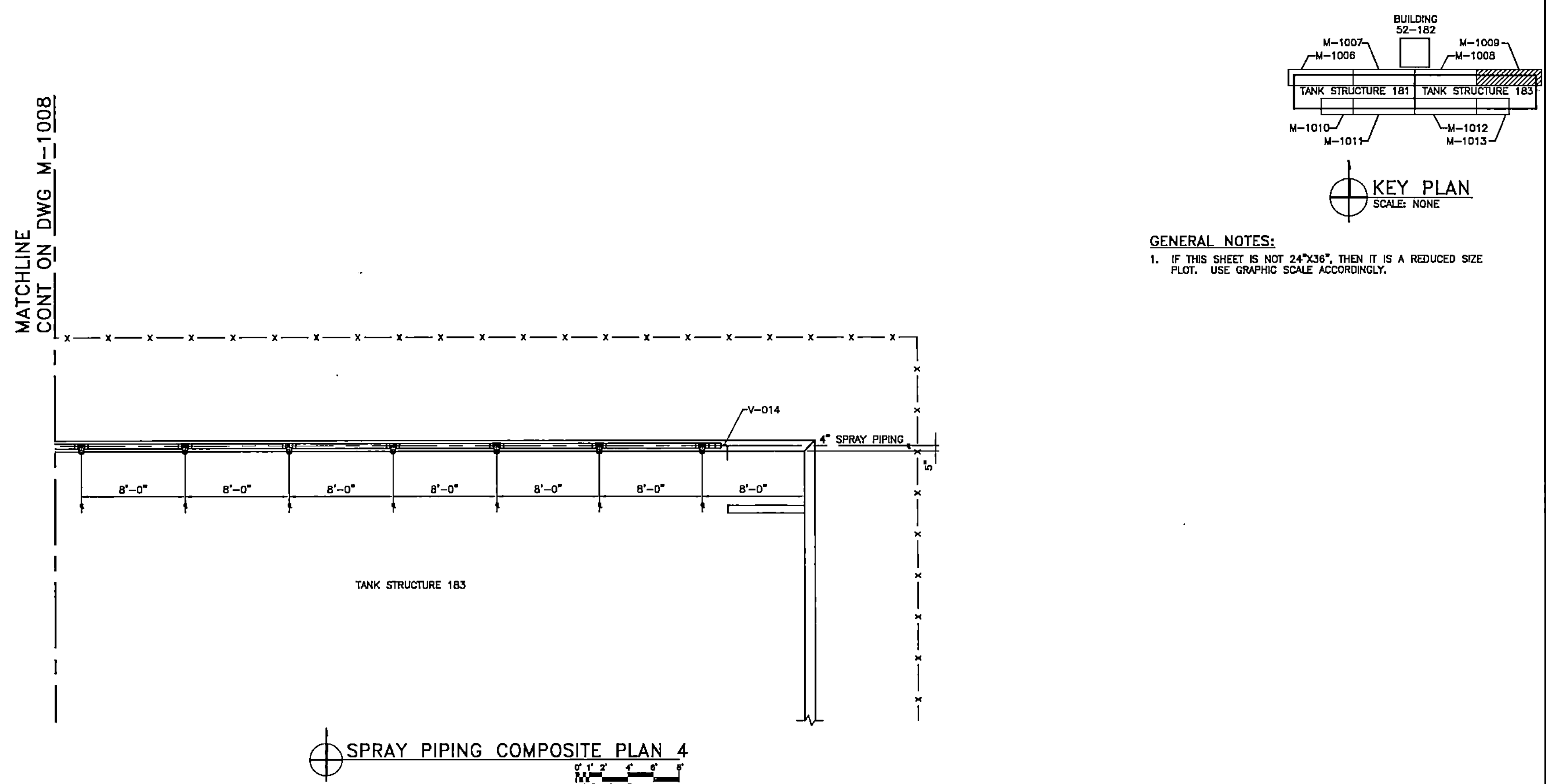
SHEET M-1008 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A



GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD SPRAY PIPING COMPOSITE PLAN

BLDG 183 TA-52

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

SUBMITTED | APPROVED FOR RELEASE

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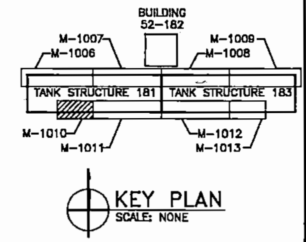
SHEET M-1009 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

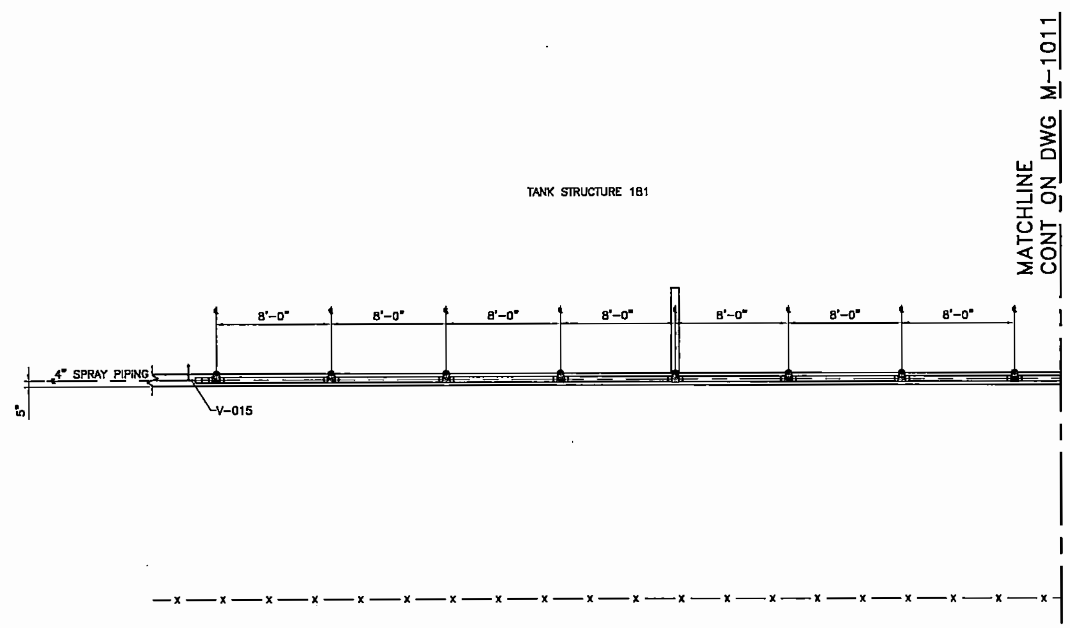
Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-1009-RA.DWG



KEY PLAN
SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



SPRAY PIPING COMPOSITE PLAN 5
1/4"=1'-0"

"NOT FOR CONSTRUCTION"
60% REVIEW

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD SPRAY PIPING COMPOSITE PLAN

BLDG 181 TA-52

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

SUBMITTED | APPROVED FOR RELEASE

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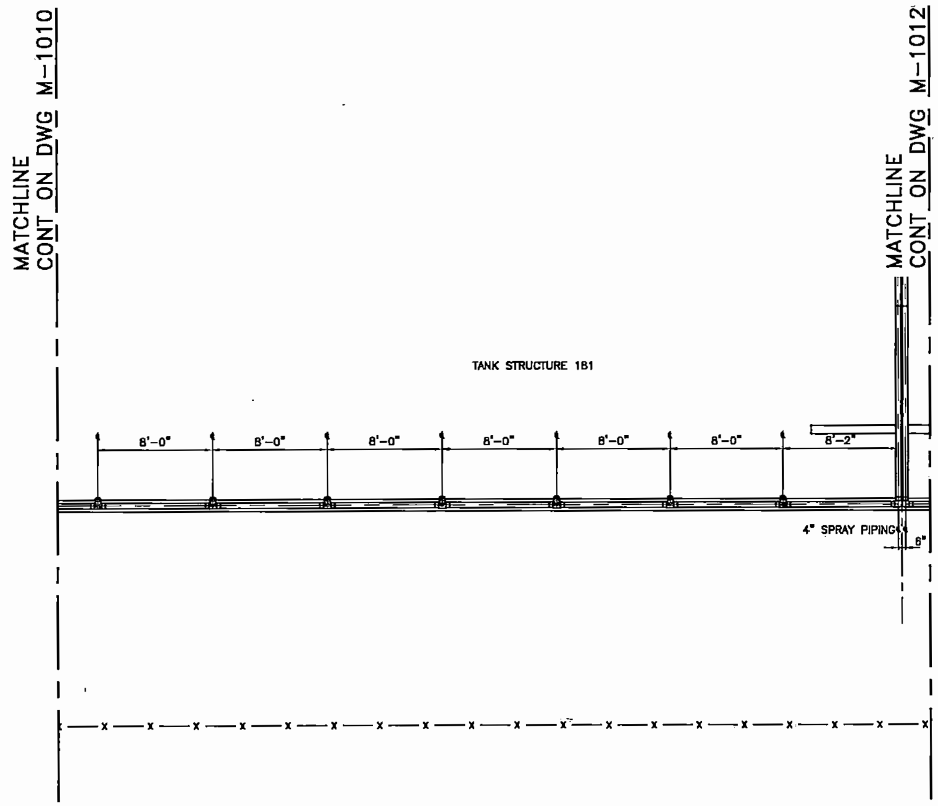
SHEET M-1010 OF

CLASSIFICATION U | REVIEWER | DATE

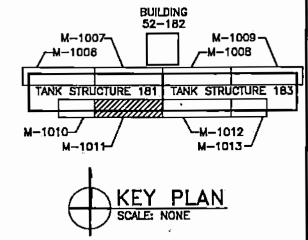
PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPER Plot Date: 7/8/2011
FILE NAME: C55751-M-1010-RA.DWG



SPRAY PIPING COMPOSITE PLAN 6

1/4"=1'-0"



KEY PLAN

SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

"60% REVIEW "NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD SPRAY PIPING COMPOSITE PLAN

BLDG 181,183 TA-52

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

SUBMITTED

APPROVED FOR RELEASE

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SHEET M-1011 OF

CLASSIFICATION U

REVIEWER

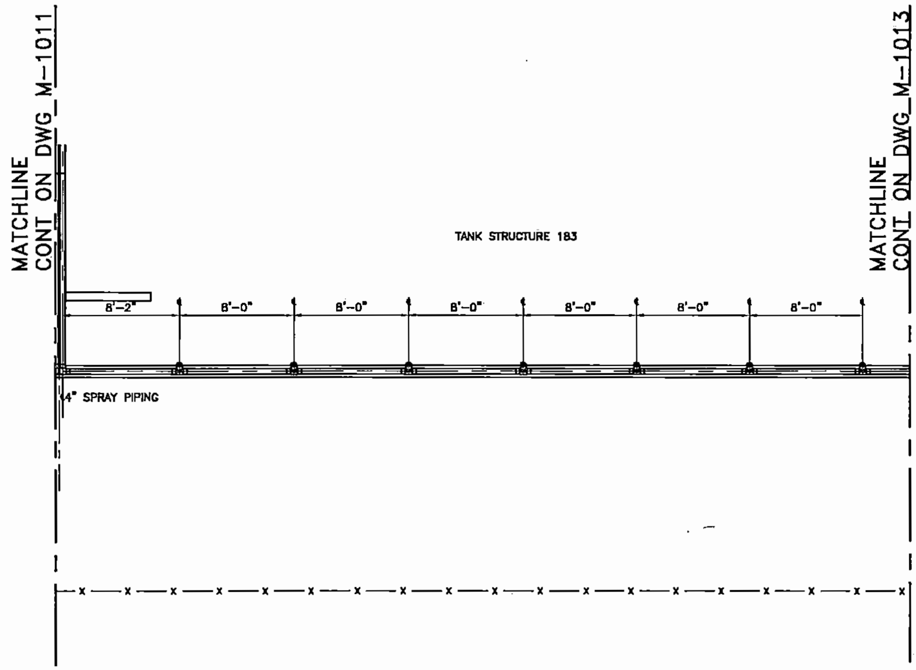
DATE

PROJECT ID 100761

DRAWING NO C-55751

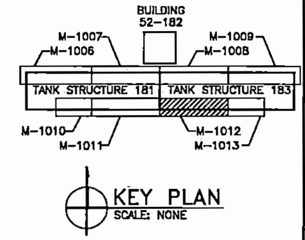
REV A

Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-1011-RA.DWG



SPRAY PIPING COMPOSITE PLAN 7

1/4"=1'-0"



KEY PLAN
SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD SPRAY PIPING
COMPOSITE PLAN

BLDG 183 TA-52

DRAWN T. HARPER
DESIGN T. HARPER
CHECKED S. STUHRKE
DATE

SUBMITTED
APPROVED FOR RELEASE

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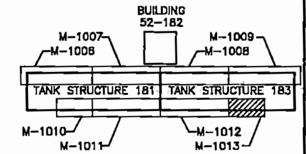
PO Box 1663
Los Alamos, New Mexico 87545

SHEET M-1012
OF

CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

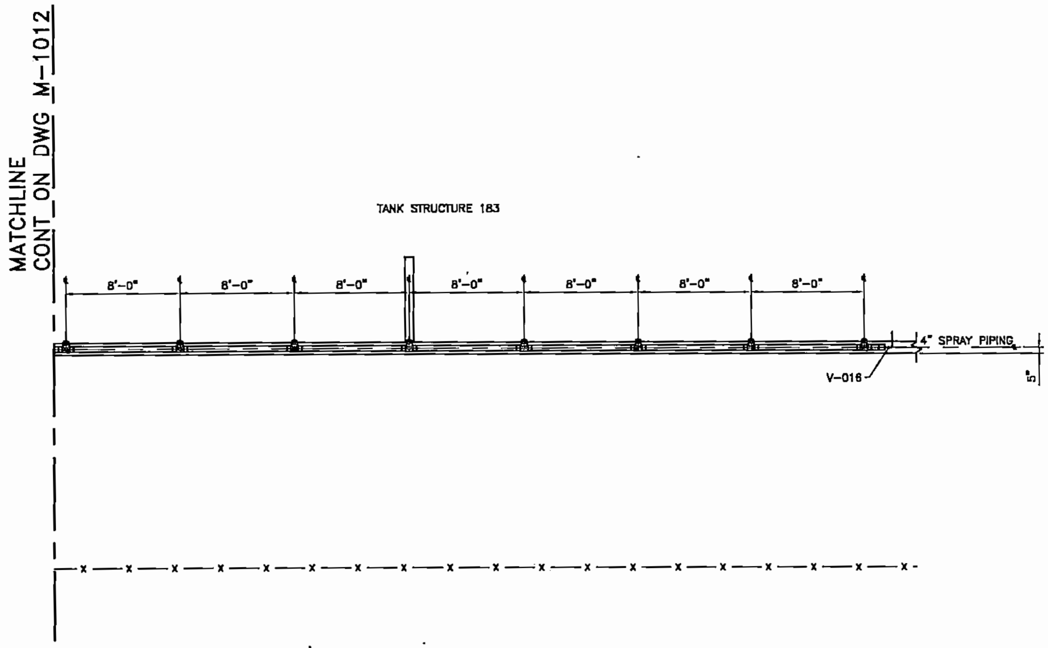
Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-1012-RA.DWG



KEY PLAN
SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



SPRAY PIPING COMPOSITE PLAN 7

0' 1' 2' 4' 6' 8'
1/4"=1'-0"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD SPRAY PIPING COMPOSITE PLAN

BLDG 183 TA-52

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

SUBMITTED

APPROVED FOR RELEASE

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Los Alamos, New Mexico 87545

SHEET M-1013 OF

CLASSIFICATION U

REVIEWER

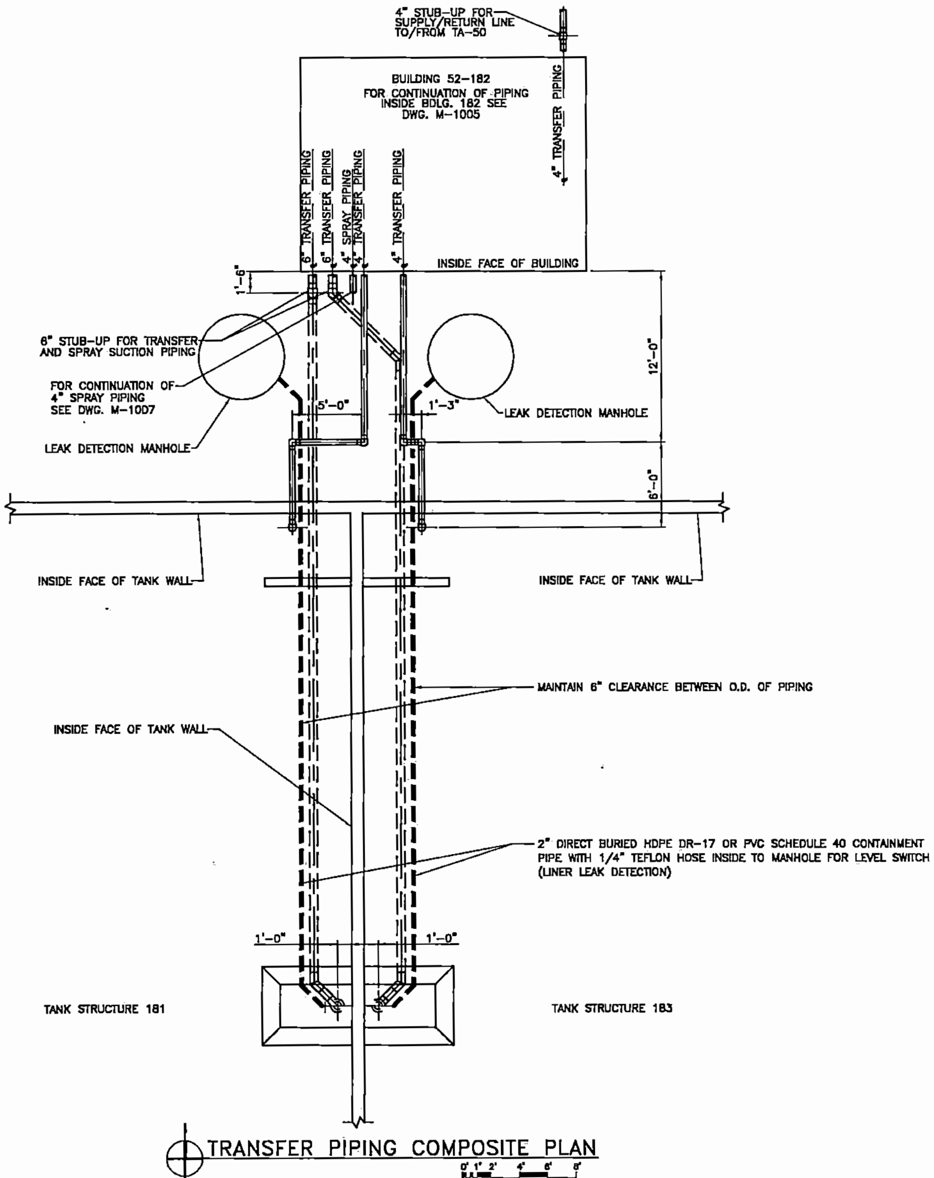
DATE

PROJECT ID 100761

DRAWING NO C-55751

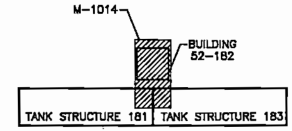
REV A

Plotted By: HARPERT Plot Date: 7/6/2011
FILE NAME: C55751-M-1013-RA.DWG



TRANSFER PIPING COMPOSITE PLAN

0' 1' 2' 4' 6' 8'
1/4"=1'-0"



KEY PLAN
SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZLD TRANSFER PIPING COMPOSITE PLAN AT TANKS

BLDG 181,182,183 TA-52

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

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SHEET M-1014 OF

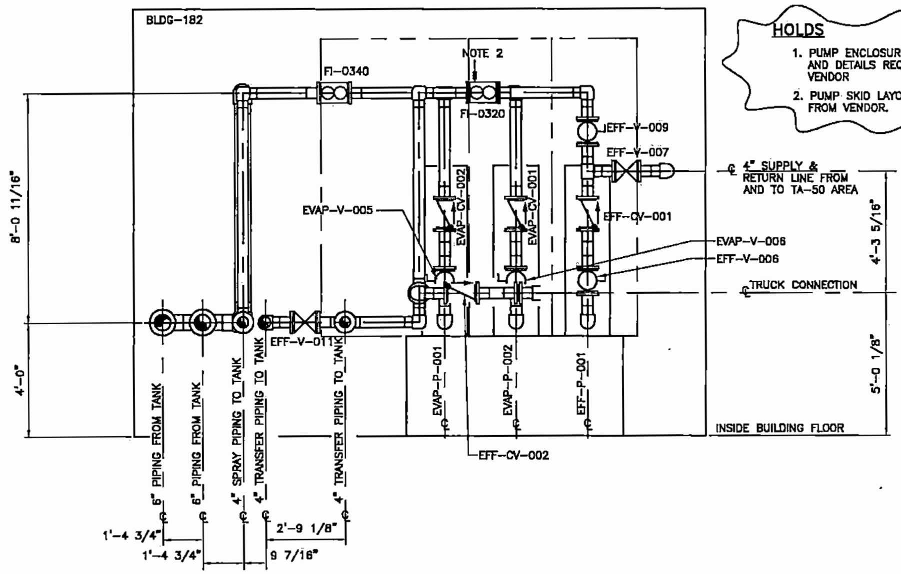
CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-1014-BA.DWG

GENERAL NOTES:

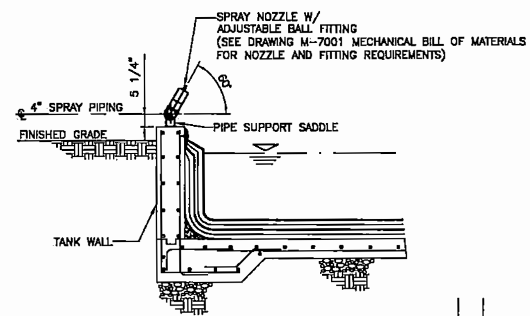
1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. SPRAY NOZZLE HEADERS ARE TO BE SELF DRAINING. LOCATE ¾" VENT WITH GLOBE VALVE AT HIGH POINT OF SPRAY PIPING AND ¾" DRAINS AS REQUIRED ON SPRAY HEADERS AT LOW POINTS. SPRAY PIPING HIGH POINT SHALL BE LOCATED INSIDE THE PUMP HOUSE.



HOLDS
1. PUMP ENCLOSURE DIMENSIONS AND DETAILS REQUIRED FROM VENDOR
2. PUMP SKID LAYOUT REQUIRED FROM VENDOR.

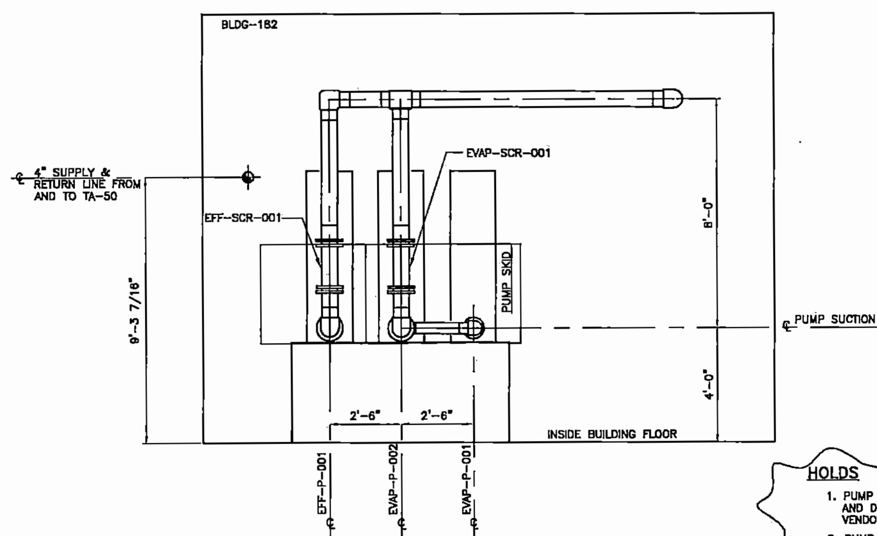
A / M-1005 SECTION

2" 1" 0 1" 2"
1/2"=1"



C / M-1006 SECTION

2" 1" 0 1" 2"
1/2"=1"



HOLDS
1. PUMP ENCLOSURE DIMENSIONS AND DETAILS REQUIRED FROM VENDOR
2. PUMP SKID LAYOUT REQUIRED FROM VENDOR.

B / M-1005 SECTION

2" 1" 0 1" 2"
1/2"=1"

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

PIPING SECTIONS

DRAWN: T. HARPER
DESIGN: T. HARPER
CHECKED: S. STUHRKE
DATE:

BLDG 181,182,183 TA-52

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PO Box 1663 Los Alamos, New Mexico 87545

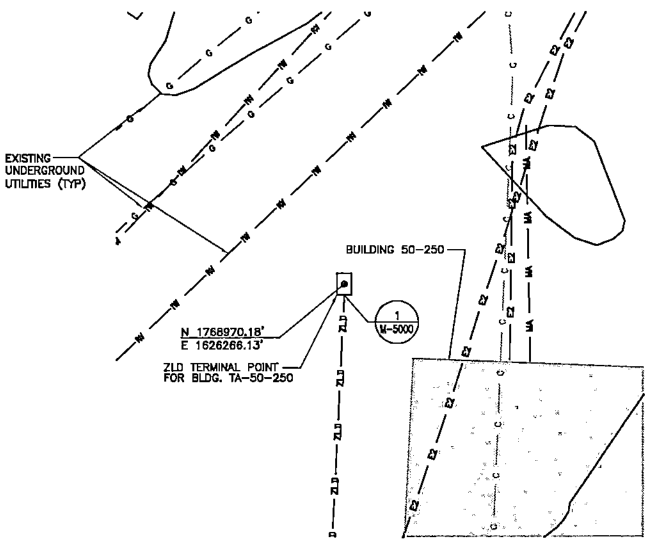
SHEET M-3000 OF

CLASSIFICATION U | REVIEWER | DATE

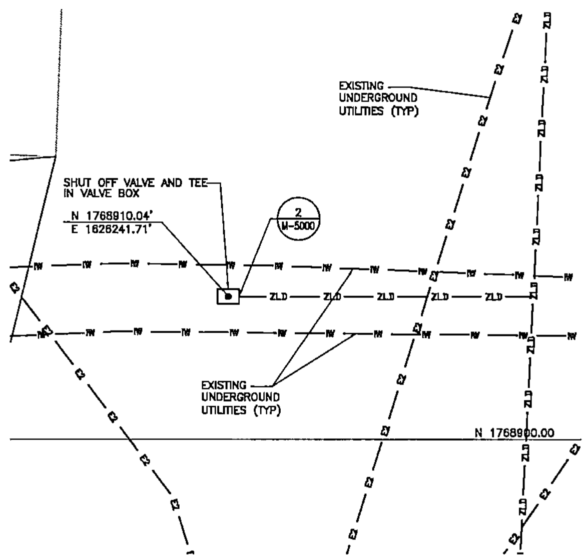
PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPER Plot Date: 7/8/2011
FILE NAME: C55751-M-3000-PIPING

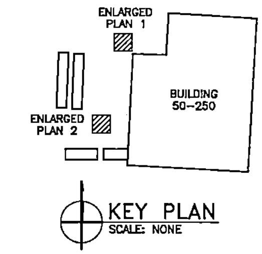
2458



1 M-1004 ENLARGED PLAN VIEW
ZLD TRANSFER PIPING TERMINAL POINT
0' 1' 2' 4' 6' 8'
1/4"=1'-0"



2 M-1004 ENLARGED PLAN VIEW
FUTURE CONNECTION/TIE-IN
0' 1' 2' 4' 6' 8'
1/4"=1'-0"



KEY PLAN
SCALE: NONE

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

"60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TERMINAL POINTS
ENLARGED PLAN VIEWS

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

BLDG N/A TA-50
SUBMITTED
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PO Box 1663
Los Alamos, New Mexico 87545

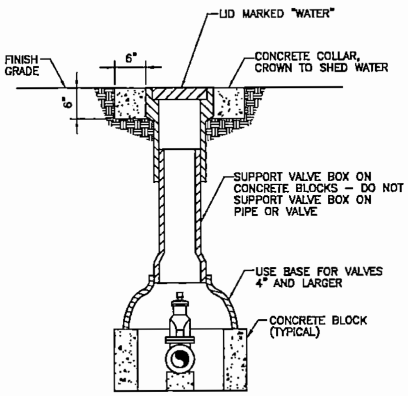
SHEET M-4000
OF

CLASSIFICATION U
REVIEWER
DATE
PROJECT ID 100761
DRAWING NO C-55751
REV A

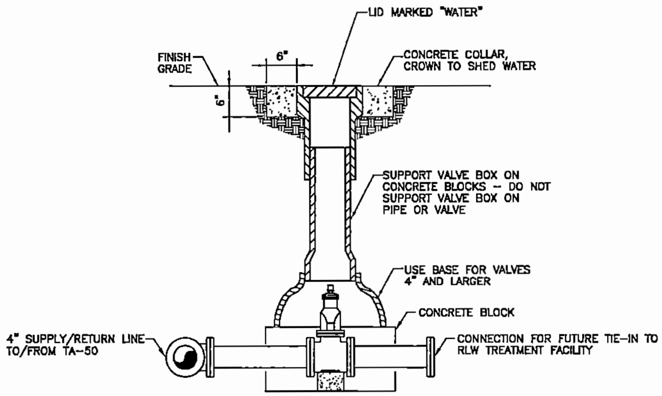
Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-4000-RA.DWG

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. TERMINAL POINT AND FUTURE CONNECTION/TIE-IN SHALL INCLUDE BLIND FLANGE.



1 M-4000 VALVE BOX DETAIL – TERMINAL POINT
SCALE: NONE



2 M-4000 VALVE BOX DETAIL – FUTURE CONNECTION/TIE-IN
SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

TYPICAL DETAILS

DRAWN	T. HARPER
DESIGN	T. HARPER
CHECKED	S. STUHRKE
DATE	

BLDG N/A TA-50

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SHEET M-5000 OF

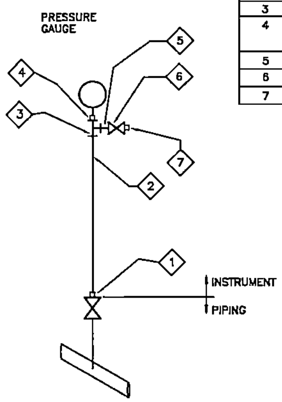
CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: HARPERT Plot Date: 7/8/2011
FILE NAME: C55751-M-5000-RA.DWG

GENERAL NOTES:

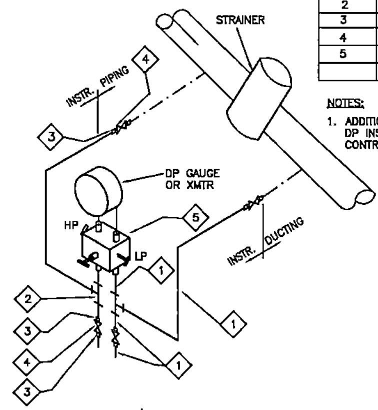
1. DETAILS ARE TYPICAL. VARIATIONS DUE TO EQUIPMENT CONFIGURATIONS ARE ALLOWABLE.
2. FOR INSTRUMENT INDEX, SEE DRAWING M-7000



BILL OF MATERIALS

PART #	QTY.	DESCRIPTION
1	1	3/4"x1/2" PIPE REDUCER INSERT, CS
2	1	1/2" NPT x 3" LENGTH NIPPLE, CS
3	1	1/2"x1/2"x1/2" FNPT PIPE TEE, CS
4	1	1/2"xA/B" ADAPTER, CS (IF GAUGE CONNECTION IS NOT 1/2")
5	1	1/2" NPT x 2" PIPE NIPPLE, CS
6	1	1/2" FNPT BALL VALVE, CS, TEFLON PKG.
7	1	1/2" NPT PLUG, CS

1 LOCAL PRESSURE INSTRUMENT
M-7000 SCALE: NONE



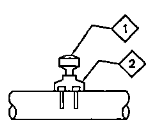
BILL OF MATERIALS

PART #	QTY.	DESCRIPTION
1	AS REQ	1/2" OD x 0.049"W TUBE, SS
2	2	1/2"x1/2"x1/2" UNION TEE, TUBE, SS
3	6	1/2"NPT x 1/2" TUBE MALE CONNECTOR, SS
4	4	1/2" FNPT BALL VALVE, SS, TEFLON PKG.
5	1	3 VALVE MANIFOLD, SS

NOTES:

1. ADDITIONAL FITTINGS MAY BE REQUIRED TO CONNECT MANIFOLD TO DP INSTRUMENT, DEPENDING ON MANIFOLD TYPE SELECTED BY CONTRACTOR.

2 LOCAL DIFF PRESSURE INSTRUMENT
M-7000 SCALE: NONE



BILL OF MATERIALS

PART #	QTY.	DESCRIPTION
1	1	FLOW METER WITH INTEGRAL ASSEMBLY
2	1	PIPE SADDLE MOUNT (FURNISHED W/FLOW INST)

NOTES:

1. FLOW INSTRUMENT ORIENTATION AND PIPE PENETRATION SHALL BE PER MANUFACTURER'S INSTRUCTIONS.

3 FLOW METER/SWITCH
M-7000 SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

MISCELLANEOUS INSTRUMENTS
INSTRUMENT INSTALLATION DETAILS

BLDG 181,182,183 TA-52

DRAWN: L. BARAKA
DESIGN: L. BARAKA
CHECKED: K. COLE
DATE:

SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-5006 OF

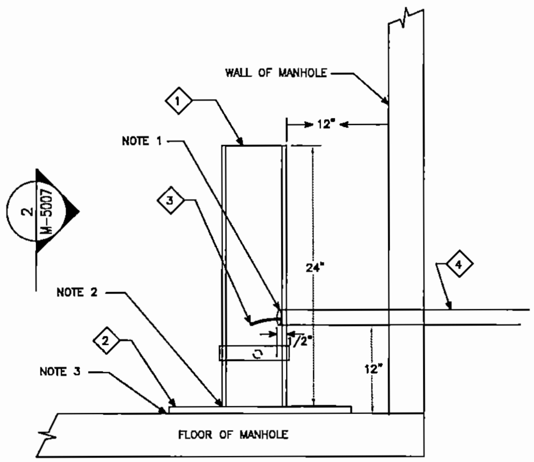
CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: BARAKAI Plot Date: 7/6/2011
FILE NAME: C55751-M-5006-RA.DWG

GENERAL NOTES:

1. DETAILS ARE TYPICAL. VARIATIONS DUE TO EQUIPMENT CONFIGURATIONS ARE ALLOWABLE.
2. FOR INSTRUMENT INDEX, SEE DRAWINGS M-7000



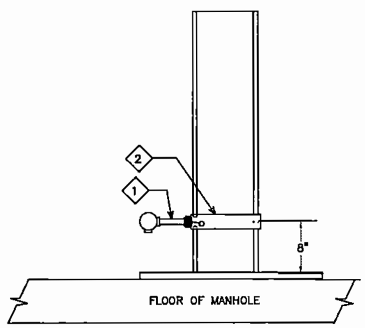
1 M-7000 LEAK DETECTION STANDPIPE
SCALE: NONE

BILL OF MATERIALS

PART #	QTY.	DESCRIPTION
1	1	4" SCHEDULE 40 PVC OR HDPE DR17 PIPE
2	1	12"X12"X1/2" THICK PVC SHEET
3	1	1/4" TEFLON TUBE CUT TO LEAVE 2" EXPOSED (BY MECHANICAL CONTRACTOR)
4	1	2" HDPE DR17 OR PVC SCHEDULE 40 PIPE (BY MECHANICAL CONTRACTOR)

NOTES:

1. DRILL HOLE IN 4" PVC PIPE TO MATCH OD OF 2" PIPE. INSERT 2" PIPE THROUGH HOLE AND SEAL WITH PVC SOLVENT GLUE.
2. ATTACH PVC PIPE TO SHEET USING PVC SOLVENT GLUE.
3. ATTACH PVC SHEET TO FLOOR OF MANHOLE USING CONSTRUCTION ADHESIVE.



BILL OF MATERIALS

PART #	QTY.	DESCRIPTION
1	1	LEVEL SWITCH- DWYER, WE ANDERSON FLOTECT MODEL L6EPS-S-3-0-JCTLH
2	1	PVC OR HDPE PIPE SADDLE CLAMP FOR 4" SCHEDULE 40 PIPE, 1" NPT OUTLET

2 M-7000 LEAK DETECTION LEVEL SWITCH
SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

LEAK DETECTION LEVEL SWITCH INSTRUMENT INSTALLATION DETAILS

BLDG 181,183 TA-52

DRAWN L. BARAKA
DESIGN L. BARAKA
CHECKED K. COLE
DATE

SUBMITTED | APPROVED FOR RELEASE

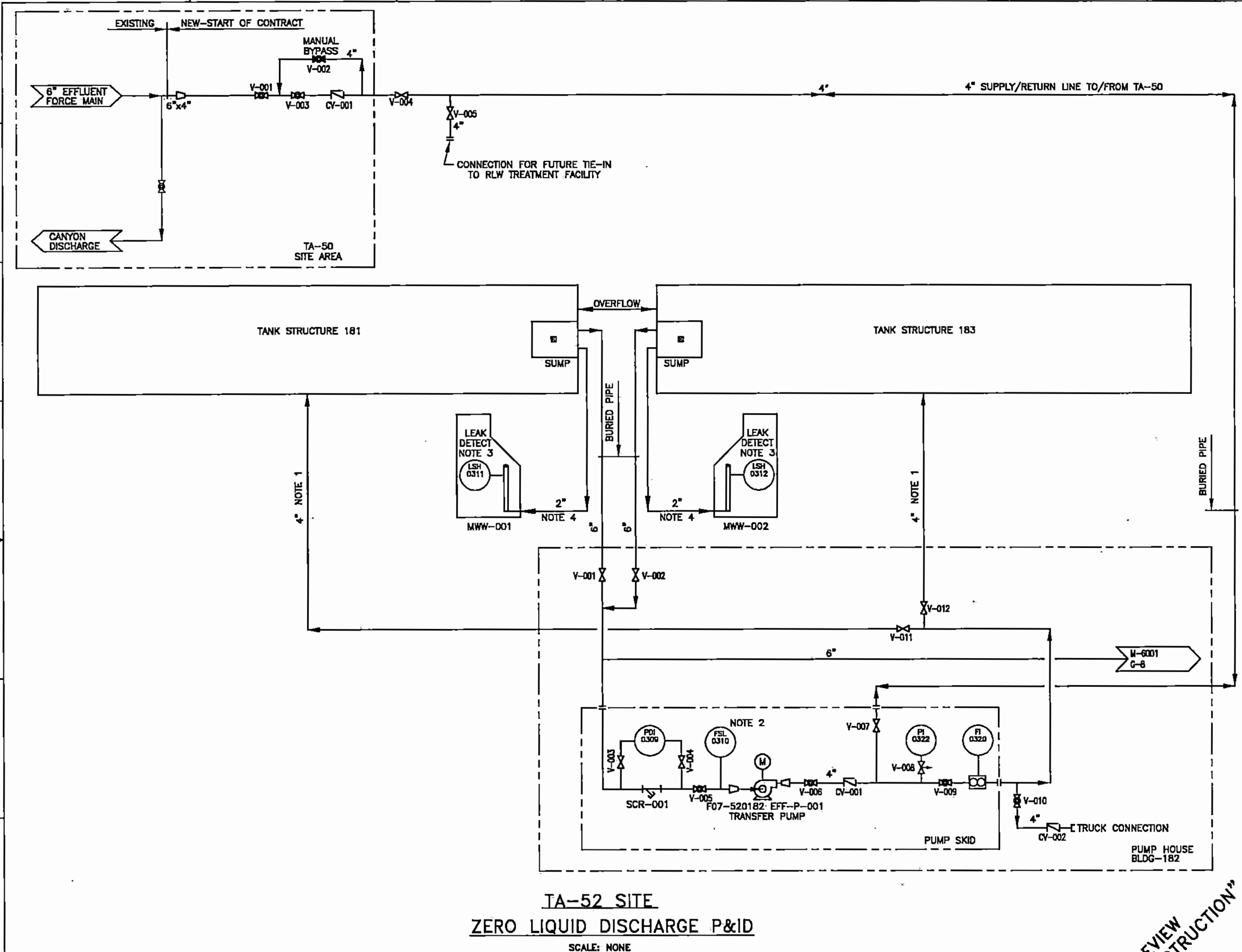
Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-5007 OF

CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: BARAKAI Plot Date: 7/8/2011
FILE NAME: C55751-M-5007-RA.DWG



TA-52 SITE
ZERO LIQUID DISCHARGE P&ID

SCALE: NONE

GENERAL NOTES:

1. HEAT TRACE ABOVE GROUND PIPING ONLY AS REQUIRED.
2. LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF PUMP FLOW DROPS OR RUNS DRY (AFTER DELAY).
3. LEAK DETECTION ALARMS ARE DIRECTED TO A LOCAL ALARM PANEL, WITH FLASHING BEACON, AT THE PUMP ENCLOSURE.
4. 2" DIRECT BURIED HDPE DR-17 OR PVC SCHEDULE 40 CONTAINMENT PIPE WITH ¾" TEFLON HOSE (INSIDE) TO MAN HOLE FOR LEVEL SWITCH.
5. ALL VALVES ON THIS DRAWING HAVE A PREFIX OF "EFF" (i.e. EFF-V-001).
6. SEE "MECHANICAL BILL OF MATERIALS" DRAWING M-7001 FOR DETAILS AND REQUIREMENTS FOR EQUIPMENT AND SPECIALTY ITEMS.
7. SEE "VALVE SCHEDULES" DRAWING M-7002 FOR DETAILS AND REQUIREMENTS FOR VALVES.

SEQUENCE OF OPERATION:

TRANSFER PUMPS:
LOW FLOW SWITCH WILL CAUSE TRANSFER PUMP TO TRIP IF PUMP FLOW DROPS OR RUNS DRY (AFTER DELAY). WITH PROPER VALVE LINEUPS TANK CONTENTS CAN BE TRANSFERRED FROM ONE TANK TO ANOTHER TANK OR RETURNED TO SOURCE (TA-50 AREA) BY THE TRANSFER PUMP.

LEAK DETECTION:
LEAK DETECTION ALARMS ARE DIRECTED TO A LOCAL ALARM PANEL IN THE PUMP HOUSE. A FLASHING BEACON, VISIBLE FROM THE ROAD, LOCATED OUTSIDE ABOVE THE ENTRANCE TO THE PUMP HOUSE SHALL ALARM AND MONITOR FOR TANK LEAKAGE THROUGH THE LINER.

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE TRANSFER SYSTEM P&ID AND SEQUENCE OF OPERATION TA-50 TA-52 TA-63

BLDG 181,182,183

DRAWN	T. HARPER
DESIGN	S. STUHRKE
CHECKED	S. STUHRKE
DATE	

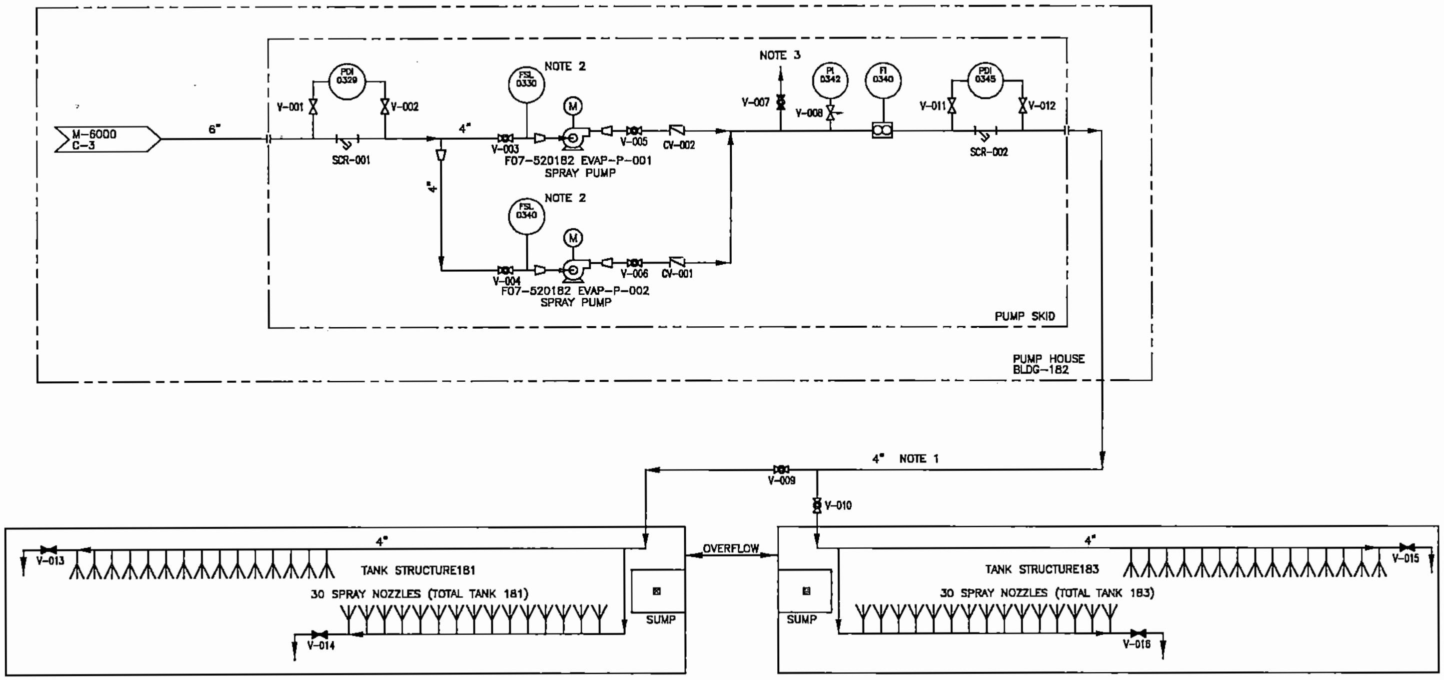
SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-6000 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A



GENERAL NOTES:

1. HEAT TRACE ABOVE GROUND PIPING ONLY AS REQUIRED.
2. LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF PUMP FLOW DROPS OR RUNS DRY (AFTER DELAY).
3. SPRAY NOZZLE HEADERS ARE TO BE SELF DRAINING. LOCATE 3/4" VENT WITH GLOBE VALVE AT HIGH POINT OF SPRAY PIPING AND 3/4" DRAINS AS REQUIRED ON SPRAY HEADERS AT LOW POINTS. SPRAY PIPING HIGH POINT VENT SHALL BE LOCATED INSIDE THE PUMP HOUSE.
4. ALL VALVES ON THIS DRAWING HAVE A PREFIX OF "EVAP" (i.e. EVAP-V-001).
5. SEE MECHANICAL "BILL OF MATERIALS" DRAWING M-7001 FOR DETAILS AND REQUIREMENTS FOR EQUIPMENT AND SPECIALTY ITEMS.
6. SEE "VALVE SCHEDULES" DRAWING M-7002 FOR DETAILS AND REQUIREMENTS FOR VALVES.

SEQUENCE OF OPERATION:

SPRAY SYSTEM:

NOZZLES:

VEEJET SPRAY (FLAT FAN PATTERN NOZZLES), AS MANUFACTURED BY SPRAYING SYSTEMS. COMPLETE WITH ADJUSTABLE BALL FITTINGS (TOTAL 60 REQUIRED).

SPRAY PUMPS:

LOW FLOW SWITCH WILL CAUSE PUMP TO TRIP IF PUMP FLOW DROPS OR RUNS DRY (AFTER DELAY). MANUAL OPERATION WHEN SPRAYING IS REQUIRED TO ENHANCE EVAPORATION. ONE PUMP WILL BE UTILIZED FOR SPRAYING ONE TANK. EITHER PUMP CAN BE USED FOR EITHER TANK THROUGH VALVE LINE UPS. SYSTEM IS DESIGNED FOR SPRAYING BOTH TANKS SIMULTANEOUSLY. STARTING AND STOPPING OF ONE OR BOTH SPRAY PUMPS IS A MANUAL OPERATION VIA A LOCAL START/STOP PUSH BUTTON. LOW FLOW OR NO FLOW WILL CAUSE A PUMP OR PUMPS TO TRIP IF TANK OR TANKS RUNS DRY (AFTER DELAY). TO WINTERIZE SPRAY SYSTEM AND SHUTDOWN THE EVAPORATION SPRAY SYSTEM, MAKE SURE ALL SYSTEM VALVES ARE OPEN, INCLUDING NORMALLY CLOSED VENT VALVE (-V-007) AND NORMALLY CLOSED SPRAY HEADER VALVES (-V-013, -V-014, -V-015, AND -V-016) TO ALLOW FOR SELF DRAINING OF THE SPRAY HEADERS AND NOZZLES.

TA-52 SITE
SPRAY SYSTEM FOR EVAPORATION TANKS

SCALE: NONE

"60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE EVAPORATION SPRAY SYSTEM P&ID AND SEQUENCE OF OPERATION

BLDG 181,182,183 TA-50 TA-52, TA-63

DRAWN T. HARPER
DESIGN S. STUHRKE
CHECKED S. STUHRKE
DATE

SUBMITTED
APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET M-6001 OF

CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

GENERAL NOTES:

1. FOR PROCESS SYMBOLS AND ABBREVIATIONS SEE DRAWINGS M-0001, M-0002, M-0003, M-0004, AND M-0005.

3. CONTRACTOR TO PURCHASE INSTRUMENTS AS LISTED BY MANUFACTURER AND MODEL NUMBER OR EQUIVALENT.

TA	BLDG	SYSTEM	FUNCTION	LOOP	SERVICE DESCRIPTION	TERM DEVICE	P&ID	INSTALLATION DETAIL	MANUFACTURER	MODEL NUMBER
52	181	EVAP	LSH	0311	TK-181 LEAK DETECTION LEVEL HI	JB-1	C54159 M-6000	C55751-M-5007	FLOTECT	L6EPS-S-3-0-JCTLH
52	181	EVAP	PDI	0329	SPRAY P-001/002 INLET PRESS DIFF		C54159 M-6001	C55751-M-5006 DET #2	ASHCROFT	10-5509-S-L-S-04L-L-0/15 PSID
52	181	EVAP	FSL	0330	SPRAY P-001 LOW FLOW SWITCH	JB-1	C54159 M-6001	C55751-M-5006 DET #3	SIGNET	3-2537-3C-P1, IR8S060
52	181	EVAP	FI	0340	SPRAY P-001/002 OUTLET FLOW		C54159 M-6001	C55751-M-5006 DET #3	SIGNET	3-8550-1, 3-8510-P1, 3-8051, IR8S060
52	181	EVAP	PI	0342	SPRAY P-001/002 OUTLET PRESS		C54159 M-6001	C55751-M-5006 DET #1	ASHCROFT	45-1010-S-04L-L-0/160 PSI
52	182	EFF	PDI	0309	XFER P-001 INLET PRESS DIFF		C55751 M-6000	C55751-M-5006 DET #2	ASHCROFT	10-5509-S-L-S-04L-L-0/15 PSID
52	182	EFF	FSL	0310	XFER P-001 LOW FLOW SWITCH	JB-1	C55751 M-6000	C55751-M-5006 DET #3	SIGNET	3-2537-3C-P0, IR8S040
52	182	EFF	FI	0320	XFER P-001 OUTLET FLOW		C54159 M-6000	C55751-M-5006 DET #3	SIGNET	3-8550-1, 3-8510-P0, 3-8051, IR8S040
52	182	EFF	PI	0322	XFER P-001 OUTLET PRESS		C54159 M-6000	C55751-M-5006 DET #1	ASHCROFT	45-1010-S-04L-L-0/160 PSI
52	183	EVAP	LSH	0312	TK-183 LEAK DETECTION LEVEL HI	JB-1	C54159 M-6000	C55751-M-5007	FLOTECT	L6EPS-S-3-0-JCTLH
52	183	EVAP	FSL	0335	SPRAY P-001 LOW FLOW SWITCH	JB-1	C54159 M-6001	C55751-M-5006 DET #3	SIGNET	3-2537-3C-P1, IR8S060
52	183	EVAP	PDI	0345	SPRAY P-001/002 DOWNSTREAM PRESS DIFF		C54159 M-6001	C55751-M-5006 DET #2	ASHCROFT	10-5509-S-L-S-04L-L-0/15 PSID

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

INSTRUMENT INDEX

BLDG 181,182,183 TA-52

DRAWN: L. BARAKA
DESIGN: L. BARAKA
CHECKED: K. COLE
DATE:

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PO Box 1663
Los Alamos, New Mexico 87545

SHEET M-7000 OF

CLASSIFICATION / REVIEWER / DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

MECHANICAL BILL OF MATERIAL

THE BILL OF MATERIAL IS INTENDED ONLY AS AN AID IN ESTIMATING AND MATERIAL TAKE-OFF, AND DOES NOT NECESSARILY INCLUDE ALL MATERIAL REQUIRED. UNLESS NOTED, CATALOG NUMBER IS GIVEN AS REFERENCE ONLY, AND APPROVED EQUAL SUBSTITUTION MAY BE MADE. ALL MATERIAL SHALL BE FURNISHED BY THE CONTRACTOR UNLESS OTHERWISE NOTED.

GENERAL NOTES:

1. FOR MECHANICAL LEGEND, SYMBOLS & GENERAL NOTES SEE DRAWING M-0001, M-0002 AND M-0003.

PUMP SCHEDULE

EQUIPMENT NUMBER	LOCATION	MANUFACTURER	TYPE	DESIGN GPM	HEAD FT OF H_2O	PUMP RPM	MOTOR DATA				REMARKS
							HP	FRAME	ELECTRICAL DATA	APPROX WT. (LBS)	
F07-520182-EFF-P-001	TA-52	GOULDS PUMPS	IN-LINE	150	157	1750	25	254TC	460/3/60	853.2	MODEL: 3996MT SIZE:2X3-13, 12.625 In IMPELLER WITH MECHANICAL SEAL (JOHN CRANE 1N CONVENTIONAL DOUBLE)
F07-520182-EVAP-P-001	TA-52	GOULDS PUMPS	IN-LINE	150	100	1750	15	284TSC	460/3/60	820.5	MODEL: 3996MT SIZE:2X3-13, 10.125 In IMPELLER WITH MECHANICAL SEAL (JOHN CRANE 1N CONVENTIONAL DOUBLE)
F07-520182-EVAP-P-002	TA-52	GOULDS PUMPS	IN-LINE	150	100	1750	15	284TSC	460/3/60	820.5	MODEL: 3996MT SIZE:2X3-13, 10.125 In IMPELLER WITH MECHANICAL SEAL (JOHN CRANE 1N CONVENTIONAL DOUBLE)

STRAINERS

EQUIPMENT NUMBER	SIZE	MESH	MANUFACTURER/MODEL	CLASS	TYPE	MATERIAL	END CONNECTION	COVER	RATING	END CONNECTION
F07-520182-EFF-SCR-001	6"	40	HAYWARD MODEL 85	125/150	Y STRAINER	IRON (CAST/DUCTILE)	FLANGED	BOLTED	200 psi @ 150F	COMPRESSED, NON-ASBESTOS, SYNTHETIC FIBER
F07-520182-EVAP-SCR-001	6"	40	HAYWARD MODEL 85	125/150	Y STRAINER	IRON (CAST/DUCTILE)	FLANGED	BOLTED	200 psi @ 150F	COMPRESSED, NON-ASBESTOS, SYNTHETIC FIBER
F07-520182-EVAP-SCR-002	4"	60	HAYWARD MODEL 85	125/150	Y STRAINER	IRON (CAST/DUCTILE)	FLANGED	BOLTED	200 psi @ 150F	COMPRESSED, NON-ASBESTOS, SYNTHETIC FIBER

PIPING SCHEDULE

PIPING SCHEDULE	DESIGN PRESSURE (PSIG)	DESIGN TEMPERATURE (F)	MATERIAL	MATERIAL GRADE	CODE OF REFERENCE	SCHEDULE	REMARKS
PS-502F TRANSFER PIPING	85	70	HDPE ASTM D3035	PE 3408	B31.3, 2002	DR17	ALL PIPING FORMULATED WITH A MINIMUM OF 2% CARBON BLACK FOR MAXIMUM PROTECTION AGAINST UV RAYS FOR ADDED ASSURANCE. ALL PIPE FITTINGS SHALL CONFORM TO FITTING REQUIREMENTS OF PS-502F (BUTT FUSION FITTINGS: ASTM D3261, ASTM D1248, PE3408)
PS-502F SPRAY PIPING	85	70	HDPE ASTM D3035	PE 3408	B31.3, 2002	DR17	ALL PIPING FORMULATED WITH A MINIMUM OF 2% CARBON BLACK FOR MAXIMUM PROTECTION AGAINST UV RAYS FOR ADDED ASSURANCE. ALL PIPE FITTINGS SHALL CONFORM TO FITTING REQUIREMENTS OF PS-502F (BUTT FUSION FITTINGS: ASTM D3261, ASTM D1248, PE3408)

SPRAY NOZZLES

EQUIPMENT NUMBER	QUANTITY	MAKE	MODEL	PART NUMBER	TYPE	MATERIAL	INLET DIAMETER	FLOW RATE	PRESSURE	SPRAY HEIGHT	SPRAY DISTANCE	SPRAY WIDTH	FITTING
F07-520182-EVAP-NZL-001	60	SPRAYING SYSTEMS CO	4050	H 1/4 U-4050	VEEJET (FLAT FAN PATTERN)	BRASS	1/4" NPT(M)	5 gpm	40 psi	3 ft	20'-6"	7'-6"	BRASS ADJUSTABLE BALL FITTING, PART NUMBER 36275-1/4"(F)X1/4"(M)

MANUAL VALVES (NON CODE)

SIZE	SERVICE	TYPE	MATERIAL	CLASS	END TYPE	OPERATOR	CODE OF REFERENCE	STANDARDS
ALL SIZES	LOW RADIOACTIVE WATER	GATE, GLOBE, CHECK	IRON (CAST/DUCTILE)	125/150	FLANGED	MANUAL	B31.3, 2002	ASME B16.34, MSS-SP-70,-71, AND-85

"60% REVIEW"
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ECC

ZERO LIQUID DISCHARGE SUBPROJECT

MECHANICAL BILL OF MATERIALS
SHEET 1

TA-50
TA-52
TA-63

BLDG 181,182,183

DRAWN	E. NEMCEK
DESIGN	G. DUNN
CHECKED	S. STUHRKE
DATE	

SUBMITTED

APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY
PO Box 1663
Los Alamos, New Mexico 87545

SHEET M-7001
OF

CLASSIFICATION U
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

VALVE SCHEDULE FOR EFFLUENT TRANSFER SYSTEM

VALVE TAG NUMBER	SIZE (INCHES)	RATING	CLASS NUMBER	TYPE	DESIGN PRESS (PSIG)	DESIGN TEMP (DEG. F)	OPERATOR TYPE	END CONNECTION	P&ID NO.	REMARKS
F07-500000-EFF-V-001	4	125/150	125/150	GLOBE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-500000-EFF-V-002	4	125/150	125/150	GLOBE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-500000-EFF-V-003	4	125/150	125/150	GLOBE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-500000-EFF-V-004	4	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-500000-EFF-V-005	4	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-500000-EFF-CV-001	4	125/150	125/150	CHECK	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-001	6	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-002	6	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-003	3/4	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-004	3/4	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-005	6	125/150	125/150	GLOBE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-006	4	125/150	125/150	GLOBE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-007	4	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-008	3/4	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-009	4	125/150	125/150	GLOBE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-010	4	125/150	125/150	GLOBE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-011	4	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-V-012	4	125/150	125/150	GATE	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-CV-001	4	125/150	125/150	CHECK	85	70	MANUAL	FLANGED	C55751-M-6000	
F07-520182-EFF-CV-002	4	125/150	125/150	CHECK	85	70	MANUAL	FLANGED	C55751-M-6000	

VALVE SCHEDULE FOR EVAPORATION SPRAY SYSTEM

VALVE TAG NUMBER	SIZE (INCHES)	RATING	CLASS NUMBER	TYPE	DESIGN PRESS (PSIG)	DESIGN TEMP (DEG. F)	OPERATOR TYPE	END CONNECTION	P&ID NO.	REMARKS
F07-520182-EVAP-V-001	3/4	125/150	125/150	GATE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-002	3/4	125/150	125/150	GATE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-003	4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-004	4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-005	4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-006	4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-007	3/4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-008	3/4	125/150	125/150	GATE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-009	4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-010	4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-011	3/4	125/150	125/150	GATE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-012	3/4	125/150	125/150	GATE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-013	3/4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-014	3/4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-015	3/4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-V-016	3/4	125/150	125/150	GLOBE	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-CV-001	4	125/150	125/150	CHECK	65	70	MANUAL	FLANGED	C55751-M-6001	
F07-520182-EVAP-CV-002	4	125/150	125/150	CHECK	65	70	MANUAL	FLANGED	C55751-M-6001	

"60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

VALVE SCHEDULES

BLDG 181,182,183 — TA-50 TA-52

DRAWN: E. NEMCEK
DESIGN: G. DUNN
CHECKED: S. STUHRKE
DATE:

SUBMITTED — APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY
PO Box 1663
Los Alamos, New Mexico 87545

SHEET M-7002 OF

CLASSIFICATION U — REVIEWER — DATE

PROJECT ID 100761 — DRAWING NO C-55751 — REV A

SYMBOL LEGEND

(NOT ALL SYMBOLS WILL APPLY TO THIS PROJECT)

SYMBOL	DESCRIPTION
	EXISTING
	REMOVE
	NEW WORK
	HIDDEN OR BURIED
	HOMERUN CONDUIT
	– GROUND
	– PHASE
	– SWITCHED
	– NEUTRAL
	– ISOLATED GROUND
	FLEXIBLE CONDUIT
	CONDUIT TURNING DOWN
	CONDUIT TURNING UP
	CONDUIT UP AND DOWN
	CONDUIT SEAL
	CONDUIT CAP
480V 600A	BUSWAY WITH DESCRIPTION
G	GROUNDING CONDUCTOR
8 X 24	CABLE TRAY WITH DESCRIPTION
J	CEILING JUNCTION BOX
J	WALL JUNCTION BOX
	DUPLEX RECEPTACLE OUTLET
	SINGLE RECEPTACLE OUTLET
	DOUBLE DUPLEX RECEPTACLE OUTLET
GFCI WP	GROUND FAULT CIRCUIT INTERUPTER DUPLEX OUTLET WITH WEATHERPROOF COVER
	SPLIT WIRED DUPLEX RECEPTACLE
IG	DUPLEX ISOLATED GROUND
A	SPECIAL PURPOSE OUTLET – USE SUBSCRIPT TO IDENTIFY TYPE IN SPECS
A	FLOOR RECEPTACLE OUTLET USE SUBSCRIPT TO IDENTIFY TYPE IN SPECS
	RECEPTACLE RACEWAY
$a	SINGLE POLE SWITCH – USE SUBSCRIPT TO DESIGNATE CONTROL OF PARTICULAR OUTLETS
$2	DOUBLE POLE SWITCH
$3	THREE-WAY SWITCH
$4	FOUR-WAY SWITCH
$WP	WEATHERPROOF SWITCH
$K	KEY OPERATED SWITCH
600	DIMMER SWITCH – NUMBER INDICATES WATTAGE
	OCCUPANCY SENSING SWITCH
P	PHOTOCELL
6 30	REMOTE CONTROL SWITCH 6 POLE, 30 AMPS
A 1, b	FLUORESCENT LUMINAIRE A=FIXTURE TYPE 1=CIRCUIT NUMBER b=SWITCH CONTROLLING FIXTURE
	FLUORESCENT STRIP LUMINAIRE
	WALL MOUNTED FLUORESCENT LUMINAIRE
	CEILING MOUNTED LUMINAIRE
	WALL MOUNTED LUMINAIRE
	EMERGENCY LUMINAIRE
	LIGHT POLE WITH LUMINAIRE

SYMBOL	DESCRIPTION
	EMERGENCY LIGHTING UNIT
	CEILING MOUNTED EXIT SIGN – ARROW AS INDICATED
	TWO FACED EXIT SIGN
	WALL MOUNTED EXIT SIGN
	SWITCHBOARD, POWER PANELBOARD
LP-XX	LIGHTING PANELBOARD
T	TRANSFORMER
30	NON-FUSIBLE SAFETY SWITCH (NUMBER INDICATES SWITCH SIZE)
40/60 F	FUSED SAFETY SWITCH (NUMBERS INDICATE FUSE/SWITCH SIZES)
2 20	COMBINATION MAGNETIC STARTER AND CIRCUIT BREAKER 2 – INDICATES NEMA STARTER SIZE 20 – INDICATES CIRCUIT BREAKER TRIP
	MAGNETIC STARTER
ASD	ADJUSTABLE SPEED DRIVE
3	MOTOR (NUMBER INDICATES HP)
	BELL
H	HORN "H" OR SIREN "S"
	BUZZER
	PUSHBUTTON
F	MANUAL PULL STATION
V	FIRE ALARM HORN (V=VISUAL SIGNAL)
P	PHOTOELECTRIC SMOKE DETECTOR
I	IONIZATION SMOKE DETECTOR
T	THERMAL DETECTOR
P D	DUCT SMOKE DETECTOR (PHOTOELECTRIC)
DH	MAGNETIC DOOR HOLDER
PS	PRESSURE SWITCH
FS	FLOW SWITCH
S	VALVE SUPERVISORY SWITCH
FACP	FIRE ALARM CONTROL PANEL
F	FIRE ALARM RACEWAY
S	CEILING SPEAKER
S	WALL SPEAKER
	TELECOMMUNICATIONS OUTLET
	FLOOR MOUNTED TELECOMMUNICATIONS OUTLET
	INTERCOM OUTLET
T	TELECOMMUNICATIONS RACEWAY
D	PROTECTED TRANSMISSION SYSTEM (PTS) DATA TERMINAL CONNECTION
TV	TELEVISION OUTLET
CR	CARD READER
ES	ELECTRIC DOOR STRIKE
DC	DOOR CONTACTS
RAP	REMOTE ACCESS PANEL
HG	HAND GEOMETRY UNIT
MD	MOTION DETECTOR
C	CLOSED CIRCUIT TV CAMERA
Z	ALARM BEACON

SYMBOL	DESCRIPTION
100/3	MEDIUM VOLTAGE DISCONNECT SWITCH
600	MEDIUM VOLTAGE DRAWOUT CIRCUIT BREAKER
480V 500 KVA 208Y/120V	TRANSFORMER (DELTA-WYE CONN.)
	SHIELDED TRANSFORMER
1000/1600	DRAWOUT CIRCUIT BREAKER (TRIP/FRAME)
300/400 GFI	CIRCUIT BREAKER (TRIP/FRAME) WITH GROUND FAULT INTERRUPTER
7 MCP	MOTOR CIRCUIT PROTECTOR
30 MCP	MOTOR CONTROL CENTER STARTER UNIT
	FUSE
	GROUND
G	GENERATOR
3000/5 3	CURRENT TRANSFORMER (NUMBERS INDICATE RATIO AND QUANTITY)
3	POTENTIAL TRANSFORMER (NUMBER INDICATES QUANTITY)
AS	AMMETER SWITCH
VS	VOLTMETER SWITCH
V	VOLTMETER
A	AMMETER
KW	KILOWATT METER
N E L	TRANSFER SWITCH
K1	KEY INTERLOCK #1
	BATTERY
	NORMALLY CLOSED CONTACT
	NORMALLY OPEN CONTACT
	PROTECTIVE RELAY, SOLENOID COIL
	THERMAL OVERLOAD
	CONNECTION
	CROSS, NO CONNECTION
	SURGE ARRESTOR
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
	CAPACITOR
CR1	CONTROL RELAY #1
	BUS PLUG CIRCUIT BREAKER
T	THERMOSTAT
1	KEYED NOTE DESIGNATION
3	ELECTRICAL EQUIPMENT DESIGNATION (SEE SCHEDULE)
5	MECHANICAL EQUIPMENT DESIGNATION (SEE SCHEDULE)
7	NAMEPLATE DESIGNATION (SEE SCHEDULE)
WP AFF	WEATHERPROOF ABOVE FINISH FLOOR

GENERAL NOTES

1. PERFORM INSTALLATION IN ACCORDANCE WITH THE CURRENT EDITION OF THE NATIONAL ELECTRICAL CODE (NEC), THE OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA), AND APPLICABLE DOE ORDERS. EQUIPMENT SHALL BE LISTED BY A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL).
2. PROVIDE AND MAINTAIN A CLEAR WORKING SPACE ABOUT ELECTRIC EQUIPMENT (SWITCHBOARDS,PANELBOARDS, ETC.) IN ACCORDANCE WITH NEC ARTICLES 110.26 AND 110.34.
3. USE 600 VAC CIRCUIT BREAKERS IN 480V AND 480Y/277V SWITCHBDARDS, PANELBOARDS AND STARTERS.
4. PROVIDE CIRCUIT BREAKERS WITH UL LISTED INTERRUPTING RATING (RMS SYMMETRICAL AMPERES) GREATER THAN THE AVAILABLE FAULT CURRENT SHOWN ON THE ELECTRICAL ONE-LINE DIAGRAM.
5. PROVIDE PADLOCKING PROVISIONS FOR EACH TWO- AND THREE-POLE CIRCUIT BREAKER.
6. BOND RACEWAYS AND THE FRAMES AND ENCLOSURES OF MOTORS, BREAKERS, SWITCHES, AND OTHER ELECTRICAL EQUIPMENT TO THE BUILDING GROUNDING SYSTEM. INSTALL AN INSULATED EQUIPMENT GROUND CONDUCTOR IN EACH RACEWAY OR CONDUIT. SIZE EQUIPMENT GROUND CONDUCTOR IN ACCORDANCE WITH NEC TABLE 250.122.
7. IDENTIFY NEW BRANCH CIRCUITS AT THE PANEL AND AT THE LOAD OUTLET, RECEPTACLE AND SWITCH. IDENTIFY THE PURPOSE OF INDIVIDUAL CIRCUIT BREAKERS, SAFETY SWITCHES AND MOTOR STARTERS BY MEANS OF NAMEPLATES AS INDICATED.
8. ROUTE CONDUITS TO SUIT EQUIPMENT AND BUILDING STRUCTURE. USE INTERMEDIATE METAL CONDUIT (IMC) OR RIGID GALVANIZED STEEL CONDUIT (RGS) FOR WORK EMBEDDED IN CONCRETE OR EXPOSED TO PHYSICAL DAMAGE. USE MINIMUM 3/4 INCH CONDUIT EXCEPT AS FOLLOWS: 1/2" CONDUIT MAY BE USED FOR 20 AMP GENERAL LIGHT AND POWER CIRCUITS FOR CONTROL CIRCUITS. USE LIQUID TIGHT FLEXIBLE METAL CONDUIT FOR FLEXIBLE CONNECTIONS TO EQUIPMENT IN MECHANICAL ROOMS OR OUTDOORS.
9. SEAL AROUND CONDUIT PENETRATIONS THROUGH INTERIOR WALLS AND FLOORS SEPARATING AREAS TO RESTORE ORIGINAL FIRE RATING; USE A UL CLASSIFIED FIRE SEALANT. SEAL PENETRATIONS THROUGH ROOF AND EXTERIOR WALLS TO MAKE WATERPROOF. REQUEST INSPECTION OF FIRE SEALS BY ELECTRICAL INSPECTOR FROM AUTHORITY HAVING JURISDICTION BEFORE AND AFTER PLACEMENT OF FIRE SEAL MATERIALS.
10. USE 12 AWG OR LARGER CONDUCTORS FOR POWER WIRING. USE 14 AWG STRANDED CONDUCTORS FOR CONTROL WIRING UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS.
11. USE ONLY COPPER CONDUCTORS ON CIRCUITS 600V AND LESS. CONDUCTORS 10 AWG AND SMALLER SHALL BE SOLID AND 8 AWG AND LARGER AWG SHALL BE STRANDED. PROVIDE TYPE THHN/THWN WIRE INSULATION; XHHW INSULATION MAY BE USED FOR 1 AWG AND LARGER.
12. USE THE FOLLOWING CONDUCTOR COLOR CODES:

	208Y/120 VOLT	480Y/277 VOLT
PHASE A	BLACK	BROWN
PHASE B	RED	ORANGE
PHASE C	BLUE	YELLOW
NEUTRAL	WHITE	GRAY
EQUIP. GROUND	GREEN	GREEN

13. ARRANGE CONNECTIONS FOR SINGLE PHASE CIRCUITS TO ACHIEVE THREE PHASE LOAD BALANCE WITHIN 20% OF THE AVERAGE PHASE LOAD CURRENT. UNGROUNDED CONDUCTORS USING A COMMON NEUTRAL MUST ORIGINATE FROM DIFFERENT PHASES.
14. INSTALL OUTDOOR EQUIPMENT TO BE WEATHERPROOF AND TO EXCLUDE BIRDS AND RODENTS WITH MAXIMUM 1/2" DIAMETER UNPROTECTED OPENINGS IN ENCLOSURES.
15. ITEMS DESIGNATED BY A NUMBER IN A HEXAGON ARE DESCRIBED IN THE ELECTRICAL EQUIPMENT LIST. ITEMS DESIGNATED BY A NUMBER IN A DIAMOND ARE DESCRIBED IN THE MECHANICAL EQUIPMENT LIST. NAMEPLATES ARE DESIGNATED BY A NUMBER IN A RECTANGLE AND ARE DESCRIBED IN THE NAMEPLATE SCHEDULE.
16. PROVIDE LIGHTNING PROTECTION IN ACCORDANCE WITH NFPA 780. PROVIDE MATERIAL THAT IS UL LABELED FOR LIGHTNING PROTECTION SERVICE. THE LIGHTNING PROTECTION SYSTEM DESIGN AND INSTALLATION SHALL FOLLOW THAT SHOWN ON THE DRAWINGS.
17. TEST CONDUCTORS FOR CONTINUITY AND FREEDOM FROM SHORTS AND UNINTENTIONAL GROUNDS.
18. ELECTRICAL EQUIPMENT SPECIFIED IN THIS DOCUMENT SHALL BE ACCEPTANCE TESTED AND INSPECTED IN ACCORDANCE WITH NETA ATS BY THE LANL SUPPORT SERVICES SUB-CONTRACTOR.
19. ELECTRICAL MATERIALS AND CONSTRUCTION SHALL CONFORM TO LOS ALAMOS NATIONAL LABORATORY STANDARD CONSTRUCTION SPECIFICATIONS WHERE APPLICABLE.
20. DISPOSE OF ITEMS REMOVED AS DIRECTED BY THE LANL CONSTRUCTION INSPECTOR.
21. REPAIR AREAS DAMAGED DURING CONSTRUCTION TO MATCH ADJACENT AREAS WITH RESPECT TO BOTH COLOR AND FINISH.
22. KEEP JOB SITE IN AN ORDERLY CONDITION AND AT PROJECT COMPLETION, REMOVE ALL WASTE. LEAVE THE JOB SITE IN A CONDITION ACCEPTABLE TO THE LANL CONSTRUCTION INSPECTOR.
23. IF A CONFLICT ARISES BETWEEN THE FIELD CONDITIONS AND THESE GENERAL ELECTRICAL REQUIREMENTS, CONTACT THE LANL PROJECT LEADER FOR DIRECTIONS.
24. TIE-INS TO EXISTING POWER SYSTEMS WILL BE PERFORMED BY THE LANL SUPPORT SERVICES SUB-CONTRACTOR.

60% REVIEW "NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ELECTRICAL SYMBOL LEGEND AND GENERAL NOTES

BLDG 181, 182, 183 TA-52

DRAWN	MM
DESIGN	AD
CHECKED	JF
DATE	

SUBMITTED | APPROVED FOR RELEASE

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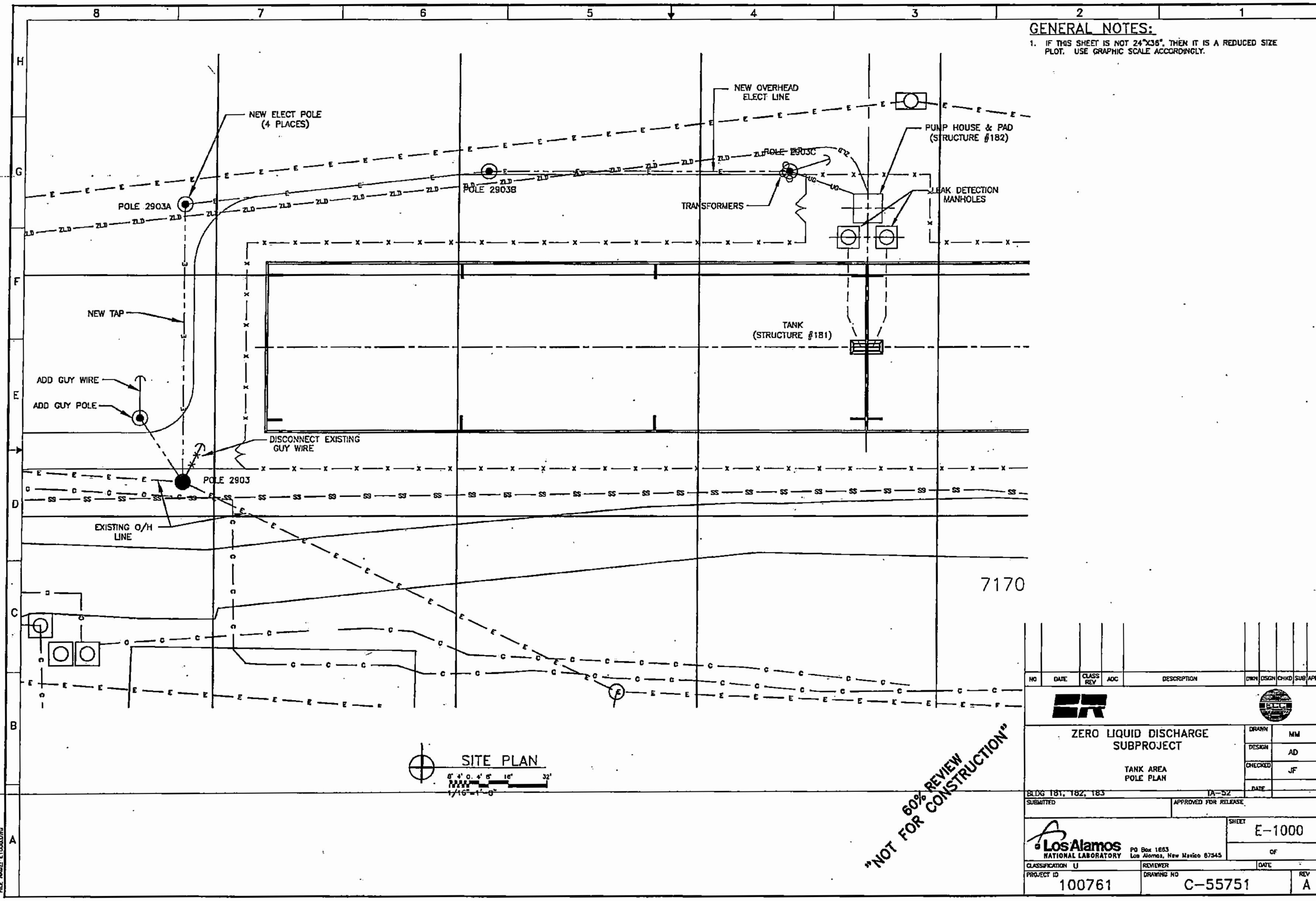
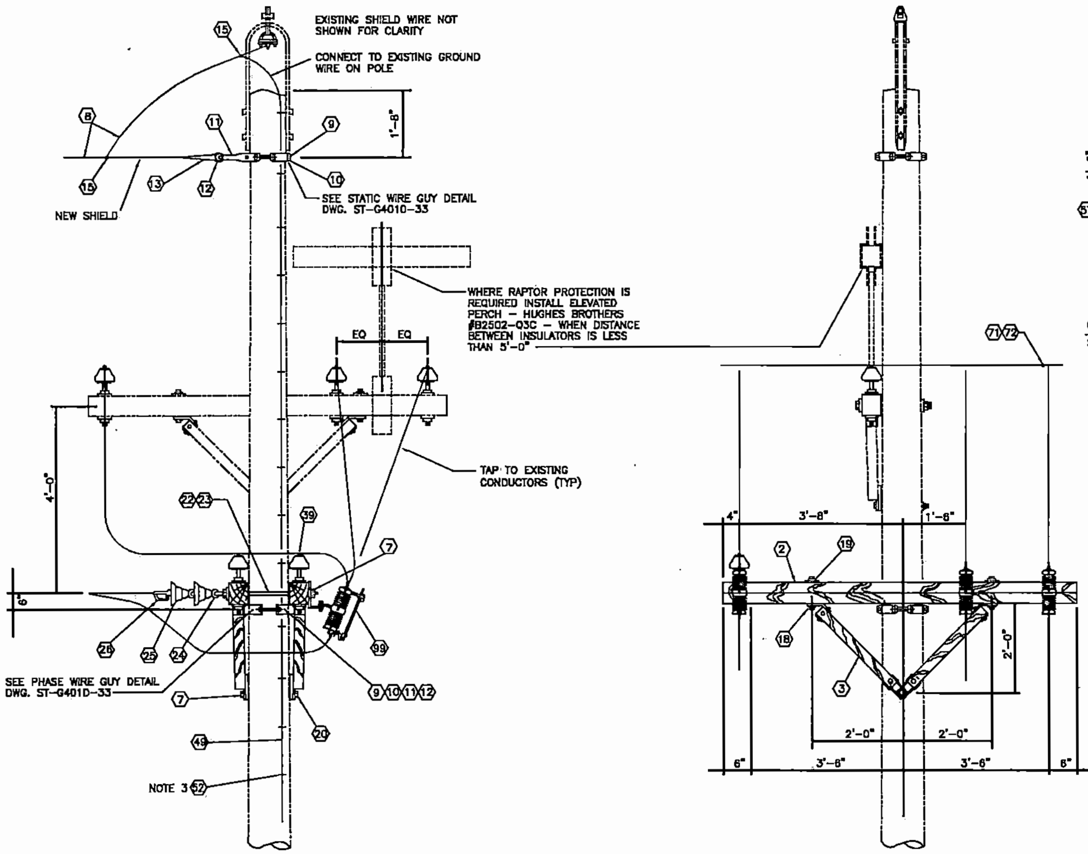
SHEET E-0001 OF

CLASSIFICATION | REVIEWER | DATE

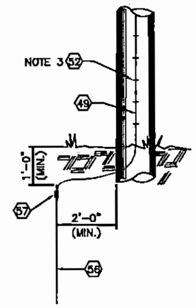
PROJECT ID 100761 | DRAWING NO C-55751 | REV A



GENERAL NOTES:
1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
NEW OVERHEAD ELECT LINE
NEW ELECT POLE (4 PLACES)
PUMP HOUSE & PAD (STRUCTURE #182)
POLE 2903C
POLE 2903B
POLE 2903A
TRANSFORMERS
LEAK DETECTION MANHOLES
NEW TAP
TANK (STRUCTURE #181)
ADD GUY WIRE
ADD GUY POLE
DISCONNECT EXISTING GUY WIRE
POLE 2903
EXISTING O/H LINE
7170
SITE PLAN
1/16"=1'-0"
60% REVIEW
"NOT FOR CONSTRUCTION"
NO | DATE | CLASS REV | ADC | DESCRIPTION | DRN | DSGN | CHKD | SUB | APP
ZERO LIQUID DISCHARGE SUBPROJECT
TANK AREA POLE PLAN
DRAWN MM
DESIGN AD
CHECKED JF
DATE
BLDG 181, 182, 183
TA-52
SUBMITTED
APPROVED FOR RELEASE
Los Alamos NATIONAL LABORATORY
PO Box 1663 Los Alamos, New Mexico 87545
SHEET E-1000
OF
CLASSIFICATION U
REVIEWER
DATE
PROJECT ID 100761
DRAWING NO C-55751
REV A



NEW 3–WAY TAP ON EXISTING TANGENT STRUCTURE DETAIL
POLE #2903
SCALE: NONE



GROUNDING DETAIL
SCALE: NONE

GENERAL NOTES:

1. CONSTRUCTION FOR WIRE SIZES #4 SOLID COPPER TO #3/0 ACSR (6/1).
2. GROUND OVERHEAD STATIC AT EVERY POLE (SEE GROUNDING DETAIL). WHERE RAPTOR PROTECTION IS REQUIRED, GROUNDING DOWN CONDUCTOR SHALL BE INSULATED TO 3'-0" BELOW CROSS ARM BRACE.
3. STAPLES ON GROUND WIRE SHALL BE 2'-0" APART EXCEPT FOR A DISTANCE OF 8'-0" ABOVE GROUND AND 8'-0" FROM TOP OF POLE WHERE THEY SHALL BE 6" APART.
4. FOR BILL OF MATERIALS, SEE DWG. E-1002.
5. EQUIPMENT ITEM NUMBERS (1) REFER TO EQUIPMENT NUMBERS IN LANL SUPPORT SERVICES CONTRACTOR'S MASTER BILL OF MATERIALS. ONLY THOSE NUMBERS USED ON THIS DRAWING ARE SHOWN.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

DISTRIBUTION – NEW 3–WAY TAP ON EXISTING POLE 2903 DETAIL

BLDG 181, 182, 183 TA–52

DRAWN	MM
DESIGN	AD
CHECKED	JF
DATE	

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SHEET E–1001 OF

CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C–55751 | REV A

BILL OF MATERIALS

ITEM	DESCRIPTION	QTY	MFR. CATALOG No.
2	CROSS ARM, WOOD, 3 1/2" X 4 1/2" X 8'-0", 4 PIN	2	HUGHES #2202C
3	CROSS ARM BRACE, 1 11/16" X 2 11/16" X 48" SPAN	2	BROOKS #446-48-24
7	SPRING WASHER, 5/8" SIZE	4	JOSLYN #J177
8	WIRE, 3/8" (7#8) H.S. STATIC, 30% COND.	AS REQ'D	COPPERWELD
9	POLE BAND, 4-WAY, FOR 7 1/2" TO 12" DIA.	2	HUGHES #1111
10	LAG SCREW, 1/2" X 4"	2	JOSLYN #J8784
11	CONNECTING LINK	2	HUGHES #3170
12	GUY ROLLER, WHEEL TYPE, WITH 3/4" X 2" BOLT	2	HUGHES #28082
13	GUY GRIP DEAD END, "B" COAT, 3/8" SIZE, GALVANIZED	1	PREFORMED #CDE3115
15	CRIMP CONNECTOR	3	HYTAP
16	LOW VOLTAGE STEEL PIN, 5/8", 6" HEIGHT	2	JOSLYN #J207Z
17	PIN INSULATOR, ANSI CLASS 55-5	2	VICTOR #9R
18	MACHINE BOLT, 1/2" X 8"	4	JOSLYN #J8706
19	SPRING WASHER, 1/2" SIZE	4	JOSLYN #J176
20	MACHINE BOLT, 5/8" X 14"	1	JOSLYN #J8814
22	SQUARE WASHER, 5/8" SIZE	4	JOSLYN #J1074
23	DOUBLE ARMING BOLT, 5/8" X 22"	3	JOSLYN #J8872
24	EYE NUT, 5/8" SIZE	6	JOSLYN #J1092
25	SUSPENSION INSULATOR, POLYMER	6	JOSLYN #L1510
28	STRAIN CLAMP, DEADEND	3	HUBBELL/ANDERSON #GDW-2040
39	DIST. TIES FOR 3/0 ACSR (6/1)	4	PREFORMED #UTF-1207
49	NO. 1/0 BARE COPPER WIRE, 7 STRAND	AS REQ'D	
52	GROUND WIRE STAPLE, 2"	AS REQ'D	JOSLYN #J8655
56	GROUND ROD, 3/4" X 8'	1	JOSLYN #J5338
57	GROUND ROD CLAMP, HEX HEAD, 3/4"	1	JOSLYN #J8493
71	LINE TAP CRIMPITS, COPPER YC-C	3	FCI-BURNCY #YC26C28
72	LINE TAP CRIMPITS, ACST YP-U	3	
99	DISCONNECT SWITCH 600A TYPE D73-CD	3	KEARNEY #3127740ACLPX

GENERAL NOTES:

1. THIS BILL OF MATERIALS APPLIES TO DRAWING E-1001.
2. EQUIPMENT ITEM NUMBERS (1) REFER TO EQUIPMENT NUMBERS IN LANL SUPPORT SERVICES CONTRACTOR'S MASTER BILL OF MATERIALS. ONLY THOSE NUMBERS USED ON SHT. 1 OF THIS DRAWING ARE SHOWN.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

DISTRIBUTION-NEW 3-WAY TAP ON EXISTING POLE 2903
BILL OF MATERIALS

BLDG 181, 182, 183 TA-52

DRAWN MM | DESIGN AD | CHECKED JF | DATE

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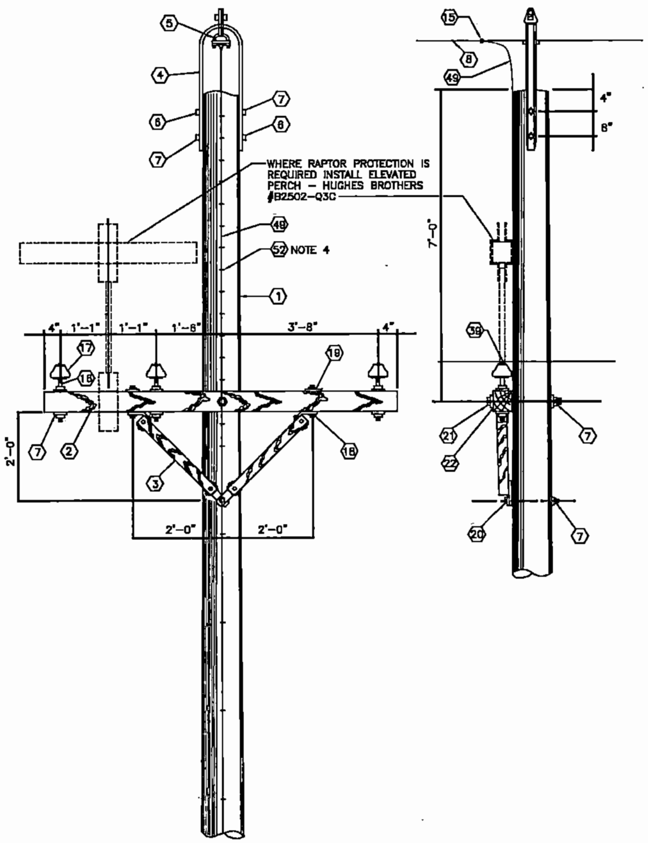
SHEET E-1002 OF

CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

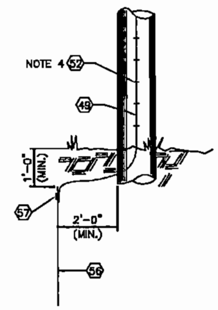
GENERAL NOTES:

1. 7'-0" FRAMING DIMENSION SHALL BE CHANGED TO 8'-0" WHEN POLE BAND IS USED FOR STATIC WIRE.
2. CONSTRUCTION FOR WIRE SIZES #4 SOLID COPPER TO #3/0 ACSR (6/1).
3. GROUND OVERHEAD STATIC AT EVERY POLE (SEE GROUNDING DETAIL). WHERE RAPTOR PROTECTION IS REQUIRED, GROUNDING DOWN CONDUCTOR SHALL BE INSULATED TO 3'-0" BELOW CROSS ARM BRACE.
4. STAPLES ON GROUND WIRE SHALL BE 2'-0" APART EXCEPT FOR A DISTANCE OF 8'-0" ABOVE GROUND AND 8'-0" FROM TOP OF POLE WHERE THEY SHALL BE 6" APART.
5. FOR BILL OF MATERIALS, SEE DWG. E-1004.
6. EQUIPMENT ITEM NUMBERS (1) REFER TO EQUIPMENT NUMBERS IN LANL SUPPORT SERVICES CONTRACTOR'S MASTER BILL OF MATERIALS. ONLY THOSE NUMBERS USED ON THIS DRAWING ARE SHOWN.



SINGLE ARM TANGENT STRUCTURE DETAIL POE 2903B

SCALE: NONE



GROUNDING DETAIL

SCALE: NONE

"60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

DISTRIBUTION
SINGLE ARM POLE 2903B DETAIL

DRAWN: MM
DESIGN: AD
CHECKED: JF
DATE:

BLDG 181, 182, 183 TA-52

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PO Box 1663 Los Alamos, New Mexico 87545

SHEET: E-1003
OF

CLASSIFICATION | REVIEWER | DATE

PROJECT ID: 100761
DRAWING NO: C-55751
REV: A

BILL OF MATERIALS

ITEM	DESCRIPTION	QTY	MFR. CATALOG No.
1	WOOD POLE, DF, 45', CLASS 3	1	
2	CROSS ARM, WOOD, 3 1/2" X 4 1/2" X 8'-0", 4 PIN	1	HUGHES #2202C
3	CROSS ARM BRACE, 1 11/16" X 2 11/16" X 48" SPAN	2	BROOKS #446-48-24
4	RIDGE IRON, SHIELD WIRE TYPE	1	HUGHES #1155
5	SUSPENSION CLAMP	1	HUBBELL/ANDERSON #MS-48-N
6	MACHINE BOLT, 5/8" X 12"	2	JOSLYN #J8812
7	SPRING WASHER, 5/8" SIZE	7	JOSLYN #J177
8	WIRE, 3/8" (7#8) H.S. STATIC, 30% COND.	AS REQ'D	COPPERWELD
15	CRIMP CONNECTOR	1	HYTAP
16	LOW VOLTAGE STEEL PIN, 5/8", 6" HEIGHT	3	JOSLYN #J207Z
17	PIN INSULATOR, ANSI CLASS 55-5	3	VICTOR #9R
18	MACHINE BOLT, 1/2" X 8"	2	JOSLYN #J8708
19	SPRING WASHER, 1/2" SIZE	2	JOSLYN #J176
20	MACHINE BOLT, 5/8" X 14"	1	JOSLYN #J8814
21	MACHINE BOLT, 5/8" X 18"	1	JOSLYN #J8818
22	SQUARE WASHER, 5/8" SIZE	1	JOSLYN #J1074
39	DIST. TIES FOR 3/0 ACSR (6/1)	3	PREFORMED #UTF-1207
49	NO. 1/0 BARE COPPER WIRE, 7 STRAND	AS REQ'D	
52	GROUND WIRE STAPLES, 2"	AS REQ'D	JOSLYN #J6655
56	GROUND ROD, 3/4" X 8'	1	JOSLYN #J5338
57	GROUND ROD CLAMP, HEX HEAD, 3/4"	1	JOSLYN #J8493

GENERAL NOTES:

1. THIS BILL OF MATERIALS APPLIES TO DRAWING E-1003.
2. EQUIPMENT ITEM NUMBERS (1) REFER TO EQUIPMENT NUMBERS IN LANL SUPPORT SERVICES CONTRACTOR'S MASTER BILL OF MATERIALS. ONLY THOSE NUMBERS USED ON SHT. 1 OF THIS DRAWING ARE SHOWN.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

DISTRIBUTION – SINGLE ARM POLE 2903B
BILL OF MATERIALS

BLDG 181, 182, 183 TA-52

DRAWN: MM
DESIGN: AD
CHECKED: JF
DATE:

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Los Alamos, New Mexico 87545

SHEET E-1004 OF

CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

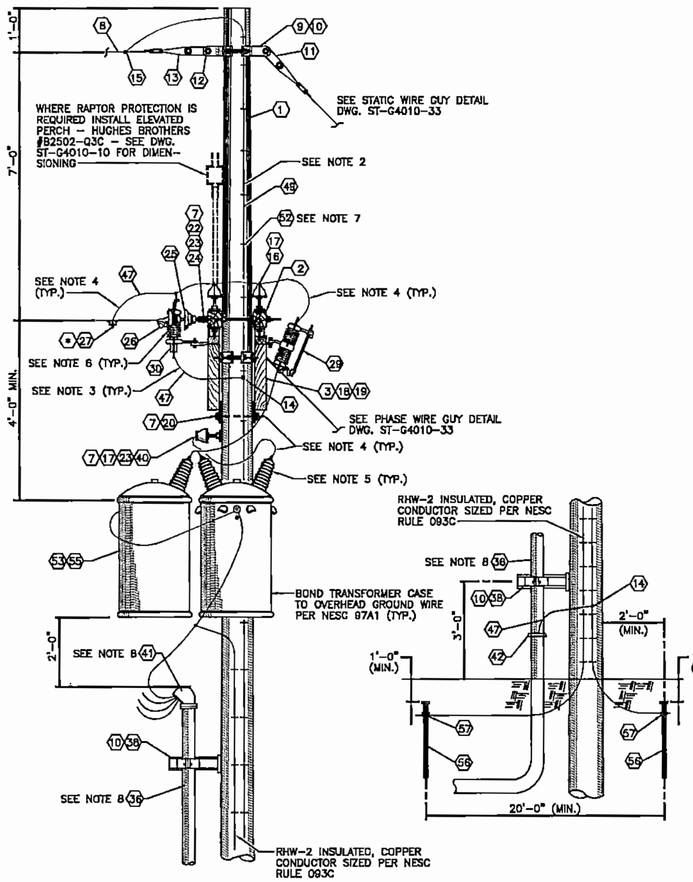
FILE NAME: E-1004.DWG

8	7	6	5	4	3	2	1

BILL OF MATERIALS

ITEM	DESCRIPTION	QTY	MFR. CATALOG No.
1	WOOD POLE, DF, 45', CLASS 3	1	
2	CROSS ARM, WOOD, 3 1/2" X 4 1/2" X 8'-0", 4 PIN	2	HUGHES #2202C
3	CROSS ARM BRACE, 1 11/16" X 2 11/16" X 48" SPAN	2	BROOKS #446-48-24
7	SPRING WASHER, 5/8" SIZE	5	JOSLYN #J177
8	WIRE, 3/8" (7#8) H.S. STATIC, 30% COND.	AS REQ'D	COPPERWELD
9	POLE BAND, 4-WAY, FOR 7 1/2" TO 12" DIA.	2	HUGHES #1111
10	LAG SCREW, 1/2" X 4"	4	JOSLYN #J8784
11	CONNECTING LINK	1	HUGHES #3170
12	GUY ROLLER, WHEEL TYPE, WITH 3/4" X 2" BOLT	1	HUGHES #28082
13	GUY GRIP DEAD END, "B" COAT, 3/8" SIZE, GALV.	1	PREFORMED #CDE3115
14	CRIMP CONNECTOR	2	HYTAP
15	CRIMP CONNECTOR	1	HYTAP
16	LOW VOLTAGE STEEL PIN, 5/8", 6" HEIGHT	6	JOSLYN #J207Z
17	PIN INSULATOR, ANSI CLASS 55-5	7	VICTOR #9R
18	MACHINE BOLT, 1/2" X 8"	4	JOSLYN #J8708
19	SPRING WASHER, 1/2 " SIZE	4	JOSLYN #J176
20	MACHINE BOLT, 5/8" X 14"	1	JOSLYN #J8814
22	SQUARE WASHER, 5/8" SIZE	3	JOSLYN #J1074
23	DOUBLE ARMING BOLT, 5/8" X 22"	4	JOSLYN #J8872
24	EYE NUT, 5/8" SIZE	6	JOSLYN #J1092
25	SUSPENSION INSULATOR, POLYMER	6	JOSLYN #L1510
26	STRAIN CLAMP, DEAD END	3	HUBBELL/ANDERSON #GDW-2040
27	CLAMP, HOT LINE, FOR ACSR	3	CHANCE #S1530-AGP
• 28	HOT LINE CLAMP ADAPTER, 1/0-4/0 ACSR	3	FCI-BURNDY #YCB-28U26
29	DIST. FUSE CUTOUT, 100 AMP.	3	KEARNEY #144261-020
30	DIST. TYPE METAL OXIDE SURGE ARRESTER WITH MOUNTING BRACKET	3	HUBBELL/OHIO BRASS MODEL PDV-100, #213613-7224
36	CONDUIT, 4" IMC OR 6" RIGID	AS REQ'D	
38	CONDUIT STANDOFF BRACKET WITH STRAP KIT	2	ALUMAFORM #6-CSO-12
40	LEAD THREAD ADAPTER, TRANS.	1	JOSLYN #J2840
41	WEATHERHEAD FOR 4" CONDUIT	1	COOPER/CROUSE-HINDS #F1066
42	GROUND CLAMP FOR 4" OR 6" CONDUIT	1	O.Z. GEDNEY #CG4104
47	NO. 4 BARE COPPER WIRE, 7 STRAND	AS REQ'D	
49	NO. 1/0 BARE COPPER WIRE, 7 STRAND	AS REQ'D	
52	GROUND WIRE STAPLE, 2"	AS REQ'D	JOSLYN #J8855
53	TRANSFORMER, CONV. CLASS A, 13,200-480/277 LV, 37.5KVA	3	ABB TRANSFORMER
55	TRANSFORMER MOUNTING BRACKETS	1 SET	ALUMAFORM
56	GROUND ROD, 3/4" X 8'	1	JOSLYN #J5338
57	GROUND ROD CLAMP, HEX HEAD, 3/4"	1	JOSLYN #J8493
• 73	HOT LINE CLAMP BAIL FOR COPPER	3	THOMAS & BETTS/BLACKBURN #7030C
• 74	COMPRESSION TAP, 1/0 TO #2 SOLID COPPER	3	THOMAS & BETTS/BLACKBURN #CF102-1
• 75	COMPRESSION TAP, 2/0 TO #2 SOLID COPPER	3	THOMAS & BETTS/BLACKBURN #CF402-1

* USE ITEM 73 AND 74 OR 75 FOR COPPER CONDUCTORS.
USE ITEM 28 FOR ACSR CONDUCTORS.



NEW 3-PHASE TRANSFORMER BANK ON DEADEND POLE 2903C WITH UNDERGROUND SECONDARY DETAIL

SCALE: NONE

"60% REVIEW "NOT FOR CONSTRUCTION"

GENERAL NOTES:

1. CONSTRUCTION FOR WIRE SIZES #4 SOLID COPPER TO #3/0 ACSR (6/1).
2. GROUND OVERHEAD STATIC AT EVERY POLE. WHERE WILDLIFE/RAPTOR PROTECTION IS REQUIRED, GROUNDING DOWN CONDUCTOR SHALL BE INSULATED FROM OVERHEAD SHIELD WIRE TO 3'-0" BELOW TRANSFORMERS.
3. WHERE WILDLIFE/RAPTOR PROTECTION IS REQUIRED USE 600V. INSULATED WIRE.
4. WHERE WILDLIFE/RAPTOR PROTECTION IS REQUIRED USE NON-SHIELDED 15kV INSULATED CABLE FOR CONNECTIONS TO TRANSFORMER PRIMARY BUSHINGS.
5. WHERE WILDLIFE/RAPTOR PROTECTION IS REQUIRED PROVIDE BUSHING COVERS SIMILAR TO PREFORMED LINE PRODUCTS #WP-10T.
6. WHERE WILDLIFE/RAPTOR PROTECTION IS REQUIRED USE HUBBELL/OHIO BRASS #7325 MOUNTING BRACKET WITH PROTECTIVE CAPS IN LIEU OF #7224 MOUNTING BRACKET.
7. STAPLES ON GROUND WIRE SHALL BE 2'-0" APART EXCEPT FOR A DISTANCE OF 8'-0" ABOVE GROUND AND 8'-0" FROM TOP OF POLE WHERE THEY SHALL BE 6" APART.
8. LANL UTILITY SERVICES INSTALLS ALL SECONDARY CONDUIT & CONDUCTORS TO THE FIRST DISCONNECT DEVICE.
9. EQUIPMENT ITEM NUMBERS (1) REFER TO EQUIPMENT NUMBERS IN LANL SUPPORT SERVICES CONTRACTOR'S MASTER BILL OF MATERIALS. ONLY THOSE NUMBERS USED ON THIS DRAWING ARE SHOWN.

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

NEW 3 PHASE TRANSFORMER BANK ON DEADEND POLE 2903C WITH UNDERGROUND SECONDARY DETAIL

BLDG 181, 182, 183 TA-52

DRAWN	MM
DESIGN	AD
CHECKED	JF
DATE	

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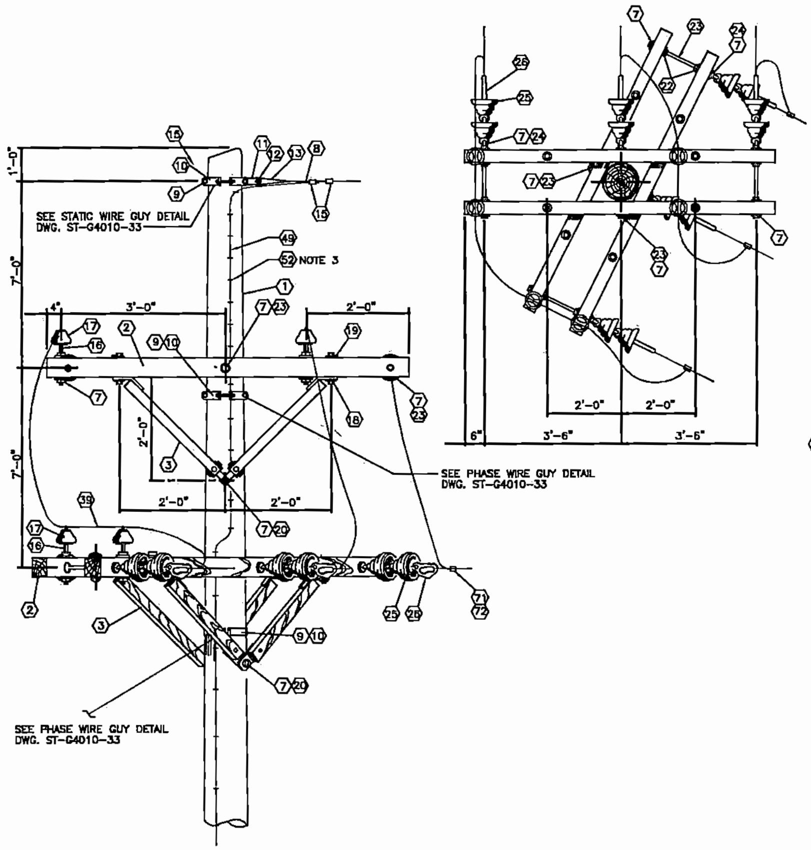
SHEET E1005 OF

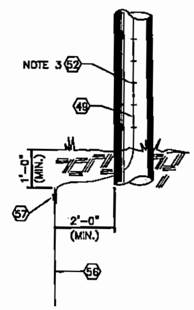
CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

GENERAL NOTES:
1. CONSTRUCTION FOR WIRE SIZES #4 SOLID COPPER TO #3/0 ACSR (6/1).
2. GROUND OVERHEAD STATIC AT EVERY POLE (SEE GROUNDING DETAIL).
3. STAPLES ON GROUND WIRE SHALL BE 2'-0" APART EXCEPT FOR A DISTANCE OF 8'-0" ABOVE GROUND AND 8'-0" FROM TOP OF POLE WHERE THEY SHALL BE 8" APART.
4. FOR BILL OF MATERIALS, SEE DWG. E-1007.
5. EQUIPMENT ITEM NUMBERS (1) REFER TO EQUIPMENT NUMBERS IN LANL SUPPORT SERVICES CONTRACTOR'S MASTER BILL OF MATERIALS. ONLY THOSE NUMBERS USED ON THIS DRAWING ARE SHOWN.



60°-90° ANGLE STRUCTURE DETAIL POLE 2903A
SCALE: NONE



GROUNDING DETAIL
SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

DISTRIBUTION
60°-90° ANGLE POLE 2903A DETAIL

BLDG 181, 182, 183 TA-52

DRAWN MM
DESIGN AD
CHECKED JF
DATE

SUBMITTED
APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET E1006 OF

CLASSIFICATION
REVIEWER
DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

FILE NAME: E-1006.DWG

8	7	6	5	4	3	2	1

BILL OF MATERIALS

ITEM	DESCRIPTION	QTY	MFR. CATALOG No.
1	WOOD POLE, DF, 45', CLASS 3	1	
2	CROSS ARM, WOOD, 3 1/2" X 4 1/2" X 8'-0", 4 PIN	2	HUGHES #2202C
3	CROSS ARM BRACE, 1 11/16" X 2 11/16" X 48" SPAN	2	BROOKS #446-48-24
7	SPRING WASHER, 5/8" SIZE	13	JOSLYN #J177
8	WIRE, 3/8" (7#8) H.S. STATIC, 30% COND.	AS REQ'D	COPPERWELD
9	POLE BAND, 4-WAY, FOR 7 1/2" TO 12" DIA.	2	HUGHES #1111
10	LAG SCREW, 1/2" X 4"	2	JOSLYN #J8784
11	CONNECTING LINK	2	HUGHES #3170
12	GUY ROLLER, WHEEL TYPE, WITH 3/4" X 2" BOLT	2	HUGHES #28082
13	GUY GRIP DEAD END, "B" COAT, 3/8" SIZE, GALVANIZED	2	PREFORMED #CDE3115
15	CRIMP CONNECTOR	4	HYTAP
16	LOW VOLTAGE STEEL PIN, 5/8", 6" HEIGHT	6	JOSLYN #J2072
17	PIN INSULATOR, ANSI CLASS 55-5	6	VICTOR #9R
18	MACHINE BOLT, 1/2" X 6"	4	JOSLYN #J8706
19	SPRING WASHER, 1/2" SIZE	4	JOSLYN #J176
20	MACHINE BOLT, 5/8" X 14"	1	JOSLYN #J8814
22	SQUARE WASHER, 5/8" SIZE	4	JOSLYN #J1074
23	DOUBLE ARMING BOLT, 5/8" X 22"	3	JOSLYN #J8872
24	EYE NUT, 5/8" SIZE	12	JOSLYN #J1092
25	SUSPENSION INSULATOR, POLYMER	12	LAPP #151001A
26	STRAIN CLAMP, DEADEND	6	HUBBELL/ANDERSON #GDW-2040
39	DIST. TIES FOR 3/0 ACSR (6/1)	6	PREFORMED #UTF-1207
49	NO. 1/0 BARE COPPER WIRE, 7 STRAND	AS REQ'D	
52	GROUND WIRE STAPLES, 2"	AS REQ'D	JOSLYN #J8655
56	GROUND ROD, 3/4" X 8'	1	JOSLYN #J5338
57	GROUND ROD CLAMP, HEX HEAD, 3/4"	1	JOSLYN #J8493
71	LINE TAP CRIMPITS, COPPER YC-C	6	FCI-BURNCY #YC26C26
72	LINE TAP CRIMPITS, ACST YP-U	6	

GENERAL NOTES:

1. THIS BILL OF MATERIALS APPLIES TO DRAWING E-1006.
2. EQUIPMENT ITEM NUMBERS (1) REFER TO EQUIPMENT NUMBERS IN LANL SUPPORT SERVICES CONTRACTOR'S MASTER BILL OF MATERIALS. ONLY THOSE NUMBERS USED ON SHT. 1 OF THIS DRAWING ARE SHOWN.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

DISTRIBUTION – 60°-90° ANGLE POLE 2903A
BILL OF MATERIALS

BLDG 181, 182, 183 TA-52

DRAWN	MM
DESIGN	AD
CHECKED	JF
DATE	

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SHEET E-1007 OF

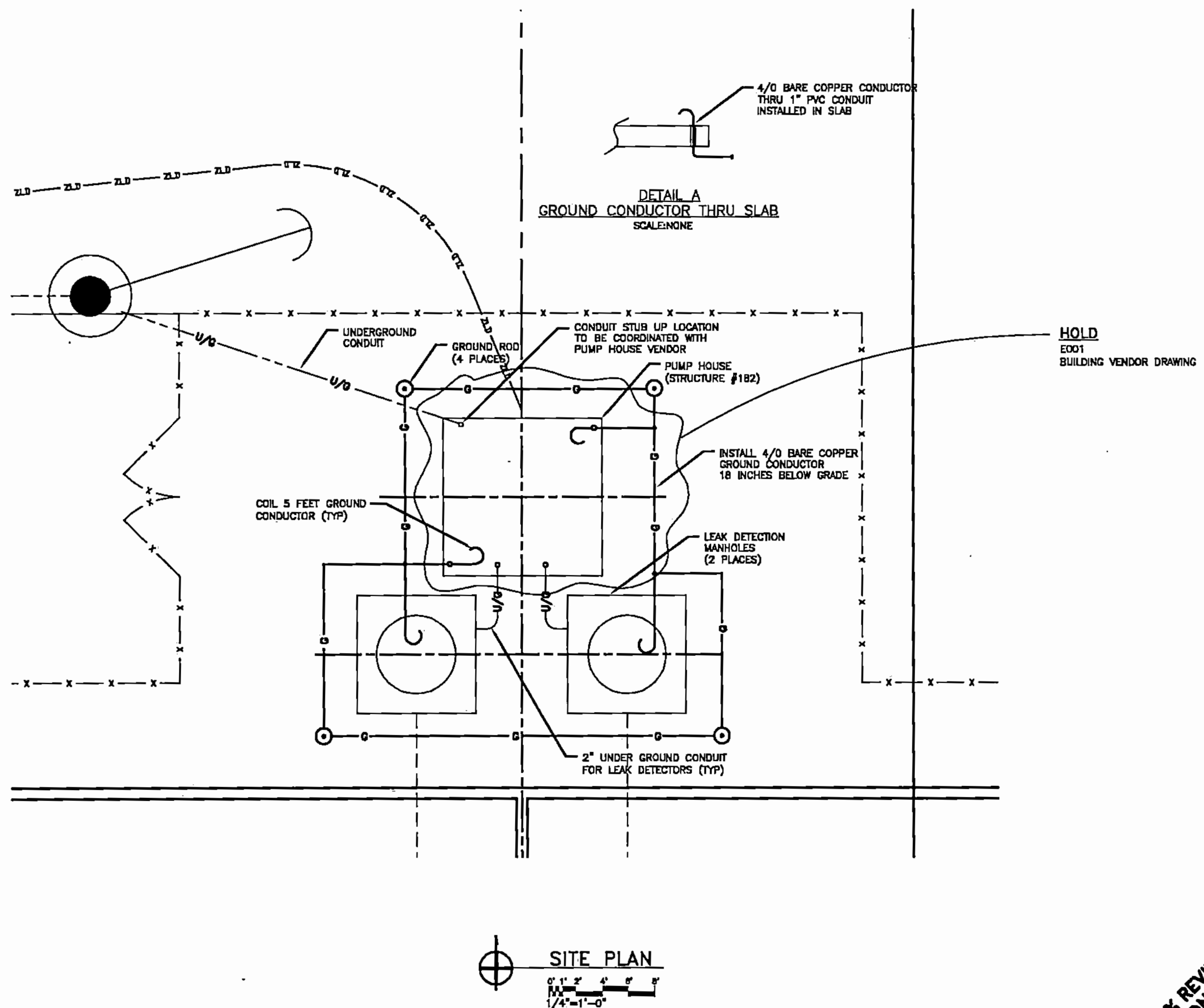
CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

FILE NAME: E-1007.DWG

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.



"60% REVIEW "NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

PUMP HOUSE
U/G CONDUIT AND GROUNDING PLAN

BLDG 181, 182, 183 — TA-52

DRAWN: MM
DESIGN: AD
CHECKED: JF
DATE:

SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY — PO Box 1663 Los Alamos, New Mexico 87545

SHEET E-1008 OF

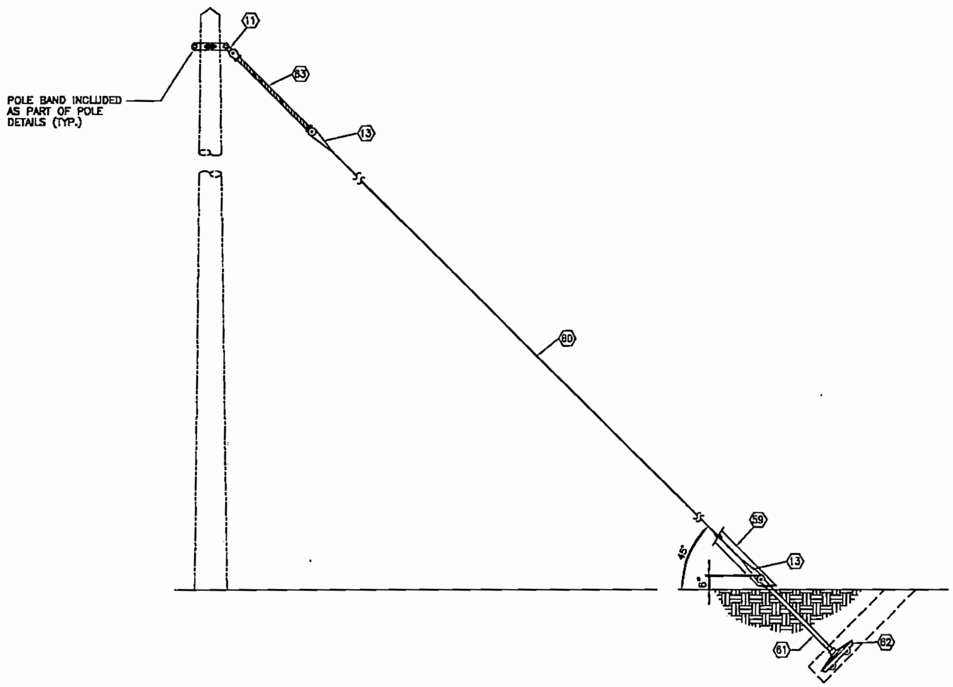
CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: MURIZANA Plot Date: 7/8/2011
FILE NAME: E1008.DWG

GENERAL NOTES:

1. EQUIPMENT ITEM NUMBERS (1) REFER TO EQUIPMENT NUMBERS IN LANL SUPPORT SERVICES CONTRACTOR'S MASTER BILL OF MATERIALS. ONLY THOSE NUMBERS USED ON THIS DRAWING ARE SHOWN.



PHASE WIRE GUY DETAIL

NOTE: CONSTRUCTION FOR WIRE SIZES #4 SOLID COPPER TO #3/0 ACSR (6/1)

BILL OF MATERIALS

ITEM	DESCRIPTION	QTY	MFR. CATALOG No.
11	CONNECTING LINK	1	HUGHES #3170
13	GUY GRIP DEAD END, "B" COAT, 3/8" SIZE, GALVANIZED	2	PREFORMED #CDE3115
59	GUY GUARD, POLYETHYLELE	1	JOSLYN #J28520-8Y
60	GALVANIZED GUY WIRE, 7 STRAND, 6,950#, 3/8"	AS REQ'D	
61	ANCHOR ROD, TWIN EYE, 3/4" x 8'	1	JOSLYN #J7528
62	ANCHOR, 8-WAY EXPANDING	1	JOSLYN #J8135
63	FIBERGLASS STRAIN INSULATOR, 15,000#	1	JOSLYN #150-78

GUY DETAILS

SCALE: NONE

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

GUY POLE DETAILS

BLDG 181, 182, 183 TA-52

DRAWN: MM
DESIGN: AD
CHECKED: JF
DATE:

SUBMITTED | APPROVED FOR RELEASE

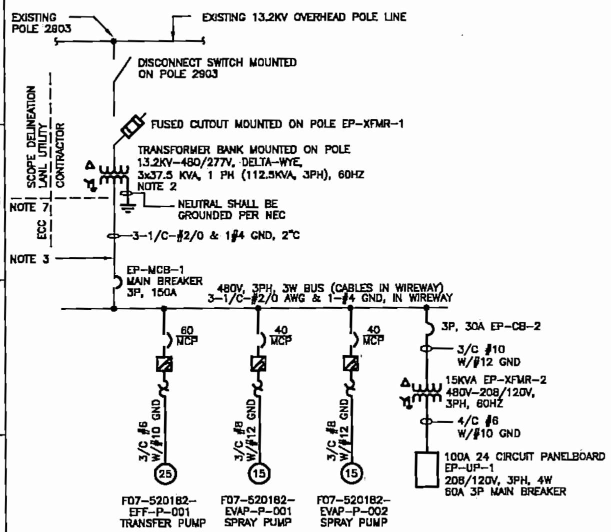
Los Alamos NATIONAL LABORATORY, PO Box 1663, Los Alamos, New Mexico 87545

SHEET: E-1009 OF

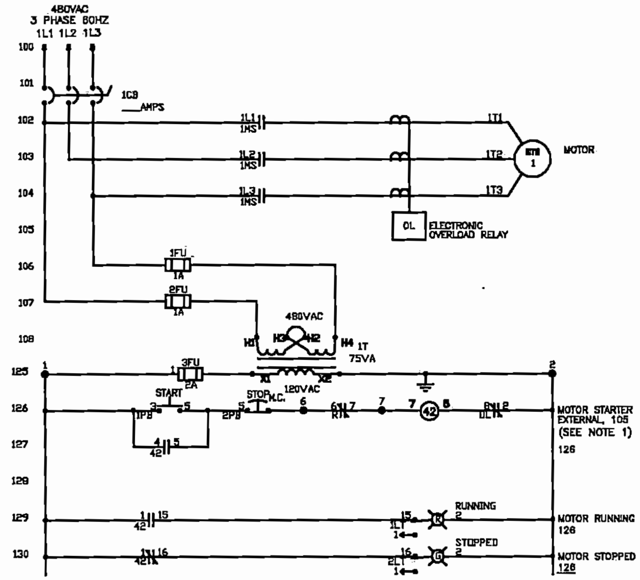
CLASSIFICATION | REVIEWER | DATE

PROJECT ID: 100761 | DRAWING NO: C-55751 | REV: A

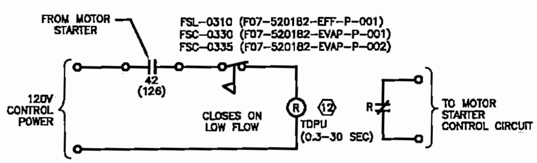
FILE NAME: E-1009.DWG



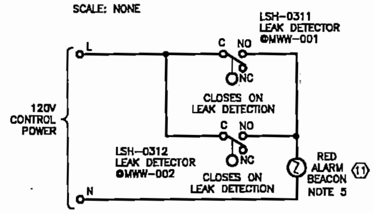
ONE LINE DIAGRAM
SCALE: NONE



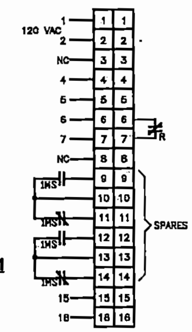
MOTOR CONTROL DIAGRAM – TWO WIRE CONTROL
SCALE: NONE

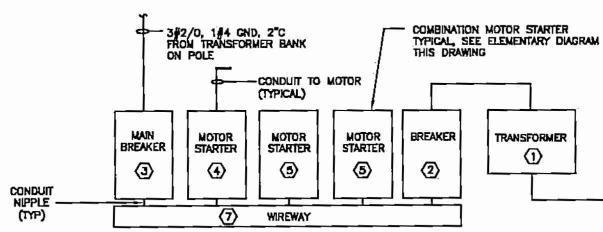


LOW FLOW INTERLOCK CIRCUIT JB1
(APPLIES TO TRANSFER PUMP P-3001A AND SPRAY PUMPS P-3002A/B)



LINER LEAK DETECTION ALARM CIRCUIT JB1





ZERO LIQUID DISCHARGE RISER DIAGRAM
ALL ELECTRICAL EQUIPMENT SHALL BE MOUNTED ON WALL INSIDE PUMP ENCLOSURE

GENERAL NOTES:

1. FOR ELECTRICAL SYMBOLS LEGEND AND GENERAL NOTES SEE DRAWING E-0001.
2. 150A SERVICE TO ZLD SYSTEM PUMP ENCLOSURE.
3. MAIN BREAKER (3P, 150A, 480V) SHALL BE SUITABLE FOR USE AS SERVICE EQUIPMENT.
4. MAIN BREAKER AND ALL MOTOR CIRCUIT PROTECTORS SHALL BE RATED MINIMUM 20KA SYM I.C.
5. RED ALARM BEACON MOUNTED OUTSIDE OF ZLD SYSTEM PUMP ENCLOSURE.
6. EQUIPMENT ITEM NUMBERS (11) REFER TO DRAWING E-0002 ELECTRICAL BILL OF MATERIAL.
7. OVERHEAD 13.2KV FEEDER AND POLE INSTALLATION BY LANL UTILITY CONTRACTOR, AND FROM POLE MOUNTED 480V TRANSFORMER SECONDARY ONWARD BY ECC ELECTRICAL CONTRACTOR.

"NOT FOR CONSTRUCTION" 60% REVIEW

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE SYSTEM ELECTRICAL ONE LINE DIAGRAM

DRAWN MM
DESIGN AD
CHECKED JF
DATE

BLDG 181, 182, 183 TA-52
SUBMITTED
APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET E-6000 OF

CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761
DRAWING NO C-55751
REV A

GENERAL NOTES:

1. FOR ELECTRICAL SYMBOLS LEGEND AND GENERAL NOTES SEE DRAWING E-0001.

TA-52, BLDG. 182 — EP-UP-1

SERVED BY	REF. DWG.	
15KVA TRANSFORMER	E-6000	208Y/120V,3ø,4W 60A MCB — 10000A RMS SYMETRICAL

CKT.	SUPPLIES	(VA) LOAD A	(VA) LOAD B	(VA) LOAD C	BREAKER AMP	BREAKER AMP	(VA) LOAD C	(VA) LOAD B	(VA) LOAD A	SUPPLIES	CKT.
1	RECEPTS RM XXX,XXX	720			20 GFCI	20			240	PUMP HOUSE LIGHTING	2
3	EMERG BATTERY PACK		60		20	20		120		OUTDOOR LIGHTING	4
5	LF INTLK RELAY JB1			20	20	20	40			ALARM BEACON PWR JB1	6
7	FREEZE PROTECTION	LATER			20	20			LATER	PUMP HSE EXHAUST FAN	8
9	SPARE				20	20		LATER		PUMP HSE UNIT HEATER	10
11	SPARE				20	20				SPARE	12
13	SPARE				20	20				SPARE	14
15	SPACE									SPACE	16
17	SPACE									SPACE	18
19	SPACE									SPACE	20
21	SPACE									SPACE	22
23	SPACE									SPACE	24
	SUBTOTAL CONNECTED LOAD	XX	XX	XX			XX	XX	XX	SUBTOTAL CONNECTED LOAD	
	TOTAL CONNECTED LOAD /ø	XX	XX	XX				XX		TOTAL CONNECTED VA	

CONNECTED		DESIGN	
TOTAL LIGHTING LOAD:	XX VA	LIGHTING LOAD @ 125%:	XX VA
TOTAL RECEPT. LOAD:	XX VA	RECEPTACLES PER NEC 220-44:	XX VA
TOTAL POWER LOAD:	XX VA	POWER LOADS @ 100%:	XX VA
		20% SPARES @ DESIGN LOAD:	XX VA
TOTAL CONNECTED LOAD:	XX VA	TOTAL DESIGN LOAD:	XX VA
	XX AMPS		XX AMPS

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

ZERO LIQUID DISCHARGE SYSTEM PUMP HOUSE ELECTRICAL PANEL SCHEDULE

BLDG 181, 182, 183 TA-52

DRAWN: MM
DESIGN: AD
CHECKED: JF
DATE:

SUBMITTED | APPROVED FOR RELEASE

Los Alamos NATIONAL LABORATORY
PO Box 1663
Los Alamos, New Mexico 87545

SHEET E-7000 OF

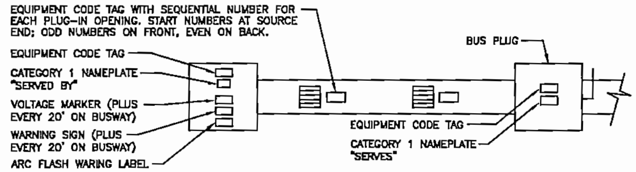
CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

NAMEPLATE SCHEDULE

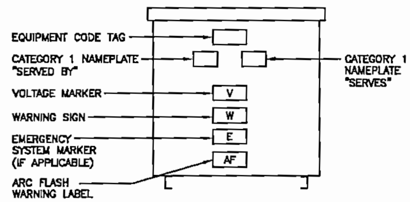
NAMEPLATES SHALL BE SUPPLIED BY THE SUBCONTRACTOR. NAMEPLATES SHALL BE 0.0625" THICK LAMINATED PHENOLIC. BLACK WITH WHITE CORE LETTERS 0.1250" HIGH ATTACH TO EQUIPMENT WITH SCREWS:

SYMBOL	DESIGNATION	QTY
1	EQUIPMENT CODE: EP-MCB-1 SERVED BY:EP-XFMR-1 VOLTAGE: 480V LOCATION: BLDG 182	1
2	EQUIPMENT CODE: EP-STR-1 SERVES: P-3001A VOLTAGE: 480V LOCATION: BLDG 182	1
3	EQUIPMENT CODE: EP-STR-2 SERVES: P-3002A VOLTAGE: 480V LOCATION: BLDG 182	1
4	EQUIPMENT CODE: EP-STR-3 SERVED BY: P-3002B VOLTAGE: 480V LOCATION: BLDG 182	1
5	EQUIPMENT CODE: EP-CB-2 SERVES: EP-XFMR-2 VOLTAGE: 480V/277V LOCATION: BLDG 182	1
6	EQUIPMENT CODE: EP-XFMR-2 SERVED BY: EP-CB 2 VOLTAGE: 480V LOCATION: BLDG 182	1
7	EQUIPMENT CODE: EP-UP-1 SERVES: UTILITIES BLDG 182 VOLTAGE: 208V/120V LOCATION: BLDG 182	1
8	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
9	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
10	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
11	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
12	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
13	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
14	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
15	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
16	EQUIPMENT CODE: SERVES: VOLTAGE: LOCATION:	0
17	EQUIPMENT CODE: SERVES: VOLTAGE: LOCATION:	0
18	EQUIPMENT CODE: SERVES: VOLTAGE: LOCATION:	0
19	EQUIPMENT CODE: SERVED BY: VOLTAGE: LOCATION:	0
20	EQUIPMENT CODE: SERVES: VOLTAGE: LOCATION:	0

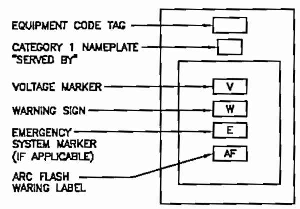


1. INSTALL EQUIPMENT CODE TAGS AT 25' INTERVALS ALONG THE LENGTH OF THE BUSDUCT.
2. INDIVIDUAL FEEDER BREAKERS WILL HAVE CATEGORY I NAMEPLATES INSTALLED ON THEM.

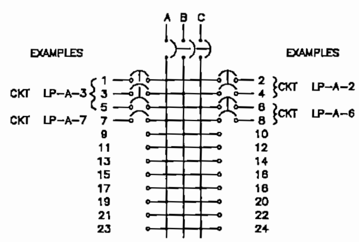
ELECTRICAL IDENTIFICATION: BUSDUCT
SCALE: NONE



ELECTRICAL IDENTIFICATION: TRANSFORMER
SCALE: NONE

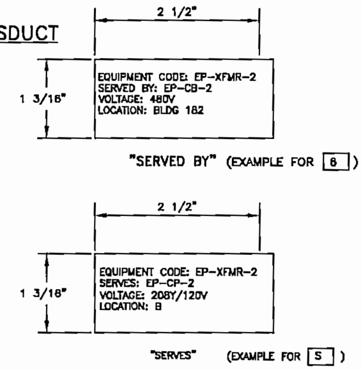


ELECTRICAL IDENTIFICATION: PANELBOARD
SCALE: NONE



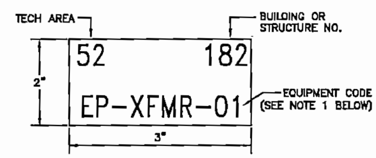
1. NUMBER POLES WITH ODD NUMBERS ON LEFT AND EVEN NUMBERS ON RIGHT.
2. FOR A MULTIPLE POLE DEVICE, UTILIZE ONLY ONE OF THE MULTIPLE NUMBERS WHICH IT COVERS AS A CIRCUIT NUMBER. PREFERABLE NUMBERS ARE TOP POLE NUMBERS ON TWO POLE AND MIDDLE NUMBER ON 3 POLE DEVICES.

CIRCUIT DESIGNATIONS: PANELBOARD



ALL LETTERING SIZE = 10 PT.

CATEGORY 1 NAMEPLATES
SCALE: NONE



ALL LETTERING SIZE = 48 PT.

1. CREATE EQUIPMENT CODE TAG(S) FOR EACH PEICE OF EQUIPMENT IN ACCORDANCE WITH SPECIFICTION 26 0553. USE THE "EQUIPMENT CODE" DESIGNATION IN THE NAMEPLATE SCHEDULE FOR THE EQUIPMENT.

EQUIPMENT CODE TAG
SCALE: NONE

GENERAL NOTES:

1. FOR LEGEND SYMBOLS AND GENERAL NOTES SEE DRAWING E-0001.

60% REVIEW
"NOT FOR CONSTRUCTION"

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP

ZERO LIQUID DISCHARGE SUBPROJECT

NAMEPLATE SCHEDULE SHEET 1

BLDG 181, 182, 183 TA-52

DRAWN: MM
DESIGN: AD
CHECKED: JF
DATE:

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Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET E-7001 OF

CLASSIFICATION | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

ELECTRICAL BILL OF MATERIAL

THE BILL OF MATERIAL IS INTENDED ONLY AS AN AID IN ESTIMATING AND MATERIAL TAKE-OFF, AND DOES NOT NECESSARILY INCLUDE ALL MATERIAL REQUIRED. UNLESS NOTED, CATALOG NUMBER IS GIVEN AS REFERENCE ONLY, AND APPROVED EQUAL SUBSTITUTION MAY BE MADE. ALL MATERIAL SHALL BE FURNISHED BY THE CONTRACTOR UNLESS OTHERWISE NOTED.

ITEM NO.	QTY.	DESCRIPTION	NOTE
1	1	DRY TYPE TRANSFORMER: 30KVA. 480V-208Y/120V, 3PH, 4W, 60HZ, DELTA PRIMARY, GROUNDED Y SECONDARY, IN NEMA-3R ENCLOSURE WITH RODENT PROOFING	SQUARE D TYPE "EE"
2	1	CIRCUIT BREAKER 30A, 480V 3P, 4W, 20KA IN NEMA-4 ENCLOSURE	SQUARE D "CLASS 610"
3	1	CIRCUIT BREAKER: 150A, 600V, 3 POLE, 4W, 20KA IN NEMA-4 ENCLOSURE	SQUARE D "CLASS 610"
4	2	COMBINATION MOTOR STARTER: 40A, NEMA SIZE 2, 3P, 3W, IN NEMA-4 ENCLOSURE	SQUARE D "CLASS 8536 TYPE S"
5	1	COMBINATION MOTOR STARTER: 60A, NEMA SIZE 2, 3P, 3W, IN NEMA-4 ENCLOSURE	SQUARE D "CLASS 8536 TYPE S"
6	1	EMERGENCY LIGHT: UNIT WITH 2-T5 (6V) LAMP HEADS, 120VAC, 3W LINE CORD, SELF-TEST/DIAGNOSTIC ELECTRONICS	CHLORIDE "6MF25WJ762-AD"
7	AS REQ'D	WIREWAY: 4"X4" RAINTIGHT	SQUARE D "SQUARE DUCT"
8	1	CIRCUIT BREAKER PANELBOARD: 100A MLO, 600V, SURFACE MOUNTED, 24 CKT, 3PH, 4W, 10KA IC RATING, WITH 100% NEUTRAL AND GROUND BUSES, NEMA-4X ENCLOSURE	SQUARE "NQ"
9	2	DUPLEX RECEPTACLE: 20A, 125VAC, 2P, 3W, SURFACE MOUNTED WITH STAINLESS STEEL WALLPLATE	HUBELL "HBL5362"
10	AS REQ'D	SURFACE-MOUNT FIXTURE: LOW PROFILE WRAP-AROUND FLUORESCENT WITH 2-32W T8 TUBES, MULTIVOLTAGE PROGRAMED START ELECTRONIC BALLAST	LITHONIA SERIES DMW CAT#DMW 232120GEB10RS
11	1	ALARM BEACON: RED 120VAC NEMA 4X	FEDERAL SIGNAL SERIES LP3
12	3	TIME DELAY RELAY (TDPU): 0.3-30 SEC, 120V, DPDT SOCKET TYPE	SQUARE D "9050JCKS2V20"
13	1	JUNCTION BOX: 12"X14"X6" NEMA 4	

GENERAL NOTES:

1. FOR ELECTRICAL LEGEND, SYMBOLS & GENERAL NOTES SEE DRAWING E-0001.

"NOT FOR CONSTRUCTION" 60% REVIEW

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
-	-	-	-	-	-	-	-	-	-

ZERO LIQUID DISCHARGE SUBPROJECT

ELECTRICAL BILL OF MATERIALS SHEET 1

BLDG 181, 182, 183 TA-52

DRAWN MM | DESIGN AD | CHECKED JF | DATE

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Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET E-7002 OF

CLASSIFICATION U | REVIEWER | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV A

Plotted By: MUNTEANA Plot Date: 7/8/2011 FILE NAME: E-7002.DWG

22542

ENCLOSURE 3
Radioactive Liquid Waste Treatment Facility
Project 100761 (RLWTF-UP)
ZLD Subproject
July 13, 22011

ENV-RCRA-11-0136
LAUR-11-11041

Los Alamos
NATIONAL LABORATORY
Los Alamos NM 87545

60% Design Package: Drawings, Specifications, Calculations

UNCLASSIFIED

"Enclosure 3_CD_Design Specifications" file

ZERO LIQUID DISCHARGE SUBPROJECT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

100761-11-000090_Specs

60% Design Submittal

Specifications, Calculations, Test and Inspection Plan, Master Document List, and Field Change Notice Criteria Document

July 13, 2011

Prepared For:

ECC
1640 Cole Boulevard
Building 21, Suite 350
Lakewood, CO 80401

Prepared By:

BURNS AND ROE ENTERPRISES
800 KINDERKAMACK ROAD
ORADELL, NJ 07649

Table of Contents

This submittal book contains the following documents:

SPECIFICATIONS

FOR

ZERO LIQUID DISCHARGE SUBPROJECT

AT THE

LOS ALAMOS NATIONAL LABORATORY

PROJECT IDENTIFICATION NUMBER 100761

TECHNICAL AREA TA-52

100761-11-000090

PREPARED BY

BURNS AND ROE ENTERPRISES
800 KINDERKAMACK ROAD
ORADELL, NJ 07649

1.7 Management Level ML-1 ☐ ML-2 ☐ ML-3 ☒ ML-4 ☐

1.8 Nuclear Functional Classification SC ☐ SS ☐ DID ☐ Not Safety Related ☒

	Name	Signature	Date
1.9 Submitted by:			
1.10 LANL Acceptance			

1.11 Derivative Classifier Review

Classification: UCNI ☐ OUO ☐ Classified ☐ Unclassified ☒

Name	Z Number	Signature	Date

: 04926

ZERO LIQUID DISCHARGE SUBPROJECT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

TECHNICAL SPECIFICATION 02 3000

GEOTECHNICAL INVESTIGATION

Prepared For:

ECC
1640 Cole Boulevard
Building 21, Suite 350
Lakewood, CO 80401

Prepared By:

BURNS AND ROE ENTERPRISES
800 KINDERKAMACK ROAD
ORADELL, NJ 07649

NEAL A. SCHLENDORF NEW MEXICO 16186 LICENSED PROFESSIONAL ENGINEER

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: 04927

TECHNICAL SPECIFICATION 02 3000

GEOTECHNICAL INVESTIGATION

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SUMMARY OF WORK

1. SCOPE

This Section of the Specification provides a brief description of the Project and the general nature of the Work required by the Specification.

Complete requirements are provided in the remainder of this Technical Specification. The Drawings listed herein shall be considered a part of this Specification.

Drawing No.	Title
SKC-1020	Boring Location Plan
SKC-1000	Site Plan

2. IDENTIFICATION OF THE PROJECT

The Work to be performed is for the Owner, Los Alamos National Laboratories (LANL), Zero Liquid Discharge Subproject (ZLD). The ZLD Project consists of two portions: a) concrete evaporation tanks, including a pump house and electrical utility poles and b) a length of direct buried pressurized transfer piping.

The tank portion of the Project is located on a site of approximately 1.0-acre, within Technical Area (TA)-52 of the LANL property. This portion of the project is located along the north side of Puye Road, bounded by the road to the south, and steep drop-off in grade and buried electrical duct bank to the north. Tanks will be surrounded by gravel surfaced driveway.

The transfer piping will be routed west from the proposed tanks located in TA-52, along the road toward the location of the RLWTF facility, located in TA-50. The total length of buried piping is approximately 3500 linear feet.

3. WORK COVERED BY THE SPECIFICATION

The Specification requires that the Lower Tier Subcontractor (LTS) furnish and perform the following Work associated with the Geotechnical Investigation for the proposed Project:

- Obtain all applicable permits
- Adhere to Project Integrated Work Document (IWD)
- Survey boring locations and elevations
- Perform test borings at locations indicated
- Perform drilling and sampling
- Perform field electrical resistivity tests
- Install piezometers (as necessary)
- Repair and restore all disturbed areas
- Perform laboratory testing on soil samples collected
- Prepare a Report providing Geotechnical Engineering parameters and recommendations for foundation design and construction as specified herein

4. SITE INSPECTION

Prior to submitting its Bid, LTS shall visit the site of the proposed Work and shall familiarize itself, in detail, with the extent of the Work to be performed; including the existing and anticipated conditions and difficulties that might affect execution of the Work.

5. PERMITS

The LTS shall be responsible for obtaining all necessary permits, including preparation of application forms, submission, and all costs and fees associated with the permits.

6. STORAGE AND LAYDOWN

Storage and laydown area(s) shall be as designated by Owner.

7. RESTRICTIONS

All Work shall be performed in accordance with the applicable Safety Standards of the Project site.

Prior to any drilling, the LTS shall locate all existing utilities within and adjacent to the Project site. Location of utilities shall be marked by the LTS.

The LTS shall perform the Work with minimum interference to the existing roads, traffic, and adjacent occupied premises. Materials and equipment shall not be placed or stored in the roads or passage ways.

The LTS shall take necessary measures to prevent tracking of sediment and dirt onto adjoining paved areas and public streets by construction equipment and vehicles. The LTS shall clean and/or restore all areas where sediment and dirt are tracked or otherwise conveyed beyond the Work area. Truck/vehicle tires shall be hosed down prior to leaving the Work area.

The LTS shall confine all activities and vehicle movement to within the area(s) designated by Owner.

8. COORDINATION

The LTS shall coordinate all site access requirements and Work with the Owner.

9. GEOTECHNICAL INVESTIGATION REQUIREMENTS

The Geotechnical Investigation shall be performed in accordance with this Technical Specification, Division 2, Section 7151, and the requirements specified hereinafter.

9.1 As a minimum, the LTS shall perform test borings at the locations and to the depths indicated on the Contract Drawings, or as required by the LTS, based on its experience, to provide optimum foundation recommendations in the Final Geotechnical Report.

9.2 The LTS shall retrieve samples (split spoons or Shelby tubes) at the following depths: continuously for the first ten feet, and at five foot intervals, thereafter.

9.3 The required number and type of laboratory tests are not specified in the Geotechnical Investigation Specification. The LTS shall develop a laboratory test program, and shall identify the number and type of tests required to establish geotechnical design criteria and develop foundation recommendations for design and construction of the proposed Project. The LTS shall include the cost of all laboratory tests in its Bid price.

10. REPAIR OF DISTURBED AREA

All areas disturbed by the LTS shall be restored to the original conditions existing prior to the start of Work.

11. GEOTECHNICAL DESIGN CRITERIA

11.1 The LTS shall furnish geotechnical criteria for the design of foundations and related subgrade preparation for the following items of construction:

Evaporation Tanks
Pump House
Electrical Utility Poles
Direct Buried Pressurized Piping

11.2 The anticipated type and size of major structure/equipment foundations, and the approximate foundation loads are as specified below:

STRUCTURE	FOUNDATION SIZE	APPROX. LOAD	SETTLEMENT LIMIT	
			TOTAL	DIFFERENTIAL
Evaporation Tanks	480'x70' slab on grade	0.5 ksf	1 in.	1/2 in./30ft
Pump House	10'x20' pad	1 ksf	1 in.	1/2 in./30ft
Electrical Poles (~40' high, wood)	1'- 2'dia.	1 ksf	1 in.	-

11.3 The LTS shall provide recommendations for construction practices that should be implemented for conditions encountered at the site.

12. GEOTECHNICAL INVESTIGATION REPORT

12.1 The LTS shall prepare and submit a Draft Geotechnical Report to the Owner for review, as an electronic file (in Adobe pdf format). Owner will provide comments within five working days. The LTS shall resolve the comments in its Final Geotechnical Report.

12.2 The LTS shall submit three copies (two bound, one unbound) of the Final Geotechnical Report. The Final Geotechnical Report shall be signed and sealed by a Professional Engineer licensed in the State of New Mexico. The LTS shall also provide an electronic file (in Adobe pdf format) of the Final Geotechnical Report.

12.3 The Geotechnical Report shall, as a minimum, contain the following information:

- Introduction
- Regional geology and site geology
- Site topography, drainage, vegetation, and existing structures
- Subsurface exploration procedures
- Soil resistivity test procedure & report
- Laboratory testing program
- Subsurface conditions and potential geological hazard
- Ground water conditions and design depth of ground water table including recommended tank wall protection
- Foundation depths based on applicable building codes, based on subsurface conditions or based on frost depth, whichever is

more stringent

- Recommendations for general site work including excavation, backfill (general and structural, including re-use of excavated material), dewatering and equipment recommended for each task
- Recommendations for design of temporary excavation support and soil embankments for open pit and trenching, including side slope ratio
- Recommendation for trench bedding and electrical pole installation
- Recommendations for acceptable fill material including density, Liquid Limit, Plasticity Index and gradation, moisture content, lift thickness and compaction requirements in terms of ASTM D1557
- Seismic design parameters in accordance with applicable codes, regulations and Owner's standards. Include identification of the Seismic Site Class.
- Recommendations for foundation systems including allowable bearing pressure (net bearing pressure), modulus of subgrade reaction, expected settlement of tank slab and pad, concrete/steel corrosion concerns, excavation and/or backfill requirements, sub-base preparation
- Recommendations for active, passive and at-rest lateral soil pressure for design of below-grade tank walls, including angle of friction, sliding friction factor and factors of safety. Include recommendations for lateral soil pressure due to seismic motions and for groundwater pressure.
- Recommendations for driveways including required excavation and/or backfill, compaction, and gravel surface gradation
- Boring location plan
- Boring logs (must be typed)
- Laboratory test results
- Any other pertinent information deemed necessary for the intended design including any special recommendations for earthwork construction and schedule impact, rough grading, site preparation, equipment access and operation.

12.4 The Geotechnical Report shall be formatted in accordance with Owner's standards as follows:

- Title Page - State the nature of the investigation, the project it is being performed for, the Technical Area(s) affected, the organization that it is being performed for (LANL), prepared by (Organization and Geotechnical Engineer) and approved by (Responsible Engineer). The seal of the Responsible Engineer shall be placed on this page.
- Table of Contents - Include report sections and appendices
- Summary of Conclusions - Executive summary listing the conclusions reached through the investigation
- Introduction - Describe the purpose of the investigation,

including a description of the facilities to be located at that site. Also include a description of any existing facilities, known utilities and other structures/items which could be affected by the Work.

- Site Description: Describe the site along with existing buildings, surface drainage, trees, vegetation, applicable elevation information, top soil, man-made fills, undisturbed tuff, and general description of the underlying tuff.
- Conclusions and Recommendations: Detailed conclusions and recommendations made in accordance with this specification.
- Appendix A: Location of the area investigated in terms relevant to the project. This may include sketch maps or aerial photos of which the test pits, boreholes and sample areas are located as well as geomorphological data relevant to the determination of the various soil and rock types. Such data includes elevation contours, streambeds, outcroppings, existing and planned structures and utility locations.
- Appendix B: Log of test borings and pits, including laboratory test results of each
- Appendix C: Results of in-situ testing accomplished
- Appendix D: Calculations to support conclusions
- Appendix E: Recommended Specifications, field control requirements, etc.
- Appendix F: Results of the soil resistivity measurements in accordance with ASTM G57.
- Appendix G: Quality Control plan implemented on the project

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DIVISION 02
SECTION 7151

SUBSURFACE INVESTIGATION

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SUBSURFACE INVESTIGATION

1. SCOPE

This Section of the Specification defines the requirements for subsurface investigation.

2. GENERAL REQUIREMENTS

2.1 Work to be Provided

The LTS shall complete the following Work, as shown on Contract Drawings and specified herein:

Provide all surveys to locate the Work specified

Perform boring and drilling as specified

Prepare boring logs

Perform soil resistivity tests

Install piezometers (as necessary)

Furnish all laboratory testing and testing services

Furnish all submittals required by this Section of the Specification.

2.2 Applicable Publications

The latest edition and addenda of the following publications in effect on the date of Contract Award are part of this Specification, and where referred to by title or designation only, are applicable to the extent indicated by the specific reference:

American Society for Testing and Materials (ASTM)

D1586	Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils
D1587	Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes

D2113	Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation
D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D2488	Standard Practice for Description and Identification of Soils (Visual—Manual Procedure)
D3550	Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils
D4220	Standard Practices for Preserving and Transporting Soil Samples
D5079	Standard Practices for Preserving and Transporting Rock Core Samples
D5434	Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock
D5778	Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils
G57	Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

Additional Standards are listed in Table 1.

3. DETAILED REQUIREMENTS

3.1 General

3.1.1 The extent of, and access to, the Work area is indicated on the Contract Drawings. The LTS shall provide its own means, during performance of the Work, consistent with site conditions, for access to the locations where the Work is to be performed. The LTS shall be responsible for securing right-of-way across private, public, or government property over which access is required.

3.1.2 Locations of borings and piezometers shall be as shown on the Contract Drawings, unless otherwise directed by Owner. The LTS shall provide all surveying services necessary to locate borings and resistivity tests and to establish pertinent ground surface elevations. Horizontal tolerance for the locations of borings shall be 2 feet, unless otherwise approved by the Owner. Ground surface elevations shall be determined to a tolerance of 0.1 foot at the borings included in the Work.

3.2 Restrictions

3.2.1 The LTS shall exercise care to protect existing structures, and overhead and buried utility lines, shown on the Contract Drawings or discovered during performance of the Work.

3.2.2 The LTS shall investigate available clearance for its equipment passing, or operating, under overhead utility lines in the Work area. The LTS shall notify the Owner, with its Bid, of any operating or clearance restrictions that might affect its performance of the Work.

3.2.3 The LTS shall ascertain and comply with all applicable laws and regulations relating to its Work; including the requirements for plugging or otherwise preparing bore holes for abandonment.

3.3 Protection

The LTS shall exercise care so as not to disturb existing survey control monuments, benchmarks, utilities, and structures indicated on the Contract Drawings. Any damage shall be reported to the Owner, and shall be repaired immediately by the LTS as approved by the Owner. The existing underground utilities encountered by the LTS, not indicated on the Contract Drawings, shall not be disturbed and shall be called to Owner's attention when uncovered.

3.4 Sequence of Work

Owner reserves the right to require the LTS to perform specific borings in a specific order.

3.5 Personnel, Equipment, and Methods

3.5.1 The LTS shall furnish a competent drilling crew experienced in drilling test borings, and shall designate a Drilling Foreman on the job site at all times during drilling operations. The Drilling Foreman shall direct the LTS's personnel, and shall be authorized to accept, and act upon, any instructions from the Owner or its representative in accordance with this Specification. In addition, the LTS shall designate a Field Geotechnical Engineer or Engineering Geologist for oversight of drilling operations.

3.5.2 Equipment shall satisfy all requirements of ASTM D1586, ASTM D1587, ASTM D2113, and ASTM D5778, as applicable.

3.5.3 Equipment and methods to be used by the LTS shall be subject to approval by the Owner or its representative before the Work is started.

3.6 Obstructions

The LTS shall carry borings through, or past, boulders or other obstructions, which may be encountered. For payment purposes, rock will be considered to have been reached when materials, in the opinion of Owner or its representative, cannot be penetrated by chopping bit or by any means other than by diamond bit drilling.

3.7 Borings

3.7.1 General

3.7.1.1 All drilling, field testing, and sampling operations shall be performed under the direction of the Owner or its representative in accordance with ASTM D1586, ASTM D1587, ASTM D2113, and ASTM D5778, as applicable.

3.7.1.2 Methods for advancing borehole shall be as required to obtain satisfactory samples as approved by the Owner or its representative.

3.7.2 Boring Requirements

The number, location, sampling depths, and the requirements for each boring, are indicated on the Contract Drawings. Modifications to the indicated information may be made, by Owner or its representative, in the field as the Work progresses. The Owner reserves the right to increase or decrease the quantity of any particular item of Work. If such changes in items of Work or quantities thereof are made, Contract completion time will be adjusted accordingly.

3.7.3 Drilling Procedure

3.7.3.1 Drilling shall be performed in such a manner, and at such speed, as to avoid disturbance of the soils to be sampled.

3.7.3.2 Bore holes shall be drilled with hollow stem augers. Should groundwater be encountered requiring bore hole stabilization with drilling fluid, revert or bentonite drilling mud shall be used.

3.7.3.3 Driller shall keep a full head of drilling fluid in the bore hole at all times, and shall replace the drilling fluid as the tube is withdrawn. When very soft, cohesive, or water-bearing granular soils are encountered, the borehole shall be maintained full of water, or at an elevation higher than the ground water level, before sampling to prevent the possibility of soil flowing up in the casing.

3.8 Standard Penetration Test

3.8.1 Standard Penetration Test shall be performed in accordance with ASTM D1586, except as specified hereinafter.

3.8.1.1 If 50 blows on the split-barrel sampler result in less than one inch of penetration, it shall be considered as refusal. If the boring is to extend to depths beyond the point of refusal, rock coring methods shall be used.

3.8.1.2 In hard driving, the penetration obtained by driving the sampler using 100 blows for a distance less than six inches may be reported in lieu of the blow count for six inches.

3.8.2 The selection of the type of split spoon sampler and support equipment to be used at individual sampling elevations shall depend on the soil condition at the sampling elevation and the requirements for sampling, and shall be subject to approval by the Owner or its representative. The LTS's equipment shall be capable of obtaining samples acceptable to the Owner. The LTS shall use a split-spoon sampler 24 inches long, unless otherwise approved by the Owner or its representative. In no case shall the sampler be driven a distance greater than the chamber.

3.8.3 Soil sampling shall be performed at the intervals shown on the Contract Drawings, and at every stratum change, or more frequently as required by the Owner or its representative. Locations, sequence, and type of procedure shall be determined by the Field Engineer prior to the start of any boring, in accordance with the instructions provided by the Owner or its representative.

3.8.4 Samples shall be preserved and transported in accordance with ASTM D4220, and as approved by the Owner or its representative.

3.9 Rock Coring

3.9.1 In the event rock is encountered during boring operation, rock coring shall be performed as specified herein.

3.9.2 For payment purposes, rock shall be as defined in 3.6. Boulders, which are greater than 24 inches thick and penetrated by coring, will be considered rock for payment purposes, provided core recovery is more than 50 percent of the depth of core.

3.9.3 If feasible, soft or decomposed rock shall be sampled with a driven sampler.

3.9.4 Borings in bedrock or in very dense cemented soils, which cannot be sampled with the standard split-barrel, shall be cored by the diamond drill method in accordance with ASTM D2113. Borings encountering rock need not extend beyond 20 feet into rock stratum.

3.9.5 In the event that during coring operations there is a sudden increase in the drill penetration rate, the coring tool shall be immediately withdrawn from the hole and an attempt shall be made to sample the core using a split–barrel sampler. Drilling shall be continuous in runs not exceeding five feet unless approved by the Owner or its representative; runs shall be of such length, depending on the nature of the rock encountered, as to assure maximum core recovery. Where soft or broken rock is anticipated, the LTS shall reduce the length of runs to minimize core disturbance.

3.9.6 Rock coring shall be performed using an "NXM" double-tube core barrel, or as approved by the Owner or its representative. The core barrel shall be capable of obtaining satisfactory cores with at least 70 percent recovery of materials that would normally produce 70 percent recovery, as determined by the Owner or its representative.

3.9.7 Rock coring shall be performed at the depths indicated on the Contract Drawings, or as deemed necessary by the Field Geotechnical Engineer or Owner during boring operation.

3.9.8 All core samples shall be protected from freezing, excessive heat, and disturbance until tested. Samples shall be preserved and transported in accordance with ASTM D5079.

3.10 Undisturbed Test Samples

3.10.1 Undisturbed test samples may be considered based on soil types encountered during exploration and based on recommendations of the Geotechnical Engineer and as approved by Owner. Samples shall be taken at depths indicated on the Contract Drawings, or as otherwise directed by the Owner or its representative. Samples taken shall be relatively undisturbed, taken in accordance with ASTM D1587, using three-inch (outside diameter) thin wall tubes (Shelby Tubes). Alternatively, samples may be taken in accordance with ASTM D3550, using a thick walled, ring lined split-barrel sampler. Undisturbed samples acceptable for payment shall have a minimum recovery of 95 percent, unless otherwise approved by the Owner or its representative. Samples should show no significant visual disturbance.

3.10.2 If an acceptable sample cannot be obtained on the first attempt in any particular stratum, the LTS shall make a second attempt and, if still unsuccessful, further attempts, to obtain an acceptable sample shall be made until the Owner or its representative directs the LTS to discontinue.

3.10.3 Immediately upon removal from borehole, bottom of sample tube shall be covered by a plastic cap. The base of the sample shall then be supported and the sample maintained in an upright position until recovery measurements have been made and the top of the tube cleaned and sealed. The ends of the tube shall be closed with tight-fitting metal or plastic caps which shall be secured in place with friction tape and sealed with wax.

3.10.4 All samples shall be protected from freezing, excessive heat, and disturbance, and shall remain in their tubes until tested. Samples shall be preserved and transported in accordance with ASTM D4220.

3.11 Ground Water Readings

3.11.1 Ground water readings shall be taken for each boring; when first encountered; daily prior to start of drilling, if the boring is not completed in one day; and, at completion of the boring.

3.11.2 In the event that ground water is encountered during boring operations screened well points/piezometers shall be placed in locations deemed appropriate by Field Engineer, Owner or its representative.

3.11.3 Any unusual conditions and elevations at which water under excess pressure is observed shall be recorded in the log. If water under excess pressure is observed, drilling shall stop and casing shall be extended above the ground surface in order to contain the flow of water. After allowing the water level to equalize, the height of water above the ground surface shall be recorded.

3.12 Not Used

3.13 Sample Identification and Records

3.13.1 The body and/or cap of each sample jar and each undisturbed tube shall be permanently and clearly labeled with the boring number, sample number, elevations (depths) between which the sample was taken, and number of blows it took to drive the sample 18 inches (in six-inch increments). If two or more materials are encountered in a sampler, separate jars shall be used for each material. Letters such as "A", "B", etc., shall be added to the sample number on each such jar to identify different materials. The Shelby tubes containing undisturbed samples shall be marked "TOP" and "BOTTOM". The LTS shall furnish the sample jars for soil samples; jars shall be of sufficient size to retain a representative sample.

3.13.2 Any rock cores obtained shall be stored in wood "core sample" boxes capable of holding approximately 20 feet of cores in one layer. Each row of core samples shall be separated from the adjacent row by a wood strip. Core samples from each run shall be separated by a wood block nailed in place. Core boxes shall be properly labeled on the top cover with project title, boring number(s), sample number(s), the elevations or depths between which each individual core run was taken, and the top and bottom of each run.

3.13.3 Cores shall be measured to determine the linear feet of core recovered. The percentage of core recovery (REC) for each run shall be indicated on the core box. Rock Quality Designator (RQD) shall be determined for each core run. RQD shall be given as a percentage (total length of core in pieces, four inches and longer, per length of run) and that information recorded on the core box.

3.14 Boring Logs

The boring logs shall be typed unless otherwise approved by the Owner, and shall contain not less than the information specified hereinafter.

3.14.1 Title Block

The title block shall include: project name and location, start and completion date of boring, name of driller and inspector, boring number, location, ground surface elevation, and groundwater levels as specified

3.14.2 Soil Samples

The soil sample description shall include at a minimum, the sample number, elevations and depths of sample, and standard penetration test values, including number of blows for each six inch increment. Soil samples shall be visually classified using the Unified Soil Classification System (UCS). The soil samples shall be classified in accordance with ASTM D2487 and ASTM D2488. In addition, soil description shall include: color, moisture, consistency or density, type and grain size distribution with percentages. Any unusual conditions or observations, including the presence of water, shall also be included on the boring logs.

3.14.3 Rock Samples

The rock core sample description shall include: core run number, elevations and depths of run, percent recovery and rock quality designation (RQD). The rock core classification shall include the type, color, hardness, weathering, discontinuities with locations (such as fractures, faults, joints, bedding planes, foliation, mineralization etc.) voids, open or filled cavities and groundwater conditions. Any unusual conditions or observations, including the presence of water, shall also be included on the boring logs.

3.14.4 Tuff Samples

Tuff samples shall be described in boring logs in a similar manner as outlined for Soil and Rock Samples, using the descriptors in Table 2.

3.15 Not Used

3.16 Not Used

3.17 Site Cleanup

3.17.1 After completion of the Work at each hole, the LTS shall promptly remove all debris, and other materials brought to the site, and restore the site, as nearly as possible, to its original condition.

3.17.2 All holes shall be plugged with cement grout, flush with the surface, after completion of the Work. If permitted by governing state and local agencies, bore hole cutting soil may be substituted for cement grout hole plug material.

3.17.3 Holes to be plugged with soil shall be backfilled and tamped in lifts not greater than 24 inches, for full height of bore hole, to prevent settling of soil.

3.18 Quality Assurance

The LTS shall employ such Quality Assurance measures as are necessary to ensure that the Work conforms to this Specification and to Owner's requirements.

4. INSTALLATION

4.1 General

The LTS shall perform all operations in accordance with the requirements specified in this Section of the Specification, and as required by the Owner or its representative.

4.2 Observation Wells and Piezometers

4.2.1 Should water be encountered in bore holes during site boring activities, observation wells and/or piezometers shall be installed by the LTS in locations deemed appropriate by Field Engineer, Owner or its representative according to site conditions and knowledge of the site. Appropriate screen size and filter material shall be selected for piezometer construction. Screens are to be located a minimum of five feet below the lowest ground water level observed at the site.

4.2.2 Any observation well or piezometer which is damaged or destroyed due to the LTS's operations shall be replaced by the LTS at no additional cost to the Owner.

4.2.3 The LTS shall, by adding or removing water from observation well risers, or by any other methods approved by the Owner or its representative, demonstrate that they are functioning properly.

4.2.4 The LTS shall record the elevation of the top of the piezometer or observation well.

5. TESTING

5.1 General

Testing shall be performed in accordance with the requirements specified herein, and as indicated on the Contract Drawings. Additional testing, if required, may be ordered by Owner as the Work progresses; requirements for such additional testing will be provided by Owner.

5.2 Laboratory Testing

Laboratory testing shall be performed as specified and as indicated in TABLE 1, *Schedule of Laboratory Testing.* Test data shall be reduced, plotted, calculated, and presented in a form acceptable to the Owner.

5.3 Field Testing

Field testing shall be performed as specified, as indicated on the Contract Drawings, or as otherwise required by the Owner, in accordance with applicable Contract Prices. Reports shall be typewritten and shall contain detailed test procedures, all field data, documentation, and a summary of results.

6. INFORMATION TO BE SUBMITTED

The LTS shall submit, with its Bid, details of materials and equipment to be used, including year and model.

The LTS shall submit field logs, on a weekly basis, as the Work progresses.

The LTS shall submit the Draft Geotechnical Report for review and comment by the Owner within one week after conclusion of field Work.

The LTS shall submit Final Geotechnical Report within one week after resolution of Owner's comments.

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TABLE 1

SCHEDULE OF LABORATORY TESTING

NOTE: The required number and type of laboratory tests are not specified. The LTS shall develop a laboratory test program, and shall identify the type and number of tests necessary to establish geotechnical design criteria and develop foundation recommendations for design and construction of the proposed Project.

ASTM No.	Title	Quantity of Tests
D422	Standard Test Method for Particle-Size Analysis of Soils	
D1140	Standard Test Methods for Amount of Material in Soils Finer Than No. 200 (75-µm) Sieve	
	(Gradation)	______
	(Gradation with Hydrometer)	______
	(Percent Passing No. 200 Sieve)	______
D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)	______
D2166	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil	______
D2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass	______
D2435	Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading	______
D2938	Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens	______
D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	______
D4546	Standard Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils	______
	pH of Soil (AASHTO T289), Sulfate Ion Concentration (AASHTO T290), and Chloride Ion Concentration (AASHTO T291)	______

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TABLE 2

TERMINOLOGY FOR IN-SITU TUFF

NOTE: The following terms shall be used when describing tuff samples.

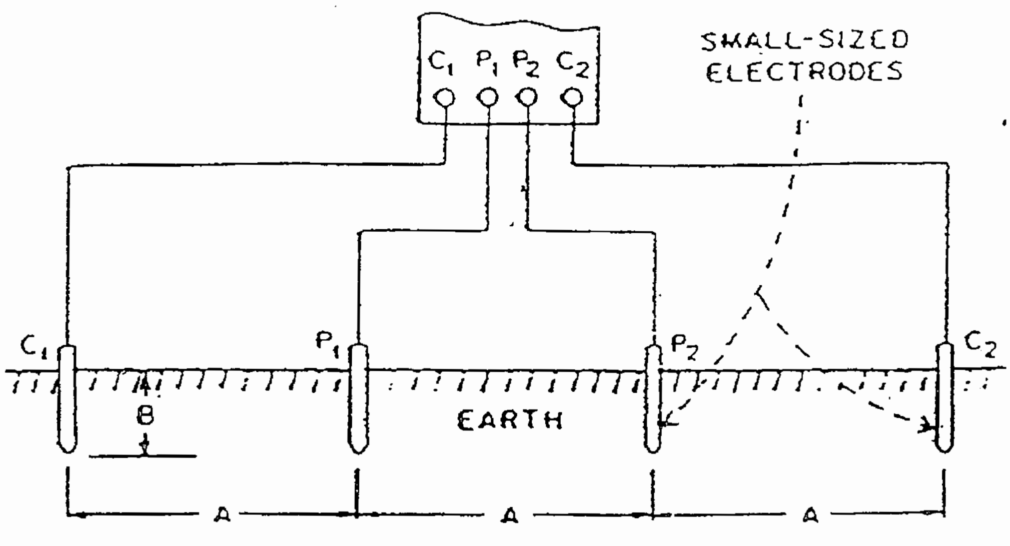
General Property	Descriptive Term	Visual of Physical Properties
Weathering	Very Weathered	Abundant fractures coated with oxides, carbonates, sulfates, mud, etc., through discoloration, rock disintegration, mineral decomposition
	Moderately Weathered	Some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition
	Slightly Weathered	A few stained fractures, slight discoloration, little to no effect on cementation, no mineral decomposition
	Fresh	Unaffected by weathering agents, no appreciable change with depth
Fracturing	Intensely Fractured Very Fractured Moderately Fractured Slightly Fractured Solid	Less than 1 inch spacing 1 inch to 6 inch spacing 6 inch to 12 inch spacing 12 inch to 36 inch spacing 36 inch spacing or greater
Stratification	Thinly Laminated Laminated Very Thinly Bedded Thinly Bedded Thickly Bedded	Less than 1/10 inch 1/10 inch to 1/2 inch 1/2 inch to 2 inch 2 inch to 2 feet More than 2 feet
Hardness	Soft	Can be dug by hand and crushed with fingers
	Moderately Hard	Friable, can be gouged deeply with knife and will crumble readily under light hammer blows
	Hard	Knife scratch leaves dust trace, will withstand a few hammer blows before breaking
	Very Hard	Scratched with knife with difficulty, difficult to break with hammer blows

TECHNICAL PROCEDURE FOR SOIL RESISTIVITY TESTING

Soil resistivity measurements shall be obtained at locations as shown on the Contract Drawings. At each of the test locations, measurements shall be obtained in the N-S and E-W directions at electrode spacing of 8, 12, 20, 30, 50, 70 and 100 feet. Where the test lines are restricted due to site conditions, the line or lines may be shifted to avoid obstructions.

Testing shall be performed in accordance with the Wenner Four-Electrode Method, as specified in ASTM G57. In brief, four probes are driven into the earth along a straight line, at equal distance "A" apart, driven to a depth B. The voltage between the two inner (potential) electrodes is then measured and divided by the current between the two outer (current) electrodes to give a value of resistance R. Where B is kept small compared to the distance between electrodes (A) the following formula applies:

$$\rho \text{ (soil resistivity)} = 2\pi \text{ A R}$$



"Four Terminal" Method of Measuring Earth Resistivity

The LTS shall also record the average soil temperature at one-half the probe depth and include in its Report.

Where a monument or any other known impediment to obtaining proper resistivity is present, the affected line shall be relocated as required to provide suitable clearance. Instrument error shall be no greater than 10% of the readings.

The instrument utilized for taking resistivity readings shall be one that is designed to minimize impact of extraneous currents in the ground from affecting readings.

Tests shall not be run if the test probes are inserted in frozen earth so that readings would be in error by more than 10% from those values that would be obtained without frozen earth.

The attached Soil Resistivity Testing Form shall be used to record resistance readings and meter multipliers for each "A" value and a copy of this Form shall be submitted as field data to support the calculated resistivity values.

The LTS shall calculate the earth resistivity values in ohm-meters for various readings taken and submit a completed Soil Resistivity Testing Form with all requested data and information for each of the test locations.

SOIL RESISTIVITY TESTING

Project Name: **Location:** **Prepared for:**	**Date:** **Signature of Tester:**

Instrument Manufacture/Model #:	Remarks:
Instrument Calibration Date:	
Soil Temperature:	
Air Temperature:	
Ground Water Table:	
Last 48 Hours Precipitation (inches):	
Ground Surface Elevation:	

Test Location	**Reading #**	**Spacing (feet) A**	**Resistance (ohm) R**	**Meter Multiplier M**	**Resistivity (ohm-m)**
Test Location R-N-S	1	8			
	2	12			
	3	20			
	4	30			
	5	50			
	6	70			
	7	100			
Test Location R-E-W	1	8			
	2	12			
	3	20			
	4	30			
	5	50			
	6	70			
	7	100			

Typical form for resistivity test

TECHNICAL SPECIFICATION 02 3000

GEOTECHNICAL INVESTIGATION

BID SCHEDULE

TECHNICAL SPECIFICATION 02 3000

BID SCHEDULE

1. Bidder Identification:

Name ____

Address ____

____

Telephone No.____

Contact ____

Authorized Signature____

2. The Bidder hereby declares that it has carefully examined all Contract Documents and hereby proposes to perform all Work in accordance with the enclosed documents for the prices quoted below and within the time schedule set forth herein.

3. Bidder acknowledges that it has had the opportunity to familiarize itself with the nature of the Work, locality and with all local conditions and federal, state and local laws, ordinances, rules and regulations under which the Work will be performed.

4. Bid Price

Firm fixed price to perform all Work including materials, equipment, tools, labor, transportation and other services required all in accordance with the Contract Documents for the following items of Work:

A Mobilization and Demobilization $____________

B Subsurface Investigation
Owner may delete one or more items at its option prior to award of Work

i) Surveying test borings and resistivity tests $____________

ii) Borings (soil drilling)
(Total drilling = _______LF) $____________

iii) NX rock coring (as necessary)
(Total footage = ________LF) $____________

iv) Piezometers (as necessary) $______________
(Total footage = _________LF)

v) Grouting Bore holes (as necessary in accordance w/ Owner)
(Total footage = _________LF) $______________

vi) Resistivity tests $______________

vii) Field engineer/engineering geologist $______________
(______________/Day(s))

viii) Laboratory testing $______________
(Tests identified in Item 7)

x) Geotechnical Engineering Report $______________

TOTAL FIRM FIXED PRICE $______________

5. Schedule:

Authorization to proceed: ______________

Complete on-site Work: ______________

Draft report for review:
(As a minimum, foundation recommendations must be submitted for review prior to issuance of final report). ______________

Final report: ______________

6. Unit Prices

Owner may add to or deduct from the scope of Work identified in the drawings and specifications, or the existing conditions may require a change in the scope of Work. The LTS shall provide unit prices for the following items of Work, which Owner will use to change the Contract amount for the change in the scope of Work recommended by the LTS and authorized by Owner.

a) Soil drilling with continuous SPT's or Shelby tubes $__________/LF

b) Soil drilling with SPT's or Shelby tubes at 5 foot intervals $__________/LF

c) Additional SPT's $__________/Each

d) Additional undisturbed samples (Shelby tubes) $__________/Each

e) NX rock coring $______/LF

f) Backfilling boreholes with cement grout $______/LF

g) Piezometers $______/LF

h) Resistivity test $______/Each

i) Field oversight by Geotechnical Engineer $______/Day

j) Standby (Owner caused delay) $______/Hour

k) Laboratory Testing

The LTS shall provide unit prices for the laboratory tests listed in Item 7. In addition, the LTS shall furnish, with its Bid, its own schedule of fees for laboratory tests not listed below.

i) Particle size analysis (ASTM D422) and Soils finer than No 200 sieve (ASTM D1140)
   - Gradation $______/Each
   - Gradation with hydrometer $______/Each
   - Percent passing No. 200 sieve $______/Each

ii) Modified Proctor (ASTM D1557) $______/Each

iii) Unconfined compression (ASTM D2166) $______/Each

iv) Natural moisture content (ASTM D2216) $______/Each

v) Consolidation test (ASTM D2435) (To include 8 load increments, 1 unload/reload cycle, unit strain plot) $______/Each

vi) Triaxial Compression, unconsolidated, undrained (ASTM D2850) $______/Each

vii) Unconfined compressive strength of rock (ASTM D2938) $________/Each

viii) Liquid limit, plastic limit, and plasticity index (ASTM D4318) $________/Each

ix) Swell test (ASTM D4546) $________/Each

x) Chemical test (AASHTO T-289,290,291) pH, sulfate and chloride $________/Each

7. Schedule of Laboratory Testing

ASTM #	ASTM Title	No. of Tests
D422	Standard Test Method for Particle-Size Analysis of Soils	______
D1140	Standard Test Methods for Amount of Material in Soils Finer than No.200 Sieve	
	Gradation	______
	Gradation with Hydrometer	______
	% Passing No. 200 Sieve	______
D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)	______
D2166	Standard Test Method for Unconfined Compressive Strength of Cohesive Soils	______
D2216	Standard Method of Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass	______
D2435	Standard Test Methods for One-Dimensional Consolidation Properties of Soils	______
D2850	Standard Test Method for Unconsolidated, Undrained Strength of Cohesive Soils in Triaxial Compression	______
D2938	Standard Method for Unconfined Compressive Strength of Intact Rock Core	______

D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils	______
D4546	Standard Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils	______
	Chemical Testing (AASHTO T-289,290,291) pH, Sulfate Ion Concentration, and Chloride Ion Concentration	______

:04958

TECHNICAL SPECIFICATION 02 3000

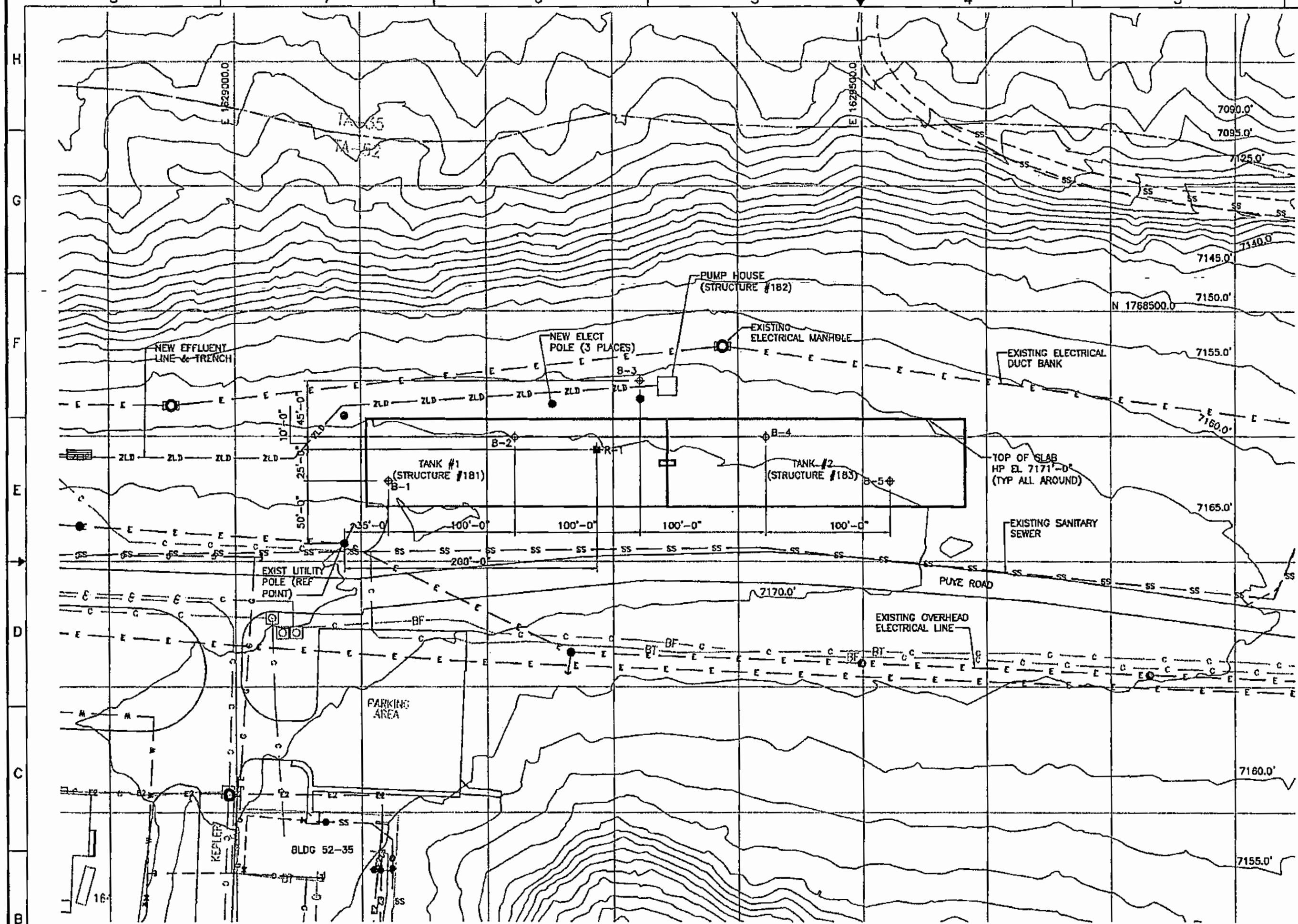
GEOTECHNICAL INVESTIGATION

CONTRACT DRAWING LIST

DRAWING NO.	REVISION	TITLE
SKC-1020	D	Boring Location Plan

REFERENCE DRAWING LIST

DRAWING NO.	REVISION	TITLE
SKC-1000	A	SITE PLAN



BORING LOCATION PLAN

1"=40'-0"

FOR INFORMATION ONLY

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.
2. FIELD WORK OF SUBSURFACE INVESTIGATION SHALL CONSIST OF ADVANCING BORINGS AND PERFORMING RESISTIVITY TESTS.
3. CONTRACTOR SHALL LOCATE BORINGS AND RESISTIVITY TESTS PRIOR TO INVESTIGATION AND SHALL DETERMINE GROUND SURFACE ELEVATION AT EACH TEST LOCATION.
4. CONTRACTOR SHALL VERIFY LOCATION OF UNDERGROUND UTILITIES ON-SITE, PRIOR TO START OF DRILLING OPERATIONS.
5. CONTRACTOR SHALL PERFORM SITE CLEARING, IF NECESSARY, IN ORDER TO ACCESS THE TEST LOCATIONS.
6. CONTRACTOR SHALL PROVIDE A FIELD GEOTECHNICAL ENGINEER OR ENGINEERING GEOLOGIST FOR OVERSIGHT OF FIELD OPERATIONS.
7. FOR TEST BORINGS, CONTRACTOR SHALL UTILIZE DRILLING METHODOLOGY THAT ALLOWS FOR OBTAINING GROUND WATER MEASUREMENT (HOLLOW STEM AUGER). PIEZOMETERS SHALL BE INSTALLED PER SPECIFICATION SHOULD WATER BE ENCOUNTERED IN ANY BORING.
8. BORINGS SHALL EXTEND TO A MINUMUM DEPTH OF 25' AND MAXIMUM DEPTH OF 35'. IF REFUSAL OTHER THAN OBSTRUCTIONS IS ENCOUNTERED AT SHALLOWER DEPTH, ROCK CORING IN ACCORDANCE WITH SPECIFICATION REQUIREMENTS SHALL BEGIN AT THAT DEPTH. OTHER BORINGS SHALL BE TERMINATED AT REFUSAL. REFUSAL IS DEFINED AS 50 BLOWS ON THE SPLIT-SPOON SAMPLER (ASTM D1586) RESULTING IN LESS THAN ONE INCH OF PENETRATION. BORING DEPTH MAY BE ALTERED IN THE FIELD BY OWNER'S REPRESENTATIVE.
9. SAMPLING SHALL BE CONTINUOUS FROM EXISTING GRADE TO A DEPTH OF TEN FEET (I.E. 0-2', 2-4', 4-6', 6-8', 8-10') AND THEREAFTER AT 5-FOOT INTERVALS STARTING FROM A DEPTH OF 10 FEET, CONTINUING TO THE BOTTOM OF EACH BORING (I.E. 10-12', 15-17', 20-22', ETC.). FOR GRANULAR SOILS, SAMPLING SHALL BE OBTAINED WITH A SPLIT-BARREL SAMPLER. FOR COHESIVE SOILS, SAMPLING SHALL CONSIST OF ADVANCING SHELBY TUBES. THE UNCONFINED COMPRESSIVE STRENGTH OF ALL RECOVERED COHESIVE SOIL SAMPLES SHALL BE DETERMINED IN FIELD WITH A POCKET PENETROMETER.
10. RESISTIVITY TESTING SHALL BE PERFORMED IN ACCORDANCE WITH THE WENNER FOUR-ELECTRODE METHOD. RESISTIVITY TEST PROBE SPACING SHALL BE AS INDICATED IN SOIL RESISTIVITY PROCEDURE OF SPECIFICATION. RESISTIVITY TEST SHALL BE PERFORMED IN BOTH NORTH-SOUTH AND EAST-WEST DIRECTIONS.
11. REFER TO TABLE 1 FOR REFERENCE UTILITY POLE, BORING AND RESISTIVITY TEST LOCATIONS.

TABLE 1

MARK	EAST	NORTH
POLE	1629086.98'	1768314.28'
B-1	1629121.98'	1768364.28'
B-2	1629221.98'	1768399.28'
B-3	1629321.98'	1768444.28'
B-4	1629421.98'	1768399.28'
B-5	1629521.98'	1768364.28'
R-1	1629286.98'	1768389.28'

LEGEND

⊕ B-1 BORING LOCATION

✚ R-1 RESISTIVITY TEST LOCATION

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
D	6/2/2001	-	-	FOR INFORMATION ONLY	JA	BU	-	-	-
C	5/27/2011	-	-	FOR INFORMATION ONLY	JA	BU	-	-	-
B	5/19/2011	-	-	FOR INFORMATION ONLY	RD	BU	-	-	-
A	5/12/2011	-	-	FOR INFORMATION ONLY	KC	BU	-	-	-

Burns and Roe Enterprises, Inc.

ZERO LIQUID DISCHARGE SUBPROJECT

BORING LOCATION PLAN

DRAWN K.CUSTER
DESIGN B. URGO
CHECKED
DATE

BLDG N/A TA-52

SUBMITTED

APPROVED FOR RELEASE JOSEPH BROPHY

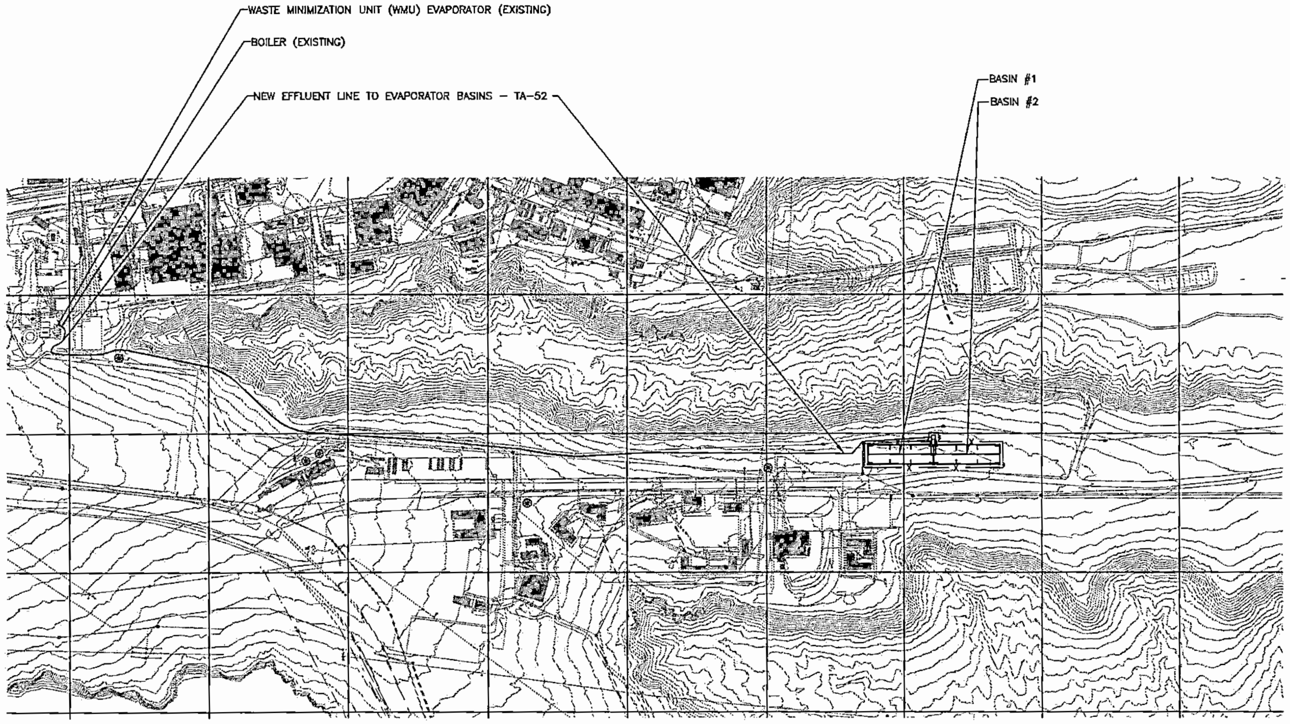
Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET SKC-1020 OF

CLASSIFICATION U | REVIEWER EDWARD ARTIGLIA | DATE

PROJECT ID 100761 | DRAWING NO C-55751 | REV D

FILE NAME: SKC-1020.DWG Plot Date: 6/2/2011



SITE PLAN

2000' 0 1000' 3000'
1000' 2000' 4000'
1"=3000'

GENERAL NOTES:

1. IF THIS SHEET IS NOT 24"X36", THEN IT IS A REDUCED SIZE PLOT. USE GRAPHIC SCALE ACCORDINGLY.

NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DSGN	CHKD	SUB	APP
–	–	–	–	–	–	–	–	–	–

Burns and Roe Enterprises, Inc.

LANL RADIOACTIVE LIQUID WASTE TREATMENT FACILITY (RLWTF)	DRAWN	K.CUSTER
	DESIGN	B. URGO
ZERO LIQUID DISCHARGE SITE PLAN	CHECKED	J. LANTRY
BLDG N/A TA-52	DATE	2-8-11

SUBMITTED PROJ_ENGIN | APPROVED FOR RELEASE PROJ_TEAM_LEADER

Los Alamos NATIONAL LABORATORY PO Box 1663 Los Alamos, New Mexico 87545

SHEET OF

CLASSIFICATION Classification | REVIEWER Reveeer | DATE Date

PROJECT ID | DRAWING NO SKC-1000 | REV A

Plotted By: CUSTERK Plot Date: 5/12/2011
FILE NAME: RLWTF-SKC-1000 SITE PLAN.DWG

SPECIFICATIONS

FOR

ZERO LIQUID DISCHARGE SUBPROJECT

AT THE

LOS ALAMOS NATIONAL LABORATORY

PROJECT IDENTIFICATION NUMBER 100761

TECHNICAL AREA TA-52

100761-11-000090

PREPARED BY

BURNS AND ROE ENTERPRISES

800 KINDERKAMACK ROAD

ORADELL, NJ 07649

1.7 Management Level	ML-1 ☐	ML-2 ☐	ML-3 ☒	ML-4 ☐
1.8 Nuclear Functional Classification	SC ☐	SS ☐	DID ☐	Not Safety Related ☒

	Name	Signature	Date
1.9 Submitted by:			
1.10 LANL Acceptance			

1.11 Derivative Classifier Review

Classification: UCNI ☐ OUO ☐ Classified ☐ Unclassified ☒

Name	Z Number	Signature	Date

: 04962

ZERO LIQUID DISCHARGE SUBPROJECT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

TECHNICAL SPECIFICATION 03131- E 26 4100

Facility Lightning Protection

Prepared For:

ECC/LANL
1640 Cole Boulevard
Building 21, Suite 350
Lakewood, CO 80401

Prepared By:

BURNS AND ROE ENTERPRISES
800 KINDERKAMACK ROAD
ORADELL, NJ 07649

Revision	Date	Issued For	Prepared By Print/Sign/Date	Technical Approval Print/Sign/Date	Project Approval Print/Sign/Date
A	**6/28/2011**	**Review 60% Submittal**	**Jacob Filak**		

: 04963

SECTION 26 4100

FACILITY LIGHTNING PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install lightning protection system including the following:

1. Integral air terminal system to protect the structure.
2. Interconnecting lightning protection conductors.
3. Lightning protection grounding electrode system.
4. Surge arresters on all conductors entering the structure.

1.2 LANL PERFORMED WORK

A. LANL will inspect the lightning protection system for acceptance.

1.3 PERFORMANCE REQUIREMENTS

A. Protect the entire building including roof projections, chimneys, roof mounted equipment, associated exposed structures, electrical services, antennas, alarm services, and telecommunications services.

B. Design system based on a 150 ft lightning striking distance as defined in NFPA 780.

C. Design grounding system to achieve a ground resistance of not over 25 ohms.

1. Test reports for all inspection and testing required by this Section.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 780 Standard for the Installation of Lightning Protection Systems and UL 96A Installation Requirements for Lightning Protection Systems.

B. Engage a qualified installer to design and install the lightning protection system. Installer shall have either a current LPI Master Installer certification or current UL listing (Category OWAY) for Lightning Protection Installation. The installer shall have successfully completed not less than 5 lightning protection installations of similar scope to this project.

C. LANL will inspect the lightning protection system for acceptance in accordance with NFPA 780 and UL 96A.

D. Provide products that are NRTL listed for lightning protection use.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installation of lightning protection system with the installation of other building systems and components, including electrical wiring, supporting structures and building materials, and metal bodies requiring bonding to lightning protection systems.

B. Coordinate inspections so lightning protection conductors and bonding connections will be inspected and photographically documented before being covered with concrete or other building materials.

1.6 RECEIVING, STORING, AND PROTECTING

A. Receive, store, protect, and handle products according to NECA 1 Standard Practices for Good Workmanship in Electrical Construction.

B. Handle conductors to prevent nicking, kinking, gouging, flattening, or otherwise deforming or weakening conductor or impairing its conductivity.

PART 2 PRODUCTS

2.1 LIGHTNING PROTECTION MATERIAL

A. Provide lightning protection materials and components that conform to NFPA 780 and UL 96 Standard for Safety for Lightning Protection Components.

B. Provide lightning protection materials that are galvanically compatible with each other and with surfaces on which they are mounted or which they contact. In general use copper conductors and bronze fittings; use aluminum conductors and fittings only where required for galvanic compatibility.

1. Metals acceptable for contact with copper include copper, nickel, brass, tin, lead, stainless steel, and Monel.
2. Metals acceptable for contact with aluminum include aluminum, magnesium, zinc, galvanized steel, stainless steel, lead, and wrought iron.
3. Provide conductors with protective coatings or oversize conductors where unusual conditions exist which would cause corrosion of conductors.

C. Air terminals:

1. Copper: Provide 1/2 inch-diameter, rounded-tip, solid-copper air terminals.
2. Aluminum: Provide 5/8 inch-diameter, rounded-tip, solid aluminum air terminals.
3. Air terminal tips shall have a tip radius of curvature of from 3/16 inch to 1/2 inch.
4. Provide a cast base for each air terminal that matches the air terminal material, has a bolted pressure type cable connector, will support the terminal in a vertical position, and is suitable for the surface to which it will be attached.

D. Conductors:

1. Copper Main Conductor: Provide copper cable with minimum 17 AWG strand size and a minimum cross sectional area of 57,400 circular mils.
2. Aluminum Main Conductor: Provide aluminum cable with minimum 14 AWG strand size and a minimum cross sectional area of 98,600 circular mils.
3. Copper Bonding Conductor: Provide copper cable with minimum 17 AWG strand size and a minimum cross sectional area of 26,240 circular mils.

4. Aluminum Bonding Conductor: Provide aluminum cable with minimum 14 AWG strand size and a minimum cross sectional area of 41,100 circular mils.

E. Provide bolted pressure type connectors; finger, crimp, or pressure saddle style cable connectors are not acceptable.

F. For installations on standing seam metal roofs provide air terminal bases and cable fasteners that clamp to the standing seams and are compatible with the roofing system and the lightning protection system materials.

G. Provide cast swivel couplings as required to install air terminals vertically.

H. For installations on membrane roofing or other surfaces that must not be penetrated provide attachments for air terminal bases and cable fasteners that do not depend on adhesive alone for proper performance.

1. Provide adhesives for cable fasteners and air terminal bases that are compatible with surface or roofing material to which bases or fasteners are to be attached.

2. Provide bases and fasteners that will stay in position and prevent overturning by using gravity or mechanical attachment.

I. Manufacturers: East Coast Lightning Equipment, Harger Lightning Protection, Thompson Lightning Protection.

2.2 GROUNDING SYSTEM MATERIAL

A. Ground Rods:

1. Provide NRTL listed ground rods as shown on the Drawings.

2. Furnish ground rods that comply with ANSI C135.30 with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core, approximately 10 feet long, 3/4 inches in diameter.

3. Manufacturers: Blackburn, Thomas & Betts, Harger

B. Ground Cable:

1. Provide bare stranded, soft temper copper cable that conforms to ASTM B8, Standard Specification for Concentric-Lay Stranded Copper Conductors.

2. Provide cable size as indicated on the Drawings or specified in this Section, 1/0 AWG minimum.

C. Ground Electrode Backfill Material:

1. Provide a bentonite clay or equivalent commercial ground enhancement backfill material for ground rods and cable type electrodes.

2. Backfill material, when at 300% moisture content (weight of water/weight of material) x (100), shall have a resistivity of approximately 250 ohm-cm and a pH of 8 to 10.

3. Manufacturers: WYO-BEN Inc, ERICO

D. Bolted Ground Connectors:

1. Provide NRTL listed copper alloy bolted connectors with silicon bronze hardware for making cable connections to pipes, ground rods, exposed structural steel, roof deck, and wall panels.

2. Manufacturers: Blackburn, Burndy, O.Z.

E. Exothermic Weld Connections:

1. Provide molds and welding material in kit form for exothermic weld connections.

2. Match mold and weld material to material types, shapes and sizes to be joined.

3. Manufacturer: ERICO Cadweld

F. Compression Grounding Connectors:

1. Provide NRTL listed wrought copper connectors, terminals and splices for making compression grounding connections on concentric lay ground electrode cable and bonding connections to reinforcing steel.

2. Furnish connectors that have been tested successfully according to the requirements of IEEE Std. 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

3. Provide hydraulic compression tools and dies that match the connectors.

4. Match connector and die size to material shapes and sizes to be joined.

5. Manufacturer: Blackburn, Burndy.

2.3 SURGE SUPPRESSORS

A. Provide surge suppressors for all power, control, and communications conductors entering the building.

PART 3 EXECUTION

3.1 EXISTING WORK

A. Existing lightning protection material and components that meet the requirements of this Section and are in good condition may be re-conditioned and re-used. Re-conditioning includes removal of adhesive, removal of corrosion, and wire brushing contact areas.

B. Inspect, test, and repair the parts of the existing lightning protection system on the structure that are to remain in service. Use test instruments that are capable of measuring within plus or minus 10 percent of the required reading and have current calibration. Provide certified test results and instrument calibration information to the LANL Subcontract Technical Representative (STR).

1. Make continuity tests of concealed parts of existing systems that may be re-used and are not available for visual inspection.

2. Perform continuity tests to verify that electric service(s), telecommunications service(s), antenna system grounds, and underground metallic piping systems are bonded to the existing lightning protection system.

3. Perform ground-impedance measurements of existing lightning protection grounds to verify that ground resistance is less than 25 ohms.

   a. Perform ground resistance measurements with the lightning protection ground system temporarily disconnected from all other grounding and piping systems.

   b. Use the "fall-of-potential" method in accordance with IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System. Use instrumentation specifically designed for ground impedance testing as defined in Section 12 of the above guide. Provide sufficient spacing of test electrodes so that the plotted curves flatten in the 62% area of the distance between the item under test and the current electrode. When sufficient spacing of electrodes is impractical for the "fall-of-potential" method, perform ground-impedance measurements using either the "intersecting curves method" or the "slope method", references 40 and 41 in IEEE Std. 81.

   c. If the lightning protection ground system resistance exceeds 25 ohms, add ground rods, plates, or other approved electrodes to obtain 25 ohms or less.

C. Visually inspect existing surge suppression devices on electrical services, electrical circuits, and communications, alarm, control, and antenna systems for indication of damage. Replace missing or damaged surge suppression devices.

3.2 EXAMINATION

A. Examine surfaces and conditions, with Installer present, for compliance with installation tolerances and other conditions affecting performance of the lightning protection system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION - GENERAL

A. Install lightning protection system according to NFPA 780, UL 96A, the NEC, as specified in this Section, and as shown on the Drawings.

B. Install lightning protection components according to manufacturer's written instructions.

C. Install air terminals on ridges, parapets, and around the perimeter of buildings with flat roofs at spacing not to exceed 20 feet. Install supplemental air terminals as required by and NFPA 780. Permanently and rigidly attach air terminals to prevent overturning. Install swivel adapters as required to position air terminals vertically.

D. On standing seam metal roofs use attachments for air terminal bases and cable fasteners that clamp to the standing seams.

E. On membrane roofing or other surfaces that must not be penetrated, attach air terminal bases and cable fasteners using materials and methods that do not depend on adhesive alone for proper performance. Coordinate with roofing material installer.

   1. Acceptable installation methods on membrane roofs include:

      a. Mechanical fastening to nailer blocks that are pre-installed by the roofing subcontractor. Coordinate locations with the roofing subcontractor.

      b. Use approved top-fill ballast pans, 6-inch diameter for air terminals and 3-inch diameter for cable fasteners, which are filled with structural-density concrete then attached with adhesive to the membrane roof.

2. Use adhesives that are recommended by manufacturer of the cable fasteners and air terminal bases and are approved by manufacturer of the roofing material. Prepare roof surface and apply adhesives according to manufacturer's instructions.

F. Install roof conductors so they will be visible for inspection and testing.

G. Install down conductors at locations compatible with the building structure and architectural design with consideration given to the location of ground connections.

1. Course exposed down conductors over the extreme outer portions of the exterior of the building, such as corners.

2. Install concealed down conductors on building structural columns. Make connections from roof conductors to down conductors on parapet walls; avoid using through-roof connectors.

H. Install an accessible down conductor disconnect in each down conductor except the one nearest the building electrical service entrance; use 4-bolt tubular splice fittings.

I. Cover down conductors that are subject to physical damage or displacement with Schedule 80 PVC conduit. Cover down conductors from grade level up to 6 ft above grade. Support conduit with conduit clamps spaced not more than 36 inches apart.

3.4 LIGHTNING PROTECTION GROUNDING ELECTRODE SYSTEM

A. Counterpoise Electrode: Install a counterpoise ring around the building or structure. Use minimum 1/0 AWG ground cable located 5 ft outside the building perimeter and at least 6 ft from any electrical system or communications system grounding. Install the counterpoise at least 3 ft below grade. Encase the counterpoise in a 2 inch envelope of ground electrode backfill material slurry.

B. Other Made Electrodes: Where it is not possible to install a counterpoise ring as the lightning protection ground, or the ground must be supplemented, install one or more ground rods located 5 ft outside the building perimeter and at least 6 ft from any electrical system or communications system grounding. Install ground rods in 6 inch diameter augered holes with at least 10 ft separation between rods. Backfill hole with a slurry of ground electrode backfill material.

C. Connect the counterpoise to the main grounding electrode ground bar located near the building electrical service entrance. Interconnections to electrical power, telephone, and piping systems will be made at the main grounding electrode ground bar.

3.5 LIGHTNING PROTECTION CONNECTIONS

A. Clean contact surfaces to which lightning protection connections are to be made. Remove non-conductive coatings such as paint, enamel, and oil film.

B. Use the following connection methods:

1. Use exothermic weld connections for underground or concealed connections of dissimilar materials.

2. Use exothermic weld or compression grounding connections for underground or concealed connections of like materials. Do not use compression grounding connectors for rope lay lightning conductor connections or for lightning protection ground rod connections.

3. Use exothermic weld or bolted connections for accessible connections.

4. Use high strength silicon bronze bolts, nuts, flat washers and toothed lockwashers for making bolted connections.

C. Tighten lightning protection connectors, screws and bolts in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with UL 486A and UL 486B. Use a calibrated torque wrench.

D. Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed.

E. Install exothermic welds in accordance with manufacturer's instructions and recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

F. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.

2. Make connections with clean bare metal at points of contact.

3. Make aluminum to steel connections with stainless steel separators and mechanical clamps.

4. Make aluminum to galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections involving dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

G. Protect lightning protection connections to prevent them from being painted or covered with material such as fire proofing or roofing adhesive.

3.6 FIELD QUALITY CONTROL

A. Use test instruments that are capable of measuring within plus or minus 10 percent of the required reading and have current calibration.

B. Test the lightning protection grounding electrode system using the “fall of potential” method. Make test at least 30 days after installation of the electrode and before any connections are made to the electrode. Verify that resistance to earth reading is 25 ohms or less. Supplement grounding electrode if resistance exceeds 25 ohms. Use test instruments that are designed specifically for earth resistance testing. Provide certified test results and instrument calibration information to the LANL STR.

C. Inspect and test the lightning protection system to determine:

1. That the system complies with the current requirements of NFPA 780.

2. That all required bonds are in place and are secure.

3. That all AC power lines, communications, and data lines that enter the facility have surge suppression devices that are properly installed and functional.

Take corrective action to correct deficiencies. Provide certified inspection and test results and instrument specifications and calibration information to the STR.

D. An inspection of the lightning protection system will be conducted by the LANL STR prior to system acceptance.

1. Notify the LANL STR 10 working days in advance of the expected completion of the lightning protection system installation. Inspection can be scheduled in parts or by area depending on the system and construction schedule.

2. Promptly correct all deficiencies as required by the LANL STR

END OF SECTION

SPECIFICATIONS

FOR

ZERO LIQUID DISCHARGE SUBPROJECT

AT THE

LOS ALAMOS NATIONAL LABORATORY

PROJECT IDENTIFICATION NUMBER 100761

TECHNICAL AREA TA-52

PUMP HOUSE

PREPARED BY

BURNS AND ROE ENTERPRISES

800 KINDERKAMACK ROAD

ORADELL, NJ 07649

100761-11-000090

1.7 Management Level ML-1 ☐ ML-2 ☐ ML-3 ☒ ML-4 ☐

1.8 Nuclear Functional Classification SC ☐ SS ☐ DID ☐ Not Safety Related ☒

	Name	Signature	Date
1.9 Submitted by:			
1.10 LANL Acceptance			

1.11 Derivative Classifier Review

Classification: UCNI ☐ OUO ☐ Classified ☐ Unclassified ☒

Name	Z Number	Signature	Date

ZERO LIQUID DISCHARGE SUBPROJECT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

SPECIFICATIONS, MECHANICAL

PUMP HOUSE

Prepared For:

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Revision	Date	Issued For	Prepared By Print/Sign/Date	Technical Approval Print/Sign/Date	Project Approval Print/Sign/Date
A	7/13/2011	60% Design Review	Stephen Stuhrke SPStuhrke	Al Cesnavicius A. Cesnavicius	Norman Lacy

01973

Design Professional Seal Mechanical	*Burns and Roe Enterprises, Inc. (BREI) Professional seal applies to the following specification sections:*
	M 1000 Pump House 01 2500 Substitution Procedures

: 04974

TA-52 ZERO LIQUID DISCHARGE SUBPROJECT

PUMP HOUSE

SUBCONTRACTOR SPECIFICATIONS INDEX

SECTION 01 2500

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 RELATED SECTIONS

A. 01 3300 Submittal Procedures

1.2 SUBSTITUTIONS

"Or approved equal" is always implied after a brand name, patented process or catalog number. The Subcontractor may substitute any brand or process approved as an equal by the specifying Architect/Engineer through the submittal process. The only exception is where "no substitution" is specified. See General Provision "Material and Workmanship".

A. Non-Structural Systems and Components, and Non-Building Structures

1. If the Subcontractor wants to substitute an "equal" architectural, mechanical or electrical system or component, or non-building structure, the component/structure should also be reviewed by the design structural engineer for anchorage and support.

    a. If and when approved, the design structural engineer shall make any necessary anchorage and support revisions to the construction specifications and drawings associated with the equal component/structure.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 01 2500 Rev. 1, dated April 14, 2008.

: 04976

PUMP HOUSE TECHNICAL SPECIFICATION M 1000

PART 1 GENERAL

1.1 Scope

A. Design, engineer, manufacture, furnish, and deliver a pre-engineered metal pump house or pumps enclosure to be mounted on customer provided slab foundation. Enclosure to withstand loads from wind, seismic forces, snow, ambient conditions, structural movement including thermally induced and to resist in-service use conditions that the enclosure will experience, including weather, without failure or visible deformation.

B. Provide technical direction of the installation of the pre-engineered pumps enclosure.

C. Furnish all documentation identified herein.

1.2 SYSTEM DESIGN CRITERIA AND PERFORMACE REQUIREMENTS

A. Applicable Publications:

The latest edition and addenda of the following publications in effect on the date of Contract Award unless otherwise noted are a part of this Specification and, where referred to by title or basic designation only, are applicable to the extent by the specific reference.

AAMA – American Architectural Manufacturers Association

AISC – American Institute of Steel Construction

AISI – American Iron and Steel Institute

ANSI – American National Standards Institute

ASME - American Society of Mechanical Engineers

ASTM – American Society of Testing and Materials

IBC – International Building Code 2006

IEEE – Institute of Electrical and Electronics Engineering

MBMA – Metal Building Manufacturers Association

NEC – National Electric Code

NEMA – National Electric Manufacturers Association

NFPA – National Fire Protection Association

US Department of Labor Code of Federal Regulations (CFR)

29 CFR 1910 – Occupational Safety and Health Act (OSHA)

State, County, and Local Codes

SSPC – Steel Structure Painting Council

B. Detailed Requirements:

1. The package pump house or pumps enclosure shall provide a weather proof enclosure for both the Transfer Pump and the Spray Pumps for the LANL Radioactive Liquid Discharge Waste Treatment Facility (RLWTF) tanks as part of the Zero Liquid Discharge Subproject. The tanks, pumps enclosure, and support facilities will be located in Technical Area (TA) – 52 at the LANL facilities, Los Alamos, New Mexico.
2. Design each member to withstand stresses resulting from combinations of loads that produce the maximum stresses in that member
3. Use design loads or combination of loads as prescribed in MBMA's "Design Practices Manual" or as set forth herein, whichever is more demanding.

C. Site Design Conditions:

The site ambient conditions for the Pumps Enclosure are as follows:

1. Wind Loads

Wind loads shall be calculated in accordance with the criteria set forth in the International Building Code (IBC-2006), Chapter 16, and ASCE 7-05 using the following parameters:

Basic wind speed (3 second gust)	90 miles per hour
Importance Factor, I_w	1.0
Exposure	C

2. Seismic Loads

Seismic loads shall be calculated in accordance with IBC 2006. Analysis procedure shall be selected in accordance with the requirements of ASCE 7-05.

Occupancy Category	II
Seismic Importance Factor, I_E	1.0
Site Class	D (TBD per Geotechnical Investigation)

: 04978

SDS = SMS x 2/3 (0.2 second period) 0.75g

SD1 = SM1 x 2/3 (1.0 second period) 0.64g

Seismic Design Category D

Seller shall determine all other seismic parameters required for the design.

3. Snow Loads

Snow loads shall be in accordance with ASCE 7-05, figure 7-1. Design ground snow load is 16 psf.

Importance Factor, I_s 1.0

4. Ambient Condition

Outdoor: Winter Mean Design Dry Bulb Temperature = - 5° F

Summer Mean Design Dry Bulb/Wet Bulb Temperature = 89° F/60° F

Indoor: Design Minimum = 50° F

Design Maximum = 100° F

D. Design Life:

The design life of the pumps enclosure shall be thirty (30) years.

E. Design and Construction Features:

The Seller shall provide an enclosure for the RLWTF pumping systems and all accessories. The size of the pumps enclosure shall be by the Seller and shall be in accordance with all applicable codes, regulations, and standards. The pumps enclosure with all pump skids and equipment installed shall provide for easy access and maintenance of the equipment and devices located within.

The attached Pump Enclosure General Arrangement drawing, System P&IDs, and pump information provides general location information plus guidance on locations for various interface points. Seller shall provide specific interface location information for all interface points with the bid.

The pumps enclosure shall be self framing using the roof and walls as the primary structural support system. There shall be no interior columns within the pumps enclosure. The building shall have a 1-1/2 inch deep interlocking panel roof system. The metal roof construction shall be "Class 1" or "Fire Classified". The roof panels shall be attached to the wall cap with stainless steel fasteners.

The roof shall include gutters and down spouts at side walls matching building trim. All gutters and trim shall be a minimum 26 gauge, pre-painted, galvanized steel.

The interior of the walls shall be lined with 48 inch wide x 1-1/2 inch thick polyisocyanurate foam board faced with #019 patterned white metal on the exposed side. The interior liner shall be secured to the exterior metal panels with vertical PVC retainers. There shall be no metal to metal contact through the completed wall assembly and there shall be no exposed fasteners on the interior metal liners.

The liner system shall be furnished complete with base, top, and accessory trim. All PVC trim shall be self-extinguishing grade material having a flame spread rating of 25 or less.

The insulation core shall have an Underwriter Laboratory Rating of flame spread 25 or less, fuel contributed of 10 or less, and smoke developed 155-190 in accordance with UL 723 Testing Method. The void between the exterior wall panel and the liner shall be insulated with 3 inch thick unfaced fiberglass insulation. The "U" value of the assembled wall system shall be 0.05 Btu/hr ft^2 °F (maximum) when calculated using ASHRAE methods.

The metal ceiling system shall consist of 16 inch side interlocking panels of minimum 24 gauge embossed galvanized steel factory painted "Parchment." The ceiling system shall be supported at its perimeter by concealed angles and hook bolts. The ceiling system shall be furnished complete with all necessary connectors and fasteners.

Metal ceilings shall be insulated with 16 inch wide by 3 inch thick unfaced fiberglass insulation laid at right angles to the panel ribs. The "U" value through the finished ceiling section shall be a maximum of 0.09 Btu/hr ft^2 °F when calculated using ASHRAE methods.

Seller shall provide sufficient information for the Purchaser's design of the pumps enclosure building foundation and any other equipment not directly supported as part of the pumps enclosure.

F. Foundation design information shall include:

1. Total weight of pump enclosure under design and operating conditions.
2. Maximum loads on foundation separated into dead load, live load, wind load, seismic, etc.
3. Dynamic loads on foundation, as applicable.
4. Special foundation requirements including location of any required foundation penetrations.

G. Anchoring design information shall include:

1. Size (diameter), material, strength, and length of bolts

2. Bolt pattern and spacing

3. Bolt projection above top of base plate

The pumps enclosure shall be complete in every way necessary for satisfactory use for its intended purpose. As a minimum, the pumps enclosure shall include the systems, features, and accessories listed in this Specification section.

H. Mechanical/Electrical Requirements

1. A 480V, three phase, 60 Hertz service disconnect shall be provided to accept incoming electrical power. An enclosed starter rack with wire way shall be provided to distribute power to the pump motors and other 480V electrical loads and to the transformer feeding a 208V/120V circuit breaker panel board. See drawing E-6000 "ZLD System one-Line Diagram".

2. A 208V/120V, three phase, 60 Hertz circuit breaker panel board shall be provided to accept the 208V/120V power and distribute to lighting, utility electrical outlets, and other 120V electrical loads. An adequately sized transformer shall be installed to feed this three phase circuit breaker panel from the 480V starter rack described above.

3. An enclosure ventilation system shall be provided. System shall consist of outside air intake louver with motorized damper and exhaust fan. System shall be designed to provide enclosure ventilation. System shall also be designed to maintain the maximum indoor design conditions specified with the pumps operating during maximum outdoor design conditions. System shall be capable of manual operation via a control station and automatic operation via a thermostat. See drawings E-7000 "ZLD System - Panel Schedule" and E-7001 "ZLD System – Nameplate Schedule".

4. A enclosure heating system shall be provided. System shall utilize thermostatically controlled electric heater to maintain the enclosure at the minimum indoor design temperature during minimum outdoor design conditions. Heating system shall be designed to maintain the required enclosure temperature accounting for normal ventilation requirements.

5. General enclosure lighting with an average lighting illumination level of 30 foot-candles shall be provided utilizing T8 fluorescent lights with a light switch at the entrance doors. Outdoor high pressure sodium lights shall be provided at the entrance, automatically controlled by means of an integral photocell. Battery operated emergency lighting shall be provided for the interior. A weatherproof "red" beacon shall be provided and mounted to the exterior of the pump house.

6. Utility electrical outlets shall be provided on each wall. Quantity and locations shall be in accordance with the NEC, except that there shall be at least one (1) on each wall.
7. Lightning protection shall be provided.
8. Grounding lug pads shall be provided at enclosure base 180 degrees diagonally apart.
9. The pumps enclosure and internal components shall be arranged to allow normal, required maintenance activities in addition to the removal of major items such as: pumps, motors with minimal need to disconnect and remove other components.
10. All electrical enclosures shall be rated NEMA 4.

1.3 SUBMIITTALS

A. Submit the following:

1. Detailed design calculations for the structural building components prepared and sealed by a registered structural engineer. Calculations shall meet the design criteria given.
2. Manufacturer's catalog data, including performance and loading charts, specifications, and installation instructions for building components and accessories.
3. Color samples of the following items: The LANL Subcontract Technical Representative (STR) will review for color and texture only. Compliance with other requirements is the responsibility of the Seller.
    a. For the initial selection, submit manufacturer's color charts or chips showing full range of colors, textures, and patterns available for metal panels with factory applied finishes.
    b. For initial selection, submit manufacturer's color chart or chips showing full range of colors available for sealants and closures.
4. Shop Drawings:
    a. Shop drawings sealed by a registered structural engineer.
    b. Shop drawings of the anchor bolt locations, including material and size.
    c. Shop drawings of the metal enclosure indicating:
        i. Fabrication and assembly of structural frame in accordance with AISC Manual of Steel detailing.
        ii. Layout of siding and roofing panels, details of all edge conditions, joints, corners, custom profiles, supports, anchorages, trims, flashing, covering and trim, and accessory installations.
        iii. Window/louver anchorage and flashing.
        iv. Door frame anchorage.
5. Minimum Warranty:

a. Twenty-year manufacturer's written warranty on the exterior panel and trim finish. The finish shall be warranted against the following:
   i. Cracking, checking, or peeling.
   ii. Chalk in excess of numeral rating of eight (ASTM S659).
   iii. Fade or change in color in excess of five units of color (ASTM D2244).
   iv. Ten year warranty for weather tight and water tight installation.

6. Provide electrical bill of material, lighting, conduit drawings, and wiring diagrams for approval.
7. Project record documents.

1.4 QUALITY ASSURANCE

A. Manufacturer's qualifications: Provide pre-engineered metal enclosure produced by a manufacturer with a minimum of twenty (20) years' experience in the design and fabrication of pre-engineered metal enclosures of the type and quality required.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package metal sheets or panels for protection against transportation damage.

B. Exercise care in handling panels to prevent bending twisting, and surface damage.

C. Stack materials on platforms or pallets covered with suitable weather-tight, ventilated coverings for shipping. Metal sheets or panels packaged shall be free draining so that water will not accumulate.

PART 2 PRODUCTS

2.1 MATERIALS

A. Metals:

1. Hot-Rolled Structural Shapes: ASTM A36 or A992.

2. Tubing: ASTM A500, Grade B.

3. Steel Members Fabricated from Plate or Bar Stock: ASTM A529, A1011, or A572, 42000 psi minimum yield strength.

4. Steel Members Fabricated by Cold Forming: ASTM A1008, Grade 50.

5. Cold-Rolled Carbon Steel Sheet: ASTM A568 or ASTM A336.

6. Hot-Rolled Carbon Steel Sheet: ASTM A568 or ASTM A1011.

7. Structural Quality Zinc-Coated (Galvanized) Steel Sheet: ASTM A653 with G90 coating, "Class" to suit enclosure manufacturer's standards.

8. Commercial Quality Zinc-Coated (Galvanized) Steel Sheets: ASTM A653 with G90 coating, ASTM A525.

9. Aluminum-Coated Steel Sheets: ASTM A463 with TI-40 coating.

10. Bolts for Structural Framing: ASTM A325 as necessary for design loads and connection details.

B. Paint and Coating Materials: Unless otherwise indicated, paint and coating materials shall comply with performance requirements of the Federal Specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of Federal Specifications indicated is not required.

1. Shop Primer for Ferrous Metal: Fast curing, lead-free, "universal" primer as selected by the manufacturer for resistance to normal atmospheric corrosion, compatible with finish paint systems indicated and capable to provide a sound foundation for field applied topcoats despite prolonged exposure. Comply with performance requirements of FS TT-P-654.

2. Shop Primer for Galvanized Metal Surfaces: Zinc dust-zinc oxide primer selected by the manufacturer for compatibility with substrate. Comply with performance requirements of MIL-DTL-24441/20.

2.2 STRUCTURAL FRAMING

A. Design units for design loads and criteria specified herein.

B. Steel Frames/Structures

1. Hot-rolled structural steel. Provide built-up "I-beam" shape or open web type frames consisting of either tapered or parallel flange beams and tapered or straight columns.

2. Cold-formed steel structures. Provide shear wall type construction.

3. Provide frames factory welded and shop painted. Furnish frames complete with attachment plates, bearing plates, and splice members. Factory drill frames for bolted field assembly.

C. Wind/Seismic Bracing: Diagonal internal bracing or diaphragm bracing.

D. Panel Finish: Provide one (1) of the following as indicated:

1. Baked Enamel Finish: Shop-applied baked enamel finish to galvanized steel liner panels, and related trim and accessory elements. Apply finish coat on the exposed face and manufacturers' standard wash coat on the reverse face.

    a. Clean galvanized steel with an alkaline compound, then treat with a zinc phosphate conversion coating, and seal with a chromic acid rinse.

    b. Apply a baked-on thermo-setting synthetic enamel system, such as acrylic enamel or silicone polyester to pretreated steel sheets, in one or more coats as standard with the manufacturer to achieve a minimum dry film thickness of one (1) mil.

    c. For roofing and siding, apply finish coat on exterior facings and manufacturer's standard wash coat on reverse face.

    d. Provide colors as indicated or as selected by LANL STR from manufacturer's standard colors.

2. Fluoropolymer Finish: Shop-applied fluoropolymer finish to galvanized steel siding and soffit panels, and related trim and accessories elements. Apply finish coat on the exposed face and manufacturer's standard wash coat on the reverse face.

    a. Clean galvanized steel with an alkaline compound, then treat with a zinc phosphate conversion coat, and seal with a chromic acid rinse.

    b. Apply a two-coat fluoropolymer coating system to pretreated steel. Coating shall consist of primer applied to a dry film thickness of 0.15 mil to 0.25 mil, and a finish coat of polyvinyl fluoride applied to a dry film thickness of 0.80 mils to 1.3 mils.

    c. Color as indicated or as selected by LANL STR from the manufacturer's standard colors.

2.3 WINDOWS AND DOORS

A. Window Classification:

1. Commercial Windows: For non-hardened areas, provide pre-glazed window units complying with requirements of AAMA Grade and Performance Class appropriate to the designated wind velocity.

2. Window Types (Fixed): Drawings indicate location of windows.

B. Glass Types and Qualities:

1. Dual glazed insulating glass made with Type 1, Class 1, Quality q3, clear float glass. Solar tint where shown.

C. Doors

1. Provide a standard insulated hollow double metal door assembly, exterior rated with clear opening and no center post. Doors shall be rated for all appropriate loading conditions.

2. Provide security locks using best 1C7G1 7 pin interchangeable cores.

2.4 SHEET METAL ACCESSORIES

A. General: Provide sheet metal accessories with coating to match coated steel roofing, liner, and siding panels.

B. Gutters: Form gutters in sections not less than eight (8) feet in length, complete with end pieces, outlet tube, and other special pieces as may be required for a complete system. Join sections with riveted and soldered or sealed joints. Provide expansion type slip joint at center of runs. Furnish gutter supports spaced at 36" on center, constructed of the same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at each outlet. Finish to match roof fascia and rake.

C. Downspouts: Form downspouts in sections approximately ten (10) feet long, complete with elbows and offsets. Join sections with not less than 1 ½ inch telescoping joints. Provide fasteners, designed to securely hold downspouts not less than one (1) inch away from wall; locate fasteners at top and bottom and at approximately five (5) feet on center in between. Finish to match wall panels. Provide preformed concrete splash pads at each downspout.

2.5 FABRICATION

A. General: Design of the pump house shall be factory prefabricated to the greatest extent possible. Any necessary field connections required for erection to permit easy assembly and disassembly. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.

1. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.

B. Structural Framing: Shop-fabricate structural framing components complete with baseplates, bearing plates, and other plates required for erection. Provide required holes for anchoring to support pad as shop drilled.

1. Shop Connections: Power riveted or high strength bolted. Welded shop connections permitted only with LANL STR approval.

2. Field Connections: Bolted field connections.

PART 3 EXECUTION

3.1 Field erection/installation of the pump house will be by others.

SPECIFICATIONS

FOR

ZERO LIQUID DISCHARGE SUBPROJECT

AT THE

LOS ALAMOS NATIONAL LABORATORY

PROJECT IDENTIFICATION NUMBER 100761

TECHNICAL AREA TA-52

EVAPORATION TANKS

PREPARED BY

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1.11 Derivative Classifier Review

Classification: UCNI ☐ OUO ☐ Classified ☐ Unclassified ☒

Name	Z Number	Signature	Date

ZERO LIQUID DISCHARGE SUBPROJECT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

SPECIFICATIONS, CIVIL/STRUCTURAL

EVAPORATION TANKS

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Revision	Date	Issued For	Prepared By Print/Sign/Date	Technical Approval Print/Sign/Date	Project Approval Print/Sign/Date
A	**07/13/2011**	**60% Design Review**	**Brian Urgo**		

: 04989

Design Professional Seal Structural	Burns and Roe Enterprises, Inc (BREI) Professional seal applies to the following specification sections:
	03 1534 Post-Installed Concrete Anchors Purchase – Normal Confidence 03 1550 Post-Installed Concrete Anchors - Installation and Testing 03 3001 Reinforced Concrete 03 3053 Miscellaneous Cast-In-Place Concrete 07 9200 Joint Sealants 31 2000 Earth Moving 31 2323.33 Flowable Fill 32 3113 Chain Link Fence and Gates 33 0513 Manholes and Structures

TA-50-52 ZERO LIQUID DISCHARGE SUBPROJECT

EVAPORATION TANKS

SUBCONTRACTOR SPECIFICATIONS INDEX

SECTION 03 1534

POST-INSTALLED CONCRETE ANCHORS PURCHASE – NORMAL CONFIDENCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The technical requirements for purchasing post-installed concrete anchors for Management Level ML-4 and ML-3 applications at Los Alamos National Laboratory (LANL).

B. The purchase of post-installed concrete anchors for PC-1 and PC-2 structures, systems, and components (SSC). This specification applies to expansion, adhesive, undercut, and screw. Definitions and descriptions for post-installed anchors per ACI 355.2 apply.

C. Does not apply to cast-in-place anchors or purchase of tools or equipment required for installation or testing.

D. Does not cover installation, testing, or design of post-installed anchors.

1.2 RELATED SECTIONS

A. 01 4000 Quality Requirements

B. 03 1550 Post-installed Concrete Anchors – Installation and Testing

1.3 REFERENCES

ACI 355.2	Qualification of Post-Installed Mechanical Anchors in Concrete
ICC AC 193	Acceptance Criteria for Mechanical Anchors in Concrete Elements
ICC AC 308	Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements
ASTM E488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on iron and Steel
ASTM E1512	Standard Specification for Testing Bond Performance of Bonded Anchors

1.4 SUBMITTALS

A. Verification Documents

The following verification documentation shall be submitted by the Supplier for any anchors not in Table 1, Approved Anchors:

1. Submit the ICC-ES Evaluation Report (ESR) for each product.
2. Submit technical documentation of the product, including, but not limited to: anchor design strength in shear and tension, minimum spacing and edge distances, anchor dimensions, materials and coatings used, installation instructions, and all required design parameters.
3. For chemical anchors, also submit information on adhesives, including, but not limited to: elevated temperature versus load capacity effects (80-350°F), fire resistance, radiation effects, sunlight exposure effects, adverse chemical reactions, storage instructions, missing system, injection systems, mixing rations, gel time, setting time, shelf life, and hole cleanliness requirements.
4. For chemical anchors, also submit threaded rod or deformed reinforcing bar information as applicable, including geometry, shape, material properties, and any special requirements.
5. Submit shipping, handling, and packaging procedures as described in Para 1.6 below.
6. Submit cleaning and coating documentation for review.
7. Submit quality assurance program to meet requirements of Para 1.5.
8. Certificates of Compliance certifying that the anchors meet the requirements of this specification.

1.5 QUALITY ASSURANCE

All material shall be procured as Commercial Material. The same quality assurance requirements shall be passed down to any lower tier subcontractor.

1.6 PACKAGING, SHIPPING, HANDLING, AND STORAGE

A. Establish and maintain controls for material handling and storage during fabrication and preparation for shipment to prevent damage and deterioration.

B. Prior to packaging an item, remove dirt, oil residue, water, metal chips, or other contamination.

C. If nuts, washers, sleeves and anchors are packaged and shipped unassembled, any components that are damaged during handling, shipping & storage, or that don't fit properly (upon assembly during anchor installation), shall be replaced at no cost to LANL.

D. Bolting of different types and/or different sizes shall be packaged separately.

PART 2 PRODUCTS

2.1 Anchor types including nuts and washers: expansion, adhesive, and undercut and their intended Natural Phenomena Hazards (NPH) Performance Category.

Table 1
Approved Anchors

Anchor Type	**Manufacturer**	**Product Name**	**NPH Performance Category**
Expansion: Wedge	Hilti	Kwik Bolt TZ	PC-1 and PC-2
Heavy-Duty Sleeve	Hilti	HSL-3	PC-1 and PC-2
Adhesive	Hilti	HIT-RE 500-SD	PC-1 and PC-2
Adhesive	Hilti	HIT-HY 150 MAX-SD	PC-1 and PC-2
Undercut	Hilti	HDA	PC-1 and PC-2

2.2 Definitions of anchors per ACI 355.2 (as amended by ICC AC 193) apply. Supply anchor products of the following types:

A. Mechanical anchors: undercut, expansion (drop-in, heavy-duty sleeve, wedge, screw), and screw anchors.

B. Bonded or adhesive anchor systems: chemical anchors.

C. All material shall be Commercial Material.

D. All anchors shall have a current ICC-ES Evaluation Service Report that contains recommended design capacities. Load tests used in the ICC ES Reports shall be performed in accordance with ICC AC 193 and ASTM E488 for mechanical anchors, AC 308 and ASTM E1512 for adhesive anchors.

E. Provide carbon steel or stainless steel anchors as specified. Submit documentation of materials used.

F. Non-stainless steel items shall be zinc coated for corrosion resistance in accordance with ASTM B633 or approved equal. Submit documentation of coating thickness used, service class level, and type.

G. Anchor head shall be stamped, or otherwise permanently marked, with the total anchor length of a length code that can be related to the total anchor length.

H. Anchor head, nut, or washer shall not be marked with a letter "Q" or be marked with the color blue. If the letter "Q" is contained in the length code, those anchors shall be excluded from use.

2.3 TEST AND INSPECTIONS

A. The Supplier is responsible for performing inspections, as necessary to ensure compliance with all material and documentation requirements identified in this Specification. Documentations of inspections will be available to LANL if requested.

B. LANL representative shall have the option of inspecting anchors for finish, workmanship, and dimensional tolerances before any shipment is made.

C. Materials that are not properly marked, have poor workmanship, are corroded, have defective threads, or are improperly documented shall be rejected.

PART 3 EXECUTION

Not Used.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 03 1534 Rev. 2, dated March 1, 2011.

SECTION 03 1550

POST-INSTALLED CONCRETE ANCHORS – INSTALLATION AND TESTING

PART 1 GENERAL

1.0 SUMMARY

1.1 SECTION INCLUDES

The technical requirements for field installation, testing and inspection of post-installed structural anchors in concrete structures and facilities for all Management Level applications and NPH PC-1, -2, -3, and -4 (structural performance categories) Structures, Systems, and Components (SSCs). Non-structural anchors, as specified in Engineering Standards Manual Chapter 5, Section II, Appendix A, Item A.7 (Rev 4), are excluded from the in-process inspection and testing requirements.

1.2 REFERENCES

The following codes and standards are used as reference for this specification. The codes and standards apply as referenced within the body of this specification. The date of issue (or revision) indicated shall apply. If no date of issue is given, the most current revision shall apply.

In case of conflicts between the various codes and standards, the more restrictive requirement shall apply. When conflict exists between the codes and standards, and engineering drawings, the latter shall prevail.

1.3 INDUSTRY STANDARDS

ACI 355.2	Evaluating the Performance of Post-installed Mechanical Anchors in Concrete
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 349	Code Requirements for Nuclear Safety Related Concrete Structures
IBC-2006	International Building Code, 2006
ASTM A 36	Standard Specification for Carbon Steel
ASTM A 193	Standard Specification for Alloy-Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications

ASTM F 436	Standard Specification for hardened Steel Washers

Other ICC Documents

ICC ES Reports	International Code Council Evaluation Services Reports
ICC ESR-1545	Hilti HSL-3 Carbon Steel Heavy Duty Expansion Anchors for Cracked and Uncracked Concrete, March 2010 or later
ICC ESR-1546	Hilti HDA Carbon Steel and Stainless Steel Undercut Anchors for Cracked and Uncracked Concrete, November 2008 or later
ICC ESR-1917	Hilti Kwik Bolt TZ Carbon and Stainless Steel Anchors in Cracked and Uncracked Concrete, September 2009 or later
ICC ESR-2322	Hilti HIT-RE 500-SD Adhesive Anchors in Concrete, April, 2010 or later
ICC ESR-3013	Hilti HIT-HY-150 MAX-SD Adhesive Anchor System for Cracked and Uncracked Concrete, April 2010 or later

Note: Currently available ES Reports dated within 1 year of issuance of this Specification shall take precedence over any older editions of listed reports.

1.4 RELATED SECTIONS

01 4000 Quality Requirements

03 1534 Post-Installed Concrete Anchor Purchase – Normal Confidence

1.5 DEFINITIONS

All notations are identical to those used in ACI 318 Appendix D or ACI 349 Appendix B. Where additional terms or notations are used, their definitions are included in this text.

PART 2 PRODUCTS

2.1 Grouted anchor bolts and base plates: Grouted anchor bolts, base plates and nuts shall meet design requirements. Washers shall be compatible with bolt classification.

2.2 Non-shrink grout: Non-shrink grout shall be one of the following products or an equivalent as approved by the Engineer ("Masterflow 928", "Embeco 885", "Masterflow 816", "Masterflow 713 Plus").

2.3 Drypack mortar: Drypack mortar shall consist of a mixture (by volume) of one part of Portland cement to 2-1/2 parts of sand graded so that 100 percent will pass the No. 16

screen. Alternatively, "Emaco T430", or other approved rapid strength repair mortar may be used.

PART 3 EXECUTION

3.1 INSTALLERS

A. Implement a training and/or qualification program, for installers of post-installed anchors. Anchor installers shall be trained and made fully familiar with the manufacturer's installation procedures including additional requirements as noted in this document.

3.2 EXAMINATION/SITE VERIFICATION OF CONDITIONS

A. The use of anchors shall be restricted to the applications and installations defined in the design drawings. Construction aids are exempt from this requirement.

B. Post-installed anchors shall be installed in 14 day or older concrete that has attained its minimum specified design strength. (The engineer of record is responsible for determining the strength of concrete for existing facilities)

C. Post-installed anchors may only be installed in sound concrete. Surfaces showing obvious distress by way of porosity, disintegration, carbonation and cracks over 0.02 inches in width and 12 inches or longer and within the distance of the embedment length shall be reported to the Engineer of Record for evaluation.

D. Post-installed anchors shall not be drilled into the bottom of precast and post-tensioned T-beam stems. Drilling into the sides of the T-beam stems shall be specifically pre-approved by the Engineer of Record. No cutting of the strands shall be permitted.

3.3 PREPARATION

A. Use of a rebar locator or drilling pilot holes is recommended to establish the rebar pattern before drilling in congested areas. Pilot holes shall be drilled with a carbide-tip bit to avoid rebar damage.

B. For safety, consider drill bits/drills that automatically shut off when the bit hits metal, particularly in older construction for which electrical configuration is not well-documented.

C. No cutting of rebar shall be permitted without prior Engineer of Record approval. Multi-cutting of the same bar is considered as one cut.

D. Rebar will be considered to be cut if:

1. For #4 through #7 – Cuts, nicks, or drill into bar body is greater than 1/16"
2. For #8 and larger – Cuts, nicks, or drill into bar body is greater than 1/8"

E. When installing anchors through cut rebar, the anchoring mechanism shall be located at least two anchor diameters clear beyond the cut rebar.

3.4 INSTALLATION

A. Anchors shall be installed according to the locations, embedment depth, spacing, and edge distance specified in the project documents.

B. Drill holes and install anchors in accordance with the International Code Council Evaluation Services (ICC-ES) reports (Appendix A) and manufacturer's installation instructions. Where installation criteria differ, the order of precedence from highest to lowest is 1) this specification, 2) the ICC reports, 3) the manufacturer's installation instructions.

C. Drilled holes are to be cleaned of chips, dust, loose material, and water prior to anchor installation. The hole diameters and depths shall be as those recommended in the manufacturer's instructions. Construction should verify depth of the concrete member before drilling holes. The embedment depth of the post-installed anchor shall not exceed the greater of 2/3 of the concrete member thickness or the concrete member thickness less 4 inches. Contact the Engineer of Record if these requirements cannot be met based on the actual member thickness.

D. Anchors shall be installed perpendicular to the concrete surface within a ± 5 degree tolerance. Post installation verification of this criterion may be satisfied by visual inspection to verify proper seating of the nut and washer. When an anchor is replaced with an anchor of diameter one size larger, maintain the spacing requirements of the original size anchor.

E. In areas where concrete has been removed, the minimum anchor embedment shall be measured from the surface of sound concrete.

F. Unless otherwise noted on project documents, use the spacing requirements per the ICC ES Reports. For an anchor located adjacent to a PC-3 or PC-4 anchor or embedded item, use a spacing equal to the sum of 1.5 times the embedment length of one anchor plus 1.5 times the embedment length of the other anchor, unless otherwise approved by the Engineer of Record.

G. Bending and welding of post-installed anchors, except grouted anchors, are not permitted.

H. The nut thread engagement for the anchors (studs) shall be such that the bolt threads are flush with or project past the outside face of the nut when completely installed.

I. Nuts and washers for anchors that are lost or damaged during installation shall be replaced with manufacturer's specified component or equivalent.

J. Flat washers supplied with post-installed anchors shall be used in all cases except where details of the design drawings specify the use of another washer under the nuts. A washer may be trimmed to clear interferences. The trimmed edge shall not be closer than 7/8 of the bolt diameter from the center of the washer (Ref. ASTM F436).

K. Do not damage the length identification code on the head of the anchor. Anchor projection may be cut off subject to the Engineer of Record approval and documentation of the location, embedment, and length code on a LANL inspection report by a LANL construction inspector prior to cutting.

L. Unused adhesive anchors shall be cutoff flush with the surface of the concrete. Unused mechanical anchors shall be driven in and cut-off flush. Cut-off anchors shall be considered an abandoned ungrouted hole for future anchor spacing requirements.

M. The center-to-center distance between a new post-installed anchor hole and an exploratory or unused hole or an abandoned cut-off anchor shall not be less than three times the diameter of the larger hole or 1" of clear concrete between the holes, whichever is greater, unless approved by the Engineer of Record. When exploratory or unused holes are grouted with non-shrink grout and the grout has attained the strength of the concrete, the center-to-center distance shall not be less than 1.5 times the diameter of the larger hole or 1" of clear concrete between holes, whichever is greater, unless approved by the Engineer of Record.

N. Anchors may be installed through metal decking, in the top or bottom flute, as specified on engineering drawings. Anchors shall not be located closer than 1", measured horizontally, to the edge of the flute and measured from the edge of the anchor. The minimum embedment shall be measured from top of deck rib. The post-installed anchors shall be located where the attachment plate spans at least two ribs. The space between the decking and attachment plate, at locations where post-installed anchors are used, shall not be filled with grout or concrete or any other material except that spray-applied fire resistive materials are permitted.

O. Care shall be exercised to avoid bending anchors to match baseplate holes, or loosening of anchors by prying sideways after tightening. Care shall also be exercised to ensure that the cone nut of an undercut anchor does not become loose from the stud during the setting or tensioning operation.

P. Non-grouted baseplates installed with post-installed anchors may have a maximum 1/8 inch gap as evidenced under exterior edges around the plate provided that (1) the plate exhibits bearing contact within its interior against the concrete surface and (2) the uneven bearing does not prevent application of the prescribed torque. If an unacceptable bearing contact condition exists, one of the following procedures shall apply:

1. The concrete surface shall be reworked to obtain a proper fit.

2. For gaps of up to 1 inch, the baseplate may be grouted instead using the following technique:

    a. Insert post-installed anchors and set the baseplate.

    b. Install nuts to finger tight condition.

c. Install shims positioned no more than ½ inch away from the anchors to reduce gaps between baseplates shims to 1/8 inch or less at anchor locations.

d. Apply tightening torque. The bolt tightening shall not be performed when interior shims under the baseplates have been placed away from anchors, so that downward bending of the baseplate would result upon tightening. Shims shall be moved as close as possible to the anchors before applying the installation torque.

e. Fill the gap with non-shrink grout leaving the shims in place. For baseplates on walls, where grouting is not feasible, the gap may be filled with shim plates. The shims may be stacked, but no more than four shims shall be stacked.

Q. The post-installed anchors shall not be used with leveling nuts placed under mounting plates; this restriction is to preclude interference with pretensioning anchor.

R. Relocating holes within baseplate: The baseplate with bolts may be relocated no more than 1" in any direction with respect to the attachment principal axis, unless otherwise noted on the engineering drawings.

3.5 UNDERCUT ANCHOR INSTALLATION/INSPECTION

A. When undercut PC-3 and PC-4 anchors are used in PC-1 and PC-2 applications, the same installation requirements apply. Testing frequency may be reduced to that given for PC-1 and PC-2 in Article 3.7.B Testing, Para 1.

B. The ESM Structural POC may reduce or waive the required installation pre-tension/torque for applications not subject to vibratory loads.

C. Anchors are set, then the baseplate is attached, then the bolts are tensioned to the manufacturer's recommendations for torque or tension.

D. Setting may be achieved by any of the following methods: 1) Manual (not recommended unless space is limited), 2) Hydraulic (recommended for all diameters, especially 1" to 1-1/4"), and 3) Manual Setter (only recommended for up to 3/4" diameters).

E. Tensioning may be achieved by any of the following methods: 1) Torque wrench (recommended only for up to 3/4" diameter), 2) Hydraulic Tensioning (recommended for 1" to 1-1/4" diameter).

F. The ESM Structural POC recommends the following Installation/ Inspection options. The tension testing requirement (Table 2, Attribute 14) may be waived when Option 2 is used (i.e., all bolts hydraulically tensioned).

G. Inspection devices and testing devices (torque wrenches, hydraulic tensioning, etc.) must be calibrated and controlled in accordance with LANL standards P 330-2, Control and Calibration of Measuring and Test Equipment (M&TE)] or equivalent.

Table 1 Anchor Setting/Tensioning/Testing Options

	Bolt Diameter (inches)	Setting Method	Tensioning Method	Testing Requirement
Option 1	Up to 3/4 1 to 1-1/4	Manual Hydraulic	Torque Wrench Hydraulic Tensioning	Verify torque or perform direct tension test
Option 2	Up to 3/4 1 to 1-1/4	Manual Hydraulic	Hydraulic Tensioning Hydraulic Tensioning	Testing may be waived

3.6 INSTALLATION OF GROUTED ANCHORS

A. Holes shall be drilled as shown on the engineering drawings.

B. The hole surface shall be wire brushed to clean and remove all loose particles. In addition, for core-drilled holes with diamond-tip bits, the holes shall be visually examined to confirm that there is no smooth glazing on the hole surface, and the sides of the hole may be roughened, as required, to ensure proper bond. The hole shall be cleaned of chips, dust, water and other loose material. The hole shall be kept damp for a minimum of six hours prior to grouting.

C. Anchors shall be properly positioned and supported and the hole filled with non-shrink grout having a minimum compressive strength of 5 ksi.

D. The grout shall be mixed and placed in accordance with the manufacturer's instructions.

E. Cold bending of ASTM A 307 or A 36 grouted anchors is permitted to enable the anchor to clear reinforcing steel, provided that the axis of bent anchor is not more than 30 degrees. Field bent anchors should be inspected by LANL construction inspection to verify radius of bend and lack of surface cracking.

3.7 INSPECTION, TESTING, AND ACCEPTANCE CRITERIA

A. INSPECTION

1. Structural anchors shall be visually inspected in order to verify and document that they have been installed in accordance with Article 3.4. Attributes requiring inspection include, but are not limited to those shown in Table 2. Inspection attributes shall (as a minimum) comply with the special inspection section of the applicable ICC ER report (with the exception of validating the strength of existing concrete which is the engineer of record's responsibility) plus additional attributes imposed by this specification and the engineer of record. These attributes of inspection shall be identified in the inspection report documentation.

   a. Anchors for connection of pump house enclosure to support pad shall be considered structural anchors unless otherwise directed by LANL STR.

2. Non-structural anchors shall be visually inspected, following installation, only

to ensure compliance with the non-structural-anchor provisions of ESM Chapter 5, Section II, Appendix A, paragraph A.7 (i.e., must ensure anchor used complies with IBC and ESM Chapter 16).

3. If visual inspection reveals that the installed anchor does not meet the requirements of this document, the anchor shall be relocated as permitted by this document, or shall be removed and replaced by another anchor, or referred to the Engineer of Record for evaluation.

Table 2 Required Inspection Attributes

	Inspection Attribute	Wedge, Screw & Heavy Duty Sleeve (HDS)		Adhesive	Undercut
1	Anchor type/Product description	X		X	X
2	Anchor diameter (or rod dia. for adhesive)	X		X	X
3	Anchor length	X			X
4	Minimum embedment	X		X	X
5	Minimum center-to-center spacing	X		X	X
6	Minimum edge distance	X		X	X
7	Angularity (degrees from perpendicular)	X		X	X
8	Verify length of undercut tool prior to drilling				X
9	Verify undercut is acceptable (depth & size)				X
10	Verify the setting load				X
11	Verify the tensioning load				X Opt. 13
12	Drilled hole dimensions	X		X	X
13	Installation torque	X			X Opt. 14
14	Direct tension testing	X Opt. 11		X	X Opt. 11, 13
15	Maximum embedment (drop-in type only)				
16	Hole cleanliness	X except HDS		X	
17	Adhesive expiration date			X	
18	Anchor rod length			X	
19	Anchor projection after setting				X
Powder or pneumatically driven fasteners shall be visually inspected for proper fastener penetration.					

Opt. # = Option to waive this inspection attribute if the optional attribute is verified.

Notes on Table 2 (for (ML-3 and ML-4 installations):

- Attributes 1-3, 5, 6, and 8 are visually inspected before the anchor is installed in the concrete. Attributes 7, 13, 14, and 19 are inspected after installation. The remaining attributes are verified by the installer during installation and inspected by the LANL Construction Inspector through random monitoring.

4. All installations shall comply with Table 3 below.

Table 3 Specifics on Selected Inspection Attributes

Attribute 7, Angularity, is visually inspected after installation by ensuring proper seating of the nut and washer.
Attribute 8, Length of the Undercut Tool, is to be verified prior to drilling. See manufacturer's instruction for details. Length of the undercut shall equal the required embedment depth of the anchor.
Attribute 9, Verify undercut is Acceptable. Undercut is determined to be acceptable if: 1) the undercutting blades pass the "Go/No Go Gage" test and 2) the undercut is located at the proper depth. Depth of the undercut may be verified by inserting the verified undercut tool into the hole and verifying that the indicator pin slides completely to the end of the slot. A verified undercut tool is one that passes the "Go/No Go Gage" test and is measured to verify that the distance between the bottom tip of the undercutting blades and the bearing sleeve is equal to the embedment depth of the anchor. (See manufacturer's installation instructions for details).
Attribute 10, Setting Load. The setting load may be obtained either by hydraulic setting or using the hand bolt setter. If hydraulic setting is used, read the pressure from the pump gage and compare with the corresponding Table in the manufacturer's installation instructions. If the manual setter is used, check that the indicator pin slides fully to the end of the slot per manufacturer's instructions.
Attribute 11, Tensioning Load. Either tensioning load or installation torque may be verified as determined by construction (it is not required to do both).
Attribute 12, Drilled Hole Dimensions, are verified ensuring that the proper size drill bits are used. Drill bits shall be randomly monitored such that they maintain the allowable tolerances. Physical measuring of holes is not required.
Attribute 13, Installation Torque. Verify torque with a calibrated torque wrench. For Maxi-Bolts, the LANL Construction Inspector has the option of testing the anchor by torque (Attribute 13) or by direct tension testing (Attribute 14). See 3.9.B Testing for details. If Maxi-Bolts are hydraulically tensioned, per Attribute 10, or if torque verification is performed after installation per Attribute 9.
Attribute 14, Direct Tension Testing. For Maxi-Bolts, Attribute 14 may be waived if the anchor was hydraulically tensioned (Attribute 11) or if torque verification is performed after installation per Attribute 9.
Attribute 15, Maximum Embedment of Drop-in Anchors, may be verified by using the setting tool.
Attribute 16, Hole Cleanliness. This shall be in accordance with manufacturer's instructions.
Attribute 18, Anchor Rod Length. Rods for adhesive anchors will not have a length code stamp; therefore, the total rod length during installation shall be verified.
Attribute 19, Projection after Setting. For Maxi-Bolts, shall be within a tolerance of plus 1/2 inch & minus 1/4 inch. Projection is taken as overall length minus the embedment length.

B. TESTING

1. Testing of post-installed anchors is to be witnessed by the LANL Construction Inspector. Testing of post-installed anchors for permanent PC-1 and PC-2 installations shall be as required by the LANL STR, the Engineer of Record, the project Testing and Inspection Plan (TIP) and as specified herein.

   a. Testing Method

      Wedge, screw or sleeve type anchors are tested by either the torque method or the direct tension method described below. Drop-in and adhesive anchors are tested by the direct tension method only. For undercut anchors, the direct tension method is preferable. For undercut anchors, direct tension testing may be waived if the anchors are set by hydraulic setting according to the manufacturer's instructions. The following two methods of testing are acceptable for post-installed anchors. One or both may be used in a single test program. The testing of post-installed anchors may be completed prior to or after installation of the attachment/baseplate.

      i. Torque Method: The installed post-installed anchors shall be tested with a manually operated calibrated torque wrench. Acceptable test torque values for anchors tested after installation shall not be less than 80% of the tightening torque as specified by the manufacturer, or project documents. Post-installed anchors may be tested at the time of installation, by utilizing the torque values specified by the manufacturer, or the project documents.

      ii. Direct Tension Method: A tensile load as defined in "Test Load" below is applied. If the tension load is applied by jacking against the concrete, the jacking pressure is to be distributed outside of an area having its center at the post installed anchor and its diameter, or least dimension, equal to the required anchor spacing as given in the ICC ES report. Post installed anchors tested by this method shall be retightened by applying the installation torques.

b. Test Load

Tension test load shall be specified by the manufacturer or project documents. The following methodology is used to determine the test load:

i. For PC-1 and PC-2 anchors, the test load is equal to the lesser of:

- A tensile load equal to 80% of the specified yield strength of the anchor bolt material times the tensile area of the bolt; or
- A tensile load equal to a minimum of one and a half times the design allowable from the ICC report (maximum of two times the design allowable from the ICC report).

c. Test Frequency

Unless otherwise specified, the following test frequencies shall apply:

i. ML-3 and ML-4 installations: When required, test one randomly selected anchor from the populations covered by the inspection record, not to exceed a population of 50 anchors.

ii. All Installations: If a tested anchor meets the acceptance criteria given in "Acceptance Criteria" below, then the other anchors in the same population are also acceptable. If a tested anchor fails to meet the acceptance criteria, three additional anchors from the population are to be tested; if any of these three anchors do not meet the acceptance criteria, then all the remaining anchors in the population are to be tested.

C. ACCEPTANCE CRITERIA

1. Torque Method

When tested by the torque method, a post-installed anchor is acceptable if the minimum installation torque is attained without:

- A drop in torque value as the torque is applied.
- Turning the nut more than one and a half (1-1/2) turns during torquing.
- Bolt failure.
- A sign of damage in the surrounding concrete as defined in Article 3.9 Repair/Restoration, Para A.3.

2. Direct Tension Method

When tested by the direct tension method, a post-installed anchor is acceptable if the test load defined in Subparagraph 3.7.B.1.b is attained without:

a. Slippage of more than:

i. 1/16 inch for non-ductile anchors (all anchors except undercut anchors).

ii. 2.5 percent of the embedded length, rounded to the nearest 1/16 inch for undercut anchors.

b. Bolt failure.

c. A sign of damage in the surrounding concrete as defined in Article 3.9, Repair/Restoration.

3.8 DOCUMENTATION

A. Installation Inspection Record

The Installation Inspection Record shall contain the information listed in Table 2.

B. Test Inspection Record

The test inspection record shall contain the following:

1. General location of anchor and group represented.
2. Method of test or verification.
3. Test results, accepted or rejected.
4. LANL Inspector's name.
5. Date of test.
6. ID number of testing tool.

C. Failed Anchor Documentation

Documentation for anchors is required for an anchor that does not pass the test acceptance criteria of Para 3.7.C. Failed anchor documentation shall be submitted to the Engineer of Record. The documentation shall contain the following:

1. Exact location of failed anchors.
2. Reason for failure.
3. Repair steps taken.
4. LANL Inspector's name.
5. Date of test.

3.9 REPAIR/RESTORATION

A. Abandoned holes shall be grouted with non-shrink grout or drypack mortar as specified in Paras 2.2 and 2.3. Anchors installed near an abandoned grouted or ungrouted hole must be located as specified in Para 3.4.M. The grout or mortar shall have strength equal or larger than the strength of the concrete.

When post-installed anchors fail to meet the acceptance criteria under inspection and testing, the following repairs may be undertaken:

1. When failure is due to excessive anchorage pullout, the Engineer of Record shall be contacted to evaluate the damage and approve a repair method. If approved, the anchor may be reset once prior to redrilling the hole and installing an anchor of diameter one size larger. Use the minimum spacing, embedment depth, and installation torque required for the original anchor.
2. When failure is due to breaking of the anchor, slippage or loosening, bending, improper installation or poor embedment:
   - Remove the defective anchor, redrill hole and install the same diameter anchor if the integrity of surrounding concrete has not been disturbed.
   - For cases where excessive slippage upon torquing is experienced, or usage of the same hole is not possible, fill the existing hole with approved grout or drypack mortar as specified in Paras 2.2 and 2.3 and relocate the anchor location as specified in Para 3.4.M.
3. When failure is due to breakout of concrete around the anchor, the Engineer of Record shall develop an appropriate repair. The Engineer of Record shall be contacted to evaluate the damage and repair method. Local spalling of the concrete around the anchor, up to a maximum depth of 1/4 inch, is not considered a concrete breakout failure.

4. Mislocated anchors may be cut flush with concrete surface, and need not be removed if they do not interfere with subsequent installations.

5. Mislocated anchors or anchors installed for temporary applications may be left in place. Those anchors that must be removed to accommodate other attachments, aesthetics or safety of personnel, may be removed completely, or abandoned in place by cutting off beneath the surface after chipping the concrete 1" minimum, and patching with approved grout or drypack. Mislocated anchors that will be covered by a baseplate or an attachment may be cut off flush with the concrete. In the event that an anchor must be removed from the hole and a new anchor installed, the removal and installation of the new anchor shall be in accordance with the manufacturer's specifications. The wedges of anchors that are "lost" during anchor removal may be abandoned in place. The abandoned hole or removed concrete shall be filled with approved non-shrink grout or drypack.

6. Removal of installed anchors for inspection or replacement may be performed using Bolt Extractor manufactured by Drillco Devices Ltd. or an equivalent.

7. Retest all replaced anchors in accordance with Article 3.7.B, Testing.

Appendix A

ICC ES Reports

Anchor Type	Manufacturer	Product Name	ICC ES Report #	Oldest Acceptable Report Date
Expansion: Wedge	Hilti	Kwik Bolt TZ	ESR-1917	(9/10)
Drop-in	not allowed	n/a	n/a	n/a
Heavy Duty Sleeve	Hilti	HSL-3	ESR-1545	(3/10)
Adhesive	Hilti	HIT-RE 500-SD	ESR-2322	(4/10)
Adhesive	Hilti	HIT-HY150 MAX-SD	ESR-2322	(4/10)
Undercut	Hilti	HDA	ESR-1546	(11/08)

ICC ES Reports are available for download online at http://www.icc-es.org/

Or search for an individual report by number at:

http://www.icc-es.org/reports/index.cfm?search=search

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 03 1550 Rev. 2, dated March 1, 2011.

SECTION 03 3001

REINFORCED CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork, shoring, bracing, and anchorage.

B. Concrete reinforcing and accessories.

C. Cast-in-place concrete.

D. Control, expansion, and contraction joint devices associated with concrete work.

1.2 DEFINITIONS

A. "Cementitious material" as used herein shall include all Portland cement, pozzolan, fly ash, and silica fume.

B. Reinforced concrete is structural concrete reinforced with no less than the minimum amounts of prestressing steel or non-prestressed reinforcement specified in ACI 318 Chapters 1 through 21 and Appendices A through C.

C. Plain concrete is structural concrete with no reinforcement or with less reinforcement than the minimum amount specified for reinforced concrete. Specifications for plain concrete are presented in Section 03 3053, Miscellaneous Cast-in-Place Concrete.

D. Engineer-of-record and Architect/Engineer are synonymous and indicate the responsible engineer for the overall design of the facility or project.

1.3 REFERENCES

A. References noted in these specifications form a part of these specifications to the extent applicable. The publications are referred to in the text by the basic designation only. The related publishing organizations are stipulated in Section 01 4200, References.

B. All concrete work, products and materials shall conform to ACI 301 and other specific referenced publications and standards except where otherwise specified herein. The submittals listed in the attached Submittal Tables are those specific submittals that the subcontractor shall provide to LANL.

1.4 SUBMITTALS

Submittals that are required to be submitted to LANL are included in the attached Submittal Tables as they apply (including submittals times, unless the LANL Subcontract Technical representative (STR) authorizes changes to the submittal times). Note: All submittals require engineer-of-record approval. For design-build subcontracts, this approval must occur prior to submittal to LANL.

1.5 QUALITY ASSURANCE

A. Follow ACI 301, 318, and 347; ACI SP-66; CRSI 63, 65 and Manual of Practice; ANSI/ASTM A184; and DOE Order 414.1 latest version with the exception of those alternatives identified in this specification.

B. The work shall be subject to inspection at all times by the Owner and Owner's Independent Testing Agency for the purpose of determining that the work is properly executed in accordance with this specification. Failure to detect defective workmanship or material during any interim inspection shall not constitute acceptance of workmanship and materials.

C. Acquire cement, aggregate, and fly ash from same source as used to produce the specific mix design for all work. Formally notify LANL of any material source changes prior to concrete delivery including the test agency test documentation. The subcontractor must provide LANL a certificate of conformance prior to the initial delivery that confirms the source of the constituents, that tests confirm compliance, and that these sources are the same for the mix design testing and the delivered mix.

D. Conform to ACI 305R when concreting during hot weather, 306R during cold weather.

E. Testing Agency Qualifications: Testing agencies that perform concrete related testing shall be nationally accredited in accordance with ASTM C1077 and testing agencies that perform reinforcing steel testing shall meet ASTM E329. For field and laboratory testing agencies and testing personnel request approval by the LANL Building Official, or designee, in accordance with the provisions of the IBC and the LANL Engineering Standards Manual Chapter 16.

F. Comply with the provisions of ASTM A615 and ASTM A-706 (as applicable) to assure that the manufacturer's tags have the heat number or test number and these tags are traceable to the associated CMTR(s). In addition, unless specifically authorized by the government, foreign reinforcing steel is not allowed.

G. The batch plant must be certified (and maintain current certification) under the NRMCA (National Ready Mix Concrete Association) process.

H. The reinforcement bar manufacturer / fabricator must be certified (and maintain current certification) under the CRSI (Concrete Reinforcing Steel Institute) process.

1.6 DELIVERY, STORAGE AND HANDLING

A. Do not deliver concrete until forms (including confirmation of approved calculations for formwork when required), reinforcement, embedded items, chamfer strips, and any other prerequisites specified in the job specific "Test and Inspection Plan" are in place and ready for concrete placement. Job site storage of materials shall be in accordance with ACI 301. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

B. Inspection/Documentation Verification Hold Point: Product and raw material inspection shall be performed at time of delivery to site receiving area and prior to off-loading and incorporation into the work. Verify conformance with specified requirements and project environmental, safety and health (ES&H) and radiological requirements through inspection of material, shipping documentation, material safety data sheets (MSDS) documentation, data sheets, test documentation and other shipping manifest information. Material not passing inspection shall be marked and prevented from entering the site or placed in an off-site quarantine area until the inspection and verification process is satisfactorily completed.

1. Reinforcement: Store reinforcement of different sizes and shapes in separate piles on racks raised above the ground (to avoid excessive rusting). Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed. Painting on reinforcement must be approved in writing by the engineer-of-record.

PART 2 PRODUCTS AND MATERIALS

2.1 GENERAL

A. All concrete work, projects and materials shall conform to applicable provisions of ACI 301 except as otherwise specified herein.

2.2 FORM MATERIALS AND ACCESSORIES

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints

1. Plywood, metal, or other approved panel materials.

    a. Metal form surfaces shall not contain irregularities, dents, or sags.

    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

        i. High-density overlay, Class 1 or better.

        i. Medium density overlay, Class 1 or better; mill-release agent treated and edge sealed.

        ii. Structural 1, B-B or better; mill oiled and edge sealed.

        iii. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

    c. AHA A135.4, hardboard for smooth form lining.

2. Prefabricated forms.

    a. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

    b. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

    c. Pan Type: Glass fiber of size and profile required.

d. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes required.

e. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inch thick.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Ties: Snap-off type, galvanized metal cone type with waterproofing washer free of defects that could leave holes larger than 1 in. in concrete surface.

D. Form Release Agent: Colorless mineral oil which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

E. Corners: Chamfered, wood strip type; ¾ x ¾ in. size.

F. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

G. Flashing Reglets: Galvanized steel, 22 gage thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

H. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size as required, of sufficient strength and character to maintain formwork in place while placing concrete.

I. Waterstops: Polyvinyl chloride, minimum 1750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, in accordance to CRD-572 provided in maximum possible lengths, ribbed profile, preformed corner sections. Waterstops shall be dumbbell type or center-bulb type, as specified on Drawings. Waterstop shall be installed in accordance with the manufacturer's recommendations for installation.

2.3 REINFORCING AND ACCESSORIES

A. Reinforcing Steel: ASTM A 615, grade 60 deformed bars and stirrups; and ties unless otherwise specified by the engineer. Manufacturer's CMTRs are required for each delivery. See 1.5.F above for additional requirements.

B. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice.

C. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Vertical splices for column steel and other applications shall be installed with the required stagger specified by ACI 318 unless otherwise approved by the engineer-of-record.

D. Welding of reinforcing bars is not permitted. Reinforcing steel cannot be used for filler metal, gap filler, lightning grounding, or other uses that involve welding.

E. Chairs, Bolsters, Bar Supports, Spacers: Size and shape for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture. Special chairs, bolsters, bar supports, spacers adjacent to weather exposed concrete surfaces to be plastic coated steel type; size and shape as required. Note: concrete "dobie" blocks used to hold up and position rebar must have documentation to show that they are at least the PSI compression strength of the concrete used for the placement.

F. Tie Wire: Minimum 16 gage annealed type.

2.4 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type II.

B. Fine and Coarse Aggregates: Conform to ASTM C 33.

C. Water: Potable water that is clean and not detrimental to concrete.

D. Fly Ash: Conform to ASTM C 618, type F. Fly ash, 20% to 30% of combined weight of fly ash and cement shall be used for the LANL standard concrete mix. For alternate acceptable means of reducing alkali-silica reaction (ASR), see Para 2.7.B.

2.5 ADMIXTURES

A. Air Entrainment: Conform to ASTM C260.

B. Chemical: Conform to ASTM C494.

2.6 ACCESSORIES

A. Bonding Agent: Polymer resin emulsion.

B. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.

C. Joint Filler: ASTM D 1751; asphalt impregnated fiberboard or felt, 1/4 in. thick.

2.7 CONCRETE MIX

A. STANDARD MIX DESIGN

1. The standard mix design for LANL shall contain from 20% to 30% by weight of total cementitious material Type F fly ash conforming to ASTM C 618 for mitigating the deleterious effects of alkali-silica reaction in concrete that is common with the silicious nature of aggregates found in northern New Mexico. Pre-approved mix designs shown in 2.7.H may be used as long as the materials, their sources, and their properties remain constant and as long as the aggregate correction factor is verified by testing per ASTM C 231.

B. ALTERNATE MIX DESIGNS

Alternate means for mitigating alkali-silica reaction, including use of silica fume, or lithium compound admixtures will be acceptable if appropriate tests and documentation are submitted (per the Submittal Attachment) in advance to LANL and approved. Note: Mix designs intended to provide more flexibility than the ranges (slump, air-content, water cement ratio, etc.) must obtain a formal variance to the specification.

1. Where aggregates are provided which are demonstrated through appropriate tests to have acceptable ASR levels (less than 0.1%), mix designs may be provided without the fly ash or other ingredients as noted in Para. 2.7.B, above. Tests required are ASTM C1260 or AASHTO T 303-00 (or other pre-approved alternate).

2. Demonstrate acceptable ASR resistance for concrete with fly ash using ASTM C 1260 or AASHTO T 303-00. Also see Para 1.4.B.1 above.

3. Select proportions for normal weight concrete in accordance with ACI 301, proportioning on the basis of previous field experience or trial mixtures method, for

   f_{cr} = the larger of:

   $f_{cr} \geq f'_c + 1.34s$, or

   $f_{cr} \geq f'_c + 2.33s - 500$, where:

   f_{cr} = required average compressive strength of concrete mix design, psi

   f'_c = specified design compressive strength of concrete, psi

   s = standard deviation, psi

   If a suitable record of tests is not available to establish a standard deviation, use the following:

   $f_{cr} \geq f'_c + n$, where:

   n = additional required strength, psi, for a specified f'_c:

   n = 1000 psi for f'_c = less than 3000 psi.
   n = 1200 psi for f'_c = 3000 to 5000 psi.
   n = 1400 psi for f'_c = over 5000 psi.

4. Concrete Mix Designs shall be original work performed by the supplier's testing agency (pre-approval of the testing agency by the LANL Building Official is required). Mix designs extrapolated from pre-selected data are not permitted. Configuration mix designs -- i.e., those already in use by the supplier -- are also not permitted, except for those shown in 2.7.H. All mix designs will be established through the process of trial batch determination of the compressive strengths at the various water-cement ration trial points for each concrete class, and shall adhere to the requirements of this Section.

5. Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Subcontractor. Mixture proportions shall be based on compressive strength (as noted above) as determined by test specimens fabricated in accordance with ASTM C 192 and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's

test report indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1. Note that the use of fly ash may require an increase of air entraining admixture to attain specified air content of concrete. The trial mixture shall use at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required will be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, [silica fume,] and ground granulated blast-furnace slag by weight equivalency method. Laboratory trial mixture shall be designed for maximum permitted slump and air content. Each combination of materials proposed for use shall have a separate trial mixture, except accelerators or retarders can be used without separate trial mixtures. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192 and tested in accordance with ASTM C 39 for 7 and 28 days. From these results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition a curve shall be plotted showing the relationship between 7 and 28 day strengths.

C. Provide concrete meeting the following criteria, for use in the construction of the evaporation tanks only:

1. Exterior concrete exposed to freezing and thawing.

   a. Compressive strength, f'_c: 4,000 psi @ 28 days.

   b. Maximum nominal aggregate size: 0.75 in.

   c. Maximum water / cement ratio: 0.44.

   d. Slump: 3 inch.

   e. Air content: 5 percent.

   f. Fly Ash: 20 percent

   g. Superplasticizer(SP) is recommended, provided SP is be added to mix at jobsite after mix has been tested for slump and air content. Test cylinders shall be prepared after SP has been added to mix.

D. In designing concrete mixes with fly ash and ASR aggregates, consider effects on workability, set times, times for strength development and curing, and other characteristics. Make appropriate adjustments in construction activities, for example, times for removing forms or shoring.

E. Use accelerating admixtures in cold weather only when submitted and approved as a constituent of the design mix prior to use. Use of admixtures will not relax cold weather placement requirements.

F. Do not use calcium chloride as an admixture.

G. Use set retarding admixtures during hot weather only when submitted and approved as a constituent of the design mix prior to use.

H. Pre-approved Concrete Design Mixes (Ref: Amec Project No. 4-519-003279). These mix designs can be used as long as material properties remain constant. Submit (per the Submittal Attachment) source documentation and component analyses to verify compliance of the batching materials used for pre-approved mix design.

- LATM Mix No. 19 -- Exterior, 4000 psi concrete, 4" slump, 5% air (use aggregate correction factor of 0.3 for ML-3 and ML-4 concrete) [(7)], 20% fly ash (Proportions per CY):

Type I-II Cement: Gcc Rio Grande, Tijeras	656 lbs
Class F, Fly Ash: Salt River Materials, 4-Corners	164 lbs
Water	295 lbs
Washed Concrete Sand: El Guique Quarry	1079 lbs
Sz#67 Coarse Aggregate: El Guique Quarry	1630 lbs
Water Reducer: Mb poly heed 997	41 oz[(1)]
Air Entraining Agent: MB Micro Air,	8.2 oz[(2)]

- LATM Mix No. 44 -- Exterior, 4000 psi concrete to be pumped, 6" slump, 5% air (use aggregate correction factor of 0.3 for ML-3 and ML-4 concrete)[(7)], 20% fly ash (Proportions per CY):

Type I-II Cement: Gcc Rio Grande, Tijeras	656 lbs
Class F, Fly Ash: Salt River Materials, 4-Corners	164 lbs
Water	295 lbs
Washed Concrete Sand: El Guique Quarry	1079 lbs
Sz#67 Coarse Aggregate: El Guique Quarry	1630 lbs
Water Reducer, Mb poly heed 997	57.4 oz[(1)]
Air Entraining Agent: MB Micro Air,	8.2 oz[(2)]

Note (1): Temperature and slump variation may require adjustment in dosage within the range of 24.6 fl oz / cy to 57.4 fl oz / cy
Note (2): Temperature and slump variation may require adjustment in dosage within the range of 1.025 fl oz / cy to 12.3 fl oz / cy
Note (7): When this mix is used in an ML-1 or ML-2 application, the aggregate correction factor must be determined by testing in accordance with ASTM C 231

PART 3 EXECUTION

3.1 GENERAL

A. Conform to applicable provision of ACI 301 unless otherwise specified herein.

B. Mix, test, and deliver concrete, along with test records in accordance with ASTM C 94. Mixing water must be added with the use of a calibrated measuring device, such as a mechanical water meter. Tank sight glasses are not acceptable.

3.2 EXAMINATION

A. Verify lines, levels, and centers before proceeding with formwork. Ensure that dimensions agree with the Drawings. Verify "Square" for slabs, floors, and walls.

"Square" specifically means a 90 degree corner or connection, whether horizontal or vertical, such as a floor, wall or ceiling. Note: all required preliminary activities, such as geotechnical and soil compaction/moisture testing, must be confirmed in order to be considered completed.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

C. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

D. Do not use wood formwork more than three times for concrete surfaces to be exposed to view. Do not patch formwork.

E. Verify that concrete cover for reinforcement conforms to the drawings and to Para 3.4.C below.

3.3 FORMWORK

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

B. Erect formwork, shoring and bracing to achieve design requirements and maintain tolerances in accordance with requirements of ACI 301 and ACI 347(or more stringent design requirements). Camber structural slabs and beams in accordance with ACI 301. Contact surfaces of the formwork should be carefully installed to produce neat and symmetrical joint patterns, unless otherwise specified. Joints should be vertical or horizontal and, where possible, should be staggered to maintain structural continuity.

C. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

D. Arrange and assemble formwork to permit dismantling, stripping and removal of remaining principal shores. Do not damage concrete during stripping.

E. Align joints and make watertight. Keep form joints to a minimum.

F. Obtain approval from the Engineer-of-Record for all construction joint locations not shown on the drawings and before framing openings (in structural members) which are not detailed on Drawings.

G. Provide chamfer strips on external corners of walls.

H. Apply form release agent prior to placement of reinforcing steel, anchoring devices, and embedded items.

I. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

J. Do not apply form release agent where concrete surfaces receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

K. Provide formed openings where required for items to be embedded in or passing through concrete work.

L. Locate and set in place items which cast directly into concrete.

M. Clean formed cavities of debris prior to placing concrete. Clean and remove foreign matter as erection proceeds.

N. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

O. Install waterstops continuous without displacing reinforcement.

P. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

Q. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

R. During cold weather, remove ice and snow from within forms. Do not use deicing salts or water to clean out forms. Use compressed air or other means to remove foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

S. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and other imposed loads without excessive deflection or creep. Perform form removal in accordance with the recommendations of ACI 347.

T. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

U. Store removed forms in manner to avoid any damage to form surfaces that will later be in contact with fresh concrete. Discard damaged forms.

V. After formwork removal, place construction or equipment loads on reinforced concrete only after cylinder break results indicate strengths meet specified requirements. Exceptions to this requirement must be approved in writing by the engineer of record.

3.4 REINFORCING PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Maintain minimum concrete cover around reinforcing as follows:

Item	**Minimum cover, in.**
***Formed Concrete Surfaces Exposed to Earth/Water Weather*:**	
No. 5 bars and smaller, W31 or D31 wire and smaller	1-½
No. 6 through No. 18 bars, W45 or D45 wire	2

Item	Minimum cover, in.
Walls: Dry Conditions – No. 11 bars and smaller No. 14 and 18 bars Exposed to earth, water, weather – All bars	 ¾ 1-½ 2
Footings and Base Slabs: At formed surfaces and bottoms bearing on concrete workmat At unformed surfaces and bottoms in contact with earth Top of footings Over top of piles	 2 3 Same as slabs 2

3.5 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush, pressure washing, or other acceptable means to fully remove any laitance to assure that a "roughened" surface exists for bonding with the new concrete. When authorized by the engineer-of-record, apply bonding agent in accordance with the manufacturer's recommendations. Laitance is a weak layer of cement and aggregate fins on a concrete surface that is usually caused by an overwet mixture, overworking the mixture, improper or excessive finishing or combination thereof. Note: The more stringent of this paragraph, ACI 318, and ACI 301 apply.

B. In locations shown on the design drawings where new concrete is to be dowelled to existing work, unless noted otherwise on the design drawings, drill holes in existing concrete; insert steel dowels to the specified depth and pack solid with non-shrink grout that meets or exceeds the concrete minimum strength. Note: Non-shrink grout must be mixed, applied, and cured per the manufacturer's requirements.

3.6 PLACING CONCRETE

A. Place concrete in accordance with ACI 301. Consolidate concrete by internal vibration per ACI 309R-2005 or latest edition; whichever is more stringent, unless otherwise directed by the engineer-of-record.

B. Notify the LANL STR a minimum of 24 hours prior to commencement of concrete operations.

C. Ensure that reinforcement, inserts, embedded parts, formed joint fillers, joint devices, and formwork are not disturbed during concrete placement.

D. Install joint filler, primer and sealant in accordance with manufacturer's instructions.

E. Install joint devices in accordance with manufacturer's instructions.

F. Place concrete continuously between predetermined expansion, control, and construction joints.

G. Unless noted otherwise on the design drawing(s), screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 inches in 10 ft.

3.7 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed with smooth rubbed finish.

B. Finish concrete floor surfaces in accordance with ACI 301.

1. Finishes shall meet the requirements of ACI 301 section 5.3.4.2 and tolerances shall conform to ACI 117.

2. Tolerances for floors, slabs, and floor finishes shall be confirmed by measuring in conformance with ACI 301 section 5.3.4.3.

C. Steel trowel surfaces which are scheduled to be exposed.

3.8 CURING AND PROTECTION

A. General

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.

2. Use all applicable practices and recommendations: for hot weather concrete application, from ACI 305R; for cold weather concrete applications from ACI 306R; for curing from ACI 308. Note: ACI 301 applies for any conditions not specifically addressed by one of these noted standards.

B. Hot Weather Applications

1. These practices (ACI 305R) shall be used when ambient daytime temperature at any time is 75 degrees F or more.

2. All applicable practices (ACI 305R) for production control and delivery including but not limited to temperature control, water content, slump, admixtures, and batching and mixing shall be employed.

3. Protection shall be provided from the sun and wind and all practice from ACI 305R Chapter 4 shall be followed in placing and curing.

4. Curing shall be by water curing methods per ACI 308.1 Sections 4, 5, 6, and/or 7.

5. Alternate means of curing will be allowed only if pre-approved by LANL. If approved, liquid membrane curing must strictly follow manufacturer's recommendations for application including volume of coverage per square foot. Application shall follow ACI 308.1 Section 3.

6. Protection and curing of concrete shall conform to provisions of ACI 301 Paragraph 5.3.6.

C. Cold Weather Applications

1. Use applicable provisions from ACI 306R and meet the requirements of ACI 306.1. Comply with recommended concrete temperatures "as mixed" and "as placed and maintained" from Table 3.1 of ACI 306.R. Comply with Para 4.2.2.8 of ACI 301 for temperatures of delivered concrete.

2. Curing shall be in accordance with ACI 306R Paragraphs 8.2 and 8.3, ACI 306.1 Paragraphs 3.3 and 3.4, ACI 308.1, and other applicable provisions.

3.9 CONTROL/CONTRACTION JOINTS

A. While the concrete is still plastic (i.e., within several hours after placement), provide joints in slabs as shown on Drawings. The depth of each joint will be at least one-quarter of the slab thickness, but not less than one inch. Modifications to the joint locations shown on Drawings may be made by Contractor, in accordance with Attachement 1, Submittal Tables.

3.10 FIELD QUALITY CONTROL

A. Provide a certified testing agency to perform field testing in accordance with ACI 301. Testing laboratory certification may be obtained through AASHTO or another nationally recognized accreditation service as allowed by ASTM C 1077. Testing agencies shall conform to requirements of ASTM E329. National accreditations must be specific to the specific facility and/or mobile unit. The engineer-of-record and the LANL Building Official, or designee must approve the test agency prior to performance any work. See LANL Engineering Standards Manual (ESM) Chapter 16 for additional details/requirements.

1. Testing agencies for performing testing services on concrete materials shall meet the requirements of ASTM 1077.

2. Field testing of concrete shall be performed by an ACI Certified Concrete Field Testing Technician – Grade I.

3. Laboratory testing of concrete shall be done by ACI-Certified concrete laboratory technician-grade 1 or equivalent per ASTM C 1077

B. Inform the LANL STR 48 hours in advance of field testing to allow for witnessing of testing.

C. The Testing Agency shall perform the following tests and collect strength cylinders on one batch in every 50 cu. yds. of concrete placed or once a day when less than 50 cu. yds. is placed. Samples for Acceptance Testing are to be taken at the discharge from the transit mixer (and into a wheel barrow per ASTM C 172.), except when using concrete pumps or conveyors to transport concrete to its final placement location. When pumps or conveyors are used, the samples for acceptance tests shall be taken at the end of the pipe or last conveyor belt. Pumping of concrete should follow ACI 304.2R. Note: The tests below shall always be performed whenever concrete test specimens are taken. All concrete is to be tested.

1. Sample concrete in accordance with ASTM C 172.

2. Record temperature of concrete in accordance with ASTM C 1064.

3. Perform slump test in accordance with ASTM C 143.

4. Perform air content test in accordance with ASTM C 231, pressure method.

5. Perform density testing in accordance with ASTM C 138 when required by ASTM C94.

6. Take 4 concrete strength test cylinders in accordance with ASTM C 31.

D. The Testing Agency shall test the strength test cylinders in accordance with ASTM C 39 at 7 days and 28 days. Strength test cylinders must be picked-up at the job site between 8 and 48 hours after molding.

E. Coordinate the sequencing of concrete construction to schedule LANL concrete special inspection per the requirements of IBC Chapter 17. Provide 48 hour notification to schedule special inspectors.

3.11 CONCRETE ACCEPTANCE CRITERIA

A. Fresh Concrete

1. Temperature - Less than 90 degrees F.

2. Slump - per paragraph 2.7. Note: Slump that is lower than the minimum slump may be placed when the LANL inspector determines that the concrete is workable and can be vibrated. (This does not authorize low slump for other reasons such as concrete being placed beyond the time limit.) The LANL inspector will note the low slump in the inspection report but will not generate an NCR unless the concrete strength report indicates that it is unacceptable.

3. Air content - per paragraph 2.7. Note: High air-content beyond the specified range becomes a factor that can impact strength but not durability. The LANL inspector will note the high air-content the inspection report but will not generate an NCR unless the concrete strength report indicates that it is unacceptable.

4. Drum revolution counter - 300 maximum revolutions within 1-1/2 hours after initial mixing for Central-Mixed concrete or 100 to 300 revolutions within 1-1/2 hours after initial mixing for Shrink-Mixed and Truck-Mixed concrete.

B. Strength

1. Concrete strength is satisfactory if the average of all sets of 3 consecutive strength test results equal or exceed the specified 28 day strength f ' c and no individual strength test result falls below the specified 28 day strength f ' c by more than 500 psi.

C. Appearance

1. Free from honeycombs, embedded debris, and dimensional variance beyond ACI 301 and its references.

D. Construction requirements

1. Conforming to required lines, details, dimensions and tolerances specified for construction.

3.12 DEFECTIVE CONCRETE

A. Defective concrete is concrete not conforming to acceptance criteria in paragraph 3.11.

B. Do not accept or place defective concrete that is not in conformance with acceptance criteria. Return the fresh concrete to the supplier.

C. Replace defective concrete not meeting strength criteria, at Subcontractor's expense. The Subcontractor may, at its expense, evaluate the concrete's in-place strength by testing 3 core samples for each strength test where LANL cured cylinders were more than 500 psi below f'_c in accordance with ACI 301 and ASTM C42. Fill core holes in accordance with ACI 301.

D. Replace defective concrete not meeting appearance criteria, at Subcontractor's expense. The STR may allow repair of defective concrete at Subcontractor's expense.

E. Replace concrete not in conformance with details, tolerances, and other construction requirements at Subcontractor's expense.

ATTACHMENT 1
SUBMITTAL TABLES

Subcontractor is responsible for full compliance to all of ACI 301 and this specification. The submittals listed in these Submittal Tables (and any others in the body of the specification) are those specific submittals that LANL must receive from the Subcontractor.

Other potential submittals associated with the various codes and standards and required by the engineer of record remain the responsibility of the Subcontractor.

The items below must be submitted by the Construction Subcontractor to the LANL STR within the time frame noted in the "timeframe" column to the right of the submittal item. The submittal time frames may be adjusted for individual projects by Subcontract or the LANL STR. The LANL STR will obtain the review and approval of the engineer-of-record and any other authority and notify the Subcontractor after approval is granted for each submittal.

In addition, the Subcontractor must schedule and manage any sub-tiers to ensure that the proper approach and scheduling is used to obtain all necessary approvals and tests of concrete constituents that make up new mix designs.

Table 1.A submittals are always required. Submittals in Table 1.B ("LANL-Approved Variance and Alternate") are only required when the subject matter of/ in the requirement is applicable. For example, the reason ACI-301 paragraph 1.7.1.4 is included in Table 1.B is that proposed repair methods, materials, and modifications are needed to repair the concrete work to meet the requirements of Subcontract Documents. Submittals in Table 1.B are not required if the concrete work meets the requirements of the Subcontract Documents (i.e., repair is not necessary / applicable). Finally, because the need for them will be rare, these 1B submittals are not included in the Subcontract Exhibit I Attachment B listing of submittals, but are nevertheless required when needed.

The submittal reviews should be generally consistent with the following schedule:

1. 2 days for the STR to give the submittal to the A/E
2. 10 days for the A/E to approve the submittal.
3. 2 days for the STR to return the approved submittal
4. 5 - 10 days for the Subcontractor to act on the approval
5. 5 days for the Subcontractor to correct any submittals for re-review followed by a 5-day review period

(A mature process will take approximately 5 weeks if the submittal is not returned unapproved).

Note 1: Design-build Subcontractors shall obtain their engineer-of-record approvals before submitting the submittals to the LANL STR (differs from Para 3 above).

Note 2: Additional items may need to be added for nuclear or radiological projects or specialty construction (i.e., high-density concrete, self-consolidating concrete, etc.).

Note 3: The term "engineer-of-record" is synonymous with the term "architect/engineer (i.e., as applicable to project in question)."

Note 4: Source: Requirement source is ACI 301-05 unless noted otherwise

TABLE 1.A SUBMITTALS ALWAYS REQUIRED

No.	SUBMITTAL	TIMING	SOURCE
	General		
A-01	Documentation that testing agencies have been accepted by the engineer-of-record before performing any testing work.	4 months before performing any work. Includes A/E acceptance and LANL LBO acceptance.	*1.6.3.1*
A-02	Documentation that testing agencies have been approved by the LANL Building Official (LBO) prior to performing any work. Important note: This also applies to subtier concrete fabricators and batch plants. This places a premium on planning to assure that the testing agencies are properly approved before all of the required concrete constituent / material testing is begun to support any alternate mix design(s) which have to be submitted for LANL engineering approval 30 days before using the concrete mix. The best alternative is to choose from the list of LBO-approved test agencies from Chapter 16 of the ESM (Engineering Services Manual). Using a testing agency on the approved list will save time by having the LBO approval in advance and then there is only the engineer-of-record's approval to obtain.	2 months before performing any work. Note: LANL will normally require that the subcontractor hire the test agency(s). If LANL provides the test agency(s) then this submittal only applies to the subcontractor when they contract the engineer-of-record.	*IBC Chapter 17 and ESM Chapter 16*
A-03	Documentation that quality control program of the concrete supplier is accepted by A/E.	3 months before the initial placement.	1.6.3.2.f
A-04	The testing agency shall report test and inspection results that pertain to the Work to the engineer-of-record, construction Subcontractor, and concrete supplier within 7 days after tests and inspections are performed. For timing for submittals to LANL in column to the right.	Within 2 days for the initial slump and air content and within 7 days for each specified break report sequence (i.e., 7, 14, and 28 day breaks).	1.6.4.1.c
A-05	Data on form-facing materials proposed for smooth-form finish if not specified in the design media: • Rough-form finish on concrete surfaces not exposed to public view; and • Smooth-form finish on concrete surfaces exposed to public view.	15 work days (or 3 weeks) before form installation.	2.2.1.1
A-06	Data on formwork release agent or formwork liners.	15 work days (or 3 weeks) before form work installation start	2.1.2.1.f and spec. 2.2.D
A-07	Design calculations per ACI 347 indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components (design forms for full liquid static head of concrete). Formwork drawings showing details of formwork including; joints, supports, studding and shoring, and sequence of form and shoring removal, prepared by or under supervision of a Professional Engineer detailing fabrication, assembly, and support of formwork. For shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members, Drawings and calculations prepared by or under supervision of a Professional Engineer.	15 working days before formwork installation begins	Specification and ACI-301 para. 2.1.2.2.a and b

No.	SUBMITTAL	TIMING	SOURCE
A-08	Data and sample of attachment accessories and form ties.	15 work days (or 3 weeks) before form work installation start	2.1.2.2.c, 5.1.2.3.f
A-09	Data and sample of expansion joint materials (sealer and filler)	15 work days (or 3 weeks) before form work installation start	2.1.2.2.d
A-10	Data and sample of waterstop.	15 work days (or 3 weeks) before form work installation start	2.1.2.2.e and spec. 2.2.I
A-11	Alternative locations and details for formed construction and contraction joints.	1.5 months before form work installation	2.2.2.5.d
A-12	Product data on admixtures, materials for coring concrete		
	Reinforcing Material		
A-13	Rebar manufacturer's certified test report (CMTRs) traceable to the heat# or test identification # on the shipping tags.	15 work days (or 3 weeks) before the planned shipment date	3.1.1.1a, codes, and ASTM A615 / A706
A-14	Shop drawings indicating bar sizes, spacing, locations, piece numbers, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, supporting and spacing devices. Identify all lap splice lengths	1 month before re-enforcement placement	3.1.1.1.b
A-15	List of splices and request to use splices not indicated in Subcontract Documents.	1 month before re-enforcement placement	3.1.1.1.c
A-16	Request to use mechanical splices not shown on the project drawings. In addition, submit the ICC Evaluation Report(s) showing the requested mechanical splices to meet the requirements of ACI 318/ACI 355.2 for the IBC year edition applicable for the project. ACI 301-[2005] paragraph 3.1.1.1.d (and ACI 355.2 section 12) requiring objective evidence that ICC (the evaluation agency) has approved the mechanical splice for use under IBC (year edition applicable). http://www.icc-es.org/reports/index.cfm?csi_num=03151&view_details=yes	1 month before re-enforcement placement	3.1.1.1.d, ACI 355.2, and IBC Sections 1704.1 and 1704.13
A-17	Request and procedure to field bend or straighten reinforcement partially embedded in concrete.	15 work days (or 3 weeks) before placement of reinforcement	3.1.1.1.f and 3.3.2.8
A-18	Copy of current CRSI Plant Certification for any reinforcement manufacturer's plant.	15 work days (or 3 weeks) before the planned shipment date.	3.1.1.1.g
A-19	If coated reinforcement is required, description of reinforcement supports and materials for fastening coated reinforcement not described in 3.3.2.4 of ACI 305-05 (later edition if applicable)	15 work days (or 3 weeks) before placement of reinforcement	3.1.1.2.b
A-20	Submittal to obtain engineer-of-record approval to field-cut reinforcing steel.	15 work days (or 3 weeks) before cutting any reinforcing steel	3.3.2.9

No.	SUBMITTAL	TIMING	SOURCE
A-21	CMTRs for each rebar delivery traceable to the rebar bundle tags. Must be included with delivery of the rebar at the site.	Upon receipt	
A-22	Not Used		
A-23	Certified copies of CMTRs for reinforcing and other construction materials such as form savers, cadwelds, etc. Mechanical splices must be supported by ICC evaluation reports showing full compliance to the applicable IBC code of record for the project.		
	Concrete and Concrete Materials –Spec (Pre-Approved) Mix Designs		
A-24	Source documentation and component analyses to verify compliance of concrete batch materials to the pre-approved mix design. The laboratory test reports shall include manufacturers' certified material test report(s) and all other tests for cement, fly ash [slag], [silica fume], aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained versus sieve size.	Prior to first concrete placement for either of the two pre-approved LATM exterior concrete	03 3001 Section 2.7.H
A-25	Not Used		
	Concrete and Concrete Materials – Alternate Mix Designs		
	Reminder: The LANL Building Official must approve the Test Agency (ies) prior to performing the necessary tests. The engineer-of-record must also approve all test agencies and those test result submittals required by ACI 301.		

No.	SUBMITTAL	TIMING	SOURCE
A-26	Mix design for each strength and type of concrete to LANL's Chief Civil/Structural engineer for approval. A complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, [silica fume], ground slag, and admixtures; and applicable reference specifications shall be included in the mix design submittal. In addition, the documentation provided shall include cementitious materials producers' names, and plant locations; and, for aggregates, types, pit, quarry locations, producer's names, gradings, and properties required by ASTM C33. Except for admixtures and water, test results confirming conformance with applicable specifications shall not be more than 90 days old. Test results for aggregate soundness, abrasion, and reactivity may be older than 90 days, but not older than 1 year, provided test results for the other properties specified in ASTM C 33 indicate that the aggregate quality has not changed. Note that the use of fly ash may require an increase of air entraining admixture to maintain air content of concrete within specified levels. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, and approved in writing by LANL. Clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. In addition, copies of the fly ash, [silica fume], and pozzolan test results shall be submitted. The approval of fly ash, [silica fume], and pozzolan test results shall have been within 6 months of submittal date. Obtain acknowledgement of LANL's approval of the concrete mix design prior to concrete placement. Note, design mixes intended to provide more flexibility than the stated ranges [slump, air content, water cement ratio, etc.] must obtain a formal variance to the specification. a. Submit separate mix design for: i. Each concrete strength ii. Each specified or range of air content iii. Each specified or range of slump iv. Each nominal maximum aggregate size v. Concrete to be pumped vi. Concrete with identifiable admixtures b. Include the following information with each design: i. Quantity of Water ii. Type, brand, certification, and quantity of cement iii. Source, certification, and quantity of each nominal maximum size of aggregate iv. Type, brand, sources, certification and quantity of admixture, if used v. Type, source, certification and quantity of fly ash vi. Water/cement ratio vii. Air-content viii. Slump ix. Aggregate-correction factor to meet ASTM C 231. c. Test Reports for each design: i. Concrete mix tests including strength in accordance with ACI 301, ASR resistance for mix (in accordance with ASTM C 1260 or AASHTO T 303-00), air content, weight and yield (ASTM C 138). ii. All mix designs (except pre-approved LATM mix	30 days prior to use of the concrete mix	03 3001 2.7 and ACI-301 paragraph 4.1.2.3

No.	SUBMITTAL	TIMING	SOURCE
	designs –see paragraph 2.7.H) shall be tested for durability in accordance with ASTM C 666. iii. Copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include manufacturer's certified material test and all other tests for cement, fly ash [slag], [silica fume], aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with any new concrete mix design. Obtain approval from LANL before concrete placement. iv. Fly ash and other pozzolans: ASTM C 618. v. Ground blast furnace slag, where used, ASTM C 989. vi. Aggregates, petrographic analysis, ASTM C 295 and potential ASR use ASTM C 1260 (with no additives such as fly ash) or one of several other ASTM tests for ASR (ASTM C 227, ASTM C 289, or ASTM C 1293). vii. Unless otherwise stated, the time restrictions associated with the above tests shall comply with ACI 301.		
A-27	Mixture proportions and characteristics: Evidence that mixture proportions conform to the requirements of 4.2.2 for cementitious material content, water-to-cementitious material ratio, slump, nominal maximum size of coarse aggregate, air content, admixtures, and chloride-ion concentration, as well as compressive strength and yield.	Approximately 15 work days (or 3 weeks) before the planned placement	4.1.2.1
A-28	Method and test data used to establish mixture proportions: Several different methods can be used to select mixture proportions to produce the necessary placeability, density, strength, and durability of the concrete. Field experience of concrete mixtures previously used under similar conditions provides the best assurance that the proposed concrete mixture can be used satisfactorily and will have the specified properties. If there is no field experience, ACI 211.1 provides guidance for selection of the initial quantities of materials based on material properties and specified concrete properties. When a field test record is not available, ACI 211.1 recommends that mixture characteristics be checked by trial batches in the laboratory or in the field. Blending aggregates to meet criteria for a combined grading is another proportioning method that can be used. Listed below are some of the different procedures that have been used to determine proportions of blended aggregates: • Combined fineness modulus; • 8 to 18% retained on each of the standard sieves; • Coarseness factor chart; and • 0.45 power chart. When one of the above or other similar proportioning methods is used, submit the specific combined grading to which aggregate is to be blended, along with the tolerances for control. This proportioning method also requires concrete characteristics to be checked by trial batches.	Approximately 15 work days (or 3 weeks) before the planned placement	4.1.2.2, 4.2.3.4.a
A-29	Materials, mixture proportions, and field strength-test data used for	To support mix	4.1.2.4.

No.	SUBMITTAL	TIMING	SOURCE
	proportioning.	design sequence	
A-30	Requests for adjustments to mixture proportions.	Two weeks before use in a placement	4.1.2.5
A-31	Evaluation and test results required in 4.2.2.1 verifying the adequacy of concrete to be placed in floors if the cementitious materials content is less than the minimum specified in Table 4.2.2.1 of ACI 301 [2005].	15 days before the initial placement.	4.1.2.6
	Handling, Placing, and Constructing		
A-32	Test and inspection records. Note: This applies to the Subcontractor when the test agency reports to them contractually.	Within 30 days after the placement	5.1.2.1.a
A-33	Description of conveying equipment.	15 days before the initial placement.	5.1.2.1.b
A-34	Proposed method of measuring concrete surface temperature changes.	15 days before the initial placement.	5.1.2.1.c
A-35	Proposed method for removal of stains, rust, efflorescence, and surface deposits.	15 days before performing the work	5.1.2.1.d
A-36	Qualifications of finishing Subcontractor and flatwork finishers (ACI flatwork certification).	15 days before the initial placement.	5.1.2.1.e
A-37	Shop drawings of placing, handling, and constructing methods.	15 days before the initial placement.	5.1.2.2.a
A-38	Advance notification of forthcoming placement. Arrange for tests and inspection to be properly coordinated.	48 hours notice for first placement and 24 hours for all other placements	5.1.2.2.b
A-39	Request for acceptance of pre-placement activities to ensure the pre-placement activities are properly inspected, if necessary.	48 hours notice before placement	5.1.2.2.c
A-40	Proposed wet-weather protection activities.	48 hours notice before placement	5.1.2.2.d, 5.3.2.1.a
A-41	Not Used		
A-42	Not Used		
A-43	Bonding agents other than cement grout for two-course slabs.	15 days before the initial placement.	5.1.2.3.b and spec. 2.6.A
A-44	Not Used		
A-45	Batch Tickets 1. Two legible copies of the batch ticket for each load of concrete to LANL's STR, field engineer, or inspector. 2. Conform to the requirements for batch tickets in accordance with ASTM C 94. Include the following information: a. Name of ready-mix batch plant. b. Serial number of ticket. c. Date. d. Truck number. e. Name of purchaser. f. Specific designation of job (name and location). g. Specific class or designation (pre-approved design mix number) of the concrete in conformance with that employed in job specifications. h. Amount of concrete in cubic yards (or cubic meters). i. Time loaded or of first mixing of cement and	At the completion of each day's concrete placement(s) At the completion of each days concrete placement(s)	03 3001

No.	SUBMITTAL	TIMING	SOURCE
	aggregates. j. Water added by receiver of concrete and his initials. Note: any water added to the truck must also be witnessed by the LANL field engineer or inspector. k. Reading of revolution counter at the first addition of water. l. Type and brand, and amount of cement. m. Type and brand, and amount of admixtures. n. Class, brand, and amount of coal fly ash, raw or calcined natural pozzolans [grade, brand and amount of ground granulated blast-furnace slag]. o. Information necessary to calculate the total mixing water. Total mixing water includes free water on the aggregates, water, and ice batched at the plant, and water added by the truck operator from the mixer tank (must be witnessed by LANL representative). p. Maximum size of aggregate. q. Weights of fine and coarse aggregate. r. Ingredients certified as being previously approved. s. Water /cement ratio t. Amount of water that can be added at the jobsite without exceeding the water/cement ratio. u. Signature or initials of ready-mix representative. 1. Record on each, the location where placed in structure and time of placement.		
	[Architectural Concrete]		
A-46	Not Used		
A-47	Not Used		
A-48	Not Used		
A-49	Not Used		
	[Lightweight Concrete]		
A-50	Not Used		
	[Mass Concrete]		
A-51	Not Used		
	[Prestresssed Concrete]		
A-52	Not Used		
A-53	Not Used		
A-54	Not Used		
A-55	Not Used		
A-56	Not Used		
A-57	Not Used		
A-58	Not Used		
A-59	Not Used		
A-60	Not Used		
A-61	Not Used		

No.	SUBMITTAL	TIMING	SOURCE
A-62	Not Used		
	[Shrinkage-Compensating Concrete]		
A-63	Expansion test results for the proposed concrete mixtures.	30 days before the placement.	10.1.3.2 10.2.3.2
A-64	Proposed sequences of concrete placements. It is critical that the concrete be placed in such manner that will permit the placement to expand. Consult ACI 223 for guidance.	15 days before the placement.	10.1.3.3
A-65	Request to use silica fume.	15 days before the placement.	10.2.1.1.c
A-66	Proportions and expansion test results for revised mixture proportions.	30 days before the placement.	10.2.3.3

TABLE 1.B SUBMITTALS FOR LANL-APPROVED VARIANCES AND ALTERNATE METHODS

No.	SUBMITTAL	TIMING	SOURCE
	General		
B-01	Proposed repair methods, materials, and modifications to the work.	1 month before performing any work.	*1.7.1.4*
B-02	Description of repair work to be performed to bring strength-deficient concrete into compliance with the Subcontract Documents.	Provide subcontractor NCR with recommended repair disposition and allow sufficient time for LANL approval. LANL approval must be obtained before the work is started.	1.7.4.2.e
B-03	Description of repair performed to bring potentially nondurable concrete into compliance with the contract documents.	Provide subcontractor NCR with recommended repair disposition and allow sufficient time for LANL approval. LANL approval must be obtained before the work is started.	*1.7.5.2.e*
B-04	Location of construction and contraction joints proposed if different from those indicated in the Contract Documents.	15 work days (or 3 weeks) before form installation.	*2.1.2.1.b*
B-05	Correlation data for alternative methods of determining strength of concrete for formwork removal. See ACI 228.1R for recommendations on developing suitable correlation data.	15 work days (or 3 weeks) before initial placement	*2.1.2.1.c*
B-06	Detailed plan for formwork removal at a low compressive strength than specified.	15 work days (or 3 weeks) before initial placement	*2.1.2.1.d*
B-07	Plan and procedures for installation and removal of re-shoring and back-shoring. See ACI 347 for guidance on items to consider.	15 work days (or 3 weeks) before form work installation start	*2.1.2.1.e*
B-08	Earth cuts as form surfaces.	15 work days (or 3 weeks) before form work installation start	*2.2.2.3*
B-09	Alternative locations and details of construction joints.	1.5 months before form work installation	*2.2.2.5.b*
B-10	Detailed plan for formwork removal at lower compressive strength than f 'c.	15 work days (or 3 weeks) before form work installation start	*2.3.2.5*
B-11	Not Used		
B-12	Not Used		
B-13	When the Subcontractor finds it necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embedded items, review they must submit a design change request.	Obtain design change request written approval prior to embedment in concrete	*3.1.1.3.a and as stated in this req'ment*
B-14	Not Used		
B-15	Requests for adjustments to mixture proportions.	1 month before the initial	*4.2.3.5*

No.	SUBMITTAL	TIMING	SOURCE
	Requests to adjust mixture proportions necessary for workability or consistency. If the Subcontractor desires to decrease the cementitious materials content of the concrete mixture after having satisfied the requirements of 4.2.3.6, obtain engineer-of-record review and approval of the proposed revised mixture with a lower cementitious material(s) content on a trial basis. If the Subcontractor finds it necessary to increase the cementitious materials content, obtain engineer-of-record review and approval` of the proposed revised mixture with a higher cementitious material(s) content on a trial basis. Confirm adequacy of modified proportions has been verified from a set of new field test data.	placement.	
B-16	Not Used		
B-17	Request to use the volumetric batching method.	15 days before the initial placement.	*4.1.2.8, 4.3.1.1*
B-18	Requests to exceed the ASTM C 94/C 94M required time of discharge.	15 days before the initial placement.	*4.1.2.9*
B-19	Not Used		
B-20	Request to use alternative sources of water.	15 days before the initial placement.	*4.2.1.3*
B-21	Request to use admixtures.	15 days before the initial placement.	*4.2.1.4*
B-22	Request to change materials and data verifying that properties of the concrete mixture conform to the requirements of 4.2.2 of ACI 301, 2005.	1 month before the initial placement.	*4.2.1.5*
B-23	Request to use a lower cementitious material content.	1 month before the initial placement.	*4.2.2.1*
B-24	Request to use a slump other than that specified.	15 days before the initial placement.	*4.2.2.2*
B-25	Revised mixture proportions based on revised value of f 'cr.	1 month before the initial placement.	*4.2.3.6.c*
B-26	Proposed precautions for placement of concrete hotter than 90 °F.	48 hours notice before placement	*5.1.2.2.e 5.3.2.1.c*
B-27	Proposed location and treatment of construction joints not shown on the project drawings. Obtain engineer-of-record review and approval of the proposed methods for preparing the surface and the use of portland-cement grout.	15 days before the initial placement.	*5.1.2.3.a*
B-28	Proposed methods of curing other than those of 5.3.6.4 of ACI 301 , 2005. Note: Per Spec 03 3001, non-water-curing methods must be pre-approved by LANL.	15 days before the initial placement.	*5.1.2.3.e*
B-29	Specification and data and methods of use for any proposed repair material other than site-mixed portland-cement mortar described in 5.3.7.5 (see 5.3.7.6). For patches in exposed concrete, exercise caution when using the materials described in 5.3.7.6, particularly with regard to both possible color changes from weathering and delamination due to differing coefficients of thermal expansion. Ensure that the material, including ASTM type or class, is appropriate for the moisture and thermal conditions of exposure.	30 days before work start	*5.1.2.3.g 5.2.1.3, 5.3.7.6*
B-30	Proposed materials and methods to prepare the concrete surface to achieve bond.	15 days before the placement.	*5.3.2.6*
B-31	Request to use bonding agents other than cement grout.	15 days before the placement.	*5.3.4.2.f*
B-32	Detailed plan for alternative saw-cutting method, such as shallow-cut and dry-cut method. See ACI 302.1R for further guidance.	15 days before planned work	*5.3.5*
B-33	Proposed methods of curing other than those listed in 5.3.6.4.a through e of ACI 301, 2005.	15 days before the placement.	*5.3.6.4*
B-34	Not Used		
B-35	Batching and mixing procedure that varies from the specified	15 days before the placement.	*7.2.4.1*

No.	SUBMITTAL	TIMING	SOURCE
	requirements in Section 4 of ACI 301, 2005.		
B-36	If the Subcontractor needs additional water or air entrainment to bring the concrete to the specified slump, obtain engineer-of-record review and approval of the request and quantities to be added. Do not exceed water-cement ratio limits.	15 days before the placement.	*7.2.4.4*
B-37	Request to use an accelerating admixture. As a general rule, accelerating admixtures should not be used in mass concrete because they contributed to early undesirable heat development. On rare occasions, such as when early formwork removal is critical, accelerating admixtures may be needed to accelerate strength development in reinforced mass concrete during winter conditions. Calcium chloride, if used, should not be permitted in excess of 1% by weight of cement. The engineer-of-record must accept the use of any accelerating admixture.	15 days before the placement.	*8.2.1.2.a*
B-38	Not Used		
B-39	Requests to allow limits on concrete temperature at placement to exceed 70 °F or to be less than 35 °F.	15 days before the placement.	*8.3.1.1*
B-40	Request to use different grout mixtures.	30 days before the placement.	*9.2.2.2.a*
B-41	Not Used		
B-42	Proportions and expansion test results for revised mixture proportions.	30 days before the placement.	*10.2.3.3*

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 03 3001 Rev. 4, dated November 1, 2010.

SECTION 03 3053

MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete for fence posts

B. Concrete thrust blocks on utility lines

1.2 SUBMITTALS

A. Submit the following in accordance with Section 01 3300, Submittal Procedures:

1. Design mix of each class of concrete.

2. Laboratory test reports for design mix for concrete.

3. Test Reports of Concrete Field Testing.

4. Batch tickets.

1.3 RELATED SECTIONS

A. Section 31 2000 - Earth Moving

B. Section 03 3001 - Reinforced Concrete

All work performed under the subject specification shall be performed in accordance with the applicable requirements of Section 03 3001, Reinforced Concrete, unless otherwise specified herein.

1.4 QUALITY ASSURANCE

A. Perform work, materials and construction requirements, in accordance with the quality assurance requirements for Section 03 3001, Reinforced Concrete.

1.5 JOB CONDITIONS

A. Do not place concrete when base surface temperature is less than 40 degrees F.

B. Perform concrete washout, trucks and mixers, in a designated and controlled area to prevent the runoff of washout material and the co-mingling of unset concrete with storm water. Properly dispose of all hardened concrete.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials and construction requirements for forms, concrete, joints, and required accessories.

2.2 ACCESSORIES

A. Accessories shall be in accordance with the requirements for Section 03 3001, Reinforced Concrete.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify compacted, treated base is ready to support concrete and imposed loads.

B. Verify grades and elevations of base are correct.

C. Verify forms are set to the required grade and alignment and extend to the required depth.

3.2 PLACING CONCRETE

A. Notify the LANL Subcontract Technical Representative (STR) a minimum of 24 hours prior to commencement of concreting operations.

B. Ensure that reinforcement, inserts, embedded parts, fence posts, formed joint fillers, joint devices, and formwork are not disturbed during concrete placement.

C. Concrete shall be placed in the forms in one layer. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

D. Concrete Finishing

1. The surface shall be finished true to grade and section with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks.
2. Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge.
3. Slope top of concrete fence post bases to provide positive drainage.
4. Finish thrust blocks to the extent where surface voids are eliminated.

3.3 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.

B. Use all applicable practice and recommendations: for hot weather concrete application, from ACI 305R; for cold weather concrete applications from ACI 306R; for curing from ACI 308.

3.4 FIELD QUALITY CONTROL

A. Provide a certified testing agency to perform field testing in accordance with ACI 301. Testing laboratory certification may be provided by Cement and Concrete Reference Lab (CCRL).

1. Testing agencies for performing testing services on concrete materials shall meet the requirements of ASTM C 1077.

2. Field testing of concrete shall be performed by an ACI Certified Concrete Field Testing Technician – Grade I.

B. Notify the LANL STR 48 hours in advance of field testing to allow for witnessing of testing.

C. The Testing Agency shall perform the following tests and collect strength cylinders on one batch in every 50 cu. yds. of concrete placed or once a day when less than 50 cu. yds. is placed.

1. Record temperature of concrete in accordance with ASTM C 1064.

2. Perform slump test in accordance with ASTM C 143.

3. Perform air content test in accordance with ASTM C 231, pressure method.

4. Take 4 concrete strength test cylinders in accordance with ASTM C 31.

D. The Testing Agency shall test the strength test cylinders in accordance with ASTM C 39 at 7 days and 28 days.

E. Concrete to be used for nonstructural purposes that comprises an aggregate of less than 2 cu. yds. (i.e., per project) does not require field testing provided the concrete is mixed per manufacturer's instructions or approved mix design parameters. For the purposes of this testing exclusion, "nonstructural" will be taken to mean concrete on or below the ground surface that will not adversely affect Life Safety and does not require a structural design. Examples of such concrete that meet this definition of nonstructural include sidewalks, curbs and gutters, thrust blocks, valve boxes and test box collars, post and pole anchorage when under 8' tall, and manhole collars in non-vehicle-traffic-bearing areas.

3.5 DEFECTIVE CONCRETE

A. Defective concrete is concrete not conforming to strength requirements, not being free from excessive cracking, discoloration, form marks, tool marks, honeycombs, embedded debris, or otherwise non-consistent with the overall appearances of the work.

B. Do not accept or place defective concrete that is not in conformance with acceptance criteria. Return the fresh concrete to the supplier.

C. Replace defective concrete not meeting appearance criteria, at Subcontractor's expense. The STR may allow repair of defective concrete at Subcontractor's expense.

D. Replace concrete not in conformance with details, tolerances, and other construction requirements at Subcontractor's expense.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 03 3053 Rev. 4, dated April 29, 2008.

SECTION 07 9200

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Clean and prepare joint surfaces.

2. Sealant and backing materials.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 01 3300, Submittals:

B. Catalog Data: Manufacturer's data sheets on each product to be used, including, preparation instructions and recommendations, storage and handling requirements and recommendations, as well as installation methods. Additional information to include MSDS, shelf life and temperature range of storage and application.

C. Samples: Sealant colors for each type of sealant used.

D. Warranty: As specified herein.

1.3 QUALITY ASSURANCE

A. Installer qualifications: Trained, experienced, and approved or licensed by manufacturer for installation of sealant to be applied.

B. Source limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 6000 Product Requirements.

B. Store products in manufacturer's unopened packaging, with labels intact, until ready for installation.

C. Store products off ground; if stored on roof, do not exceed structural capacity of deck.

D. Store materials at minimum of 68 degrees F for at least 24 hours prior to installation, regardless of temperature at location.

E. Do not allow materials to freeze prior to application.

1.5 WARRANTY

A. Duration: Provide 3 year warranty.

B. Coverage: Replace sealants that fail because of loss of cohesion or adhesion onto surfaces applied or that do not cure. If the sealant can be detached from a surface by rubbing the surface contact point with a finger, than the surface adhesion is inadequate. Sealants that fail against infiltration of water, due to loss of cohesion, adhesion or other means shall be repaired and/or replaced as directed by LANL STR.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Comply with Section 01 2500, Substitution Procedures.

2.2 SEALANT MATERIALS

A. General: VOC Content of Interior Sealants – Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L
2. Sealant Primers for Nonporous Substrates: 250 g/L
3. Sealant Primers for Porous Substrates: 775 g/L

B. Sealant: Polysulphide base, two component, chemical curing; self-leveling type for application in horizontal joints nonsagging type for application in vertical joint; uniform, homogeneous, and free from lumps, skins, and coarse particles when mixed; conforming to federal specification TT-S-227, capable of being continuously immersed in water, withstanding movement up to 25 percent of joint width and being satisfactorily applied throughout a temperature range of 40 - 80 degrees F; shore A hardness of 15 minimum and 50 maximum; nonstaining and nonbleeding; color to be determined by LANL STR.

2.3 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Noncorrosive and non-staining type, recommended by sealant manufacturer; compatible with joint-forming materials.

C. Joint Filler: ASTM C 1330; round, type as recommended by sealant manufacturer; oversized 30 to 50 percent

D. Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to installation, notify LANL Subcontract Technical Representative (STR) that joint dimensions and physical and environmental conditions are suitable for application of joint sealers.

B. By beginning the Work of this section, Subcontractor warrants it has examined and verified that existing conditions are in accordance with provisions of 3.1.A.

3.2 PREPARATION

A. Clean, prepare, and size joints in accordance with manufacturer's instructions. Remove any loose materials and other foreign matter that might impair adhesion of sealant.

B. Verify that joint-shaping materials and release tapes are compatible with sealant.

C. Examine joint dimensions and size materials to achieve required width/depth ratios.

D. To allow sealants to perform properly, use joint filler to achieve required joint depths.

E. Use bond breaker where required.

3.3 INSTALLATION

A. Perform Work per ASTM [C1194 for solvent-release] [and] [C1193 for latex-base] sealants.

B. Install sealant per manufacturer's instructions.

C. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.

D. Tool Joints: Concave or as indicated on Drawings.

E. Joints: Free of air pockets, foreign embedded matter, ridges, and sags.

F. Follow manufacturer's recommended cure time before painting or overcoating.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 07 9200 Rev. 2, dated May 5, 2008.

SECTION 31 2000

EARTH MOVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Potholing.

B. Grading: Clear, excavate topsoil, grade and dispose of materials at site.

C. Excavation: Excavate, place, and compact earth at site.

D. Trenching: Excavate trenches for utilities.

E. Backfilling.

F. Soil compaction and testing.

1.2 LANL PERFORMED WORK

A. Obtain excavation/soil disturbance permit for Subcontractor.

B. Mark location of known underground utilities.

C. Document new and existing utility locations.

D. Locate utility shut-off points prior to potholing.

1.3 RELATED SECTIONS

A. 01 5705, Temporary Controls and Compliance Requirements

B. 32 9219, Seeding

1.4 DEFINITIONS

A. Mechanical Excavation: Use of backhoes, jackhammers, trenchers, and similar powered digging machines; excludes vacuum excavators that are equivalent to hand digging.

B. Utility and Pipe: Any active or inactive buried pipe, duct, conduit, or cable in a primary or secondary utility system.

1.5 SUBMITTALS

A. Submit the following in accordance with project submittal procedures:

1. Certifications from an independent testing laboratory that pipe bedding materials meet the specification.
2. Certifications from an independent testing laboratory that base course materials, crushed stone or crushed or screened gravel meet the specification.
3. Test reports of field-testing of material compaction.

1.6 QUALITY ASSURANCE

A. When work or portions of work of this Section requires testing, notify LANL

Subcontractor Technical Representative (STR) 48 hrs in advance of testing.

B. Ensure compacted fills are tested in accordance with Paragraph 3.10 and in compliance before proceeding with placement of next lift.

C. Do not begin any groundbreaking, fill, or soil disturbance and transfer until known utilities have been marked, and an excavation/soil disturbance permit has been issued to Subcontractor.

D. Comply with OSHA 29 CFR 1926, Subpart P for excavation and trenching operation.

E. Maintain a copy of Excavation/Soil Disturbance Permit package, potholing plan, competent person excavation logs, and test reports on site.

F. Perform pre-job briefing of Permit and associated safety and hazard documentation with workers performing the work.

G. Ensure that engineering controls and required Personnel Protective Equipment (PPE) are used by workers during work activities to maintain safety, especially during jack hammering. Breaking surface blacktop, curbs and gutters with a jackhammer does not require dielectric PPE, provided locates have been performed and the STR is confident no other unexposed utilities are present in the surface concrete, blacktop, curb, gutter or sidewalk to be removed.

H. Review and maintain the work within the established boundaries established by the permit.

1.7 SITE CONDITIONS

A. Do not place and compact backfill material when the atmospheric temperature is below 35 degrees F, unless approved by STR.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil

1. Excavated soil material, graded free of roots, rocks larger than 1 inch subsoils, and debris.

B. Fill and Backfill Material

1. Material consisting of non-plastic granular soils free of organic or other deleterious materials having a maximum particle size of 2 inches.
2. All borrow and fill material shall be provided by the Subcontractor. The LANL STR in consultation with LANL FOD-Utilities & Infrastructure (U&I) GROUP may approve a borrow/spoils area.

C. Engineered Backfill

1. General: Excavated material may be used for fill and/or backfill under sidewalks and site. Use only clean approved materials for engineered fill and/or backfill under buildings and structures. Site materials which have the required properties may be used subject to the approval of the LANL STR. If sufficient materials are not available at the site or if the site materials do not have the specified properties, materials from off-site borrow areas will be used. Off-site/imported fill should exhibit low-expansive potential. Off-site

materials may be mixed with on-site materials in the proportions necessary to meet the requirements of this section. All arrangements necessary for the use of borrow areas are the sole responsibility of the Subcontractor.

2. Laboratory Testing: Perform appropriate and specified laboratory tests as necessary to insure that soil materials proposed for use on this project meet all specified requirements. Provide a moisture-density curve for each material proposed for use as engineered fill.

3. Fill: Engineered fill required to raise the building areas and backfill around and above structures shall be clean material, free of vegetation, debris and other deleterious materials and shall meet the following requirements as determined by ASTM D 422 except as otherwise approved by the LANL STR.

Sieve Size	Percent Passing
2"	100
1/4"	40 - 100
No. 200	25 - 45

Fill shall have a P. I. of not more than 10. Testing shall be in conformance with ASTM D 4318.

D. Base Courses

1. Provide base course and aggregate composed of materials consisting of crushed stone, crushed or screened gravel, sand, RAP, or a combination of such materials. Provide base course and aggregate free from vegetable matter and other deleterious materials, including silt and clay balls. Ensure that at least 50 percent of the materials on or above the No.4 sieve have at least two fractured faces. Maximum Liquid Limit of 25 and maximum Plasticity Index of 6, per ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

2. Base course aggregate shall conform to:

<u>Base Course Gradation</u>

Sieve Size	Percent Passing
1.0 inch	100
¾ inch	80 - 100
No. 4	30 - 60
No. 10	20 - 45
No. 200	3.0 – 10.0

E. Finished Grade Surfacing and Non-Frost Susceptible Fill

1. Provide crushed stone or gravel for use as surfacing, and for extended depth frost-free fill, as indicated on the Contract Drawings. Provide aggregate composed of materials consisting of crushed stone, crushed or screened gravel, sand, RAP, or a combination of such materials. Provide aggregate free from vegetable matter and other deleterious materials, including silt and clay balls. Ensure that at least 50 percent of the materials on or above the

No.4 sieve have at least two fractured faces. Maximum Liquid Limit of 25 and maximum Plasticity Index of 6, per ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

2. Surfacing and Fill aggregate shall conform to:

Gradation

Sieve Size	Percent Passing
1.5 inch	100
No. 4	30 - 65
No. 40	5.0 - 25
No. 200	0 – 5.0

2.2 UTILITY TRENCH BED AND FILL MATERIALS

A. Provide clean sand for pipe bedding material free of any organic or deleterious substance and having 100 percent passing 3/8 inch sieve and 4 percent passing No. 100 sieve.

B. Provide fill and backfill consisting of non-plastic granular soils free of organic or other deleterious materials having a maximum particle size of 2 inches.

C. Provide crushed stone and /or crushed or screened gravel free of any organic or deleterious substance and having 100 percent passing 1 inch sieve and 0 percent passing the 1/2 inch sieve.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify stockpiled fill to be reused is approved by LANL STR.

B. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen.

3.2 PROTECTION

A. Preserve staking, marking, or other designation until the designation is no longer needed for permitted work. If marking is removed or no longer visible, notify LANL STR. The STR will contact LANL's Mapping and Locating Group to revalidate the excavation/soil disturbance permit by locating and marking the utility again.

B. Protect existing structures from equipment and vehicular traffic.

C. Maintain excavation free of standing water.

D. Notify LANL STR of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

E. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.

F. Grade top perimeter of excavation to prevent subsurface water run-off into excavation.

G. Barricades shall be erected around the excavation area before beginning work activities to prevent accidental entry into the area.

H. Protect disturbed soils, drainage ways and watercourses against soil erosion and sedimentation by employing Best Management Practices (BMPs) as identified in excavation permit review (EX-ID) comments, shown on the drawings or identified in the Storm Water Pollution Prevention (SWPP) Plan and approved by LANL STR. Remove any temporary BMP's at the close of the project.

I. Approved BMPs shall be in place per SWPP plan before soil-disturbing work begins.

J. Stabilize all disturbed areas.

3.3 PREPARATION

A. Identify required contours and data.

B. Notify LANL STR 15 working days prior to startup of construction to have LANL's Mapping and Locating Group identify known underground utilities and stake and flag locations. If a conflict exists between location of such obstacles and proposed work, promptly notify LANL STR and arrange for relocations. Proceed in same manner if a rock layer or any other unforeseen conditions encountered underground make changes advisable.

C. When necessary, compact subgrade surfaces to density requirements for backfill material. Remove unsuitable and unstable subgrade material.

D. In rock cuts, the top of the rock cut elevation shall be considered to be the same as top of subgrade. Base course may be placed directly on top of competent rock without further processing of the rock (i.e. scarify and compaction) provided that pockets in the rock are graded to drain before base course is placed. Any fill placed on top of competent rock needed to bring the top of subgrade to required elevation shall be compacted in accordance with subgrade requirements.

3.4 WORKING WITHIN 5 FEET OF UTILITIES

A. Stop work and notify the LANL STR when an unmarked utility is encountered. The STR shall contact LANL's Mapping and Locating Group so the site can be re-examined by Utility Locators.

B. If an underground utility is damaged or severed during excavation, immediately notify LANL STR. LANL STR will take immediate action to secure the area, notify the agency responsible for the utility so that the damaged section can be isolated, repairs initiated and other notifications made as required.

C. Whenever practical, utilities shall be de-energized, isolated, and tagged-out. The decision not to de-energize shall be made by LANL STR and Facility Operations Manager as appropriate.

D. Do not use mechanical excavating equipment within 5 feet of a marked, non-potholed utility. Mechanical excavation may commence within 5 feet of the underground utility only after the utility has been potholed, exposed, and well-marked and the Subcontractor is confident that there are no unexposed utilities in the excavation area.

1. Exception: Use of mechanical excavating equipment may be used where

known utility line depths and/or site conditions exceed limitations of hand or vacuum excavation. For purposes of this exception, excavate pothole perpendicular to surface locate markings for 2 feet on each side of marking to a predetermined depth. Mechanical excavation may proceed to within 18 inches of bottom of potholes under this exception. When deemed necessary, Subcontractor will ask LANL STR to contact LANL's Mapping and Locating Group for consultation, checking of existing locate marks and remarking.

E. Accomplish mechanical excavation at a distance no closer than 18 inches vertically and horizontally to potholed non-fully-exposed utility lines.

F. Fully-exposed underground utilities shall be protected, supported, or removed and reinstalled as necessary to protect employees and the utility.

1. If approved by LANL STR, powered excavation equipment may be used closer than 18 inches to any fully-exposed utilities provided that these are marked/indicated with a prominent, tall flag-on-pole, plank, or other highly visible object so the equipment operator can clearly see their locations and avoid contact. Prior to such excavating, mark and obtain approval using Attachment 1, Utility Protection Plan Form. Subcontractor shall complete the Utility Protection Plan and clearly indicate the limits of excavation/locates, utilities located, each pothole location, and description of installed marking/flagging measures. More than one form may be required for clarity.

G. Take care while hand excavating adjacent to utility line since hand tools such as shovels, picks, and digging bars can damage the utility line.

H. During machine excavation, have a spotter in place to actively monitor the positioning of the equipment.

I. Hand-excavate obstructions (i.e., guy wires, anchors, bollards, fence posts, etc.) to be removed to determine their relationship to existing marked utilities prior to removal.

3.5 POTHOLING

A. Prior to potholing the LANL STR will notify LANL's U&I Group to locate utility shut-off points. U&I Group will ensure the shut-off points are field verified and determined operable.

B. Pothole where existing buried utility lines are inside, or within 5 feet outside of excavation permit boundary limit.

C. Accomplish potholing by hand excavation or through use of vacuum potholing equipment. The use of vacuum potholing equipment is not permitted within the boundary of a Potential Release Site (PRS).

D. Pothole at vertical and horizontal utility angle points, at excavation boundary limit, and as needed. Provide additional pothole where utility depths are unknown or are in sloped work areas where utility depths may vary.

E. When unknown utility lines are marked and hand or vacuum excavation has gone 1 foot deeper than required and 3 feet to the left and right of a locate mark without finding the utility, stop excavating and contact the LANL STR for consultation and remarking.

F. Manholes or valve boxes may be used as a pothole to verify depths and locations of utilities.

G. Parallel Utilities: Pothole at 50 feet intervals where existing utilities parallel excavation and existing lines are located up to 6 feet outside excavation boundary. Hand or vacuum excavate non-conductive direct burial lines within 2 feet of excavation boundary along their entire length adjacent to excavation boundary, or pothole at 5 feet intervals.

H. Backfill potholes to original or better than condition. Refer to Paragraph 2.2B.

3.6 GRADING

A. Excavate topsoil from areas to be further excavated or regraded, and stockpile topsoil on site in area designated by LANL STR. Topsoil may be used on areas to receive landscaping and seeding.

B. Remove vegetation, debris, unsatisfactory soil materials, and obstructions from ground surface prior to grading. Properly dispose of material in accordance with Section 01 5705.

C. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.

D. Match final grade in seeded and unpaved areas to match Drawing finish contours.

E. Construct the subgrade surface elevation to a tolerance of plus or minus 0.1 foot from the specified grade and plus or minus 0.05 foot of the typical cross section, except unlined drainage ditch flow lines shown on Drawing are allowed plus or minus 0.2 foot .

F. Construct the base course to the design depth required and the final surface to a tolerance of plus or minus 0.04 foot within 10 feet.

G. Make changes in grade gradual. Blend slopes into level areas. Prepare finish grade to accept seeding by hand raking or as designated.

H. Remove surplus excavated materials from the site. Movement and proper disposal of materials from the site shall be in accordance with Section 01 5705.

3.7 EXCAVATING AND TRENCHING

A. Excavate and trench subsoil as required for Work.

B. Cut trenches sufficiently wide to enable installation of utilities to allow inspection. Trenches shall be benched, sloped, or shored to meet OSHA 29 CFR 1926 Subpart P, in particular Appendix A for Soil Classification and Appendix B for Sloping and Benching requirements. Refer to trench detail on Drawings for minimum trench width.

C. Do not interfere with normal 45 degree bearing splay of a structure foundation during excavation work. When excavating near or under a foundation a New Mexico Licensed Professional Engineer shall approve a support system to stabilize the structure or determine that excavation work will not pose a hazard.

D. Hand trim excavation and leave free of loose matter.

E. Remove lumped subsoil, boulders, and rock.

F. Correct errors in excavation.

G. Take proper precaution, such as shoring, sloping, or using a trench box when working in a trench or excavation. Provide a person who is trained and knowledgeable of soil conditions and safety requirements to make safety determinations.

H. Evaluate excavations 4 feet or deeper (or other excavation where employee exposure can be reasonably anticipated) daily and document by a designated competent person before employees are permitted to enter the excavation. Documented inspections on an excavation condition log.

I. When an oxygen deficiency or hazardous atmosphere could be reasonably expected in trenches over 4 feet in depth, such as excavating near roadways, lift stations, sewer/gas lines, etc., the excavation shall be tested with a calibrated intrinsically safe monitoring device before employees are allowed to enter the excavation. If the atmosphere tests hazardous, then do not enter the excavation or if chemical hazards exist or are created within the excavation, stop work immediately and contact the LANL STR.

J. Excavation boundaries shall be adequately marked and barriers installed to avoid inadvertent entry. Excavations that present a possibility of a worker falling to a lower level shall be evaluated by a designated Fall Protection Competent Person for necessary fall protection requirements.

3.8 DOCUMENTING UTILITY LOCATION

A. Do not cover new or exposed existing utilities until LANL's Mapping and Locating Group has verified that utility locations have been documented by the use of GPS in compliance with LANL standard reference system.

B. Subcontractor Responsibility: Notify LANL STR 5 working days in advance that new and exposed utilities will be ready for location verification.

C. LANL STR Responsibility: Notify LANL's Mapping and Locating at 665-1051 immediately after being notified by Subcontractor.

3.9 BACKFILLING EXCAVATIONS/TRENCHES

A. Backfill and fill areas to contour lines and elevations shown on the Drawings.

B. Backfill and fill systematically.

C. Do not place backfill or fill material over frozen, wet, or spongy subgrade surfaces, including surfaces containing frost or ice.

D. Recondition, reshape and recompact areas that are damaged by freezing.

E. Place backfill and fill materials in continuous layers not exceeding 8 inches in loose depth.

F. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.

G. Compact each layer to required percentage of maximum density for the area.

H. Compact layers uniformly before a succeeding layer is placed.

I. Do no disturb or damage adjacent structures during compaction.

J. Backfill against structures as follows:

1. Do not place backfill against structure walls prior to verifying the concrete has been properly cured and is of required strength to resist stresses due to backfill.
2. Take care to prevent wedging action of backfill against structures by carrying

the material uniformly around the structures to approximately the same elevation in each lift.

3. When unbalanced pressures are likely to develop on walls:

   a. Continuously monitor for displacements,

   b. Erect shoring to counteract imbalance, if required, and

   c. Leave shoring in place until LANL STR approves its removal.

3.10 SOIL COMPACTION AND TESTING

A. Control soil compaction during construction to provide the minimum percentage of density specified for each area as determined according to ASTM D 1557, Method A or D.

B. Where subgrade or layer of soil material must be moisture-conditioned before compacting, uniformly apply water to surface of subgrade or layer material to prevent free water appearing on surface during or subsequent to compacting operations.

C. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.

D. The allowable percent variation from optimum moisture is plus or minus 2 percent.

E. The paragraphs below identify location and compaction required as a percentage of maximum density and optimum moisture measured using ASTM D 1557.

1. Compact fill in 8 inch lifts that will be beneath concrete and asphalt structures to 95 percent of maximum density.

2. Compact fill in 8 inch lifts that will be beneath unpaved areas to 90 percent of maximum density.

3. Compact new aggregate base course that will be beneath asphalt structures to 95 percent of maximum density.

4. Compact pipe bedding to 90 percent of maximum density.

F. The Subcontractor shall employ an independent testing agency approved by LANL to perform testing and is responsible for the following:

1. Verify fill material to be placed is within the stated specifications, and laboratory testing is complete.

2. Verify that moisture-density relationship, ASTM D 1557, for each soil type to be placed is completed.

3. Determine field density of in-place material in accordance with any of the following methods:

   a. Nuclear Method, ASTM D 6938.

   b. Rubber-Balloon Method, ASTM D 2167.

   c. Sand-Cone Method, ASTM D 1556.

4. Determine field moisture content in accordance with either of the following methods:

   a. Nuclear Method, ASTM D 6938, or

b. Laboratory Determination, ASTM D 2216.

5. Frequency of Tests

   Testing shall be performed in all areas of fill, including but not limited to below and adjacent to new structures, areas of raising of grading, areas specifically intended for vehicular traffic and all utility and underground surface trenches.

   a. One test per 2000 square feet for each lift of compacted fill material or fraction thereof, but not less than 3 tests per 8 inches maximum for each lift.

   b. One test per 50 linear feet of trench per 8 inches maximum for each lift.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 31 2000 Rev. 5, dated January 25, 2011.

ATTACHMENT 1

Utility Protection Plan

Complete and receive approval from LANL STR before mechanically excavating within 18" of a fully-exposed underground utility line in accordance with this Specification.

Description of Utility:

____

____

____

Description of Installed Marking/Flagging Measures (e.g., tall flag-on-pole, plank, etc.):

____

____

____

Sketch:

Submitted by: ______________________________ (Subcontractor Name/Date)

Witnessed/Approved by: ______________________________ (LANL STR/Date)

SECTION 31 2323.33

FLOWABLE FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flowable fill (cement stabilized backfill).

1.2 RELATED SECTIONS

A. 31 2000 - Earth Moving

B. 03 3001 - Reinforced Concrete

1.3 SUBMITTALS

A. Submit the following in accordance with project submittal procedures.

1. Material certifications. A complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, [silica fume], ground slag, and admixtures; and applicable reference specifications shall be included in the mix design submittal. Provide design mixes and test reports.

2. Batch tickets.

3. Field test reports.

1.4 DESCRIPTION

A. Flowable fill is a self-leveling slurry of cement, fly ash, aggregates, admixtures, and water with low final strength so can be hand dug later.

B. Flowable fill may be used for trenches, pipe structures, fill for abandoned water and sewer lines, and other works where cavities exist and firm support is required.

C. The use of flowable fill around or adjacent to utility lines or structures shall be reviewed and approved by the appropriate LANL Utilities and Infrastructure system representative. Flowable fill shall not be around or adjacent to utility lines that have requirements for movement.

1.5 QUALITY ASSURANCE

A. When work or portions of work of this section are completed and require testing, notify the LANL Subcontract Technical Representative (STR).

B. Ensure all required cast-in-place concrete, embedment items, and utility work has been completed prior to placing flowable fill.

1.6 JOB CONDITIONS

A. Perform concrete washout, trucks and mixers, in a designated and controlled area to prevent the runoff of washout material and the co-mingling of unset concrete with storm water. Properly dispose of all hardened excess concrete.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement: ASTM C 150, Type I or Type II.

B. Fine and Coarse Aggregates: Conform to ASTM C 33. Provide a uniform mixture of fine aggregate or fine and course aggregate, as determined by ASTM D 422.

Aggregate Mixture Gradation Requirements

Sieve Size	Percent Passing
1 inch	100
3/8 inch	95 – 100
No. 4	80 – 100
No. 8	60 – 95
No. 16	45 – 80
No. 30	25 – 60
No.50	5 – 45
No. 100	5 – 35
No. 200	0 - 30

C. Water: Potable water that is clean and not detrimental to concrete.

D. Fly Ash: Conform to ASTM C 618, Class C or Class F.

E. Air Entrainment: Conform to ASTM C260. Air entrainment may be between 6 and 25 percent. Air entraining is not required for below grade installation in areas not subject to freeze/thaw cycles.

2.2 Proportioning and Physical Property Requirements

A. Provide a flowable fill mix design in accordance with the following limits:

1. Cement, maximum 50 lbs/yd3
2. Fly ash, from 150 lbs/yd3 to 300 lbs/yd3
3. Air content, optional
4. Slump, from 6 to 11 inches
5. Water/Cement ratio, proportioned by weight to produce a slump within limits.
6. Consistent aggregate throughtout the concrete mixture
7. Compressive strength will not exceed 150 psi at 28 days.

2.3 FLOWABLE FILL

A. Mix and deliver flowable fill in accordance with ASTM C94.

B. Use accelerating admixtures in cold weather only when approved by LANL STR. Use of admixtures will not relax cold weather placement requirements.

C. Use set retarding admixtures during hot weather only when approved by LANL STR.

D. Do not use calcium chloride as an admixture.

E. Add air-entraining agent if required to produce a flowable mix.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that all items of cast-in-place concrete, grading, trenching, and all utilities and other embedded items are in place prior to placing flowable fill.

B. Utilities that are subject to required movement (e.g., steam and condensate lines), shall not be embedded in flowable fill or otherwise have restricted movement.

C. Flowable fill shall not be used as a substitute for sand bedding or earth backfill for primary utilities unless approved by the LANL Utilities and Infrastructure system representative.

3.2 PREPARATION

A. Remove all loose material from the uneven tuff and the concrete structures.

B. Set elevation marks or otherwise determine the proper top elevation for the flowable fill.

3.3 PLACEMENT OF FLOWABLE FILL

A. Notify LANL STR a minimum of 48 hours prior to placement of flowable fill.

B. Flowable fill may be placed by direct discharge from the truck, by pumping, or by other approved methods.

C. The flowable fill shall be placed in a uniform manner that will prevent voids or segregation of the bedding and filling material. If required, the flowable fill shall be consolidated with internal vibrators.

D. Pipes, reinforcement, inserts, or other embedded parts shall be placed, supported, and secured in a manner that shall prevent the flowable fill from displacing, sagging, or from floating embedded items.

E. Flowable fill shall be brought up uniformly to the fill line shown on the plans. Formed walls or other bulkheads shall be constructed to withstand the exerted hydrostatic pressure and confine the material within a dedicated space.

F. Placement of flowable fill shall start only when weather conditions are favorable. The temperature shall be at least 35 degrees F and rising. Flowable fill shall not be placed on frozen ground or when it is raining.

3.4 CURING AND PROTECTION

A. Immediately after placement, protect flowable fill from premature drying, excessively hot or cold temperatures and mechanical injury.

B. The flowable fill shall not be subjected to load and shall remain undisturbed by construction activities for at least 24 hours after placement.

3.5 FIELD QUALITY CONTROL

A. Testing of flowable fill is not necessarily required. If testing is required, the Subcontractor shall provide a LANL approved, certified, independent testing agency to perform compressive strength test cylinders.

B. For field testing use a standard (15 lb) T-post driver to drive a #6 reinforcing bar with a flat end into the flowable fill material 24 hours after placement. Lift the driver until the bottom of the driver is even with a mark located 6 inches below the top of the rebar and then allow it to fall under its own weight. Remove and replace the flowable fill if fewer than 6 blows or more than 25 blows are required to drive the rebar 12 inches into the fill.

C. Provide unobstructed access to work and cooperate with appointed firm.

3.6 DEFECTIVE FLOWABLE FILL

A. Do not accept or place defective flowable fill that is not in conformance with acceptance criteria. Return the fresh flowable fill to the supplier.

B. Defective flowable fill is material having excessive honeycomb, embedded debris, higher than maximum compressive strength, or not conforming to required lines, details, dimensions, tolerances or specified requirements. Repair or replace defective flowable fill as directed by the LANL STR.

C. Replace flowable fill not in conformance with details, tolerances, and other construction requirements at Contractor's expense.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 31 2323.33, Rev. 4, dated December 23, 2009.

SECTION 32 3113

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fence framework, fabric, and accessories

B. Pedestrian and vehicle gates

C. Concrete

D. Electrical grounding

1.2 LANL PERFORMED WORK

A. Layout fence lines, gates, and terminal posts with suitable stakes (at intervals not exceeding 500 feet or line of sight).

B. Layout USC&G benchmarks, property monuments, and other underground structures with suitable stakes.

C. Obtain excavation/soil disturbance permit for Subcontractor.

D. Furnish signs for Subcontractor to install on fence. See Part 3.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01 3300, Submittal Procedures:

1. Catalog data on fabric, posts, accessories, fittings and hardware.
2. Two legible copies of batch tickets for each load of concrete to the LANL Subcontract Technical Representative (STR).

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle structural steel without damaging finish.

B. Deliver manufactured materials in original unopened packages, containers, or bundles with manufacturer's label intact and legible.

C. Store materials off ground, under cover, and away from damp surfaces.

D. Remove damaged unlabeled or unsatisfactory materials that do not meet this specification from the job site.

1.5 QUALITY ASSURANCE

A. Comply with the following unless otherwise noted.

Federal Specification RR-F
(http://www.dtic.mil/dtic/search/tr/)

191K	General Specification
191/1D	Fabric
191/2D	Gates
191/3D	Posts, Rails and Braces
191/4D	Accessories

American Society of Testing and Materials

ASTM F-552	Definition of Terms
ASTM F-567	Installation
ASTM F-626	Fence Fittings
ASTM F-669	Strength Requirements
ASTM F-900	Gate Construction
ASTM F-1083	Steel Pipe for Fence

PART 2 PRODUCTS

2.1 MATERIALS

A. Fabric: ASTM A392, Class 1, zinc coated (1.2 ounces), steel wire/fabric, 2 inch mesh size, 11-gage (0.120 inches) coated wire size, galvanized before weaving, with twisted barbed selvages top and bottom.

B. Posts, Rails & Braces: ASTM F1083 galvanized steel pipe.

C. Galvanizing: ASTM A123, unless otherwise indicated, provide hot-dipped, zinc-coated accessories of ferrous material with weight of zinc coating not less than 1.2 ounces per square foot.

D. Fence Fittings: ASTM F626, Standard Specification for Fence Fittings, type and components as noted.

2.2 BASIC FENCE SYSTEM COMPONENTS

A. Terminal Posts: (Angles, corners, ends, and pull posts) 2-1/2 inch Schedule 40 for fence height up to 8 feet and 3 inch Schedule 40 for fence height over 8 feet and equal to or under 16 feet.

B. Line Posts: 2 inch Schedule 40 for fabric height up to 8 feet, 2-1/2 inch Schedule 40 for fabric height over 8 feet and equal to or under 16 feet.

C. Braces at Terminal or Gateposts: 1-1/4 inch Schedule 40.

D. Tension Rods: 3/8 inch diameter galvanized steel with turnbuckle end-fitting-type tighteners.

E. Tension Wire: 7-gage coil spring, hard tempered carbon steel wire.

F. Tension Bars: 3/4 x 1/4 inch thick galvanized steel.

G. Tension Bands: 3/4 x 1/10 inch (nominal) galvanized steel offset bands.

H. Brace Bands: 3/4 x 1/10 inch (nominal) thick galvanized steel.

I. Brace Ends: Cupped fittings of formed steel or cast iron with ears for attaching horizontal braces to brace bands and for connecting diagonal tension rods.

J. Wire Ties: Galvanized, steel with a diameter of at least 0.148 inches.

K. Post Caps: Formed steel, malleable cast iron, or aluminum, sized to post diameter, with set screw retainer.

L. Hog Rings: 10 gage steel, galvanized.

M. Gate Posts:

1. Gate leaf-widths up to 6 feet: 2-1/2 inch Schedule 40.

2. Gate leaf-widths up to 12 feet: 3-1/2 inch Schedule 40.

3. Gate leaf-widths up to 18 feet: 6 inch Schedule 40.

4. Gate leaf-widths up to 23 feet: 8 inch Schedule 40.

N. Gate Frames:

1. Gate leaf-widths less than 10 feet: 1-1/2 inch Schedule 40.

2. Gate leaf-widths 10 feet to 16 feet: 2 inch Schedule 40.

3. Gate leaf-widths greater than 16 feet: 2 inch Schedule 80.

4. Diagonal tension rods for leaf-widths over 6 feet.

5. For gate leaves greater than 8 feet in any direction, provide intermediate braces placed symmetrically so that frame members, including bracing, are spaced not further than 8 feet. Provide braces same size as those called out for fence.

O. Provide non-lift-off type gate hinges sized for gate of adequate strength with large rearing surface for clamping in position so that hinges do not easily twist or turn with gate action.

2.3 FENCE GROUNDING

A. Grounding Cable: No 4/0 AWG bare, stranded, soft temper copper cable conforming to ASTM B8, Standard Specification for Concentric-Lay stranded Copper Conductors.

B. Flexible Braid: Tinned copper braid with tinned copper ferrules; minimum 250 ampere rating; 12 inch minimum length. O-Z/Gedney Type FB

C. Cable to Pipe Clamps: NRTL (National Recognized Testing Laboratory) listed copper alloy connectors with silicon bronze hardware for making cable to pipe connections.
O-Z/Gedney Type ABG 1-1/2 inch and smaller, Type CG 2 inch and larger pipe diameter.

D. Flexible Braid to Pipe Clamps: NRTL listed copper alloy connectors with silicon bronze hardware for making braid or copper bar to pipe connections. O-Z/Gedney Type RG.

2.4 CONCRETE

A. Concrete: Furnish concrete for posts and braces in accordance with Section 03 3053, Miscellaneous Cast-In-Place Concrete.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify LANL STR 10 working days prior to start of construction to identify known utilities and stake and flag locations.

B. Before installing chain-line fence, perform site clearing and grading as noted on Drawings.

C. Allow footing to cure minimum 7 days before installing fabric and other materials.

3.2 LATCHES

A. Single gates less than 10 feet wide may use forked type latches.

B. Provide single gates, 10 feet, or more, wide, and inactive leaves of double gates with positive latching devices at top, bottom and center of closing edges such as fork type latches with full gate height plunger bar or rod.

C. At double gates, provide locking devices that retain both gate leaves in same plane when closed.

D. Arrange plunger bars and rods so that they engage gate stops and cannot be raised when locked.

E. Rigidly weld brackets for plunger bars holders to inactivate leaves.

F. Arrange latching mechanisms at double gates so one padlock can lock both gate leaves at center latch integral to gate.

G. Install keepers consisting of a mechanical device for securing free end of gate when in full open position.

3.3 POSTS

A. Space line posts equidistant at intervals not exceeding 10 feet. Measure interval parallel to grade of proposed fence and in line of fence from center to center of post.

B. Set terminal posts (end, corner, and gate) at beginning and end of each continuous length of fence and at abrupt changes in vertical and horizontal alignments.

C. Set fence and gate posts in concrete in holes of diameter and depth as follows:

1. Minimum Diameter: Four times outside diameter of post.
2. Minimum Depth: 36 inches plus an additional 3 inches for each 1 foot increase in fence height over 4 feet.

D. Set posts in a vertical position, plumb and in line. Backfill concrete into excavation and extend 2 inches above grade. An alternative method is to stop footing 2 inches below grade to allow for cover with sod, black top, or other materials. Crown concrete at top to shed water and extend minimum of 2 inches below bottom of post.

E. When solid rock or concrete is encountered, without an overburden of soil, set posts in solid rock or concrete. Depth of hole shall be twelve times the largest cross section of posts. Diameter of hole shall be 6 inch greater than largest cross section of post.

F. The use of sleeves in order to leave voids in new concrete construction is recommended.

G. Half-fill the void with non-shrinkable hydraulic cement and force post to bottom of hole and plumb. Thoroughly work additional grout into hole so as to leave no voids. Crown grout to shed water.

H. Provide tension offset bands fitted around terminal posts at maximum 15 inch intervals to attach tension bars to posts.

I. Provide brace center band to secure brace ends and tension rods to post.

3.4 FABRIC

A. Place chain-link fabric on outside of area enclosed. Locate posts, bracing, and other structural members on inside of secured perimeter.

B. Place fabric by securing one end, applying sufficient tension to remove slack before making attachment elsewhere. Tighten fabric to provide smooth uniform appearance free from sag.

C. Cut fabric by untwisting a picket and attach each span independently at terminal posts. Use stretcher bars with tension bands at maximum 15-inch intervals or any other approved method of attachment.

D. Install fence fabric 2 inches maximum above ground level. Fasten fabric to line posts at intervals not exceeding 15 inches. Fasten fabric to rail or tension wire at intervals not exceeding 24 inches.

E. Join rolls of wire fabric by weaving a single picket into ends of rolls to form continuous mesh.

F. Provide continuous length tension bars equal to fence height and located wherever chain link fabric end attaches to terminal post. Thread bars through fabric ends for full height, and attach to posts by tension bands.

G. Provide wire ties for attaching chain link fabric to tension wires at maximum 18 inch centers and fence posts at maximum 24 inch centers.

3.5 NOT USED

3.6 NOT USED

3.7 GATES

A. Install gates true to opening and plumb in closed position.

B. Hang gates so that bottom of gate is as close to ground as practical (2 inches max.) while allowing sufficient clearance for free operation through at least 90 degree in one direction from closed position.

C. Fasten gate fabric to vertical (end) gate frame members using tension bars and bands as for fence fabric. Fasten fabric to top and bottom gate frame members and to intermediate braces with 11 gage wire ties or clips at minimum spacing of 14 inches on center.

D. Extend end frame members 18 inches vertically above top member of gate frame to support barbed wire.

E. Provide tension rods as diagonal braces on gates and secure rods at gate corner only.

3.8 TOP TENSION WIRE AND RAIL

A. Provide bottom tension wire and stretch wire from end to end of each stretch of fence at height that will enable it to be fastened to fabric. Requirement for top tension wire shall be determined and directed by LANL.

B. Stretch tension wire taut (not to exceed 6 inches sideway deflection) between terminal posts for securing fence fabric within 2 inches of [top and] bottom with hog rings at 18 inches on center, secure with wire ties to every third post minimum.

C. Provide top rail and support at each post so that a continuous brace from end to end of each stretch of fence is formed. Securely fasten top rail to terminal posts and join with sleeves or coupling to allow for expansion and contraction.

3.9 GENERAL REQUIREMENTS

A. Once in place, peen or spot-weld fence hardware to prevent easy removal.

B. Coat damaged galvanized finish with zinc-enriched paint.

C. Leave area of installation neat and free of debris caused by erection of fence.

3.10 ELECTRICAL GROUNDING

A. Bond gateposts on both sides of gate openings using direct buried grounding cable and cable to pipe clamps. Bond gateposts to gates using flexible braid and flexible braid to pipe clamps. Ground posts on both ends of gates; steel posts set in concrete will be considered as adequately grounded.

B. Ground permanent metallic fences crossed by overhead power at every third post for a distance of 50 feet from the crossing; chain link fences with steel post set in concrete will be considered as adequately grounded.

C. Ground metal fences surrounding substations and switching stations to station ground system in accordance with the National Electrical Safety Codes and IEEE Std. 80.

3.11 EXCAVATION, BACKFILL, AND COMPACTION

A. Refer to Section 31 2000, Earth Moving.

3.12 SIGN INSTALLATION (GFE)

A. Install government furnished property signs, structure signs or no trespassing signs in areas as indicated by the LANL STR.

B. Signs will generally be 24"x 24" or smaller and shall be attached to the wire fabric by the use of, as specified, hog rings.

C. General sign locations will be located on all gates, 25 feet each side of gates, trail crossings, and at visible distances along the fence line, not to exceed 300 feet or as directed by the LANL STR.

D. Government furnished sign intended to be installed on pump house enclosure shall be located and attached as determined and directed by the LANL STR.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 32 3113 Rev. 2 dated August 13, 2009.

SECTION 33 0513

MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Precast concrete manhole sections and manhole frame and cover castings.

1.2 RELATED REQUIREMENTS

A. Section 31 2000, Earth Moving

B. Section 33 3200, Wastewater Utility Pumping Stations

1.3 LANL PERFORMED WORK

A. LANL Utilities and Infrastructure group (U&I) will tie into existing systems which include sanitary sewer lines, holding tanks, septic tanks, treatment plants, lift stations, and sewer manholes.

B. LANL Subcontract Technical Representative (STR) will coordinate required inspections and tie-ins.

1.4 SUBMITTALS

A. Submit the following in accordance with project submittal procedures:

1. Certifications: Furnish copies of materials certificates certifying that each material item complies with, or exceeds, specified requirements.
2. Level alarm system product data and installation instructions.
3. Submit manhole exfiltration test results within 5 working days of successful test.

PART 2 PRODUCTS

2.1 SUBSTITUTION LIMITATIONS

A. Alternate products may be accepted; follow Section 01 2500, Substitution Procedures.

2.2 MATERIALS

A. Provide precast concrete manhole sections (base barrel sections, risers and conical/eccentric tops, flat slab tops, grade rings, etc.) per ASTM C478 and the Drawings.

1. Concrete: Compressive strength of 4000 psi for 28 days.
2. Manhole: Provide 4 foot diameter manhole. Diameter furnished is dependent on depth, pipe size, number of inlet pipes, and if drop manhole.

B. Manhole Frame and Cover

1. Provide castings true to patterns in form and dimension, and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Provide castings with fillets at angles with sharp and true risers.
2. Provide castings conforming to ASTM A48, Class 30B.
   a. Machine or grind bearing surfaces of the frames and covers to furnish a uniform, flat, non-rocking seat for the cover on the frame.
3. Provide water tight and sealed cover.

C. Sealing Gasket (precast manhole or tank sections): Mastic Gasket as manufactured by RAM-NEK or Kent Seal.

D. Pipe Waterstop: Provide waterstop grouting ring for watertight connection between manhole wall and pipe, resilient rubber with stainless steel bands. Conform to physical property requirements of ASTM C 923 and ASTM C 1478. Manufacturer: Trelleborg – NPC – Waterstop Grouting Ring with NPC – Corrugated Pipe Adapter as applicable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Compact soil foundations for manhole base or tanks to a density of 95 percent of the maximum density per ASTM D 1557. Compaction shall be minimum 1 foot beyond perimeter of concrete base and shall be a minimum of 1 foot in depth.

B. Invert elevation of pipes entering or exiting manhole or tanks and interior inverts shall not vary more than 0.05 foot from the elevations shown on the Drawings.

C. Use concrete per Section 03 3053, Miscellaneous Cast-In-Place Concrete, for formed-in-place foundations or bases, concrete shelves, and pipe supports.

D. Depending on size of pipe, make connections to existing and new manholes by either core drilling through manhole wall (perform for new precast units), or carefully chipping wall segment. Take care to avoid unnecessary damage to manhole surfaces or walls.

E. Install waterstop grout ring before placing high strength, non-shrink grout around piping in concrete manhole or tank wall. Refer to Section 3.7 regarding requirement for coating of interior surface of concrete manhole.

F. Set the manhole level and plumb.

3.2 MANHOLES

A. The vertical riser sections of manhole may be of different dimensions in order that manholes of various depths can be readily assembled.

B. Install circular precast manhole sections with sealing gasket to seal joints between sections. Clean joints prior to installation. Entire width of joint shall receive a layer of sealing gasket.

C. Fill lifting holes and gaps at joints with a non-shrink grout.

D. Precast concrete manhole bases may be used when approved by a LANL Utilities & Infrastructure Group wastewater system representative. If approved, it is with the understanding that placing the bases at the specified elevation, location, and alignment is the Subcontractor's responsibility.

3.3 NOT USED

3.4 GRADE RINGS

A. Use mastic and/or grout to lay grade rings to provide watertight seal and for the prevention of displacement of rings.

B. Grade rings shall remain plumb and vertically aligned during backfilling and paving operations.

3.5 MANHOLE FRAME AND COVER

A. Provide ductile iron castings as shown on the Drawings and as specified herein. The castings shall include manhole frames and covers.

B. Seal between grade ring and frame with mastic and/or grout to provide watertight seal and for the prevention of displacement of rings and frame.

3.6 NOT USED

3.7 TESTING OF MANHOLES

A. Test manholes for leakage by a water exfiltration test. Submit test reports to the LANL STR. Perform test prior to backfilling around manhole and prior to placement of manhole frame and cover. Properly plug inlet and outlet lines and fill and seal lift holes and barrel joints as specified. In lieu of water exfiltration testing the manhole interior can be coated with a two part, high build epoxy lining with 100% solids by volume. Material shall have chemical resistance and be designed as a structural lining for manholes and vessels in wastewater facilities. Preparation of surface and application of product shall be per the manufacturer's instructions. If manhole(s) fail two exfiltration tests, the manhole(s) shall be spraylined to specifications.

1. Manufacturer: Raven Lining Systems.

B. Furnish all materials and equipment necessary to perform test and conduct test in the presence of the LANL Inspector. Allow a stabilization period of 1 hour for absorption, after which, refill manhole as necessary before starting test. Perform test for a period of 2 hours, after which refill manhole, measuring necessary quantity of water. The difference in water surface elevation from original to final level shall be measured and converted to gallons per hour lost through manhole leakage. An allowable leakage is allowed and is represented by the following formula:

$$V = 0.20\ DHT$$

Where: V = Allowable loss in gallons

D = Manhole diameter in feet

H = Initial depth of water to invert in feet

T = Duration of test in hours

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 33 0513 Rev. 5 dated February 24, 2011.

SPECIFICATIONS

FOR

ZERO LIQUID DISCHARGE SUBPROJECT

AT THE

LOS ALAMOS NATIONAL LABORATORY

PROJECT IDENTIFICATION NUMBER 100761

TECHNICAL AREA TA-52

EVAPORATION TANKS / PIPING

PREPARED BY

BURNS AND ROE ENTERPRISES

800 KINDERKAMACK ROAD

ORADELL, NJ 07649

100761-11-000090

1.7 Management Level ML-1 ☐ ML-2 ☐ ML-3 ☒ ML-4 ☐

1.8 Nuclear Functional Classification SC ☐ SS ☐ DID ☐ Not Safety Related ☒

	Name	Signature	Date
1.9 Submitted by:			
1.10 LANL Acceptance			

1.11 Derivative Classifier Review

Classification: UCNI ☐ OUO ☐ Classified ☐ Unclassified ☒

Name	Z Number	Signature	Date

: 05072

ZERO LIQUID DISCHARGE SUBPROJECT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

SPECIFICATIONS, MECHANICAL

EVAPORATION TANKS / PIPING

Prepared For:

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Building 21, Suite 350
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Prepared By:

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Revision	Date	Issued For	Prepared By Print/Sign/Date	Technical Approval Print/Sign/Date	Project Approval Print/Sign/Date
A	7/13/2011	60% Design Review	Stephen Stuhrke SPStuhrke	Al Cesnavicius A. Cesnavicius	Norman Lacy

05073

Design Professional Seal Mechanical	*Burns and Roe Enterprises, Inc. (BREI)* *Professional seal applies to the following specification sections:*
	01 2500 Substitution Procedures 01 3545 Water Discharge Requirements 01 4455 Onsite Welding & Joining Requirements 09 9100 Painting 22 0529 Hangers and Supports for Piping and Equipment 22 0713 Piping Insulation 22 0813 Testing Piping Systems 40 0527 Piping and Tubing Inspection Checklist

TA-52 ZERO LIQUID DISCHARGE SUBPROJECT

EVAPORATION TANKS / PIPING

SUBCONTRACTOR SPECIFICATIONS INDEX

SECTION 01 2500

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 RELATED SECTIONS

A. 01 3300 Submittal Procedures

1.2 SUBSTITUTIONS

"Or approved equal" is always implied after a brand name, patented process or catalog number. The Subcontractor may substitute any brand or process approved as an equal by the specifying Architect/Engineer through the submittal process. The only exception is where "no substitution" is specified. See General Provision "Material and Workmanship".

A. Non-Structural Systems and Components, and Non-Building Structures

1. If the Subcontractor wants to substitute an "equal" architectural, mechanical or electrical system or component, or non-building structure, the component/structure should also be reviewed by the design structural engineer for anchorage and support.

a. If and when approved, the design structural engineer shall make any necessary anchorage and support revisions to the construction specifications and drawings associated with the equal component/structure.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 01 2500 Rev. 1, dated April 14, 2008.

SECTION 01 3545

WATER DISCHARGE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements of Subcontractor and LANL Subcontract Technical Representative (STR) when there is a planned or accidental discharge of water, including those not covered by a NPDES permit, Ground Water Discharge Plan, or approved Notice of Intent (NOI).

1.2 RELATED SECTIONS – NOT APPLICABLE

A. Section 22 0816, Disinfection of Potable Water Piping

1.3 DEFINITIONS

A. Discharge: Release of water to environment or sanitary sewer system due to an accidental spill or planned construction activity, e.g., flushing, piping disinfection, chemical water treatment of piping systems, hydrostatic piping tests, etc.

B. Best Management Practices (BMPs): Schedules of activities, prohibition of practices, maintenance procedures, and other management practices to prevent or reduce pollution of waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control facility site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. Physical practices to control facility site runoff can be, but are not limited to silt fences, graveled construction area entry/exit points, dikes, berms, wattles, ground covers, reduced discharge rates, armoring, or other such methods emplaced to eliminate erosion or transport by water of soil or other contaminants.

1.4 SUBCONTRACTOR REQUIREMENTS

A. Discharges to Environment:

1. Discharges shall not cause or have the reasonable potential to cause or contribute to a violation of a water quality standard.

2. Employ Best Management Practices (BMPs) to prevent erosion from discharge of water.

3. Chlorinated water used for disinfection shall be dechlorinated with a neutralizing agent per Section 22 0816 prior to discharge. If discharge is not to a watercourse (e.g., flat ground), then total chlorine concentration shall be reduced to less than 1 ppm (part per million) -- *typically the same as that in the Safe Drinking Water Act.*

4. Discharges to a watercourse shall have a total chlorine concentration not greater than 0.011 mg/L (11 parts per billion). *(This value is based on 1999 changes in the New Mexico stream standards that dropped chlorine limit from 1 ppm to 11 ppb).*

5. For discharges of less than 5000 gallons, notify LANL STR at least five (5) working days in advance of the planned discharge.

6. For discharges of 5000 gallons or more, notify LANL STR at least thirty (30) working days in advance of the planned discharge.

B. Sanitary Sewer Discharges:

1. Notify LANL STR prior to any discharge.

2. Volumes greater than 1000 gallons shall not be discharged into the sanitary sewer systems without special approval by Sanitary Wastewater Operations Manager (665-7855) obtained via LANL STR.

3. Properly characterize discharges through LANL waste profile form (WPF) process and meet the TA-46 Wastewater Treatment Plant Waste Acceptance Criteria (WAC), Refer to https://policy.lanl.gov/pods/policies.nsf/MainFrameset?ReadForm&DocNum=P930-1&FileName=P930-1.pdf especially Attachment 16.

    a. WAC limits for total chlorine concentration are 3 mg/L (3 ppm). De-chlorinate water used for disinfection in excess of 20 gallons with neutralizing agent per Section 22 0816 prior to discharge.

C. Notify LANL STR immediately in the event of any accidental or unplanned discharge.

1.5 LANL SUBCONTRACT TECHNICAL REPRESENTATIVE REQUIREMENTS

A. Discharges to the Environment:

1. Keep a written record of each discharge by project. For planned discharges of less than 5000 gallons, notify the LANL Water Quality and RCRA Group (ENV-RCRA) five working days prior to the discharge. Following ENV-RCRA approval complete and return attached form "General Discharge Record" (Attachment 1) to Jacob Meadows (Email:jmeadows@lanl.gov or Fax: 665-

9344) at ENV-RCRA. Discharges will be documented and submitted to NMED in LANL's Quarterly Discharge Report.

2. For planned discharges of 5000 gallons or more, notify the LANL ENV-RCRA Group at least thirty (30) working days in advance of the planned discharge. ENV-RCRA will review the proposed discharge to determine if submittal of an NOI is required. If required ENV-RCRA will develop and submit the NOI to NMED (NMED has up to thirty (30) working days to respond). ENV-RCRA will coordinate with an ENV-EAQ review for potential impacts to critical habitat and Threatened and Endangered Species.

B. Sanitary Sewer:

1. Assist Subcontractor with characterizing discharges using LANL Waste Profile Form (WPF) process and meeting the TA-46 Wastewater Treatment Plant Waste Acceptance Criteria (WAC) described in 1.3 above.

2. Notify Sanitary Wastewater Operations Manager (665-7855) at least five (5) working days in advance for approval of planned discharge into sanitary waste water system.

C. Notify the LANL ENV-RCRA Group immediately in the event of any accidental or unplanned discharge.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 01 3545, Rev. 4, dated December 23, 2009.

NOTICE OF INTENT TO DISCHARGE
GENERAL DISCHARGE RECORD

LOCATION: TA: ______________________ **BLDG:** ______________

FIRE HYDRANT / PIPE / SECONDARY CONTAIMENT / MANHOLE #: ______________________

USER GROUP: ________________ **CONTACT PERSON:** ______________

PHONE: ______________________ **PAGER:** ______________

PERSON CONDUCTING SECONDARY CONTAINMENT DRAINAGE ACTIVITY: ______________

DATE and TIME of DISCHARGE: ________________ / ________________

DURATION of DISCHARGE: ________________ / ________________

ENV-RCRA CONTACT: **Mark Haagenstad, 665-2014**
or Jacob Meadows, 606-0185 **FAX : 665-9344**

DESCRIPTION of DISCHARGE: ______________________________

____

____

VOLUME of DISCHARGE: ______________________________

CANYON AFFECTED: ______________________________

SAMPLES TAKEN: **YES:** ________ **NO:** ________

COMMENTS: ______________________________

____

____

____

REVIEWED BY: ______________________________ **DATE:** ______________
ENV-RCRA

SECTION 01 4455

ONSITE WELDING & JOINING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for welding and joining on the LANL site as required by other sections of the Specification, consensus codes and standards, and/or engineering design.

B. Pressure-retaining code-stamped items shall only be welded on by organizations with the applicable ASME or National Board Certificate(s) of Authorization. Certificate holders are organizations that have been authorized by the ASME to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code.

1.2 "WELDING CHECKLIST" – A "Welding Checklist" shall be completed prior to onsite welding to assure that the specific requirements for welding activities have been identified and addressed. The "Welding Checklist" can be found at: http://www.lanl.gov/orgs/eng/engstandards/ESM_Ch13.shtml#checklist

1.3 DESIGN - Design of welded structures, systems and components (SSC) shall meet the requirements of LANL ESM and as a minimum identify applicable codes and standards including requirements of graded application. For welding activities that would normally fall outside the defined scope of specified national consensus codes and standards for fabrication and welding, such codes and standards shall be adopted and used to the extent possible.

Any welding for Zero Liquid Discharge project work shall be in accordance with the following code and service category:

- *ASME/ANSI B31.3 – Service Categories, D*

A. Shop drawings must show weld symbols and requirements to define the work and enable design review and inspection.

B. Applications that are not similar in materials or processes to a specified code or standard shall define and produce the following:

1. Design basis; i.e., mechanical properties, part geometry, acceptance criteria.
2. A method to verify that the welding procedure can produce acceptable welds

3. A method to demonstrate that the welder has the skill to produce sound welds in accordance with the specified welding procedure (reference GWS 1-02, *Administrative Control of Welding and Brazing, para 5.3.B*)
4. Identify methods and perform inspections, required to judge welds against predetermined acceptance criteria.
5. Provide documentation that these objectives have been defined and identified.

1.4 QUALIFIED PROCEDURES – Welding and brazing shall be performed in accordance with LANL approved welding/brazing procedure specifications (WPS/BPS) that have been qualified in accordance with applicable codes and standards or design criteria:

A. LANL-approved welding/brazing procedure specifications are located at: http://engstandards.lanl.gov/ESM_Ch13_specs.shtml

B. AWS/ANSI Standard Welding Procedure Specifications and written Prequalified Welding Procedure Specifications as allowed by applicable codes and standards may also be used if approved by the LANL Welding Program Administrator.

1.5 JOINING (solvent bonding, adhesive, and electro-fusion joints): When required by consensus codes and standards (e.g., ASME/ANSI B31.3 & 49 CFR Part 192), joining shall be done by LANL qualified personnel following LANL approved procedures.

1.6 CERTIFIED PERSONNEL - Welding and brazing shall be performed by LANL-certified welders and brazers who have demonstrated their welding/brazing skill by test at LANL.

A. Current listing located at http://zirk.lanl.gov/Welding_Prod/engstandard.aspx

1.7 CONTROL OF CONSUMABLES - Consumable welding materials shall be properly procured, received, stored, controlled, and issued to ensure weld quality and prevent use by unqualified personnel.

A. The procedure for procurement, storage, issue and control of consumables is found in ESM, Chapter 13 Welding & Joining, Volume 1, General Welding Standard (GWS) 1-03. 1-03, Welding & Brazing Material Procurement & Control

B. Filler material shall be procured with Certified Material Test Reports (CMTRs) traceable by heat/lot #.
   1. CMTRs shall meet the requirements of LANL Welding Program GWS 1-03 Attachment 5, *Filler Material Procurement, Table 1, Sch. I, Required Test,* located at: http://engstandards.lanl.gov/esm/welding/vol1/GWS%201-03-Att-5-R2.pdf
   2. Structures, systems and components (SSC) which are designated ML-1, ML-2, safety class, or safety significant shall have CMTRs for welding consumables that are traceable by heat/lot # to the weld in which they were consumed.

C. Filler materials shall be issued from approved locations by authorized personnel to qualified welders.
   1. Authorized filler material issue stations are listed at: http://zirk.lanl.gov/Welding_Prod/RO_FMAttendant.aspx

1.8 WELDING INSPECTION - shall be performed by qualified personnel in accordance with applicable consensus codes and standards and as specified in the design documents.

A. Inspector Qualification/Certification – Welding inspectors are required to be approved by LANL to perform visual and NDE inspection/examinations. LANL-approved inspectors can be found at: http://zirk.lanl.gov/Welding_Prod/RO_Inspector.aspx

B. Welding Inspections required by consensus codes and standards or design shall be documented. Welding inspection reports shall identify at least the following:
   1. Method, type, and extent of Inspection or test
   2. Acceptance/rejection as based on the criteria specified by the design documents
   3. Code or standard used for acceptance and class, category, or service
   4. Record attributes inspected and severity
   5. Identification and location of welds inspected
   6. MT&E – Identification and date of calibration expiration for measuring and test equipment used
   7. Name & date of person who performed the inspection
   8. Inspector's qualification level

C. Inspection Procedures - When inspection procedures are required by the referenced code & standards procedures shall be reviewed and approved by a LANL Level III inspector in the applicable inspection method
   1. NDE Procedure Qualification Records - When inspection procedures are required to be qualified by the referenced code & standard procedure qualification records will be reviewed and approved by a LANL Level III inspector in the applicable inspection method.

D. Inspection results, including weld maps, shall be documented and provided to the project managers within one day after completion of associated inspection work.

E. When applicable codes and standards specify two levels of inspection, the qualification of the owner's inspector and inspections will be done by LANL as specified in ESM, Chapter 13, Volume 1, GWS 1-02 Para. 5.9 see: http://engstandards.lanl.gov/esm/welding/vol1/GWS%201-02_Procedure-R6.pdf

F. LANL reserves the right of access to all welding locations and to have its own qualified inspectors and personnel present during all welding activities.
   1. At least five (5) working days notice is required prior to inspection & testing activities planned by the fabricator so that LANL can arrange for its staff's participation.
   2. Hold Points may be identified in the construction/fabrication schedule to allow for LANL's inspection activities.

1.9 SUBCONTRACTED WELDING

A. Subcontracted welding activities shall have all specifications and drawings and their applicable requirements flowed down to any sub-tier who is to perform those welding activities.

B. Requirements for subcontracted welding shall be identified in subcontract documents as outlined in GWS 1-09, *Control of Subcontracted Welding.*

1.10 RECORDS

A. The following documents shall be collected and maintained in the project files:
1. Welding/brazing/bonding procedure specifications used
2. Welder/brazer/bonder performance qualification records
3. Weld Material Requests (yellow copy)
4. CMTRs of filler material traceable to weld in which consumed for ML-1, ML-2, safety class, and safety significant SSC
5. Heat treatment charts or records
6. Inspection reports
7. Inspector qualification records
8. Inspection procedures

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 01 4455 Rev. 0, dated September 1, 2009.

SECTION 09 9100

PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation, painting, and finishing of exposed interior and exterior items and surfaces, including touch-up painting on prefinished items. Surface preparation, priming, and finish coats specified in this section are in addition to shop-priming and surface treatment specified under other sections.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory finish applied.

B. Surfaces To Be Painted

1. Paint all exposed surfaces whether or not colors are designated in Articles 3.6 and 3.7, except where surface or material is specifically indicated not to be painted or to remain natural.

2. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces.

3. If color or finish is not designated, the Subcontract Technical Representative (STR) will select from standard colors or finishes available.

4. Surfaces listed in Articles 3.6, 3.7 and 3.8, other than those listed in Sub articles 1.1 C and D, will receive the surface preparation, paints, and number of coats prescribed in the schedule.

5. Paint existing work where specified.

6. Electrical items to be painted include conduit, fittings, cabinets, panels, enclosures, junction and pull boxes, hangers and other associated Electrical items which are in "Public Spaces" and are therefore visible to the building occupants. Painting shall not obscure manufacturer's labels or additional nameplates, nor conduit color banding, nor other identification. Surfaces that are galvanized shall not be painted.

7. Mechanical items to be painted include, but are not limited to:

a. Color coat exposed piping, vessels and equipment rooms per Part 3.

b. Paint exposed piping, ductwork and hangers and supports in occupied areas to match adjacent surfaces. HDPE pipe located outdoors shall not be painted unless it does not have UV inhibitors.

c. Paint exterior piping, uninsulated ductwork, and equipment to match the building exterior.

d. It is preferred that exterior equipment be factory finished with a color that blends with the building colors. Provide available color samples with equipment submittals.

C. Surfaces Not Requiring Painting (As Applicable)

1. Prefinished items including the following factory-finished components:

a. Metal toilet enclosures, unless otherwise specified

b. Acoustic materials

c. Architectural woodwork and casework

d. Finished mechanical and electrical equipment

e. Switchgear

f. Distribution cabinets

g. Metal roofing

h. Galvanized components of prefabricated metal buildings

i. Factory painted mechanical equipment with approved finishes.

2. Concealed surfaces including wall or ceiling surfaces in unfinished spaces.

a. Foundation spaces

b. Duct shafts

c. Elevator shafts

3. Factory finished surfaces such as:

a. Anodized aluminum

b. Stainless steel

c. Chromium plate

d. Glass

e. Bronze and brass

4. Operating parts including moving parts of operating equipment such as the following:

   a. Valve and damper operators

   b. Linkages

   c. Sensing devices

   d. Motor and fan shafts

   e. Regulators, controls, instruments.

5. Electrical conduit, boxes, panels and other associated electrical equipment located in Mechanical or Electrical equipment rooms, above ceilings, in chases, in basements or in other locations where they are not normally visible to the building occupants, unless otherwise specified.

D. Surfaces For Which Painting Is Prohibited:

1. Sprinkler heads.

2. Heat and smoke detectors.

3. Pre-painted Electrical equipment in equipment rooms including Lighting Inverters, VFCs, MCCs, Switchboards, Fire Alarm and Facility Control System (FCS) panels. (Exception – to touch up existing paint damaged during installation or other construction).

4. Conduit color banding or other identification.

5. Equipment in hazardous (classified) locations.

6. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

7. Concealed auto-releasing sprinkler head covers (i.e.; escutcheon plates).

8. Glass, brass, or chrome plated portions of fire protection system control valves (i.e., PIVs, gate valves) hydrants and fire department connections. (Reference NFPA 13 and Section [21 1313 Wet-Pipe Sprinkler Systems], [21 1316 Dry-Pipe Sprinkler Systems], [21 1319 Preaction Sprinkler Systems], [21 1326 Deluge Fire-Suppression Sprinkler Systems], [21 1339 Foam Water Systems], [21 2200 Clean Agent Fire-Extinguishing Systems]).

1.2 REFERENCES

A. Abbreviations and Acronyms

1. GS – Green Seal

2. LEED – Leadership in Energy and Environmental Design

B. Definition: The term "paint" as used herein includes emulsions, primers, enamels, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Standard coating terms defined in ASTM D 16 apply to this section.

C. Reference Standards

1. ASTM

a. D 16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.

2. National Fire Protection Association (NFPA)

a. NFPA 13, Standard for the Installation of Sprinkler Systems

3. Code of Federal Regulations (CFR)

a. Title 29 Part 1910, Labor - Occupational Safety and Health Standards

b. Title 29 Part 1926, Safety and Health Regulations for Construction

4. Green Seal (GS)

a. GS-11, Paints

b. GS-47, Stains and Finishes

1.3 SUBMITTALS

A. Action/Informational Submittals:

1. Product Data: Manufacturer's catalog data, label analysis, volatile organic compound (VOC) content, and application instructions for each material proposed for use.

a. List each material and cross-reference the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.

b. Samples for initial color selection shall be in the form of manufacturer's color charts.

2. Qualification Data: For applicator per Paragraph 1.4.D.

3. Samples: For each color specified, apply a complete liquid glaze coating system to representative samples of the actual substrate to be used in the work and submit for approval. The approved sample panels will be used for quality control in applying the glaze coating system.

a. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.

b. Submit samples on the following substrates for the STR's review of color and texture only:

1. Ferrous Metal: Provide two 4 inch x 4 inch samples of flat metal and two 8 inch long samples of solid metal for each color and finish.

B. Sustainable Design Submittals

1. Certificate of compliance for specified post-consumer content.

2. List the VOC content of each product.

C. Maintenance Material Submittals

1. Extra Stock Materials

a. Provide one (1) extra gallon of each type, color, and surface texture to LANL.

b. Label each container with color, texture, room locations, in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer of the finish coats.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total coating systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the STR of problems anticipated using the materials specified.

C. Material Quality: Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification are not acceptable.

1. Proprietary names used to designate colors or materials are not intended to imply that products named are required, or to exclude equal products of other manufacturers.

D. Applicator Qualification: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this project, whose work has resulted in applications with a record of successful in-service performance on a minimum of five projects.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name, label, and the following information:

1. Product name or title of material

2. Product description (generic classification or binder type)

3. Manufacturer's stock number and date of manufacture

4. Contents by volume, for pigment and vehicle constituents

5. Thinning instructions

6. Application instructions

7. Color name and number

8. VOC content

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 Degrees F. Store all flammable materials not in use in Underwriter's Laboratories, Inc., NFPA or other approved flammable storage cabinet. Reference OSHA 29 CFR 1926 if storage of combustible or flammable liquids exceeds 25 gallons. Maintain containers and cabinets used for storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 Degrees F and 90 Degrees F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F and 95 degrees F.

C. Do not apply paint in snow, rain, fog, or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature and humidity limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Dunn Edwards Company (DE)

2. Benjamin Moore and Co. (BM)

3. Sherwin-Williams Company (S-W)

4. Visions Recycling, Inc. (VRI)

5. Kwal Paint (KW)

2.2 DESCRIPTION

A. Regulatory Requirements

1. Materials: Minimum Class B per NFPA 101 (Flame Spread 26-75, Smoke Developed 0-450).

B. Sustainability Characteristics

1. Reprocessed Latex Paint.

a. White, off-white, pastel colors: 20% post-consumer content.

b. Grey, Brown, Earth tones and other dark colors: 50-90% recovered material, including 50-99% post consumer content.

2. Consolidated Latex Paint: 100% post consumer content.

2.3 MATERIALS

A. The following compounds shall not be used in paints or primers on any projects:

1. Prohibited organic compounds

a.	Methylene chloride	k.	Di-n-butyl phthalate
b.	1,1,1-Trichloroethane	l.	Di-noctyl phthalate
c.	Benzene	m.	Diethyl phthalate
d.	Toluene (methylbenzene)	n.	Dimethyl phthalate
e.	Ethylbenzene	o.	Isophorone
f.	Vinyl chloride	p.	Formaldehyde
g.	Naphthalene	q.	Methyl ethyl ketone
h.	1,2-Dichlorobenzene	r.	Methyl isobutyl ketone
i.	Di (2-ethylhexyl) phthalate	s.	Acrolein
j.	Butyl benzyl phthalatet.	t.	Acrylonitrile
		u.	Alkylphenol Ethoxylate

2. Prohibited metals (including their oxides)

a.	Antimony	d.	Lead
b.	Cadmium	e.	Mercury
c.	Hexavalent chromium		

B. MASONRY BLOCK FILLER

1. High-Performance Latex Block Filler: Heavy-duty latex block fillers used for filling open, textured interior and exterior concrete masonry block before application of top coats.

2. Use block filler under high-performance polyamide epoxy coatings.

C. PRIMERS/SEALERS

1. Interior Latex Enamel: To be used as under-coat for smooth cementitious surfaces and bare wood. VOC content to comply with GS-11, or not exceed 150 grams per liter (g/L)

: 05093

2. Interior Latex-Based White Primer: Latex-based primer coating to be used on interior gypsum drywall under a flat latex paint or a semi-gloss latex enamel.

3. Exterior Primer Coating: Exterior alkyd wood primer used for priming wood under alkyd enamels.

4. Rust-Inhibiting Primer: Quick-drying, rust-inhibiting primer used for priming ferrous metal on the exterior under high-gloss enamel and on the interior under enamel.

5. Galvanized Metal Primer: Primer used to prime interior and exterior zinc-coated (galvanized) metal surfaces.

6. Pigmented Sealer: Pigmented sealers over concrete used under high performance polyamide epoxy coatings.

D. EXTERIOR FINISH PAINT MATERIAL

1. Exterior Acrylic: Quick-drying, flat, acrylic paint used on the exterior over concrete, stucco, and masonry (including concrete masonry block). VOC content to comply with GS-11, or not exceed 100 g/L.

2. Alkyd Enamel: Weather-resistant, air-drying, semi-gloss enamel used on the exterior over prime-coated wood, and over primed ferrous metal surfaces. VOC content to comply with GS-11, or not exceed 200 g/L.

E. INTERIOR FINISH PAINT MATERIAL

1. Interior Semi-Gloss Latex Enamel: Semi-gloss, latex enamel used over a primer on concrete, masonry (including concrete masonry block), wood and hardboard, ferrous and zinc-coated (galvanized) metal surfaces, and over a primer on gypsum drywall. VOC content to comply with GS-11, or not exceed 150 g/L.

2. Latex-Based, Interior Flat Paint: Ready-mixed, latex-based paint used as a "size" on cotton or canvas covering over insulation. VOC content shall comply with GS-11, or not exceed 50 g/L.

3. High-Performance Polyamide Epoxy Coating: High-gloss coating used over concrete and concrete masonry. VOC content shall comply with GS-11, or not exceed 200 g/L.

F. MISCELLANEOUS WOOD FINISHING MATERIALS

1. Solvent Thinned Interior Wood Stain: Slow-penetrating solvent thinned wood stain for general use on interior wood surfaces under clear finishes.

2. Sanding Sealer: Manufacturer's recommended sanding sealer, compatible with catalyzed polyurethane finish coat. Sand Paper: 220 grit.

3. VOC content for stains and sealers to comply with GS-47.

   a. Stains: 250 g/L

   b. Sealers: 200 g/L

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION

A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in places that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly-painted surfaces. Following completion of painting operations in each space or area, items shall be reinstalled in the same manner that they were removed.

B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and re-prime. Notify STR in writing when problems are anticipated in using the specified finish-coat material with substrates primed by others.

C. Cementitious Materials: Prepare concrete, concrete masonry block, and stucco to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

   1. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.

2. Determine alkalinity and moisture content of surfaces by performing appropriate tests. Pay special attention to concrete masonry unit mortar joints and patched concrete surfaces. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content of surface to be painted exceeds that permitted in manufacturer's printed directions.

3. Clean concrete floors to be painted with a five percent (5%) solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, and rinse; allow to dry and vacuum before painting.

D. Wood Materials: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper. Sand smooth surfaces exposed to view and dust off.

1. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of primer.

2. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3. When transparent finish is required, back prime with spar varnish.

4. Back prime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.

5. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery to jobsite.

E. Ferrous Metals: Clean non-galvanized ferrous-metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

1. Treat bare and sand-blasted or pickled clean metal with a metal treatment wash coat before priming.

2. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

F. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so that the surface is free of oil and surface contaminants.

Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

G. Gypsum Board: Surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of first-coat material. Repair blemishes, irregularities and damaged surfaces.

H. Material Preparation: Carefully mix and prepare paint materials in accordance with the manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3. Use only thinners approved by the paint manufacturer, and only within recommended limits. Use odorless thinner with alkyd enamel.

3.3 APPLICATION

A. General

1. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied. Spray applications will require prior approval from the STR.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Surface treatments and finishes shall be as indicated in Articles 3.6, 3.7 and 3.8 or as approved by STR.

4. Provide finish coats that are compatible with primers used.

5. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even, smooth surface in accordance with the manufacturer's directions.

6. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds and exposed

fasteners receive a dry film thickness equivalent to that of flat surfaces.

7. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.

8. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

9. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

10. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

11. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.

12. Sand lightly between each succeeding enamel or varnish coat.

13. Omit primer on metal surfaces that have been shop-primed and touch up painted.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration. Allow time between successive coats to permit proper drying per manufacturer's recommendations.

C. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer or as specified, whichever is greater.

D. Mixing and Thinning: Unless otherwise recommended by the manufacturer, paints may be thinned immediately prior to application with an approved manufacturer's thinner and used only within recommended limits when necessary to suit conditions of surface temperature, weather and application methods. The use of thinner shall not relieve the Construction Subcontractor from obtaining complete hiding, full film thickness, or required gloss. Paints of different manufacturers shall not be mixed.

E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled. Apply at a dry film thickness of not less than that recommended by the manufacturer.

F. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

G. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are not acceptable.

H. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.

I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.4 CLEANING

A. Cleanup: At the end of each work day, completely remove empty cans, rags, tools, rubbish, and other discarded paint materials from the project site.

B. Do not clean tools, brushes, applicators, and equipment at the project site unless specifically authorized by the STR. Do not use sinks in restrooms, janitors' closets, or in locations where food is prepared.

C. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to the STR.

B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINT SCHEDULE

A. Provide the following paint systems for the various substrates indicated. No primer or block filler is required on previously painted surfaces, unless specified in Contract documents or where alkaline, moisture or freeze-thaw cycles have caused blistering or peeling.

B. Concrete, Stucco, and Masonry (other than concrete masonry units):

1. Lusterless (Flat) Acrylic Finish: Two (2) coats with total dry film thickness per manufacturer's recommendations.

a. First Coat: Exterior Acrylic

b. Second Coat: Exterior Acrylic

C. Concrete Masonry Units

1. Lusterless (Flat) Acrylic Finish: Two (2) coats over block filler with total dry film thickness (filler excluded) per manufacturer's recommendations.

a. Block Filler: Latex Block Filler

b. First Coat: Exterior Acrylic

2. Second Coat: Exterior Acrylic

D. Wood

1. Alkyd Finish: Two (2) finish coats over primer with total dry film thickness per manufacturer's recommendations.

a. Primer: Exterior Primer Coating

b. First Coat: Alkyd Enamel

c. Second Coat: Alkyd Enamel

E. Ferrous Metal: Primer is not required on shop-primed items.

1. Alkyd Enamel: Two (2) finish coats over primer.

a. Primer: Rust-Inhibiting Primer

b. First Coat: Alkyd Enamel

c. Second Coat: Alkyd Enamel

F. Galvanized Metal

1. Alkyd Enamel: Two (2) finish coats over primer.

a. Primer: Galvanized Metal Primer

b. First Coat: Alkyd Enamel

c. Second Coat: Alkyd Enamel

3.7 INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates, as indicated. No primer or block filler is required on previously painted surfaces.

B. Concrete and Masonry (other than concrete masonry units):

1. Semi-Gloss Enamel Finish: Three (3) coats with total dry film thickness per manufacturer's recommendations.

   a. Primer: Interior Latex Enamel

   b. Undercoat: Interior Semi-Gloss Latex Enamel

   c. Finish Coat: Interior Semi-Gloss Latex Enamel

2. Polyamide Epoxy Coating: Two (2) coats of polyamide epoxy coating over pigmented sealer.

   a. Sealer Coat: Manufacturer's recommended pigmented sealer

   b. Intermediate Coat: Polyamide Epoxy

   c. Finish Coat: Polyamide Epoxy

C. Concrete Masonry Units

1. Semi-Gloss Alkyd Enamel Finish: Two (2) coats over filled surface with total dry film thickness (filler excluded) per manufacturer's recommendations.

   a. Block Filler: Latex Block Filler

   b. Intermediate Coat: Interior Semi-Gloss Latex Enamel

   c. Finish Coat: Interior Semi-Gloss Latex Enamel

2. Polyamide Epoxy Coating: Two (2) coats of polyamide epoxy coating over concrete masonry block filler.

   a. Primer Coat: Latex Block Filler

   b. Intermediate Coat: Polyamide Epoxy

   c. Finish Coat: Polyamide Epoxy

D. Gypsum Drywall Systems

1. Semi-Gloss Latex Enamel Finish: Three (3) coats (drywall decoration primer excluded) with total dry film thickness per manufacturer's recommendations.

    a. Primer: Interior Latex-Based White Primer

    b. Intermediate Coat: Interior Semi-Gloss Latex Enamel

    c. Finish Coat: Interior Semi-Gloss Latex Enamel

E. Woodwork and Hardboard

1. Semi-Gloss Enamel Finish: Three (3) coats.

    a. Primer: Interior Latex Enamel

    b. Intermediate Coat: Interior Semi-Gloss Latex Enamel

    c. Finish Coat: Interior Semi-Gloss Latex Enamel

F. Stained Woodwork

1. Stained, Polyurethane Finish: Premium grade, two (2) coats over stain on open-grain wood.

    a. Sanding: Sand (220 Grit)

    b. Stain Coat: Solvent Thinned Interior Wood Stain

    c. First Coat: Manufacturer's Recommended Sanding Sealer

    d. Second Coat: Catalyzed Polyurethane

G. Natural-Finish Woodwork

1. Polyurethane Finish: Premium grade, two (2) finish coats on open-grain wood.

    a. Sanding: Sand (220 Grit)

    b. First Coat: Manufacturer's Recommended Sanding Sealer

    c. Second Coat: Catalyzed Polyurethane

H. Ferrous Metal

1. Semi-Gloss Enamel Finish: Two (2) coats over primer with total dry film thickness per manufacturer's recommendations.

a. Primer: Rust-Inhibiting Primer

b. Intermediate Coat: Interior Semi-Gloss Latex Enamel

c. Finish Coat: Interior Semi-Gloss Latex Enamel

I. Zinc-Coated Metal

1. Semi-Gloss Finish: Two (2) coats over primer, with total dry film thickness not less than 2.5 mils (0.064 mm).

a. Primer: Galvanized Metal Primer

b. Intermediate Coat: Interior Semi-Gloss Latex Enamel

c. Finish Coat: Interior Semi-Gloss Latex Enamel

J. Cotton or Canvas Covering over Insulation

1. First Coat: Exterior Semi-Gloss Latex Enamel

2. Second Coat: Exterior Semi-Gloss Latex Enamel

3.8 FIRE PROTECTION PAINTING

A. Paint those portions of fire protection systems as required by LANL as follows, except as required in Section 1.1.D:

B. Color Coding of Outdoor Water-Based Fire Protection System

1. Hydrants: All fire hydrants shall be painted "Traffic Yellow." [Paint top portion (Bonnet) "Black" on fire hydrants on dedicated fire loops (TA -6, 33, 35, 39, 40 and 55.)]

2. Post Indicator Valves: Sprinkler controlled post indicator valves shall be painted "Fire Protection Red." Water distribution system division post indicator valves shall be painted "Traffic Yellow."

3. Water Motor Alarms: All water motor alarms, gongs and sprinkler system drains through walls shall be painted "Fire Protection Red."

4. Sprinkler Piping: All sprinkler piping which is exposed to exterior surface corrosion shall be painted "Fire Protection Red." Reference OSHA 29 CFR 1910 159(C).6.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 09 9100, Rev. 3, dated December 9, 2009.

SECTION 22 0529

HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install pipe hangers, supports, hanger rods, inserts, and sleeves, and other positive fastenings for mechanical non-structural components such that gravity loads are safely transferred to the structure.

1.2 RELATED REQUIREMENTS - NOT APPLICABLE

A. Refer to Section 22 0548 - Vibration and Seismic Controls for Plumbing piping and equipment for seismic control / protection requirements for mechanical non-structural components.

1.3 SUBMITTALS

A. Submit the following in accordance with subcontract submittal procedures:

1. Manufacturer's catalog data of hangers and supports including load capacity.
2. Shop Drawings showing system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
3. Manufacturer's installation instruction for special procedures and assembly of components if required.
4. Certification of offsite welders and qualified welding procedure per Section 01 4455.

1.4 QUALITY ASSURANCE

A. Hangers and supports shall conform to the requirements of the following codes and standards as applicable:

1. ASME B31.3, Process Piping
2. Uniform Mechanical Code, (UMC)

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, Substitution Procedures.

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inches: Malleable iron or carbon steel, adjustable swivel, split ring.

B. Hangers for Cold Pipe Sizes 2 inches and over: Carbon steel, adjustable, clevis.

C. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.

D. Hangers for Hot Pipe Sizes 6 inches and over: Adjustable steel yoke, cast iron roll, double hanger.

E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

F. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and over: Steel channels with welded spacers and hanger rods, cast iron roll.

G. Wall Support for Pipe Sizes to 3 inches: Strut clamp or cast iron hook.

H. Wall Support for Pipe Sizes 4 inches and over: Welded steel bracket and wrought steel clamp.

I. Wall Support for Hot Pipe Sizes 6 inches and over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

J. Vertical Support: Steel riser clamp.

K. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

L. Floor Support for Hot Pipe Sizes to 4 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

M. Floor Support for Hot Pipe Sizes 6 inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

N. Copper Pipe Support: Copper-plated, carbon steel ring.

2.3 HANGER RODS

A. Mild steel threaded both ends, threaded on one end, or continuous threaded.

B. Rods for trapeze hangers shall be a minimum 3/8-inch. The use of pipe hooks, chains, perforated iron strapping, or wire for pipe supports are NOT permitted.

2.4 INSERTS

A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment; top slot for reinforcing rods; lugs for attachment to forms; size inserts to suit threaded hanger rods.

2.5 SLEEVES

A. Sleeves for Pipes through Non-Fire Rated Beams, Walls, Footings, and Floors: Steel pipe or 18 gage galvanized steel.

B. Sleeves for Pipes through Fire Rated and Fire Resistive Floors, Walls, and Roof: Prefabricated fire rated sleeves including seals, approved by a nationally recognized testing laboratory (UL listed).

PART 3 EXECUTION

3.1 INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut.

3.2 PIPE HANGERS AND SUPPORTS

A. Support piping to maintain its alignment, and prevent sagging.

B. Place hangers within 12 inches of each horizontal elbow.

C. Support vertical piping with riser clamps secured to the piping and resting on the building structure at each floor.

D. Install hangers to provide minimum 1/2 inches space between finished covering and adjacent work.

E. Use hangers with 1-1/2 inches minimum vertical adjustment.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Provide copper plated hangers and supports for copper piping.

I. Provide insulation continuous through hangers and rollers. Protect insulation by steel shields in accordance with Section 22 0713, Plumbing and HVAC Insulation.

J. Provide hangers on piping on each side of, and within 6 inches of, hubless pipe couplings so the couplings will bear no weight.

K. Provide supports that allow free axial movement and only support the weight of the piping or tubing. Provide additional hangers or brackets to support valves, flanges, specialties, etc., to prevent excessive deflection.

L. Prime coat exposed steel hangers and supports. Refer to Section 09 9100, Painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 SLEEVES

A. Provide sleeves for all pipe penetrations through walls, roof, or slab above grade.

B. Neatly cut holes in existing walls, floors, or roof for placement of sleeves. Place sleeve and grout and caulk annular space to provide finished appearance.

C. Extend sleeves through floor slab 2 inches above finished floor level. Caulk sleeves full depth and provide floor plate.

D. Seal space between pipe and sleeve watertight for all sleeves penetrating the roof.

E. Where piping or ductwork penetrates a fire rated wall or floor, provide fire-stopping insulation so that the assembly when complete retains the fire rating of construction penetrated by the sleeve.

3.4 HANGER SPACING

A. Piping - Water, Gas, Drain, Waste and Vent (DWV)

1. Comply with the requirements of the Uniform Plumbing Code, (IAPMO), Hangers and Supports.

2. Maximum Hanger Spacing:

Steel Pipe Size (Inches)	1	1 ¼	1 ½	2	3	4	6	8
Spacing (Feet)	9	11	13	15	17	21	25	28

Note: Maximum Hanger Spacing for HDPE Pipe, please consult with manufacturer.

3.5 HANGER ROD SIZE

A. Plumbing (UPC) Piping (Water, Gas, DWV)

Pipe Size (Inches)	½ - 4	5 - 8
Rod Size (Inches)	3/8	1/2

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 22 0529 Rev. 3, dated September 1, 2009.

SECTION 22 0713

PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation for outdoor above ground heat traced piping as required.

1.2 DEFINITIONS

A. Finished Areas: Areas where floor, walls, ceilings, trim, or exposed steel are painted, tiled, or similarly finished.

B. Unfinished Areas: Areas with unpainted walls.

C. Conditioned Spaces: A heated or cooled space, or both, within a building and, where required, provided with humidification or dehumidification means so as to be capable of maintaining a space condition falling within the comfort envelope set forth in ASHRAE 55, e.g., offices, mechanical rooms, storage rooms, etc.

D. Unconditioned Spaces: Pipe tunnels, covered pipe trenches, spaces inside walls, duct or pipe shafts, spaces above dropped ceilings, unfinished attic spaces and crawl spaces.

E. Exposed Areas: Finished areas and other areas used by personnel in the normal use of the building, such as fan rooms, mechanical room, and storage rooms.

F. Concealed Areas: Pipe tunnels, covered pipe trenches, spaces inside walls, duct or pipe shafts, spaces above dropped ceilings, unfinished attic spaces and crawl spaces.

1.3 SUBMITTALS

A. Submit the following in accordance with subcontract submittal procedures:

1. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
2. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

1.4 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84 and UL 723.

B. Provide insulation material one-hundred percent (100%) asbestos free.

C. Provide products that do not promote or support the growth of mold, fungi, or bacteria.

D. Piping insulation work shall be in accordance with the following:

1. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation
2. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

3. ASTM C547 - Mineral Fiber Pipe Insulation
4. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation
5. ASTM C1290 - Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Duct
6. ASTM E84 - Surface Burning Characteristics of Building Materials
7. ASTM E96 - Water Vapor Transmission of Materials
8. UL 723 - Surface Burning Characteristics of Building Materials

1.5 QUALIFICATIONS

A. Installers: Company specializing in performing work of this Section with minimum of three (3) years' experience.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesive, mastic, and insulation cements.

B. Maintain temperature during installation per manufacturer's instructions.

C. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Alternate products may be accepted; follow Section 01 2500, Substitution Procedures.

2.2 GENERAL

A. K-factors (thermal conductivity) shown are expressed in BTU•in/hr•ft^2•F.

2.3 MANUFACTURERS

A. Knauf Fiber Glass

B. Owens/Corning Fiberglass

C. Armstrong

D. CertainTeed

E. Johns Manville

F. Rockwool Manufacturing

G. Armaflex

2.4 FIBERGLASS PIPE INSULATION

A. Insulation: Rigid molded in compliance with ASTM C547, Class 1, minimum density 3.5 pounds/cubic foot, K-factor of approximately 0.23 at 75 degrees F, suitable for temperatures from 0 degrees F to 850 degrees F.

B. Jacket: Factory applied vapor barrier reinforced foil kraft with self-sealing adhesive joints, ASTM C1136.

C. Valves and Fitting Covers: Pre-molded PVC covers with fiber glass insert. Manufacturers: Proto Corp., Ceelco.

2.5 ELASTOMERIC PIPE INSULATION

A. Insulation: Cellular closed cell in compliance with ASTM C534, Type 1, minimum density 5 pounds/cubic foot, K-factor of approximately 0.30 at 75 degrees F, suitable for temperatures up to 300 degrees F.

B. Valve and fitting covers: Same as pipe insulation, cut to fit.

C. Weather Resistant Protective Finish: Acrylic latex enamel paint. Manufacturer: WB Armaflex finish.

2.6 HYDROUS CALCIUM SILICATE PIPE INSULATION

A. Insulation: Rigid, in compliance with ASTM C533, Type 1, minimum density 13 pounds/cubic foot, K-factor of approximately 0.45 at 200 degrees F, suitable for temperature from 140 degrees F to 1200 degrees F.

B. Valve and Fitting Covers: Same as pipe insulation or "Quick Set" insulating cement.

2.7 UNDERSINK PIPING COVERS - NOT APPLICABLE

A. Provide ADA compliant resilient molded white vinyl covers for wheelchair accessible lavatory/sink P-traps and angle valve/supply line (hot and cold) assemblies.

2.8 GLASS FIBER BLANKET DUCT INSULATION - NOT APPLICABLE

A. Insulation: Flexible blanket, in compliance with ASTM C1290, Type III, minimum density 3/4 pounds/cubic foot, K-factor of approximately 0.30 at 75 degrees F, suitable for temperature up to 250 degrees F.

B. Jacket: Factory applied reinforced aluminum foil jacket meeting ASTM C1136.

C. Fittings: Same material as insulation.

2.9 GLASS FIBER BOARD DUCT INSULATION - NOT APPLICABLE

A. Insulation: Rigid glass fiber, in compliance with ASTM C612, Type IA or IB,, minimum density of 3 pounds/cubic foot, K-factor approximately 0.23 at 75 degrees F, suitable for temperature up to 450 degrees F.

B. Jacket: Factory applied metalized polypropylene scrim kraft facing] meeting ASTM C1136.

C. Fittings: Same material as insulation.

2.10 METAL JACKETING - PIPING/DUCTWORK

A. Jacketing: Aluminum, 0.016 inches thick, embossed surface, with factory bonded moisture barrier.

B. Valve and Fitting Insulation Covers: Fabricate from same material as jacketing or use prefabricated insulation covers made in two matching halves.

C. Metal Jacketing Bands: 3/8 inch wide, 0.010 inch thick stainless steel.

2.11 PROTECTION SADDLES AND SHIELDS

A. Provide factory engineered galvanized steel hanger shields on horizontal insulated pipe complying with MSS SP-58 and MSS SP-59 standards for gauge and length of saddle.

B. Saddles (Piping/tubing up to 2 inches):

1. Use 180 degree saddle on systems utilizing teardrop type hangers.
2. Use 360 degree saddle on systems utilizing trapeze hangers or clamps.

C. Inserts and Shields (Piping/tubing over 2 inches):

1. Use 360 degree calcium silicate insert with a 180 degree shield on systems utilizing clevis or teardrop type hangers.
2. Use 360 degree calcium silicate with a 360 degree shield on systems utilizing trapeze hangers or clamps.
3. The unit shall have an integral moisture barrier consisting of a tri-laminate All-Service Jacket equal and similar to the jacketing on the adjoining insulation.
4. Insert: Calcium silicate, minimum density 9 pounds/cubic foot.

2.12 EQUIPMENT NOT FACTORY INSULATED - NOT APPLIACBLE

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that items to be insulated have been pressure tested and approved before applying insulation material.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION - GENERAL

A. Install materials in accordance with manufacturer's instructions.

B. Do not insulate factory-insulated equipment.

C. Do not insulate nameplates.

D. Fit insulation tightly against surface to which it is applied.

E. Do not insulate flexible connections.

F. For non-fire rated barriers (e.g., wall, floor, ceiling, or roof) continue insulation and vapor barrier through penetrations. For fire rated barriers, provide UL/FM approved through penetration stop systems.

G. Weatherproof outdoor installations of piping or ductwork covered with aluminum jacket. Provide watershed lap joints and seal with mastic as required.

H. Do not install metal jacketing with raw edges; provide a safety edge.

I. Replace existing insulation where it has been damaged or removed as a result of modifications. Vapor barrier shall be continuous. Thickness of insulation that is replaced shall match new.

J. Do not install insulation until the Testing, Adjusting and Balancing (TAB) has been completed and the TAB test report accepted by the LANL STR.

3.3 INSTALLATION - PIPING

A. On exposed piping located in finished areas, locate insulation and cover seams in least visible area.

B. Provide continuous insulation through pipe hangers or supports. Do not notch insulation. Provide shields or saddles to prevent crushing insulation.

C. Where insulation terminates, taper to pipe and finish with insulating cement or acrylic mastic.

D. Cover insulated pipes located outdoors or in utility tunnels with aluminum jacket. Secure with aluminum bands and screws as required.

E. Tape circumferential joints of pipe insulation with 3 inch wide white vinyl tape.

F. Insulate fitting and valves where required with same material thickness as specified for adjacent pipe.

G. Insulate potable and non-potable cold water piping within walls, chases, or ceiling plenums where return air is present.

H. Insulate potable and non-potable cold water piping in equipment rooms.

I. Do not insulate unions, flanges and valves in potable or non-potable piping systems of 140 degrees F or less, except for chilled water.

J. Insulate refrigerant discharge line (hot gas discharge) when there is a danger of personnel coming in contact with piping or when the line is passing through a conditioned space. Insulate refrigerant liquid line when it is passing through spaces having temperatures greater than the refrigerant condensing temperatures.

3.4 INSULATION SCHEDULE

A. Piping Systems: Use fiberglass pipe insulation.

NOTE: Increase insulation thickness 1/2 inch when piping is exposed to outdoor temperatures except when service is noted for outdoor temperature.

Service	**Nominal Pipe Diameter (inches)**	**Insulation Thickness (inches)**
Zero Liquid Discharge Heat Traced Transfer Piping (Outdoors)	All sizes	1 1/2
Zero Liquid Discharge Heat Traced Spray Piping (Outdoors)	All sizes	1 1/2

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 22 0713 Rev. 4, dated September 1, 2009.

SECTION 22 0813

TESTING PIPING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure testing of the following systems:

1. Zero Liquid Discharge System Piping
2. Zero Liquid Discharge Spray System Piping

1.2 SUBCONTRACTOR REQUIREMENTS

A. Notify LANL Subcontract Technical Representative (STR) at least twenty-four (24) hours (one working day) in advance to arrange for witnessing of the piping test.

B. For discharge requirements of water used for pressure testing comply with Section 01 3545, Water Discharge Requirements.

C. Notify LANL STR immediately in the event of any accidental discharge.

1.3 SUBMITTALS

A. Submit the following in accordance with Project submittal procedures:

1. Test plan for approval that includes:

a. Material of construction

b. Design pressure

c. Test pressure and duration of test

d. Test medium and method of achieving the test pressure

e. Certification on calibration of pressure gauges

f. Method to exclude personnel from the area containing the system to be tested.

g. Over pressurization protection/prevention: Device make/model number, certification, pressure relief set point, point of installation in system.

2. Test Reports: Submit test results within ten (10) working days of successful test.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish instruments, equipment, material and labor necessary to conduct tests.

B. Calibrate testing equipment at reasonable intervals with devices of accuracy traceable to National Institute of Standards and Technology (NIST).

C. Test gauges used in conducting test shall be in accordance with IAPMO UPC.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Piping being tested shall remain exposed until LANL has approved the piping test results.

B. Trenches may be backfilled between joints before testing to prevent movement of pipe during testing. Ensure that thrust blocks are sufficiently hardened before testing.

C. Piping being tested shall not leak nor show any loss in test pressure for duration specified unless otherwise noted.

D. Where portion of piping system is to be concealed before completion, the portion shall be tested separately as specified for the entire system.

E. Ensure piping supports/anchors are in place.

F. Isolate system gages, sensors, etc., from pressure tests so instruments and devices are not damaged. Test pressure shall not exceed the maximum allowable test pressure for any vessel, pump, valves, or other component in the system.

G. Hydrostatic (Water) Testing:

1. Use potable water as test medium. Do not fill system until the LANL STR has approved the source of water supply.
2. Provide vents at high points to release trapped air while filling system.
3. Provide drains at low points for complete removal of test liquid.
4. Drain system if there is a potential for freezing, i.e., no heat in building, coil in outside air stream, or other similar situations.

H. Pneumatic (Air) Testing:

1. Use clean dry air (Excluded from use with natural gas pipe testing) or inert gas as the test medium.
2. Barricade the area around the system to be tested.
3. Prior to application of full air test pressure, apply a preliminary test of not more than 10 psig to reveal possible major leaks.
4. After preliminary test, raise pressure in stages not more than twenty-five percent (25%) up to full test pressure, allowing at least ten (10) minutes for equalization of strain and detection of major leaks at each intermediate stage. Hold final test pressure for time specified.

5. Examine piping for leakage using soap bubble solution, or by test gage monitoring.

I. If leaks are found, they shall be eliminated by tightening, repair, or replacement, as appropriate and test repeated until no leakage is found.

J. Where repairs or additions are made to piping system following the pressure test, the affected piping shall be tested. Minor repairs and additions are not required to be pressure tested, provided that the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other leak-detecting methods approved by the authority having jurisdiction. Testing will not be required in cases where it does not include addition to, replacement, alteration or relocation of, any piping, or in any cases where piping is set up temporarily for exhibition purposes.

3.2 PRESSURE TESTING

A. Zero Liquid Discharge Transfer Piping:

1. Below Grade: Test with water in accordance with ASME/ANSI B31.3 at 1.5 times the design pressure indicated on the contract drawings, 100 psig minimum. Test pressure shall be held for two (2) hours and until such time that all joints have been inspected for leaks. Piping shall maintain test pressure +/- 5 psi for the duration of the test and there shall be no visible signs of leakage.

2. Above Grade: Test with water in accordance with ASME/ANSI B31.3 at 1.5 times the design pressure indicated on the contract drawings, 100 psig minimum. Test pressure shall be held for two (2) hours and until such time that all joints have been inspected for leaks. Piping shall maintain pressure for two (2) hours without loss.

B. Zero Liquid Discharge Spray Piping:

1. Below Grade: Test with water in accordance with ASME/ANSI B31.3 at 1.5 times the design pressure indicated on the contract drawings, 50 psig minimum. Test pressure shall be held for two (2) hours and until such time that all joints have been inspected for leaks. Piping shall maintain test pressure +/- 5 psi for the duration of the test and there shall be no visible signs of leakage.

2. Above Grade: Test with water in accordance with ASME/ANSI B31.3 at 1.5 times the design pressure indicated on the contract drawings, 50 psig minimum. Test pressure shall be held for two (2) hours and until such time that all joints have been inspected for leaks. Piping shall maintain pressure for two (2) hours without loss.

3.3 TESTING FOR HOLIDAYS: NOT APPLICABLE

A. Test the following buried coated steel piping systems for holidays:

1. Natural gas.

B. Perform holiday test in accordance with the following procedure:

1. After pipe has been welded, joints wrapped, and pipe is ready for lowering into trench, test coating for flaws (holidays). Test coated piping system throughout its length for flaws in coating system by means of a high-potential flaw detector that can impress a maximum of 8,000 volts across coating. One electrode of tester shall maintain complete circumferential contact with coating while transversing entire length of coating system and other electrode shall be the underlying metal pipe. An electrical discharge through coating detected visually or by instrument, shall constitute failure of this test.

Actual working voltage of detector on pipe will depend upon thickness of coating and size of pipe. A thin coating on a large pipe will offer a capacitive load to the detector that will drop the working voltage several thousand volts below the "no-load" voltage. Detector output may also have to be increased to overcome conditions such as extremely dry rock, or sandy soil.

Important! Do not cut ground cable to a shorter length. The length supplied is important to proper operation of the detector. Keep as much of the cable as possible in contact with the earth. Straighten out kinks where possible and do not let it ride up over skids. In dry areas it will help to drag the cable in the ditch where there is more moisture. The pipe should be grounded.

2. Mark holidays as they are found and repair prior to lowering pipe into trench. Repair holidays in factory coating by removing initial coating and undercoating for a minimum of 4 inches on each side of holiday. Remove coating around holiday and feather edge to pipe wall for sufficient distance to make a satisfactory repair. Apply primer (Polyken 1027) to the holiday to form a bond over the entire surface of the holiday and then spirally wrap pipe with a double layer of half-lapped 35 mil polyethylene tape (Polyken 934) for a minimum of 2 inches on each side of the holiday.

Repair holidays in joint wrappings by removing field applied coating in area of holiday and rewrapping. LANL STR or designated representative will approve all areas of joint coating.

3.4 RETESTING

A. If piping does not pass test, locate and repair leaks and repeat testing procedure until satisfactory results are obtained.

B. Make repairs to piping with new materials. Caulking on screwed joints, cracks, or holes is not acceptable.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 22 0813 Rev. 3, dated September 23, 2009.

PRESSURE TEST RECORD

TEST NUMBER:	PROJECT NO.: 19570	PAGE 1 OF	
PROJECT NAME: Zero Liquid Discharge Subproject			
TEST INFORMATION			
SYSTEM DESCRIPTION:			
DESCRIPTION OF TEST BOUNDARIES: (Attach Sketch Showing Boundaries as Required. P&ID Recommended)			
DESIGN TEMPERATURE:		DESIGN PRESSURE:	
TEST METHOD: ☐ HYDROSTATIC ☐ PNEUMATIC:			
TEST FLUID:		APPLICABLE CODE:	
TEST REQUIREMENTS			
REQUIRED TEST PRESSURE:		TEST FLUID TEMPERATURE:	
REQUIRED TEST DURATION:		AMBIENT TEMPERATURE:	
GAUGE PRESSURE CALCULATION			
ELEVATION DIFFERENCE BETWEEN GAUGE AND HIGH POINT:			
X CONVERSION FACTOR:			
PLUS REQUIRED TEST PRESSURE:			
EQUALS REQUIRED GAUGE PRESSURE:			
TEST RESULTS			
TEST DATE:	START TIME:	☐ AM ☐ PM	
	FINISH TIME:	☐ AM ☐ PM	
ACTUAL GAUGE PRESSURE:			
TEST EQUIPMENT			
TYPE:	RANGE:	CAL. DATE:	CAL. DUE:
REMARKS:			
TEST ACCEPTANCE			
CODE EXAMINER:		DATE:	
CODE INSPECTOR:		DATE:	

SECTION 40 0527

PIPING AND TUBING INSPECTION CHECKLIST

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Zero Liquid Discharge System Transfer and Spray Piping

- Inspection of piping and tubing installations per design documents
- Inspection of installation workmanship
- Leak Testing

1.2 QUALITY ASSURANCE AND TESTING

A. ASME/ANSI B31.3 requirements for Category D non-metallic piping.

B. Perform inspections and testing in accordance with Section 22 0813, Testing Piping Systems.

C. Quality Assurance Program

1. For all work, the fabricator is required to develop and implement a documented quality assurance (QA) program which complies with the Contractor Requirements Document (CRD) of DOE Order 414.1 (latest).

2. The fabricator is responsible for maintaining quality and shall perform in-process and final inspection on his work as required herein. The fabricator must comply with all applicable federal, state, or local codes.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 INSPECTION ATTRIBUTES

A. General:

1. Approved design documents present.

2. Code to which it was designed identified (e.g., UPC, applicable ASME B31 code).

3. Design followed:

a. Required materials used (metal, polymer, schedule, markings per material standard on tube, pipe, and fittings).

b. No counterfeit materials.

4. Routing layout, configuration.

5. Elevations (if elevation is critical).

6. Slope (if slope is critical).

7. Location of components, instruments, fittings.

8. Orientation of components [where flow direction is important (e.g. check valves, reducers, globe valves, etc.)].

9. Support locations, types, attachments.

10. Integrity and workmanship.

3.2 CUTTING

A. Pipes are cut square.

B. Surfaces are free of sharp edges and burrs.

C. End preparation weld bevel for welded pipes.

3.3 JOINING SWAGE FITTINGS - NOT APPLICABLE

A. Installer trained per LANL or manufacturer's course

B. LANL Master Specification 40 0511, Compression Fittings on Copper and Stainless Steel Tubing, followed for cutting, bending, and assembly of these.

1. Correct parts (body, nut and ferrules).
2. Tube ends cut square.
3. Clean and smooth tube ends.
4. Tube aligned straight.
5. Tube inserted into fitting body to right depth.
6. Finger tight followed by the right torque or turns (follow vendor's instructions).
7. Go/No-Go gage check where applicable (follow vendor's instructions).

3.4 THREADING

A. Pipe or tubing size.

B. Threading tool identification.

C. Cleanliness.

D. Proper thread lubricant-sealant.

E. Threads not damaged.

F. Proper alignment before joining.

G. Sufficient insertion of pipe threads.

H. Proper alignment after joining.

3.5 COLD BENDING - NOT APPLICABLE

A. Tangent point marked.

B. Bend angle and dimensions.

C. Bend free of wrinkles.

D. Pipe or tubing wall not thinned below minimum design.

E. Ovality of cross section not over eight percent (8%) of nominal diameter.

F. No deep gouges or scratches.

3.6 WELDING

A. Certified welding inspector accepts job:

1. Welder certified.
2. Correct welding procedure used.
3. Weld map documenting weld symbols (depth on penetration, type -- fillet, butt, etc.).
4. Correct base metal used.
5. Correct filler metal used.
6. Weld procedures followed.

3.7 CLEANING

A. Weld surfaces free of contaminants.

B. Inside piping surfaces free of all non-adhering material.

C. Verify no moisture in the system.

D. Special cleaning done when required (e.g. refrigerants, oxygen, tritium).

3.8 FLANGE ASSEMBLY

A. Proper support of both sides of open flange.

B. Removal of old gasket.

C. Cleanliness.

D. No flange face imperfections.

E. Verify flange face finish compatible with new gasket.

F. Verify correct gasket.

G. Verify gasket condition.

H. Verify right bolts, verify size and markings.

I. Align flange and support flange ends.

J. Lubricate bolts and nuts (unless new and coated).

K. Verify compatibility of lubricant, if used.

L. Use washers.

M. Visual verification of fastener condition.

N. Verify use of correct fastener lubrication.

O. Verify adhesive compatibility, if used.

P. Verify Installation of all bolts.

Q. Torque wrench and multiplier calibration.

R. Torque bolts in star pattern, three passes.

S. Verify bolt torque.

T. Verify full engagement of nut (bolt threads at least flush with top on nut).

3.9 LEAK TESTING

A. General – All Testing:

1. Follow LANL Master Specification Section 22 0813, Testing Piping Systems.

B. Hydrostatic Leak Test:

1. Test boundaries, valve alignment and closure.
2. Joints visible.
3. Pressure control and overpressure protection of test.
4. System relief devices isolated.
5. Water cleanliness and chemistry (ppm chloride limit on stainless).
6. Hydrotest pressure, considering changes in elevation.
7. Supports completed.
8. Temporary supports where necessary (hydro of steam or gas lines).
9. Variable springs constrained.
10. Expansion joints constrained.
11. Verification of pressure rating of components.
12. Use of strainers to protect equipment.
13. Ambient temperature above minimum.
14. Fill and venting.
15. Time at pressure.
16. Visual inspection for leaks.
17. Tightening of leaking mechanical or flange joints.
18. Flush and water disposal.

19. Dry and clean pipe.

20. System and valve alignment returned to specified condition.

C. Pneumatic Test Piping (typically Small Bore -- 2 inch and smaller -- and below 150 psi)

1. Verify component pressure rating.

2. Examine assembly of all threaded, bolted, and other mechanical joints.

3. Verify test boundaries (valve alignment).

4. Joints visible.

5. Non-flammable nontoxic gas used.

6. Test pressure per Spec 22 0813, Testing Piping Systems.

7. Test rig equipped with Code pressure relief device.

8. Approved leak detection solution.

9. Initially pressurize gradually to lesser of 25 psi or twenty-five percent (25%) of test pressure for preliminary check.

10. Gradually increase pressure in steps, allow time between steps for strain equalization.

11. Reduce pressure to the design pressure prior to checking for leaks.

12. Depressurize system following test to no more than operating level.

D. In-Service Leak Testing

1. Joints are visible.

2. System is at normal operating pressure for at least ten (10) minutes.

3. Joints covered with bubble solution (gas).

4. No visible leaks (liquid).

5. No bubbles at joints (gas).

3.10 SUPPORTS - NOT APPLICBLE

A. Hangers and Supports installation are per LANL Master Specification 22 0529, Hangers and Supports for Plumbing Piping and Equipment.

B. Verify condition of the support steel; note any corrosion, or bent or deformed parts, missing bolts or cracks in or near welds.

C. Identify any missing bolts.

D. Identify any missing grout between the anchorage and mounted concrete surface.

E. Verify that structural surfaces are in close contact in bolted connections.

3.11 INSULATION

A. Insulation installation are per LANL Master Specification 22 0713, Plumbing and HVAC Insulation.

B. Pipe surface clean and dry.

C. Type and condition of insulation.

D. Insulation thickness.

E. Type and condition of lagging (jacket).

F. Visual inspection of installation for workmanship.

3.12 QUALITY ASSURANCE

A. Additional checks or inspections performed where required by the governing QA plan (e.g., independent inspections for certain ML-1 and ML-2 systems or components).

3.13 DOCUMENTATION

A. Assembly drawing or sketch initialed at each swage joint (if required by QA plan).

B. Work package complete, signed-off, and filed.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 40 0527 Rev. 2, dated October 5, 2009.

SPECIFICATIONS

FOR

ZERO LIQUID DISCHARGE SUBPROJECT

AT THE

LOS ALAMOS NATIONAL LABORATORY

PROJECT IDENTIFICATION NUMBER 100761

TECHNICAL AREAS TA-50, TA-52, TA-63

UNDERGROUND TRANSFER PIPING

PREPARED BY

BURNS AND ROE ENTERPRISES

800 KINDERKAMACK ROAD

ORADELL, NJ 07649

100761-11-000090

1.7 Management Level ML-1 ☐ ML-2 ☐ ML-3 ☒ ML-4 ☐

1.8 Nuclear Functional Classification SC ☐ SS ☐ DID ☐ Not Safety Related ☒

	Name	Signature	Date
1.9 Submitted by:			
1.10 LANL Acceptance			

1.11 Derivative Classifier Review

Classification: UCNI ☐ OUO ☐ Classified ☐ Unclassified ☒

Name	Z Number	Signature	Date

: 05127

ZERO LIQUID DISCHARGE SUBPROJECT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

SPECIFICATIONS, MECHANICAL
CIVIL, and STRUCTURAL

UNDERGROUND TRANSFER PIPING

Prepared For:

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Revision	Date	Issued For	Prepared By Print/Sign/Date	Technical Approval Print/Sign/Date	Project Approval Print/Sign/Date
A	7/13/2011	60% Design Review	Stephen Stuhrke SPStuhrke	Al Cesnavicius A. Cesnavicius	Norman Lacy

05128

Design Professional Seal Mechanical	Burns and Roe Enterprises, Inc. (BREI) Professional seal applies to the following specification sections:
	01 2500 Substitution Procedures 01 3545 Water Discharge Requirements 01 4455 Onsite Welding & Joining Requirements 22 0813 Testing Piping Systems 40 0527 Piping and Tubing Inspection Checklist
Design Professional Seal *Civil / Structural*	*Burns and Roe Enterprises, Inc. (BREI)* *Professional seal applies to the following specification sections:*
	03 3001 Reinforced Concrete 03 3053 Miscellaneous Cast-In-Place Concrete 31 2000 Earth Moving

TA-50-52 63 ZERO LIQUID DISCHARGE SUBPROJECT

UNDERGROUND TRANSFER PIPING

SUBCONTRACTOR SPECIFICATIONS INDEX

SECTION 01 2500

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 RELATED SECTIONS

A. 01 3300 Submittal Procedures

1.2 SUBSTITUTIONS

"Or approved equal" is always implied after a brand name, patented process or catalog number. The Subcontractor may substitute any brand or process approved as an equal by the specifying Architect/Engineer through the submittal process. The only exception is where "no substitution" is specified. See General Provision "Material and Workmanship".

A. Non-Structural Systems and Components, and Non-Building Structures

1. If the Subcontractor wants to substitute an "equal" architectural, mechanical or electrical system or component, or non-building structure, the component/structure should also be reviewed by the design structural engineer for anchorage and support.

    a. If and when approved, the design structural engineer shall make any necessary anchorage and support revisions to the construction specifications and drawings associated with the equal component/structure.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 01 2500 Rev. 1, dated April 14, 2008.

: 051 31

SECTION 01 3545

WATER DISCHARGE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements of Subcontractor and LANL Subcontract Technical Representative (STR) when there is a planned or accidental discharge of water, including those not covered by a NPDES permit, Ground Water Discharge Plan, or approved Notice of Intent (NOI).

1.2 RELATED SECTIONS – NOT APPLICABLE

A. Section 22 0816, Disinfection of Potable Water Piping

1.3 DEFINITIONS

A. Discharge: Release of water to environment or sanitary sewer system due to an accidental spill or planned construction activity, e.g., flushing, piping disinfection, chemical water treatment of piping systems, hydrostatic piping tests, etc.

B. Best Management Practices (BMPs): Schedules of activities, prohibition of practices, maintenance procedures, and other management practices to prevent or reduce pollution of waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control facility site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. Physical practices to control facility site runoff can be, but are not limited to silt fences, graveled construction area entry/exit points, dikes, berms, wattles, ground covers, reduced discharge rates, armoring, or other such methods emplaced to eliminate erosion or transport by water of soil or other contaminants.

1.4 SUBCONTRACTOR REQUIREMENTS

A. Discharges to Environment:

1. Discharges shall not cause or have the reasonable potential to cause or contribute to a violation of a water quality standard.

2. Employ Best Management Practices (BMPs) to prevent erosion from discharge of water.

3. Chlorinated water used for disinfection shall be dechlorinated with a neutralizing agent per Section 22 0816 prior to discharge. If discharge is not to a watercourse (e.g., flat ground), then total chlorine concentration shall be reduced to less than 1 ppm (part per million) -- *typically the same as that in the Safe Drinking Water Act.*

4. Discharges to a watercourse shall have a total chlorine concentration not greater than 0.011 mg/L (11 parts per billion). *(This value is based on 1999 changes in the New Mexico stream standards that dropped chlorine limit from 1 ppm to 11 ppb).*

5. For discharges of less than 5000 gallons, notify LANL STR at least five (5) working days in advance of the planned discharge.

6. For discharges of 5000 gallons or more, notify LANL STR at least thirty (30) working days in advance of the planned discharge.

B. Sanitary Sewer Discharges:

1. Notify LANL STR prior to any discharge.

2. Volumes greater than 1000 gallons shall not be discharged into the sanitary sewer systems without special approval by Sanitary Wastewater Operations Manager (665-7855) obtained via LANL STR.

3. Properly characterize discharges through LANL waste profile form (WPF) process and meet the TA-46 Wastewater Treatment Plant Waste Acceptance Criteria (WAC), Refer to https://policy.lanl.gov/pods/policies.nsf/MainFrameset?ReadForm&DocNum=P930-1&FileName=P930-1.pdf especially Attachment 16.

   a. WAC limits for total chlorine concentration are 3 mg/L (3 ppm). De-chlorinate water used for disinfection in excess of 20 gallons with neutralizing agent per Section 22 0816 prior to discharge.

C. Notify LANL STR immediately in the event of any accidental or unplanned discharge.

1.5 LANL SUBCONTRACT TECHNICAL REPRESENTATIVE REQUIREMENTS

A. Discharges to the Environment:

1. Keep a written record of each discharge by project. For planned discharges of less than 5000 gallons, notify the LANL Water Quality and RCRA Group (ENV-RCRA) five working days prior to the discharge. Following ENV-RCRA approval complete and return attached form "General Discharge Record" (Attachment 1) to Jacob Meadows (Email:jmeadows@lanl.gov or Fax: 665-

9344) at ENV-RCRA. Discharges will be documented and submitted to NMED in LANL's Quarterly Discharge Report.

2. For planned discharges of 5000 gallons or more, notify the LANL ENV-RCRA Group at least thirty (30) working days in advance of the planned discharge. ENV-RCRA will review the proposed discharge to determine if submittal of an NOI is required. If required ENV-RCRA will develop and submit the NOI to NMED (NMED has up to thirty (30) working days to respond). ENV-RCRA will coordinate with an ENV-EAQ review for potential impacts to critical habitat and Threatened and Endangered Species.

B. Sanitary Sewer:

1. Assist Subcontractor with characterizing discharges using LANL Waste Profile Form (WPF) process and meeting the TA-46 Wastewater Treatment Plant Waste Acceptance Criteria (WAC) described in 1.3 above.

2. Notify Sanitary Wastewater Operations Manager (665-7855) at least five (5) working days in advance for approval of planned discharge into sanitary waste water system.

C. Notify the LANL ENV-RCRA Group immediately in the event of any accidental or unplanned discharge.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 01 3545, Rev. 4, dated December 23, 2009.

NOTICE OF INTENT TO DISCHARGE
GENERAL DISCHARGE RECORD

LOCATION: TA: ______________________ **BLDG:** ______________

FIRE HYDRANT / PIPE / SECONDARY CONTAIMENT / MANHOLE #: ______________________

USER GROUP: __________________ **CONTACT PERSON:** ______________

PHONE: ______________________ **PAGER:** ______________

PERSON CONDUCTING SECONDARY CONTAINMENT DRAINAGE ACTIVITY: ______________

DATE and TIME of DISCHARGE: ______________ / ______________

DURATION of DISCHARGE: ______________ / ______________

ENV-RCRA CONTACT: **Mark Haagenstad, 665-2014**
or Jacob Meadows, 606-0185 **FAX : 665-9344**

DESCRIPTION of DISCHARGE: ______________________________

____

____

VOLUME of DISCHARGE: ______________________________

CANYON AFFECTED: ______________________________

SAMPLES TAKEN: **YES:** __________ **NO:** __________

COMMENTS: ______________________________

____

____

REVIEWED BY: ______________________ **DATE:** ______________
ENV-RCRA

SECTION 01 4455

ONSITE WELDING & JOINING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for welding and joining on the LANL site as required by other sections of the Specification, consensus codes and standards, and/or engineering design.

B. Pressure-retaining code-stamped items shall only be welded on by organizations with the applicable ASME or National Board Certificate(s) of Authorization. Certificate holders are organizations that have been authorized by the ASME to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code.

1.2 "WELDING CHECKLIST" – A "Welding Checklist" shall be completed prior to onsite welding to assure that the specific requirements for welding activities have been identified and addressed. The "Welding Checklist" can be found at: http://www.lanl.gov/orgs/eng/engstandards/ESM_Ch13.shtml#checklist

1.3 DESIGN - Design of welded structures, systems and components (SSC) shall meet the requirements of LANL ESM and as a minimum identify applicable codes and standards including requirements of graded application. For welding activities that would normally fall outside the defined scope of specified national consensus codes and standards for fabrication and welding, such codes and standards shall be adopted and used to the extent possible.

Any welding for Zero Liquid Discharge project work shall be in accordance with the following code and service category:

- *ASME/ANSI B31.3 – Service Categories, D*

A. Shop drawings must show weld symbols and requirements to define the work and enable design review and inspection.

B. Applications that are not similar in materials or processes to a specified code or standard shall define and produce the following:

1. Design basis; i.e., mechanical properties, part geometry, acceptance criteria.
2. A method to verify that the welding procedure can produce acceptable welds

3. A method to demonstrate that the welder has the skill to produce sound welds in accordance with the specified welding procedure (reference GWS 1-02, *Administrative Control of Welding and Brazing, para 5.3.B*)
4. Identify methods and perform inspections, required to judge welds against predetermined acceptance criteria.
5. Provide documentation that these objectives have been defined and identified.

1.4 QUALIFIED PROCEDURES – Welding and brazing shall be performed in accordance with LANL approved welding/brazing procedure specifications (WPS/BPS) that have been qualified in accordance with applicable codes and standards or design criteria:

A. LANL-approved welding/brazing procedure specifications are located at: http://engstandards.lanl.gov/ESM_Ch13_specs.shtml

B. AWS/ANSI Standard Welding Procedure Specifications and written Prequalified Welding Procedure Specifications as allowed by applicable codes and standards may also be used if approved by the LANL Welding Program Administrator.

1.5 JOINING (solvent bonding, adhesive, and electro-fusion joints): When required by consensus codes and standards (e.g., ASME/ANSI B31.3 & 49 CFR Part 192), joining shall be done by LANL qualified personnel following LANL approved procedures.

1.6 CERTIFIED PERSONNEL - Welding and brazing shall be performed by LANL-certified welders and brazers who have demonstrated their welding/brazing skill by test at LANL.

A. Current listing located at http://zirk.lanl.gov/Welding_Prod/engstandard.aspx

1.7 CONTROL OF CONSUMABLES - Consumable welding materials shall be properly procured, received, stored, controlled, and issued to ensure weld quality and prevent use by unqualified personnel.

A. The procedure for procurement, storage, issue and control of consumables is found in ESM, Chapter 13 Welding & Joining, Volume 1, General Welding Standard (GWS) 1-03. 1-03, Welding & Brazing Material Procurement & Control

B. Filler material shall be procured with Certified Material Test Reports (CMTRs) traceable by heat/lot #.
1. CMTRs shall meet the requirements of LANL Welding Program GWS 1-03 Attachment 5, *Filler Material Procurement, Table 1, Sch. I, Required Test,* located at: http://engstandards.lanl.gov/esm/welding/vol1/GWS%201-03-Att-5-R2.pdf
2. Structures, systems and components (SSC) which are designated ML-1, ML-2, safety class, or safety significant shall have CMTRs for welding consumables that are traceable by heat/lot # to the weld in which they were consumed.

C. Filler materials shall be issued from approved locations by authorized personnel to qualified welders.
   1. Authorized filler material issue stations are listed at: http://zirk.lanl.gov/Welding_Prod/RO_FMAttendant.aspx

1.8 WELDING INSPECTION - shall be performed by qualified personnel in accordance with applicable consensus codes and standards and as specified in the design documents.

A. Inspector Qualification/Certification – Welding inspectors are required to be approved by LANL to perform visual and NDE inspection/examinations. LANL-approved inspectors can be found at: http://zirk.lanl.gov/Welding_Prod/RO_Inspector.aspx

B. Welding Inspections required by consensus codes and standards or design shall be documented. Welding inspection reports shall identify at least the following:
   1. Method, type, and extent of Inspection or test
   2. Acceptance/rejection as based on the criteria specified by the design documents
   3. Code or standard used for acceptance and class, category, or service
   4. Record attributes inspected and severity
   5. Identification and location of welds inspected
   6. MT&E – Identification and date of calibration expiration for measuring and test equipment used
   7. Name & date of person who performed the inspection
   8. Inspector's qualification level

C. Inspection Procedures - When inspection procedures are required by the referenced code & standards procedures shall be reviewed and approved by a LANL Level III inspector in the applicable inspection method
   1. NDE Procedure Qualification Records - When inspection procedures are required to be qualified by the referenced code & standard procedure qualification records will be reviewed and approved by a LANL Level III inspector in the applicable inspection method.

D. Inspection results, including weld maps, shall be documented and provided to the project managers within one day after completion of associated inspection work.

E. When applicable codes and standards specify two levels of inspection, the qualification of the owner's inspector and inspections will be done by LANL as specified in ESM, Chapter 13, Volume 1, GWS 1-02 Para. 5.9 see: http://engstandards.lanl.gov/esm/welding/vol1/GWS%201-02_Procedure-R6.pdf

F. LANL reserves the right of access to all welding locations and to have its own qualified inspectors and personnel present during all welding activities.
   1. At least five (5) working days notice is required prior to inspection & testing activities planned by the fabricator so that LANL can arrange for its staff's participation.
   2. Hold Points may be identified in the construction/fabrication schedule to allow for LANL's inspection activities.

1.9 SUBCONTRACTED WELDING

A. Subcontracted welding activities shall have all specifications and drawings and their applicable requirements flowed down to any sub-tier who is to perform those welding activities.

B. Requirements for subcontracted welding shall be identified in subcontract documents as outlined in GWS 1-09, *Control of Subcontracted Welding*.

1.10 RECORDS

A. The following documents shall be collected and maintained in the project files:
   1. Welding/brazing/bonding procedure specifications used
   2. Welder/brazer/bonder performance qualification records
   3. Weld Material Requests (yellow copy)
   4. CMTRs of filler material traceable to weld in which consumed for ML-1, ML-2, safety class, and safety significant SSC
   5. Heat treatment charts or records
   6. Inspection reports
   7. Inspector qualification records
   8. Inspection procedures

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 01 4455 Rev. 0, dated September 1, 2009.

SECTION 03 3001

REINFORCED CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork, shoring, bracing, and anchorage.

B. Concrete reinforcing and accessories.

C. Cast-in-place concrete.

D. Control, expansion, and contraction joint devices associated with concrete work.

1.2 DEFINITIONS

A. "Cementitious material" as used herein shall include all Portland cement, pozzolan, fly ash, and silica fume.

B. Reinforced concrete is structural concrete reinforced with no less than the minimum amounts of prestressing steel or non-prestressed reinforcement specified in ACI 318 Chapters 1 through 21 and Appendices A through C.

C. Plain concrete is structural concrete with no reinforcement or with less reinforcement than the minimum amount specified for reinforced concrete. Specifications for plain concrete are presented in Section 03 3053, Miscellaneous Cast-in-Place Concrete.

D. Engineer-of-record and Architect/Engineer are synonymous and indicate the responsible engineer for the overall design of the facility or project.

1.3 REFERENCES

A. References noted in these specifications form a part of these specifications to the extent applicable. The publications are referred to in the text by the basic designation only. The related publishing organizations are stipulated in Section 01 4200, References.

B. All concrete work, products and materials shall conform to ACI 301 and other specific referenced publications and standards except where otherwise specified herein. The submittals listed in the attached Submittal Tables are those specific submittals that the subcontractor shall provide to LANL.

1.4 SUBMITTALS

Submittals that are required to be submitted to LANL are included in the attached Submittal Tables as they apply (including submittals times, unless the LANL Subcontract Technical representative (STR) authorizes changes to the submittal times). Note: All submittals require engineer-of-record approval. For design-build subcontracts, this approval must occur prior to submittal to LANL.

1.5 QUALITY ASSURANCE

A. Follow ACI 301, 318, and 347; ACI SP-66; CRSI 63, 65 and Manual of Practice; ANSI/ASTM A184; and DOE Order 414.1 latest version with the exception of those alternatives identified in this specification.

B. The work shall be subject to inspection at all times by the Owner and Owner's Independent Testing Agency for the purpose of determining that the work is properly executed in accordance with this specification. Failure to detect defective workmanship or material during any interim inspection shall not constitute acceptance of workmanship and materials.

C. Acquire cement, aggregate, and fly ash from same source as used to produce the specific mix design for all work. Formally notify LANL of any material source changes prior to concrete delivery including the test agency test documentation. The subcontractor must provide LANL a certificate of conformance prior to the initial delivery that confirms the source of the constituents, that tests confirm compliance, and that these sources are the same for the mix design testing and the delivered mix.

D. Conform to ACI 305R when concreting during hot weather, 306R during cold weather.

E. Testing Agency Qualifications: Testing agencies that perform concrete related testing shall be nationally accredited in accordance with ASTM C1077 and testing agencies that perform reinforcing steel testing shall meet ASTM E329. For field and laboratory testing agencies and testing personnel request approval by the LANL Building Official, or designee, in accordance with the provisions of the IBC and the LANL Engineering Standards Manual Chapter 16.

F. Comply with the provisions of ASTM A615 and ASTM A-706 (as applicable) to assure that the manufacturer's tags have the heat number or test number and these tags are traceable to the associated CMTR(s). In addition, unless specifically authorized by the government, foreign reinforcing steel is not allowed.

G. The batch plant must be certified (and maintain current certification) under the NRMCA (National Ready Mix Concrete Association) process.

H. The reinforcement bar manufacturer / fabricator must be certified (and maintain current certification) under the CRSI (Concrete Reinforcing Steel Institute) process.

1.6 DELIVERY, STORAGE AND HANDLING

A. Do not deliver concrete until forms (including confirmation of approved calculations for formwork when required), reinforcement, embedded items, chamfer strips, and any other prerequisites specified in the job specific "Test and Inspection Plan" are in place and ready for concrete placement. Job site storage of materials shall be in accordance with ACI 301. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

B. Inspection/Documentation Verification Hold Point: Product and raw material inspection shall be performed at time of delivery to site receiving area and prior to off-loading and incorporation into the work. Verify conformance with specified requirements and project environmental, safety and health (ES&H) and radiological requirements through inspection of material, shipping documentation, material safety data sheets (MSDS) documentation, data sheets, test documentation and other shipping manifest information. Material not passing inspection shall be marked and prevented from entering the site or placed in an off-site quarantine area until the inspection and verification process is satisfactorily completed.

1. Reinforcement: Store reinforcement of different sizes and shapes in separate piles on racks raised above the ground (to avoid excessive rusting). Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed. Painting on reinforcement must be approved in writing by the engineer-of-record.

PART 2 PRODUCTS AND MATERIALS

2.1 GENERAL

A. All concrete work, projects and materials shall conform to applicable provisions of ACI 301 except as otherwise specified herein.

2.2 FORM MATERIALS AND ACCESSORIES

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints

1. Plywood, metal, or other approved panel materials.

   a. Metal form surfaces shall not contain irregularities, dents, or sags.

   b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

      i. High-density overlay, Class 1 or better.

      i. Medium density overlay, Class 1 or better; mill-release agent treated and edge sealed.

      ii. Structural 1, B-B or better; mill oiled and edge sealed.

      iii. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

   c. AHA A135.4, hardboard for smooth form lining.

2. Prefabricated forms.

   a. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

   b. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

   c. Pan Type: Glass fiber of size and profile required.

d. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes required.

e. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inch thick.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Ties: Snap-off type, galvanized metal cone type with waterproofing washer free of defects that could leave holes larger than 1 in. in concrete surface.

D. Form Release Agent: Colorless mineral oil which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

E. Corners: Chamfered, wood strip type; ¾ x ¾ in. size.

F. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

G. Flashing Reglets: Galvanized steel, 22 gage thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

H. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size as required, of sufficient strength and character to maintain formwork in place while placing concrete.

I. Waterstops: Polyvinyl chloride, minimum 1750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, in accordance to CRD-572 provided in maximum possible lengths, ribbed profile, preformed corner sections. Waterstops shall be dumbbell type or center-bulb type, as specified on Drawings. Waterstop shall be installed in accordance with the manufacturer's recommendations for installation.

2.3 REINFORCING AND ACCESSORIES

A. Reinforcing Steel: ASTM A 615, grade 60 deformed bars and stirrups; and ties unless otherwise specified by the engineer. Manufacturer's CMTRs are required for each delivery. See 1.5.F above for additional requirements.

B. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice.

C. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Vertical splices for column steel and other applications shall be installed with the required stagger specified by ACI 318 unless otherwise approved by the engineer-of-record.

D. Welding of reinforcing bars is not permitted. Reinforcing steel cannot be used for filler metal, gap filler, lightning grounding, or other uses that involve welding.

E. Chairs, Bolsters, Bar Supports, Spacers: Size and shape for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture. Special chairs, bolsters, bar supports, spacers adjacent to weather exposed concrete surfaces to be plastic coated steel type; size and shape as required. Note: concrete "dobie" blocks used to hold up and position rebar must have documentation to show that they are at least the PSI compression strength of the concrete used for the placement.

F. Tie Wire: Minimum 16 gage annealed type.

2.4 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type II.

B. Fine and Coarse Aggregates: Conform to ASTM C 33.

C. Water: Potable water that is clean and not detrimental to concrete.

D. Fly Ash: Conform to ASTM C 618, type F. Fly ash, 20% to 30% of combined weight of fly ash and cement shall be used for the LANL standard concrete mix. For alternate acceptable means of reducing alkali-silica reaction (ASR), see Para 2.7.B.

2.5 ADMIXTURES

A. Air Entrainment: Conform to ASTM C260.

B. Chemical: Conform to ASTM C494.

2.6 ACCESSORIES

A. Bonding Agent: Polymer resin emulsion.

B. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.

C. Joint Filler: ASTM D 1751; asphalt impregnated fiberboard or felt, 1/4 in. thick.

2.7 CONCRETE MIX

A. STANDARD MIX DESIGN

1. The standard mix design for LANL shall contain from 20% to 30% by weight of total cementitious material Type F fly ash conforming to ASTM C 618 for mitigating the deleterious effects of alkali-silica reaction in concrete that is common with the silicious nature of aggregates found in northern New Mexico. Pre-approved mix designs shown in 2.7.H may be used as long as the materials, their sources, and their properties remain constant and as long as the aggregate correction factor is verified by testing per ASTM C 231.

B. ALTERNATE MIX DESIGNS

Alternate means for mitigating alkali-silica reaction, including use of silica fume, or lithium compound admixtures will be acceptable if appropriate tests and documentation are submitted (per the Submittal Attachment) in advance to LANL and approved. Note: Mix designs intended to provide more flexibility than the ranges (slump, air-content, water cement ratio, etc.) must obtain a formal variance to the specification.

/

1. Where aggregates are provided which are demonstrated through appropriate tests to have acceptable ASR levels (less than 0.1%), mix designs may be provided without the fly ash or other ingredients as noted in Para. 2.7.B, above. Tests required are ASTM C1260 or AASHTO T 303-00 (or other pre-approved alternate).

2. Demonstrate acceptable ASR resistance for concrete with fly ash using ASTM C 1260 or AASHTO T 303-00. Also see Para 1.4.B.1 above.

3. Select proportions for normal weight concrete in accordance with ACI 301, proportioning on the basis of previous field experience or trial mixtures method, for

   f_{cr} = the larger of:

   $f_{cr} \geq f'_c + 1.34s$, or

   $f_{cr} \geq f'_c + 2.33s - 500$, where:

   f_{cr} = required average compressive strength of concrete mix design, psi

   f'_c = specified design compressive strength of concrete, psi

   s = standard deviation, psi

   If a suitable record of tests is not available to establish a standard deviation, use the following:

   $f_{cr} \geq f'_c + n$, where:

   n = additional required strength, psi, for a specified f'_c:

   n = 1000 psi for f'_c = less than 3000 psi.
   n = 1200 psi for f'_c = 3000 to 5000 psi.
   n = 1400 psi for f'_c = over 5000 psi.

4. Concrete Mix Designs shall be original work performed by the supplier's testing agency (pre-approval of the testing agency by the LANL Building Official is required). Mix designs extrapolated from pre-selected data are not permitted. Configuration mix designs -- i.e., those already in use by the supplier -- are also not permitted, except for those shown in 2.7.H. All mix designs will be established through the process of trial batch determination of the compressive strengths at the various water-cement ration trial points for each concrete class, and shall adhere to the requirements of this Section.

5. Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Subcontractor. Mixture proportions shall be based on compressive strength (as noted above) as determined by test specimens fabricated in accordance with ASTM C 192 and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's

test report indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1. Note that the use of fly ash may require an increase of air entraining admixture to attain specified air content of concrete. The trial mixture shall use at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required will be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, [silica fume,] and ground granulated blast-furnace slag by weight equivalency method. Laboratory trial mixture shall be designed for maximum permitted slump and air content. Each combination of materials proposed for use shall have a separate trial mixture, except accelerators or retarders can be used without separate trial mixtures. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192 and tested in accordance with ASTM C 39 for 7 and 28 days. From these results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition a curve shall be plotted showing the relationship between 7 and 28 day strengths.

C. Provide concrete meeting the following criteria, for use in the construction of the evaporation tanks only:

1. Exterior concrete exposed to freezing and thawing.

a. Compressive strength, f'_c: 4,000 psi @ 28 days.

b. Maximum nominal aggregate size: 0.75 in.

c. Maximum water / cement ratio: 0.44.

d. Slump: 3 inch.

e. Air content: 5 percent.

f. Fly Ash: 20 percent

g. Superplasticizer(SP) is recommended, provided SP is be added to mix at jobsite after mix has been tested for slump and air content. Test cylinders shall be prepared after SP has been added to mix.

D. In designing concrete mixes with fly ash and ASR aggregates, consider effects on workability, set times, times for strength development and curing, and other characteristics. Make appropriate adjustments in construction activities, for example, times for removing forms or shoring.

E. Use accelerating admixtures in cold weather only when submitted and approved as a constituent of the design mix prior to use. Use of admixtures will not relax cold weather placement requirements.

F. Do not use calcium chloride as an admixture.

G. Use set retarding admixtures during hot weather only when submitted and approved as a constituent of the design mix prior to use.

H. Pre-approved Concrete Design Mixes (Ref: Amec Project No. 4-519-003279). These mix designs can be used as long as material properties remain constant. Submit (per the Submittal Attachment) source documentation and component analyses to verify compliance of the batching materials used for pre-approved mix design.

- LATM Mix No. 19 -- Exterior, 4000 psi concrete, 4" slump, 5% air (use aggregate correction factor of 0.3 for ML-3 and ML-4 concrete) (7), 20% fly ash (Proportions per CY):

Type I-II Cement: Gcc Rio Grande, Tijeras	656 lbs
Class F, Fly Ash: Salt River Materials, 4-Corners	164 lbs
Water	295 lbs
Washed Concrete Sand: El Guique Quarry	1079 lbs
Sz#67 Coarse Aggregate: El Guique Quarry	1630 lbs
Water Reducer: Mb poly heed 997	41 oz(1)
Air Entraining Agent: MB Micro Air,	8.2 oz(2)

- LATM Mix No. 44 -- Exterior, 4000 psi concrete to be pumped, 6" slump, 5% air (use aggregate correction factor of 0.3 for ML-3 and ML-4 concrete)(7), 20% fly ash (Proportions per CY):

Type I-II Cement: Gcc Rio Grande, Tijeras	656 lbs
Class F, Fly Ash: Salt River Materials, 4-Corners	164 lbs
Water	295 lbs
Washed Concrete Sand: El Guique Quarry	1079 lbs
Sz#67 Coarse Aggregate: El Guique Quarry	1630 lbs
Water Reducer, Mb poly heed 997	57.4 oz(1)
Air Entraining Agent: MB Micro Air,	8.2 oz(2)

Note (1): Temperature and slump variation may require adjustment in dosage within the range of 24.6 fl oz / cy to 57.4 fl oz / cy
Note (2): Temperature and slump variation may require adjustment in dosage within the range of 1.025 fl oz / cy to 12.3 fl oz / cy
Note (7): When this mix is used in an ML-1 or ML-2 application, the aggregate correction factor must be determined by testing in accordance with ASTM C 231

PART 3 EXECUTION

3.1 GENERAL

A. Conform to applicable provision of ACI 301 unless otherwise specified herein.

B. Mix, test, and deliver concrete, along with test records in accordance with ASTM C 94. Mixing water must be added with the use of a calibrated measuring device, such as a mechanical water meter. Tank sight glasses are not acceptable.

3.2 EXAMINATION

A. Verify lines, levels, and centers before proceeding with formwork. Ensure that dimensions agree with the Drawings. Verify "Square" for slabs, floors, and walls.

"Square" specifically means a 90 degree corner or connection, whether horizontal or vertical, such as a floor, wall or ceiling. Note: all required preliminary activities, such as geotechnical and soil compaction/moisture testing, must be confirmed in order to be considered completed.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

C. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

D. Do not use wood formwork more than three times for concrete surfaces to be exposed to view. Do not patch formwork.

E. Verify that concrete cover for reinforcement conforms to the drawings and to Para 3.4.C below.

3.3 FORMWORK

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

B. Erect formwork, shoring and bracing to achieve design requirements and maintain tolerances in accordance with requirements of ACI 301 and ACI 347(or more stringent design requirements). Camber structural slabs and beams in accordance with ACI 301. Contact surfaces of the formwork should be carefully installed to produce neat and symmetrical joint patterns, unless otherwise specified. Joints should be vertical or horizontal and, where possible, should be staggered to maintain structural continuity.

C. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

D. Arrange and assemble formwork to permit dismantling, stripping and removal of remaining principal shores. Do not damage concrete during stripping.

E. Align joints and make watertight. Keep form joints to a minimum.

F. Obtain approval from the Engineer-of-Record for all construction joint locations not shown on the drawings and before framing openings (in structural members) which are not detailed on Drawings.

G. Provide chamfer strips on external corners of walls.

H. Apply form release agent prior to placement of reinforcing steel, anchoring devices, and embedded items.

I. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

J. Do not apply form release agent where concrete surfaces receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

K. Provide formed openings where required for items to be embedded in or passing through concrete work.

L. Locate and set in place items which cast directly into concrete.

M. Clean formed cavities of debris prior to placing concrete. Clean and remove foreign matter as erection proceeds.

N. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

O. Install waterstops continuous without displacing reinforcement.

P. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

Q. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

R. During cold weather, remove ice and snow from within forms. Do not use deicing salts or water to clean out forms. Use compressed air or other means to remove foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

S. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and other imposed loads without excessive deflection or creep. Perform form removal in accordance with the recommendations of ACI 347.

T. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

U. Store removed forms in manner to avoid any damage to form surfaces that will later be in contact with fresh concrete. Discard damaged forms.

V. After formwork removal, place construction or equipment loads on reinforced concrete only after cylinder break results indicate strengths meet specified requirements. Exceptions to this requirement must be approved in writing by the engineer of record.

3.4 REINFORCING PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Maintain minimum concrete cover around reinforcing as follows:

Item	**Minimum cover, in.**
***Formed Concrete Surfaces Exposed to Earth/Water Weather*:**	
No. 5 bars and smaller, W31 or D31 wire and smaller	1-½
No. 6 through No. 18 bars, W45 or D45 wire	2

Item	Minimum cover, in.
Walls:	
Dry Conditions –	
No. 11 bars and smaller	¾
No. 14 and 18 bars	1-½
Exposed to earth, water, weather –	
All bars	2
Footings and Base Slabs:	
At formed surfaces and bottoms bearing on concrete workmat	2
At unformed surfaces and bottoms in contact with earth	3
Top of footings	Same as slabs
Over top of piles	2

3.5 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush, pressure washing, or other acceptable means to fully remove any laitance to assure that a "roughened" surface exists for bonding with the new concrete. When authorized by the engineer-of-record, apply bonding agent in accordance with the manufacturer's recommendations. Laitance is a weak layer of cement and aggregate fins on a concrete surface that is usually caused by an overwet mixture, overworking the mixture, improper or excessive finishing or combination thereof. Note: The more stringent of this paragraph, ACI 318, and ACI 301 apply.

B. In locations shown on the design drawings where new concrete is to be dowelled to existing work, unless noted otherwise on the design drawings, drill holes in existing concrete; insert steel dowels to the specified depth and pack solid with non-shrink grout that meets or exceeds the concrete minimum strength. Note: Non-shrink grout must be mixed, applied, and cured per the manufacturer's requirements.

3.6 PLACING CONCRETE

A. Place concrete in accordance with ACI 301. Consolidate concrete by internal vibration per ACI 309R-2005 or latest edition; whichever is more stringent, unless otherwise directed by the engineer-of-record.

B. Notify the LANL STR a minimum of 24 hours prior to commencement of concrete operations.

C. Ensure that reinforcement, inserts, embedded parts, formed joint fillers, joint devices, and formwork are not disturbed during concrete placement.

D. Install joint filler, primer and sealant in accordance with manufacturer's instructions.

E. Install joint devices in accordance with manufacturer's instructions.

F. Place concrete continuously between predetermined expansion, control, and construction joints.

G. Unless noted otherwise on the design drawing(s), screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 inches in 10 ft.

3.7 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed with smooth rubbed finish.

B. Finish concrete floor surfaces in accordance with ACI 301.

1. Finishes shall meet the requirements of ACI 301 section 5.3.4.2 and tolerances shall conform to ACI 117.

2. Tolerances for floors, slabs, and floor finishes shall be confirmed by measuring in conformance with ACI 301 section 5.3.4.3.

C. Steel trowel surfaces which are scheduled to be exposed.

3.8 CURING AND PROTECTION

A. General

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.

2. Use all applicable practices and recommendations: for hot weather concrete application, from ACI 305R; for cold weather concrete applications from ACI 306R; for curing from ACI 308. Note: ACI 301 applies for any conditions not specifically addressed by one of these noted standards.

B. Hot Weather Applications

1. These practices (ACI 305R) shall be used when ambient daytime temperature at any time is 75 degrees F or more.

2. All applicable practices (ACI 305R) for production control and delivery including but not limited to temperature control, water content, slump, admixtures, and batching and mixing shall be employed.

3. Protection shall be provided from the sun and wind and all practice from ACI 305R Chapter 4 shall be followed in placing and curing.

4. Curing shall be by water curing methods per ACI 308.1 Sections 4, 5, 6, and/or 7.

5. Alternate means of curing will be allowed only if pre-approved by LANL. If approved, liquid membrane curing must strictly follow manufacturer's recommendations for application including volume of coverage per square foot. Application shall follow ACI 308.1 Section 3.

6. Protection and curing of concrete shall conform to provisions of ACI 301 Paragraph 5.3.6.

C. Cold Weather Applications

1. Use applicable provisions from ACI 306R and meet the requirements of ACI 306.1. Comply with recommended concrete temperatures "as mixed" and "as placed and maintained" from Table 3.1 of ACI 306.R. Comply with Para 4.2.2.8 of ACI 301 for temperatures of delivered concrete.

2. Curing shall be in accordance with ACI 306R Paragraphs 8.2 and 8.3, ACI 306.1 Paragraphs 3.3 and 3.4, ACI 308.1, and other applicable provisions.

3.9 CONTROL/CONTRACTION JOINTS

A. While the concrete is still plastic (i.e., within several hours after placement), provide joints in slabs as shown on Drawings. The depth of each joint will be at least one-quarter of the slab thickness, but not less than one inch. Modifications to the joint locations shown on Drawings may be made by Contractor, in accordance with Attachement 1, Submittal Tables.

3.10 FIELD QUALITY CONTROL

A. Provide a certified testing agency to perform field testing in accordance with ACI 301. Testing laboratory certification may be obtained through AASHTO or another nationally recognized accreditation service as allowed by ASTM C 1077. Testing agencies shall conform to requirements of ASTM E329. National accreditations must be specific to the specific facility and/or mobile unit. The engineer-of-record and the LANL Building Official, or designee must approve the test agency prior to performance any work. See LANL Engineering Standards Manual (ESM) Chapter 16 for additional details/requirements.

   1. Testing agencies for performing testing services on concrete materials shall meet the requirements of ASTM 1077.

   2. Field testing of concrete shall be performed by an ACI Certified Concrete Field Testing Technician – Grade I.

   3. Laboratory testing of concrete shall be done by ACI-Certified concrete laboratory technician-grade 1 or equivalent per ASTM C 1077

B. Inform the LANL STR 48 hours in advance of field testing to allow for witnessing of testing.

C. The Testing Agency shall perform the following tests and collect strength cylinders on one batch in every 50 cu. yds. of concrete placed or once a day when less than 50 cu. yds. is placed. Samples for Acceptance Testing are to be taken at the discharge from the transit mixer (and into a wheel barrow per ASTM C 172.), except when using concrete pumps or conveyors to transport concrete to its final placement location. When pumps or conveyors are used, the samples for acceptance tests shall be taken at the end of the pipe or last conveyor belt. Pumping of concrete should follow ACI 304.2R. Note: The tests below shall always be performed whenever concrete test specimens are taken. All concrete is to be tested.

   1. Sample concrete in accordance with ASTM C 172.

   2. Record temperature of concrete in accordance with ASTM C 1064.

   3. Perform slump test in accordance with ASTM C 143.

   4. Perform air content test in accordance with ASTM C 231, pressure method.

   5. Perform density testing in accordance with ASTM C 138 when required by ASTM C94.

   6. Take 4 concrete strength test cylinders in accordance with ASTM C 31.

D. The Testing Agency shall test the strength test cylinders in accordance with ASTM C 39 at 7 days and 28 days. Strength test cylinders must be picked-up at the job site between 8 and 48 hours after molding.

E. Coordinate the sequencing of concrete construction to schedule LANL concrete special inspection per the requirements of IBC Chapter 17. Provide 48 hour notification to schedule special inspectors.

3.11 CONCRETE ACCEPTANCE CRITERIA

A. Fresh Concrete

1. Temperature - Less than 90 degrees F.

2. Slump - per paragraph 2.7. Note: Slump that is lower than the minimum slump may be placed when the LANL inspector determines that the concrete is workable and can be vibrated. (This does not authorize low slump for other reasons such as concrete being placed beyond the time limit.) The LANL inspector will note the low slump in the inspection report but will not generate an NCR unless the concrete strength report indicates that it is unacceptable.

3. Air content - per paragraph 2.7. Note: High air-content beyond the specified range becomes a factor that can impact strength but not durability. The LANL inspector will note the high air-content the inspection report but will not generate an NCR unless the concrete strength report indicates that it is unacceptable.

4. Drum revolution counter - 300 maximum revolutions within 1-1/2 hours after initial mixing for Central-Mixed concrete or 100 to 300 revolutions within 1-1/2 hours after initial mixing for Shrink-Mixed and Truck-Mixed concrete.

B. Strength

1. Concrete strength is satisfactory if the average of all sets of 3 consecutive strength test results equal or exceed the specified 28 day strength f ' c and no individual strength test result falls below the specified 28 day strength f ' c by more than 500 psi.

C. Appearance

1. Free from honeycombs, embedded debris, and dimensional variance beyond ACI 301 and its references.

D. Construction requirements

1. Conforming to required lines, details, dimensions and tolerances specified for construction.

3.12 DEFECTIVE CONCRETE

A. Defective concrete is concrete not conforming to acceptance criteria in paragraph 3.11.

B. Do not accept or place defective concrete that is not in conformance with acceptance criteria. Return the fresh concrete to the supplier.

C. Replace defective concrete not meeting strength criteria, at Subcontractor's expense. The Subcontractor may, at its expense, evaluate the concrete's in-place strength by testing 3 core samples for each strength test where LANL cured cylinders were more than 500 psi below f'_c in accordance with ACI 301 and ASTM C42. Fill core holes in accordance with ACI 301.

D. Replace defective concrete not meeting appearance criteria, at Subcontractor's expense. The STR may allow repair of defective concrete at Subcontractor's expense.

E. Replace concrete not in conformance with details, tolerances, and other construction requirements at Subcontractor's expense.

ATTACHMENT 1
SUBMITTAL TABLES

Subcontractor is responsible for full compliance to all of ACI 301 and this specification. The submittals listed in these Submittal Tables (and any others in the body of the specification) are those specific submittals that LANL must receive from the Subcontractor.

Other potential submittals associated with the various codes and standards and required by the engineer of record remain the responsibility of the Subcontractor.

The items below must be submitted by the Construction Subcontractor to the LANL STR within the time frame noted in the "timeframe" column to the right of the submittal item. The submittal time frames may be adjusted for individual projects by Subcontract or the LANL STR. The LANL STR will obtain the review and approval of the engineer-of-record and any other authority and notify the Subcontractor after approval is granted for each submittal.

In addition, the Subcontractor must schedule and manage any sub-tiers to ensure that the proper approach and scheduling is used to obtain all necessary approvals and tests of concrete constituents that make up new mix designs.

Table 1.A submittals are always required. Submittals in Table 1.B ("LANL-Approved Variance and Alternate") are only required when the subject matter of/ in the requirement is applicable. For example, the reason ACI-301 paragraph 1.7.1.4 is included in Table 1.B is that proposed repair methods, materials, and modifications are needed to repair the concrete work to meet the requirements of Subcontract Documents. Submittals in Table 1.B are not required if the concrete work meets the requirements of the Subcontract Documents (i.e., repair is not necessary / applicable). Finally, because the need for them will be rare, these 1B submittals are not included in the Subcontract Exhibit I Attachment B listing of submittals, but are nevertheless required when needed.

The submittal reviews should be generally consistent with the following schedule:

1. 2 days for the STR to give the submittal to the A/E
2. 10 days for the A/E to approve the submittal.
3. 2 days for the STR to return the approved submittal
4. 5 - 10 days for the Subcontractor to act on the approval
5. 5 days for the Subcontractor to correct any submittals for re-review followed by a 5-day review period

(A mature process will take approximately 5 weeks if the submittal is not returned unapproved).

Note 1: Design-build Subcontractors shall obtain their engineer-of-record approvals before submitting the submittals to the LANL STR (differs from Para 3 above).

Note 2: Additional items may need to be added for nuclear or radiological projects or specialty construction (i.e., high-density concrete, self-consolidating concrete, etc.).

Note 3: The term "engineer-of-record" is synonymous with the term "architect/engineer (i.e., as applicable to project in question)."

Note 4: Source: Requirement source is ACI 301-05 unless noted otherwise

TABLE 1.A SUBMITTALS ALWAYS REQUIRED

No.	SUBMITTAL	TIMING	SOURCE
	General		
A-01	Documentation that testing agencies have been accepted by the engineer-of-record before performing any testing work.	4 months before performing any work. Includes A/E acceptance and LANL LBO acceptance.	*1.6.3.1*
A-02	Documentation that testing agencies have been approved by the LANL Building Official (LBO) prior to performing any work. Important note: This also applies to subtier concrete fabricators and batch plants. This places a premium on planning to assure that the testing agencies are properly approved before all of the required concrete constituent / material testing is begun to support any alternate mix design(s) which have to be submitted for LANL engineering approval 30 days before using the concrete mix. The best alternative is to choose from the list of LBO-approved test agencies from Chapter 16 of the ESM (Engineering Services Manual). Using a testing agency on the approved list will save time by having the LBO approval in advance and then there is only the engineer-of-record's approval to obtain.	2 months before performing any work. Note: LANL will normally require that the subcontractor hire the test agency(s). If LANL provides the test agency(s) then this submittal only applies to the subcontractor when they contract the engineer-of-record.	*IBC Chapter 17 and ESM Chapter 16*
A-03	Documentation that quality control program of the concrete supplier is accepted by A/E.	3 months before the initial placement.	1.6.3.2.f
A-04	The testing agency shall report test and inspection results that pertain to the Work to the engineer-of-record, construction Subcontractor, and concrete supplier within 7 days after tests and inspections are performed. For timing for submittals to LANL in column to the right.	Within 2 days for the initial slump and air content and within 7 days for each specified break report sequence (i.e., 7, 14, and 28 day breaks).	1.6.4.1.c
A-05	Data on form-facing materials proposed for smooth-form finish if not specified in the design media: • Rough-form finish on concrete surfaces not exposed to public view; and • Smooth-form finish on concrete surfaces exposed to public view.	15 work days (or 3 weeks) before form installation.	2.2.1.1
A-06	Data on formwork release agent or formwork liners.	15 work days (or 3 weeks) before form work installation start	2.1.2.1.f and spec. 2.2.D
A-07	Design calculations per ACI 347 indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components (design forms for full liquid static head of concrete). Formwork drawings showing details of formwork including; joints, supports, studding and shoring, and sequence of form and shoring removal, prepared by or under supervision of a Professional Engineer detailing fabrication, assembly, and support of formwork. For shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members, Drawings and calculations prepared by or under supervision of a Professional Engineer.	15 working days before formwork installation begins	Specification and ACI-301 para. 2.1.2.2.a and b

No.	SUBMITTAL	TIMING	SOURCE
A-08	Data and sample of attachment accessories and form ties.	15 work days (or 3 weeks) before form work installation start	2.1.2.2.c, 5.1.2.3.f
A-09	Data and sample of expansion joint materials (sealer and filler)	15 work days (or 3 weeks) before form work installation start	2.1.2.2.d
A-10	Data and sample of waterstop.	15 work days (or 3 weeks) before form work installation start	2.1.2.2.e and spec. 2.2.I
A-11	Alternative locations and details for formed construction and contraction joints.	1.5 months before form work installation	2.2.2.5.d
A-12	Product data on admixtures, materials for coring concrete		
	Reinforcing Material		
A-13	Rebar manufacturer's certified test report (CMTRs) traceable to the heat# or test identification # on the shipping tags.	15 work days (or 3 weeks) before the planned shipment date	3.1.1.1a, codes, and ASTM A615 / A706
A-14	Shop drawings indicating bar sizes, spacing, locations, piece numbers, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, supporting and spacing devices. Identify all lap splice lengths	1 month before re-enforcement placement	3.1.1.1.b
A-15	List of splices and request to use splices not indicated in Subcontract Documents.	1 month before re-enforcement placement	3.1.1.1.c
A-16	Request to use mechanical splices not shown on the project drawings. In addition, submit the ICC Evaluation Report(s) showing the requested mechanical splices to meet the requirements of ACI 318/ACI 355.2 for the IBC year edition applicable for the project. ACI 301-[2005] paragraph 3.1.1.1.d (and ACI 355.2 section 12) requiring objective evidence that ICC (the evaluation agency) has approved the mechanical splice for use under IBC (year edition applicable). http://www.icc-es.org/reports/index.cfm?csi_num=03151&view_details=yes	1 month before re-enforcement placement	3.1.1.1.d, ACI 355.2, and IBC Sections 1704.1 and 1704.13
A-17	Request and procedure to field bend or straighten reinforcement partially embedded in concrete.	15 work days (or 3 weeks) before placement of reinforcement	3.1.1.1.f and 3.3.2.8
A-18	Copy of current CRSI Plant Certification for any reinforcement manufacturer's plant.	15 work days (or 3 weeks) before the planned shipment date.	3.1.1.1.g
A-19	If coated reinforcement is required, description of reinforcement supports and materials for fastening coated reinforcement not described in 3.3.2.4 of ACI 305-05 (later edition if applicable)	15 work days (or 3 weeks) before placement of reinforcement	3.1.1.2.b
A-20	Submittal to obtain engineer-of-record approval to field-cut reinforcing steel.	15 work days (or 3 weeks) before cutting any reinforcing steel	3.3.2.9

No.	SUBMITTAL	TIMING	SOURCE
A-21	CMTRs for each rebar delivery traceable to the rebar bundle tags. Must be included with delivery of the rebar at the site.	Upon receipt	
A-22	Not Used		
A-23	Certified copies of CMTRs for reinforcing and other construction materials such as form savers, cadwelds, etc. Mechanical splices must be supported by ICC evaluation reports showing full compliance to the applicable IBC code of record for the project.		
	Concrete and Concrete Materials –Spec (Pre-Approved) Mix Designs		
A-24	Source documentation and component analyses to verify compliance of concrete batch materials to the pre-approved mix design. The laboratory test reports shall include manufacturers' certified material test report(s) and all other tests for cement, fly ash [slag], [silica fume], aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained versus sieve size.	Prior to first concrete placement for either of the two pre-approved LATM exterior concrete	03 3001 Section 2.7.H
A-25	Not Used		
	Concrete and Concrete Materials – Alternate Mix Designs		
	Reminder: The LANL Building Official must approve the Test Agency (ies) prior to performing the necessary tests. The engineer-of-record must also approve all test agencies and those test result submittals required by ACI 301.		

No.	SUBMITTAL	TIMING	SOURCE
A-26	Mix design for each strength and type of concrete to LANL's Chief Civil/Structural engineer for approval. A complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, [silica fume], ground slag, and admixtures; and applicable reference specifications shall be included in the mix design submittal. In addition, the documentation provided shall include cementitious materials producers' names, and plant locations; and, for aggregates, types, pit, quarry locations, producer's names, gradings, and properties required by ASTM C33. Except for admixtures and water, test results confirming conformance with applicable specifications shall not be more than 90 days old. Test results for aggregate soundness, abrasion, and reactivity may be older than 90 days, but not older than 1 year, provided test results for the other properties specified in ASTM C 33 indicate that the aggregate quality has not changed. Note that the use of fly ash may require an increase of air entraining admixture to maintain air content of concrete within specified levels. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, and approved in writing by LANL. Clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. In addition, copies of the fly ash, [silica fume], and pozzolan test results shall be submitted. The approval of fly ash, [silica fume], and pozzolan test results shall have been within 6 months of submittal date. Obtain acknowledgement of LANL's approval of the concrete mix design prior to concrete placement. Note, design mixes intended to provide more flexibility than the stated ranges [slump, air content, water cement ratio, etc.] must obtain a formal variance to the specification. a. Submit separate mix design for: i. Each concrete strength ii. Each specified or range of air content iii. Each specified or range of slump iv. Each nominal maximum aggregate size v. Concrete to be pumped vi. Concrete with identifiable admixtures b. Include the following information with each design: i. Quantity of Water ii. Type, brand, certification, and quantity of cement iii. Source, certification, and quantity of each nominal maximum size of aggregate iv. Type, brand, sources, certification and quantity of admixture, if used v. Type, source, certification and quantity of fly ash vi. Water/cement ratio vii. Air-content viii. Slump ix. Aggregate-correction factor to meet ASTM C 231. c. Test Reports for each design: i. Concrete mix tests including strength in accordance with ACI 301, ASR resistance for mix (in accordance with ASTM C 1260 or AASHTO T 303-00), air content, weight and yield (ASTM C 138). ii. All mix designs (except pre-approved LATM mix	30 days prior to use of the concrete mix	03 3001 2.7 and ACI-301 paragraph 4.1.2.3

No.	SUBMITTAL	TIMING	SOURCE
	designs –see paragraph 2.7.H) shall be tested for durability in accordance with ASTM C 666. iii. Copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include manufacturer's certified material test and all other tests for cement, fly ash [slag], [silica fume], aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with any new concrete mix design. Obtain approval from LANL before concrete placement. iv. Fly ash and other pozzolans: ASTM C 618. v. Ground blast furnace slag, where used, ASTM C 989. vi. Aggregates, petrographic analysis, ASTM C 295 and potential ASR use ASTM C 1260 (with no additives such as fly ash) or one of several other ASTM tests for ASR (ASTM C 227, ASTM C 289, or ASTM C 1293). vii. Unless otherwise stated, the time restrictions associated with the above tests shall comply with ACI 301.		
A-27	Mixture proportions and characteristics: Evidence that mixture proportions conform to the requirements of 4.2.2 for cementitious material content, water-to-cementitious material ratio, slump, nominal maximum size of coarse aggregate, air content, admixtures, and chloride-ion concentration, as well as compressive strength and yield.	Approximately 15 work days (or 3 weeks) before the planned placement	4.1.2.1
A-28	Method and test data used to establish mixture proportions: Several different methods can be used to select mixture proportions to produce the necessary placeability, density, strength, and durability of the concrete. Field experience of concrete mixtures previously used under similar conditions provides the best assurance that the proposed concrete mixture can be used satisfactorily and will have the specified properties. If there is no field experience, ACI 211.1 provides guidance for selection of the initial quantities of materials based on material properties and specified concrete properties. When a field test record is not available, ACI 211.1 recommends that mixture characteristics be checked by trial batches in the laboratory or in the field. Blending aggregates to meet criteria for a combined grading is another proportioning method that can be used. Listed below are some of the different procedures that have been used to determine proportions of blended aggregates: • Combined fineness modulus; • 8 to 18% retained on each of the standard sieves; • Coarseness factor chart; and • 0.45 power chart. When one of the above or other similar proportioning methods is used, submit the specific combined grading to which aggregate is to be blended, along with the tolerances for control. This proportioning method also requires concrete characteristics to be checked by trial batches.	Approximately 15 work days (or 3 weeks) before the planned placement	4.1.2.2, 4.2.3.4.a
A-29	Materials, mixture proportions, and field strength-test data used for	To support mix	4.1.2.4.

No.	SUBMITTAL	TIMING	SOURCE
	proportioning.	design sequence	
A-30	Requests for adjustments to mixture proportions.	Two weeks before use in a placement	4.1.2.5
A-31	Evaluation and test results required in 4.2.2.1 verifying the adequacy of concrete to be placed in floors if the cementitious materials content is less than the minimum specified in Table 4.2.2.1 of ACI 301 [2005].	15 days before the initial placement.	4.1.2.6
	Handling, Placing, and Constructing		
A-32	Test and inspection records. Note: This applies to the Subcontractor when the test agency reports to them contractually.	Within 30 days after the placement	5.1.2.1.a
A-33	Description of conveying equipment.	15 days before the initial placement.	5.1.2.1.b
A-34	Proposed method of measuring concrete surface temperature changes.	15 days before the initial placement.	5.1.2.1.c
A-35	Proposed method for removal of stains, rust, efflorescence, and surface deposits.	15 days before performing the work	5.1.2.1.d
A-36	Qualifications of finishing Subcontractor and flatwork finishers (ACI flatwork certification).	15 days before the initial placement.	5.1.2.1.e
A-37	Shop drawings of placing, handling, and constructing methods.	15 days before the initial placement.	5.1.2.2.a
A-38	Advance notification of forthcoming placement. Arrange for tests and inspection to be properly coordinated.	48 hours notice for first placement and 24 hours for all other placements	5.1.2.2.b
A-39	Request for acceptance of pre-placement activities to ensure the pre-placement activities are properly inspected, if necessary.	48 hours notice before placement	5.1.2.2.c
A-40	Proposed wet-weather protection activities.	48 hours notice before placement	5.1.2.2.d, 5.3.2.1.a
A-41	Not Used		
A-42	Not Used		
A-43	Bonding agents other than cement grout for two-course slabs.	15 days before the initial placement.	5.1.2.3.b and spec. 2.6.A
A-44	Not Used		
A-45	Batch Tickets 1. Two legible copies of the batch ticket for each load of concrete to LANL's STR, field engineer, or inspector. 2. Conform to the requirements for batch tickets in accordance with ASTM C 94. Include the following information: a. Name of ready-mix batch plant. b. Serial number of ticket. c. Date. d. Truck number. e. Name of purchaser. f. Specific designation of job (name and location). g. Specific class or designation (pre-approved design mix number) of the concrete in conformance with that employed in job specifications. h. Amount of concrete in cubic yards (or cubic meters). i. Time loaded or of first mixing of cement and	At the completion of each day's concrete placement(s) At the completion of each days concrete placement(s)	03 3001

No.	SUBMITTAL	TIMING	SOURCE
	aggregates. j. Water added by receiver of concrete and his initials. Note: any water added to the truck must also be witnessed by the LANL field engineer or inspector. k. Reading of revolution counter at the first addition of water. l. Type and brand, and amount of cement. m. Type and brand, and amount of admixtures. n. Class, brand, and amount of coal fly ash, raw or calcined natural pozzolans [grade, brand and amount of ground granulated blast-furnace slag]. o. Information necessary to calculate the total mixing water. Total mixing water includes free water on the aggregates, water, and ice batched at the plant, and water added by the truck operator from the mixer tank (must be witnessed by LANL representative). p. Maximum size of aggregate. q. Weights of fine and coarse aggregate. r. Ingredients certified as being previously approved. s. Water /cement ratio t. Amount of water that can be added at the jobsite without exceeding the water/cement ratio. u. Signature or initials of ready-mix representative. 1. Record on each, the location where placed in structure and time of placement.		
	[Architectural Concrete]		
A-46	Not Used		
A-47	Not Used		
A-48	Not Used		
A-49	Not Used		
	[Lightweight Concrete]		
A-50	Not Used		
	[Mass Concrete]		
A-51	Not Used		
	[Prestresssed Concrete]		
A-52	Not Used		
A-53	Not Used		
A-54	Not Used		
A-55	Not Used		
A-56	Not Used		
A-57	Not Used		
A-58	Not Used		
A-59	Not Used		
A-60	Not Used		
A-61	Not Used		

No.	SUBMITTAL	TIMING	SOURCE
A-62	Not Used		
	[Shrinkage-Compensating Concrete]		
A-63	Expansion test results for the proposed concrete mixtures.	30 days before the placement.	10.1.3.2 10.2.3.2
A-64	Proposed sequences of concrete placements. It is critical that the concrete be placed in such manner that will permit the placement to expand. Consult ACI 223 for guidance.	15 days before the placement.	10.1.3.3
A-65	Request to use silica fume.	15 days before the placement.	10.2.1.1.c
A-66	Proportions and expansion test results for revised mixture proportions.	30 days before the placement.	10.2.3.3

TABLE 1.B SUBMITTALS FOR LANL-APPROVED VARIANCES AND ALTERNATE METHODS

No.	SUBMITTAL	TIMING	SOURCE
	General		
B-01	Proposed repair methods, materials, and modifications to the work.	1 month before performing any work.	*1.7.1.4*
B-02	Description of repair work to be performed to bring strength-deficient concrete into compliance with the Subcontract Documents.	Provide subcontractor NCR with recommended repair disposition and allow sufficient time for LANL approval. LANL approval must be obtained before the work is started.	1.7.4.2.e
B-03	Description of repair performed to bring potentially nondurable concrete into compliance with the contract documents.	Provide subcontractor NCR with recommended repair disposition and allow sufficient time for LANL approval. LANL approval must be obtained before the work is started.	*1.7.5.2.e*
B-04	Location of construction and contraction joints proposed if different from those indicated in the Contract Documents.	15 work days (or 3 weeks) before form installation.	*2.1.2.1.b*
B-05	Correlation data for alternative methods of determining strength of concrete for formwork removal. See ACI 228.1R for recommendations on developing suitable correlation data.	15 work days (or 3 weeks) before initial placement	*2.1.2.1.c*
B-06	Detailed plan for formwork removal at a low compressive strength than specified.	15 work days (or 3 weeks) before initial placement	*2.1.2.1.d*
B-07	Plan and procedures for installation and removal of re-shoring and back-shoring. See ACI 347 for guidance on items to consider.	15 work days (or 3 weeks) before form work installation start	*2.1.2.1.e*
B-08	Earth cuts as form surfaces.	15 work days (or 3 weeks) before form work installation start	*2.2.2.3*
B-09	Alternative locations and details of construction joints.	1.5 months before form work installation	*2.2.2.5.b*
B-10	Detailed plan for formwork removal at lower compressive strength than f 'c.	15 work days (or 3 weeks) before form work installation start	*2.3.2.5*
B-11	Not Used		
B-12	Not Used		
B-13	When the Subcontractor finds it necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embedded items, review they must submit a design change request.	Obtain design change request written approval prior to embedment in concrete	*3.1.1.3.a and as stated in this req'ment*
B-14	Not Used		
B-15	Requests for adjustments to mixture proportions.	1 month before the initial	*4.2.3.5*

No.	SUBMITTAL	TIMING	SOURCE
	Requests to adjust mixture proportions necessary for workability or consistency. If the Subcontractor desires to decrease the cementitious materials content of the concrete mixture after having satisfied the requirements of 4.2.3.6, obtain engineer-of-record review and approval of the proposed revised mixture with a lower cementitious material(s) content on a trial basis. If the Subcontractor finds it necessary to increase the cementitious materials content, obtain engineer-of-record review and approval` of the proposed revised mixture with a higher cementitious material(s) content on a trial basis. Confirm adequacy of modified proportions has been verified from a set of new field test data.	placement.	
B-16	Not Used		
B-17	Request to use the volumetric batching method.	15 days before the initial placement.	*4.1.2.8, 4.3.1.1*
B-18	Requests to exceed the ASTM C 94/C 94M required time of discharge.	15 days before the initial placement.	*4.1.2.9*
B-19	Not Used		
B-20	Request to use alternative sources of water.	15 days before the initial placement.	*4.2.1.3*
B-21	Request to use admixtures.	15 days before the initial placement.	*4.2.1.4*
B-22	Request to change materials and data verifying that properties of the concrete mixture conform to the requirements of 4.2.2 of ACI 301, 2005.	1 month before the initial placement.	*4.2.1.5*
B-23	Request to use a lower cementitious material content.	1 month before the initial placement.	*4.2.2.1*
B-24	Request to use a slump other than that specified.	15 days before the initial placement.	*4.2.2.2*
B-25	Revised mixture proportions based on revised value of f 'cr.	1 month before the initial placement.	*4.2.3.6.c*
B-26	Proposed precautions for placement of concrete hotter than 90 °F.	48 hours notice before placement	*5.1.2.2.e 5.3.2.1.c*
B-27	Proposed location and treatment of construction joints not shown on the project drawings. Obtain engineer-of-record review and approval of the proposed methods for preparing the surface and the use of portland-cement grout.	15 days before the initial placement.	*5.1.2.3.a*
B-28	Proposed methods of curing other than those of 5.3.6.4 of ACI 301 , 2005. Note: Per Spec 03 3001, non-water-curing methods must be pre-approved by LANL.	15 days before the initial placement.	*5.1.2.3.e*
B-29	Specification and data and methods of use for any proposed repair material other than site-mixed portland-cement mortar described in 5.3.7.5 (see 5.3.7.6). For patches in exposed concrete, exercise caution when using the materials described in 5.3.7.6, particularly with regard to both possible color changes from weathering and delamination due to differing coefficients of thermal expansion. Ensure that the material, including ASTM type or class, is appropriate for the moisture and thermal conditions of exposure.	30 days before work start	*5.1.2.3.g 5.2.1.3, 5.3.7.6*
B-30	Proposed materials and methods to prepare the concrete surface to achieve bond.	15 days before the placement.	*5.3.2.6*
B-31	Request to use bonding agents other than cement grout.	15 days before the placement.	*5.3.4.2.f*
B-32	Detailed plan for alternative saw-cutting method, such as shallow-cut and dry-cut method. See ACI 302.1R for further guidance.	15 days before planned work	*5.3.5*
B-33	Proposed methods of curing other than those listed in 5.3.6.4.a through e of ACI 301, 2005.	15 days before the placement.	*5.3.6.4*
B-34	Not Used		
B-35	Batching and mixing procedure that varies from the specified	15 days before the placement.	*7.2.4.1*

No.	SUBMITTAL	TIMING	SOURCE
	requirements in Section 4 of ACI 301, 2005.		
B-36	If the Subcontractor needs additional water or air entrainment to bring the concrete to the specified slump, obtain engineer-of-record review and approval of the request and quantities to be added. Do not exceed water-cement ratio limits.	15 days before the placement.	*7.2.4.4*
B-37	Request to use an accelerating admixture. As a general rule, accelerating admixtures should not be used in mass concrete because they contributed to early undesirable heat development. On rare occasions, such as when early formwork removal is critical, accelerating admixtures may be needed to accelerate strength development in reinforced mass concrete during winter conditions. Calcium chloride, if used, should not be permitted in excess of 1% by weight of cement. The engineer-of-record must accept the use of any accelerating admixture.	15 days before the placement.	*8.2.1.2.a*
B-38	Not Used		
B-39	Requests to allow limits on concrete temperature at placement to exceed 70 °F or to be less than 35 °F.	15 days before the placement.	*8.3.1.1*
B-40	Request to use different grout mixtures.	30 days before the placement.	*9.2.2.2.a*
B-41	Not Used		
B-42	Proportions and expansion test results for revised mixture proportions.	30 days before the placement.	*10.2.3.3*

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 03 3001 Rev. 4, dated November 1, 2010.

SECTION 03 3053

MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete for fence posts

B. Concrete thrust blocks on utility lines

1.2 SUBMITTALS

A. Submit the following in accordance with Section 01 3300, Submittal Procedures:

1. Design mix of each class of concrete.

2. Laboratory test reports for design mix for concrete.

3. Test Reports of Concrete Field Testing.

4. Batch tickets.

1.3 RELATED SECTIONS

A. Section 31 2000 - Earth Moving

B. Section 03 3001 - Reinforced Concrete

All work performed under the subject specification shall be performed in accordance with the applicable requirements of Section 03 3001, Reinforced Concrete, unless otherwise specified herein.

1.4 QUALITY ASSURANCE

A. Perform work, materials and construction requirements, in accordance with the quality assurance requirements for Section 03 3001, Reinforced Concrete.

1.5 JOB CONDITIONS

A. Do not place concrete when base surface temperature is less than 40 degrees F.

B. Perform concrete washout, trucks and mixers, in a designated and controlled area to prevent the runoff of washout material and the co-mingling of unset concrete with storm water. Properly dispose of all hardened concrete.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials and construction requirements for forms, concrete, joints, and required accessories.

2.2 ACCESSORIES

A. Accessories shall be in accordance with the requirements for Section 03 3001, Reinforced Concrete.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify compacted, treated base is ready to support concrete and imposed loads.

B. Verify grades and elevations of base are correct.

C. Verify forms are set to the required grade and alignment and extend to the required depth.

3.2 PLACING CONCRETE

A. Notify the LANL Subcontract Technical Representative (STR) a minimum of 24 hours prior to commencement of concreting operations.

B. Ensure that reinforcement, inserts, embedded parts, fence posts, formed joint fillers, joint devices, and formwork are not disturbed during concrete placement.

C. Concrete shall be placed in the forms in one layer. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

D. Concrete Finishing

1. The surface shall be finished true to grade and section with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks.

2. Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge.

3. Slope top of concrete fence post bases to provide positive drainage.

4. Finish thrust blocks to the extent where surface voids are eliminated.

3.3 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.

B. Use all applicable practice and recommendations: for hot weather concrete application, from ACI 305R; for cold weather concrete applications from ACI 306R; for curing from ACI 308.

3.4 FIELD QUALITY CONTROL

A. Provide a certified testing agency to perform field testing in accordance with ACI 301. Testing laboratory certification may be provided by Cement and Concrete Reference Lab (CCRL).

1. Testing agencies for performing testing services on concrete materials shall meet the requirements of ASTM C 1077.

2. Field testing of concrete shall be performed by an ACI Certified Concrete Field Testing Technician – Grade I.

B. Notify the LANL STR 48 hours in advance of field testing to allow for witnessing of testing.

C. The Testing Agency shall perform the following tests and collect strength cylinders on one batch in every 50 cu. yds. of concrete placed or once a day when less than 50 cu. yds. is placed.

1. Record temperature of concrete in accordance with ASTM C 1064.

2. Perform slump test in accordance with ASTM C 143.

3. Perform air content test in accordance with ASTM C 231, pressure method.

4. Take 4 concrete strength test cylinders in accordance with ASTM C 31.

D. The Testing Agency shall test the strength test cylinders in accordance with ASTM C 39 at 7 days and 28 days.

E. Concrete to be used for nonstructural purposes that comprises an aggregate of less than 2 cu. yds. (i.e., per project) does not require field testing provided the concrete is mixed per manufacturer's instructions or approved mix design parameters. For the purposes of this testing exclusion, "nonstructural" will be taken to mean concrete on or below the ground surface that will not adversely affect Life Safety and does not require a structural design. Examples of such concrete that meet this definition of nonstructural include sidewalks, curbs and gutters, thrust blocks, valve boxes and test box collars, post and pole anchorage when under 8' tall, and manhole collars in non-vehicle-traffic-bearing areas.

3.5 DEFECTIVE CONCRETE

A. Defective concrete is concrete not conforming to strength requirements, not being free from excessive cracking, discoloration, form marks, tool marks, honeycombs, embedded debris, or otherwise non-consistent with the overall appearances of the work.

B. Do not accept or place defective concrete that is not in conformance with acceptance criteria. Return the fresh concrete to the supplier.

C. Replace defective concrete not meeting appearance criteria, at Subcontractor's expense. The STR may allow repair of defective concrete at Subcontractor's expense.

D. Replace concrete not in conformance with details, tolerances, and other construction requirements at Subcontractor's expense.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 03 3053 Rev. 4, dated April 29, 2008.

SECTION 22 0813

TESTING PIPING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure testing of the following systems:

1. Zero Liquid Discharge System Piping
2. Zero Liquid Discharge Spray System Piping

1.2 SUBCONTRACTOR REQUIREMENTS

A. Notify LANL Subcontract Technical Representative (STR) at least twenty-four (24) hours (one working day) in advance to arrange for witnessing of the piping test.

B. For discharge requirements of water used for pressure testing comply with Section 01 3545, Water Discharge Requirements.

C. Notify LANL STR immediately in the event of any accidental discharge.

1.3 SUBMITTALS

A. Submit the following in accordance with Project submittal procedures:

1. Test plan for approval that includes:
    a. Material of construction
    b. Design pressure
    c. Test pressure and duration of test
    d. Test medium and method of achieving the test pressure
    e. Certification on calibration of pressure gauges
    f. Method to exclude personnel from the area containing the system to be tested.
    g. Over pressurization protection/prevention: Device make/model number, certification, pressure relief set point, point of installation in system.
2. Test Reports: Submit test results within ten (10) working days of successful test.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish instruments, equipment, material and labor necessary to conduct tests.

B. Calibrate testing equipment at reasonable intervals with devices of accuracy traceable to National Institute of Standards and Technology (NIST).

C. Test gauges used in conducting test shall be in accordance with IAPMO UPC.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Piping being tested shall remain exposed until LANL has approved the piping test results.

B. Trenches may be backfilled between joints before testing to prevent movement of pipe during testing. Ensure that thrust blocks are sufficiently hardened before testing.

C. Piping being tested shall not leak nor show any loss in test pressure for duration specified unless otherwise noted.

D. Where portion of piping system is to be concealed before completion, the portion shall be tested separately as specified for the entire system.

E. Ensure piping supports/anchors are in place.

F. Isolate system gages, sensors, etc., from pressure tests so instruments and devices are not damaged. Test pressure shall not exceed the maximum allowable test pressure for any vessel, pump, valves, or other component in the system.

G. Hydrostatic (Water) Testing:

1. Use potable water as test medium. Do not fill system until the LANL STR has approved the source of water supply.
2. Provide vents at high points to release trapped air while filling system.
3. Provide drains at low points for complete removal of test liquid.
4. Drain system if there is a potential for freezing, i.e., no heat in building, coil in outside air stream, or other similar situations.

H. Pneumatic (Air) Testing:

1. Use clean dry air (Excluded from use with natural gas pipe testing) or inert gas as the test medium.
2. Barricade the area around the system to be tested.
3. Prior to application of full air test pressure, apply a preliminary test of not more than 10 psig to reveal possible major leaks.
4. After preliminary test, raise pressure in stages not more than twenty-five percent (25%) up to full test pressure, allowing at least ten (10) minutes for equalization of strain and detection of major leaks at each intermediate stage. Hold final test pressure for time specified.

5. Examine piping for leakage using soap bubble solution, or by test gage monitoring.

I. If leaks are found, they shall be eliminated by tightening, repair, or replacement, as appropriate and test repeated until no leakage is found.

J. Where repairs or additions are made to piping system following the pressure test, the affected piping shall be tested. Minor repairs and additions are not required to be pressure tested, provided that the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other leak-detecting methods approved by the authority having jurisdiction. Testing will not be required in cases where it does not include addition to, replacement, alteration or relocation of, any piping, or in any cases where piping is set up temporarily for exhibition purposes.

3.2 PRESSURE TESTING

A. Zero Liquid Discharge Transfer Piping:

1. Below Grade: Test with water in accordance with ASME/ANSI B31.3 at 1.5 times the design pressure indicated on the contract drawings, 100 psig minimum. Test pressure shall be held for two (2) hours and until such time that all joints have been inspected for leaks. Piping shall maintain test pressure +/- 5 psi for the duration of the test and there shall be no visible signs of leakage.

2. Above Grade: Test with water in accordance with ASME/ANSI B31.3 at 1.5 times the design pressure indicated on the contract drawings, 100 psig minimum. Test pressure shall be held for two (2) hours and until such time that all joints have been inspected for leaks. Piping shall maintain pressure for two (2) hours without loss.

B. Zero Liquid Discharge Spray Piping:

1. Below Grade: Test with water in accordance with ASME/ANSI B31.3 at 1.5 times the design pressure indicated on the contract drawings, 50 psig minimum. Test pressure shall be held for two (2) hours and until such time that all joints have been inspected for leaks. Piping shall maintain test pressure +/- 5 psi for the duration of the test and there shall be no visible signs of leakage.

2. Above Grade: Test with water in accordance with ASME/ANSI B31.3 at 1.5 times the design pressure indicated on the contract drawings, 50 psig minimum. Test pressure shall be held for two (2) hours and until such time that all joints have been inspected for leaks. Piping shall maintain pressure for two (2) hours without loss.

3.3 TESTING FOR HOLIDAYS: NOT APPLICABLE

A. Test the following buried coated steel piping systems for holidays:

1. Natural gas.

B. Perform holiday test in accordance with the following procedure:

1. After pipe has been welded, joints wrapped, and pipe is ready for lowering into trench, test coating for flaws (holidays). Test coated piping system throughout its length for flaws in coating system by means of a high-potential flaw detector that can impress a maximum of 8,000 volts across coating. One electrode of tester shall maintain complete circumferential contact with coating while transversing entire length of coating system and other electrode shall be the underlying metal pipe. An electrical discharge through coating detected visually or by instrument, shall constitute failure of this test.

   Actual working voltage of detector on pipe will depend upon thickness of coating and size of pipe. A thin coating on a large pipe will offer a capacitive load to the detector that will drop the working voltage several thousand volts below the "no-load" voltage. Detector output may also have to be increased to overcome conditions such as extremely dry rock, or sandy soil.

   <u>Important!</u> Do not cut ground cable to a shorter length. The length supplied is important to proper operation of the detector. Keep as much of the cable as possible in contact with the earth. Straighten out kinks where possible and do not let it ride up over skids. In dry areas it will help to drag the cable in the ditch where there is more moisture. <u>The pipe should be grounded.</u>

2. Mark holidays as they are found and repair prior to lowering pipe into trench. Repair holidays in factory coating by removing initial coating and undercoating for a minimum of 4 inches on each side of holiday. Remove coating around holiday and feather edge to pipe wall for sufficient distance to make a satisfactory repair. Apply primer (Polyken 1027) to the holiday to form a bond over the entire surface of the holiday and then spirally wrap pipe with a double layer of half-lapped 35 mil polyethylene tape (Polyken 934) for a minimum of 2 inches on each side of the holiday.

   Repair holidays in joint wrappings by removing field applied coating in area of holiday and rewrapping. LANL STR or designated representative will approve all areas of joint coating.

3.4 RETESTING

A. If piping does not pass test, locate and repair leaks and repeat testing procedure until satisfactory results are obtained.

B. Make repairs to piping with new materials. Caulking on screwed joints, cracks, or holes is not acceptable.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 22 0813 Rev. 3, dated September 23, 2009.

PRESSURE TEST RECORD

TEST NUMBER:	PROJECT NO.: 19570	PAGE 1 OF
PROJECT NAME: Zero Liquid Discharge Subproject		

TEST INFORMATION	
SYSTEM DESCRIPTION:	
DESCRIPTION OF TEST BOUNDARIES: (Attach Sketch Showing Boundaries as Required. P&ID Recommended)	
DESIGN TEMPERATURE:	DESIGN PRESSURE:
TEST METHOD: ☐ HYDROSTATIC ☐ PNEUMATIC:	
TEST FLUID:	APPLICABLE CODE:
TEST REQUIREMENTS	
REQUIRED TEST PRESSURE:	TEST FLUID TEMPERATURE:
REQUIRED TEST DURATION:	AMBIENT TEMPERATURE:
GAUGE PRESSURE CALCULATION	
ELEVATION DIFFERENCE BETWEEN GAUGE AND HIGH POINT:	
X CONVERSION FACTOR:	
PLUS REQUIRED TEST PRESSURE:	
EQUALS REQUIRED GAUGE PRESSURE:	

TEST RESULTS			
TEST DATE:	START TIME:	☐ AM ☐ PM	
	FINISH TIME:	☐ AM ☐ PM	
ACTUAL GAUGE PRESSURE:			

TEST EQUIPMENT			
TYPE:	RANGE:	CAL. DATE:	CAL. DUE:
REMARKS:			

TEST ACCEPTANCE	
CODE EXAMINER:	DATE:
CODE INSPECTOR:	DATE:

SECTION 31 2000

EARTH MOVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Potholing.

B. Grading: Clear, excavate topsoil, grade and dispose of materials at site.

C. Excavation: Excavate, place, and compact earth at site.

D. Trenching: Excavate trenches for utilities.

E. Backfilling.

F. Soil compaction and testing.

1.2 LANL PERFORMED WORK

A. Obtain excavation/soil disturbance permit for Subcontractor.

B. Mark location of known underground utilities.

C. Document new and existing utility locations.

D. Locate utility shut-off points prior to potholing.

1.3 RELATED SECTIONS

A. 01 5705, Temporary Controls and Compliance Requirements

B. 32 9219, Seeding

1.4 DEFINITIONS

A. Mechanical Excavation: Use of backhoes, jackhammers, trenchers, and similar powered digging machines; excludes vacuum excavators that are equivalent to hand digging.

B. Utility and Pipe: Any active or inactive buried pipe, duct, conduit, or cable in a primary or secondary utility system.

1.5 SUBMITTALS

A. Submit the following in accordance with project submittal procedures:

1. Certifications from an independent testing laboratory that pipe bedding materials meet the specification.
2. Certifications from an independent testing laboratory that base course materials, crushed stone or crushed or screened gravel meet the specification.
3. Test reports of field-testing of material compaction.

1.6 QUALITY ASSURANCE

A. When work or portions of work of this Section requires testing, notify LANL

Subcontractor Technical Representative (STR) 48 hrs in advance of testing.

B. Ensure compacted fills are tested in accordance with Paragraph 3.10 and in compliance before proceeding with placement of next lift.

C. Do not begin any groundbreaking, fill, or soil disturbance and transfer until known utilities have been marked, and an excavation/soil disturbance permit has been issued to Subcontractor.

D. Comply with OSHA 29 CFR 1926, Subpart P for excavation and trenching operation.

E. Maintain a copy of Excavation/Soil Disturbance Permit package, potholing plan, competent person excavation logs, and test reports on site.

F. Perform pre-job briefing of Permit and associated safety and hazard documentation with workers performing the work.

G. Ensure that engineering controls and required Personnel Protective Equipment (PPE) are used by workers during work activities to maintain safety, especially during jack hammering. Breaking surface blacktop, curbs and gutters with a jackhammer does not require dielectric PPE, provided locates have been performed and the STR is confident no other unexposed utilities are present in the surface concrete, blacktop, curb, gutter or sidewalk to be removed.

H. Review and maintain the work within the established boundaries established by the permit.

1.7 SITE CONDITIONS

A. Do not place and compact backfill material when the atmospheric temperature is below 35 degrees F, unless approved by STR.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil

1. Excavated soil material, graded free of roots, rocks larger than 1 inch subsoils, and debris.

B. Fill and Backfill Material

1. Material consisting of non-plastic granular soils free of organic or other deleterious materials having a maximum particle size of 2 inches.

2. All borrow and fill material shall be provided by the Subcontractor. The LANL STR in consultation with LANL FOD-Utilities & Infrastructure (U&I) GROUP may approve a borrow/spoils area.

C. Engineered Backfill

1. General: Excavated material may be used for fill and/or backfill under sidewalks and site. Use only clean approved materials for engineered fill and/or backfill under buildings and structures. Site materials which have the required properties may be used subject to the approval of the LANL STR. If sufficient materials are not available at the site or if the site materials do not have the specified properties, materials from off-site borrow areas will be used. Off-site/imported fill should exhibit low-expansive potential. Off-site

materials may be mixed with on-site materials in the proportions necessary to meet the requirements of this section. All arrangements necessary for the use of borrow areas are the sole responsibility of the Subcontractor.

2. Laboratory Testing: Perform appropriate and specified laboratory tests as necessary to insure that soil materials proposed for use on this project meet all specified requirements. Provide a moisture-density curve for each material proposed for use as engineered fill.

3. Fill: Engineered fill required to raise the building areas and backfill around and above structures shall be clean material, free of vegetation, debris and other deleterious materials and shall meet the following requirements as determined by ASTM D 422 except as otherwise approved by the LANL STR.

Sieve Size	Percent Passing
2"	100
1/4"	40 - 100
No. 200	25 - 45

Fill shall have a P. I. of not more than 10. Testing shall be in conformance with ASTM D 4318.

D. Base Courses

1. Provide base course and aggregate composed of materials consisting of crushed stone, crushed or screened gravel, sand, RAP, or a combination of such materials. Provide base course and aggregate free from vegetable matter and other deleterious materials, including silt and clay balls. Ensure that at least 50 percent of the materials on or above the No.4 sieve have at least two fractured faces. Maximum Liquid Limit of 25 and maximum Plasticity Index of 6, per ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

2. Base course aggregate shall conform to:

Base Course Gradation

Sieve Size	Percent Passing
1.0 inch	100
¾ inch	80 - 100
No. 4	30 - 60
No. 10	20 - 45
No. 200	3.0 – 10.0

E. Finished Grade Surfacing and Non-Frost Susceptible Fill

1. Provide crushed stone or gravel for use as surfacing, and for extended depth frost-free fill, as indicated on the Contract Drawings. Provide aggregate composed of materials consisting of crushed stone, crushed or screened gravel, sand, RAP, or a combination of such materials. Provide aggregate free from vegetable matter and other deleterious materials, including silt and clay balls. Ensure that at least 50 percent of the materials on or above the

No.4 sieve have at least two fractured faces. Maximum Liquid Limit of 25 and maximum Plasticity Index of 6, per ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

2. Surfacing and Fill aggregate shall conform to:

Gradation

Sieve Size	Percent Passing
1.5 inch	100
No. 4	30 - 65
No. 40	5.0 - 25
No. 200	0 – 5.0

2.2 UTILITY TRENCH BED AND FILL MATERIALS

A. Provide clean sand for pipe bedding material free of any organic or deleterious substance and having 100 percent passing 3/8 inch sieve and 4 percent passing No. 100 sieve.

B. Provide fill and backfill consisting of non-plastic granular soils free of organic or other deleterious materials having a maximum particle size of 2 inches.

C. Provide crushed stone and /or crushed or screened gravel free of any organic or deleterious substance and having 100 percent passing 1 inch sieve and 0 percent passing the 1/2 inch sieve.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify stockpiled fill to be reused is approved by LANL STR.

B. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen.

3.2 PROTECTION

A. Preserve staking, marking, or other designation until the designation is no longer needed for permitted work. If marking is removed or no longer visible, notify LANL STR. The STR will contact LANL's Mapping and Locating Group to revalidate the excavation/soil disturbance permit by locating and marking the utility again.

B. Protect existing structures from equipment and vehicular traffic.

C. Maintain excavation free of standing water.

D. Notify LANL STR of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

E. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.

F. Grade top perimeter of excavation to prevent subsurface water run-off into excavation.

G. Barricades shall be erected around the excavation area before beginning work activities to prevent accidental entry into the area.

H. Protect disturbed soils, drainage ways and watercourses against soil erosion and sedimentation by employing Best Management Practices (BMPs) as identified in excavation permit review (EX-ID) comments, shown on the drawings or identified in the Storm Water Pollution Prevention (SWPP) Plan and approved by LANL STR. Remove any temporary BMP's at the close of the project.

I. Approved BMPs shall be in place per SWPP plan before soil-disturbing work begins.

J. Stabilize all disturbed areas.

3.3 PREPARATION

A. Identify required contours and data.

B. Notify LANL STR 15 working days prior to startup of construction to have LANL's Mapping and Locating Group identify known underground utilities and stake and flag locations. If a conflict exists between location of such obstacles and proposed work, promptly notify LANL STR and arrange for relocations. Proceed in same manner if a rock layer or any other unforeseen conditions encountered underground make changes advisable.

C. When necessary, compact subgrade surfaces to density requirements for backfill material. Remove unsuitable and unstable subgrade material.

D. In rock cuts, the top of the rock cut elevation shall be considered to be the same as top of subgrade. Base course may be placed directly on top of competent rock without further processing of the rock (i.e. scarify and compaction) provided that pockets in the rock are graded to drain before base course is placed. Any fill placed on top of competent rock needed to bring the top of subgrade to required elevation shall be compacted in accordance with subgrade requirements.

3.4 WORKING WITHIN 5 FEET OF UTILITIES

A. Stop work and notify the LANL STR when an unmarked utility is encountered. The STR shall contact LANL's Mapping and Locating Group so the site can be re-examined by Utility Locators.

B. If an underground utility is damaged or severed during excavation, immediately notify LANL STR. LANL STR will take immediate action to secure the area, notify the agency responsible for the utility so that the damaged section can be isolated, repairs initiated and other notifications made as required.

C. Whenever practical, utilities shall be de-energized, isolated, and tagged-out. The decision not to de-energize shall be made by LANL STR and Facility Operations Manager as appropriate.

D. Do not use mechanical excavating equipment within 5 feet of a marked, non-potholed utility. Mechanical excavation may commence within 5 feet of the underground utility only after the utility has been potholed, exposed, and well-marked and the Subcontractor is confident that there are no unexposed utilities in the excavation area.

1. Exception: Use of mechanical excavating equipment may be used where

known utility line depths and/or site conditions exceed limitations of hand or vacuum excavation. For purposes of this exception, excavate pothole perpendicular to surface locate markings for 2 feet on each side of marking to a predetermined depth. Mechanical excavation may proceed to within 18 inches of bottom of potholes under this exception. When deemed necessary, Subcontractor will ask LANL STR to contact LANL's Mapping and Locating Group for consultation, checking of existing locate marks and remarking.

E. Accomplish mechanical excavation at a distance no closer than 18 inches vertically and horizontally to potholed non-fully-exposed utility lines.

F. Fully-exposed underground utilities shall be protected, supported, or removed and reinstalled as necessary to protect employees and the utility.

1. If approved by LANL STR, powered excavation equipment may be used closer than 18 inches to any fully-exposed utilities provided that these are marked/indicated with a prominent, tall flag-on-pole, plank, or other highly visible object so the equipment operator can clearly see their locations and avoid contact. Prior to such excavating, mark and obtain approval using Attachment 1, Utility Protection Plan Form. Subcontractor shall complete the Utility Protection Plan and clearly indicate the limits of excavation/locates, utilities located, each pothole location, and description of installed marking/flagging measures. More than one form may be required for clarity.

G. Take care while hand excavating adjacent to utility line since hand tools such as shovels, picks, and digging bars can damage the utility line.

H. During machine excavation, have a spotter in place to actively monitor the positioning of the equipment.

I. Hand-excavate obstructions (i.e., guy wires, anchors, bollards, fence posts, etc.) to be removed to determine their relationship to existing marked utilities prior to removal.

3.5 POTHOLING

A. Prior to potholing the LANL STR will notify LANL's U&I Group to locate utility shut-off points. U&I Group will ensure the shut-off points are field verified and determined operable.

B. Pothole where existing buried utility lines are inside, or within 5 feet outside of excavation permit boundary limit.

C. Accomplish potholing by hand excavation or through use of vacuum potholing equipment. The use of vacuum potholing equipment is not permitted within the boundary of a Potential Release Site (PRS).

D. Pothole at vertical and horizontal utility angle points, at excavation boundary limit, and as needed. Provide additional pothole where utility depths are unknown or are in sloped work areas where utility depths may vary.

E. When unknown utility lines are marked and hand or vacuum excavation has gone 1 foot deeper than required and 3 feet to the left and right of a locate mark without finding the utility, stop excavating and contact the LANL STR for consultation and remarking.

F. Manholes or valve boxes may be used as a pothole to verify depths and locations of utilities.

G. Parallel Utilities: Pothole at 50 feet intervals where existing utilities parallel excavation and existing lines are located up to 6 feet outside excavation boundary. Hand or vacuum excavate non-conductive direct burial lines within 2 feet of excavation boundary along their entire length adjacent to excavation boundary, or pothole at 5 feet intervals.

H. Backfill potholes to original or better than condition. Refer to Paragraph 2.2B.

3.6 GRADING

A. Excavate topsoil from areas to be further excavated or regraded, and stockpile topsoil on site in area designated by LANL STR. Topsoil may be used on areas to receive landscaping and seeding.

B. Remove vegetation, debris, unsatisfactory soil materials, and obstructions from ground surface prior to grading. Properly dispose of material in accordance with Section 01 5705.

C. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.

D. Match final grade in seeded and unpaved areas to match Drawing finish contours.

E. Construct the subgrade surface elevation to a tolerance of plus or minus 0.1 foot from the specified grade and plus or minus 0.05 foot of the typical cross section, except unlined drainage ditch flow lines shown on Drawing are allowed plus or minus 0.2 foot .

F. Construct the base course to the design depth required and the final surface to a tolerance of plus or minus 0.04 foot within 10 feet.

G. Make changes in grade gradual. Blend slopes into level areas. Prepare finish grade to accept seeding by hand raking or as designated.

H. Remove surplus excavated materials from the site. Movement and proper disposal of materials from the site shall be in accordance with Section 01 5705.

3.7 EXCAVATING AND TRENCHING

A. Excavate and trench subsoil as required for Work.

B. Cut trenches sufficiently wide to enable installation of utilities to allow inspection. Trenches shall be benched, sloped, or shored to meet OSHA 29 CFR 1926 Subpart P, in particular Appendix A for Soil Classification and Appendix B for Sloping and Benching requirements. Refer to trench detail on Drawings for minimum trench width.

C. Do not interfere with normal 45 degree bearing splay of a structure foundation during excavation work. When excavating near or under a foundation a New Mexico Licensed Professional Engineer shall approve a support system to stabilize the structure or determine that excavation work will not pose a hazard.

D. Hand trim excavation and leave free of loose matter.

E. Remove lumped subsoil, boulders, and rock.

F. Correct errors in excavation.

G. Take proper precaution, such as shoring, sloping, or using a trench box when working in a trench or excavation. Provide a person who is trained and knowledgeable of soil conditions and safety requirements to make safety determinations.

H. Evaluate excavations 4 feet or deeper (or other excavation where employee exposure can be reasonably anticipated) daily and document by a designated competent person before employees are permitted to enter the excavation. Documented inspections on an excavation condition log.

I. When an oxygen deficiency or hazardous atmosphere could be reasonably expected in trenches over 4 feet in depth, such as excavating near roadways, lift stations, sewer/gas lines, etc., the excavation shall be tested with a calibrated intrinsically safe monitoring device before employees are allowed to enter the excavation. If the atmosphere tests hazardous, then do not enter the excavation or if chemical hazards exist or are created within the excavation, stop work immediately and contact the LANL STR.

J. Excavation boundaries shall be adequately marked and barriers installed to avoid inadvertent entry. Excavations that present a possibility of a worker falling to a lower level shall be evaluated by a designated Fall Protection Competent Person for necessary fall protection requirements.

3.8 DOCUMENTING UTILITY LOCATION

A. Do not cover new or exposed existing utilities until LANL's Mapping and Locating Group has verified that utility locations have been documented by the use of GPS in compliance with LANL standard reference system.

B. Subcontractor Responsibility: Notify LANL STR 5 working days in advance that new and exposed utilities will be ready for location verification.

C. LANL STR Responsibility: Notify LANL's Mapping and Locating at 665-1051 immediately after being notified by Subcontractor.

3.9 BACKFILLING EXCAVATIONS/TRENCHES

A. Backfill and fill areas to contour lines and elevations shown on the Drawings.

B. Backfill and fill systematically.

C. Do not place backfill or fill material over frozen, wet, or spongy subgrade surfaces, including surfaces containing frost or ice.

D. Recondition, reshape and recompact areas that are damaged by freezing.

E. Place backfill and fill materials in continuous layers not exceeding 8 inches in loose depth.

F. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.

G. Compact each layer to required percentage of maximum density for the area.

H. Compact layers uniformly before a succeeding layer is placed.

I. Do no disturb or damage adjacent structures during compaction.

J. Backfill against structures as follows:

1. Do not place backfill against structure walls prior to verifying the concrete has been properly cured and is of required strength to resist stresses due to backfill.
2. Take care to prevent wedging action of backfill against structures by carrying

the material uniformly around the structures to approximately the same elevation in each lift.

3. When unbalanced pressures are likely to develop on walls:
   a. Continuously monitor for displacements,
   b. Erect shoring to counteract imbalance, if required, and
   c. Leave shoring in place until LANL STR approves its removal.

3.10 SOIL COMPACTION AND TESTING

A. Control soil compaction during construction to provide the minimum percentage of density specified for each area as determined according to ASTM D 1557, Method A or D.

B. Where subgrade or layer of soil material must be moisture-conditioned before compacting, uniformly apply water to surface of subgrade or layer material to prevent free water appearing on surface during or subsequent to compacting operations.

C. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.

D. The allowable percent variation from optimum moisture is plus or minus 2 percent.

E. The paragraphs below identify location and compaction required as a percentage of maximum density and optimum moisture measured using ASTM D 1557.
   1. Compact fill in 8 inch lifts that will be beneath concrete and asphalt structures to 95 percent of maximum density.
   2. Compact fill in 8 inch lifts that will be beneath unpaved areas to 90 percent of maximum density.
   3. Compact new aggregate base course that will be beneath asphalt structures to 95 percent of maximum density.
   4. Compact pipe bedding to 90 percent of maximum density.

F. The Subcontractor shall employ an independent testing agency approved by LANL to perform testing and is responsible for the following:
   1. Verify fill material to be placed is within the stated specifications, and laboratory testing is complete.
   2. Verify that moisture-density relationship, ASTM D 1557, for each soil type to be placed is completed.
   3. Determine field density of in-place material in accordance with any of the following methods:
      a. Nuclear Method, ASTM D 6938.
      b. Rubber-Balloon Method, ASTM D 2167.
      c. Sand-Cone Method, ASTM D 1556.
   4. Determine field moisture content in accordance with either of the following methods:
      a. Nuclear Method, ASTM D 6938, or

b. Laboratory Determination, ASTM D 2216.

5. Frequency of Tests

Testing shall be performed in all areas of fill, including but not limited to below and adjacent to new structures, areas of raising of grading, areas specifically intended for vehicular traffic and all utility and underground surface trenches.

a. One test per 2000 square feet for each lift of compacted fill material or fraction thereof, but not less than 3 tests per 8 inches maximum for each lift.

b. One test per 50 linear feet of trench per 8 inches maximum for each lift.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 31 2000 Rev. 5, dated January 25, 2011.

ATTACHMENT 1

Utility Protection Plan

Complete and receive approval from LANL STR before mechanically excavating within 18" of a fully-exposed underground utility line in accordance with this Specification.

Description of Utility:

____
____
____

Description of Installed Marking/Flagging Measures (e.g., tall flag-on-pole, plank, etc.):

____
____
____

Sketch:

Submitted by: ____________________________________ (Subcontractor Name/Date)

Witnessed/Approved by: ______________________________ (LANL STR/Date)

SECTION 40 0527

PIPING AND TUBING INSPECTION CHECKLIST

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Zero Liquid Discharge System Transfer and Spray Piping

- Inspection of piping and tubing installations per design documents
- Inspection of installation workmanship
- Leak Testing

1.2 QUALITY ASSURANCE AND TESTING

A. ASME/ANSI B31.3 requirements for Category D non-metallic piping.

B. Perform inspections and testing in accordance with Section 22 0813, Testing Piping Systems.

C. Quality Assurance Program

1. For all work, the fabricator is required to develop and implement a documented quality assurance (QA) program which complies with the Contractor Requirements Document (CRD) of DOE Order 414.1 (latest).

2. The fabricator is responsible for maintaining quality and shall perform in-process and final inspection on his work as required herein. The fabricator must comply with all applicable federal, state, or local codes.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 INSPECTION ATTRIBUTES

A. General:

1. Approved design documents present.

2. Code to which it was designed identified (e.g., UPC, applicable ASME B31 code).

3. Design followed:

   a. Required materials used (metal, polymer, schedule, markings per material standard on tube, pipe, and fittings).

   b. No counterfeit materials.

4. Routing layout, configuration.

5. Elevations (if elevation is critical).

6. Slope (if slope is critical).

7. Location of components, instruments, fittings.

8. Orientation of components [where flow direction is important (e.g. check valves, reducers, globe valves, etc.)].

9. Support locations, types, attachments.

10. Integrity and workmanship.

3.2 CUTTING

A. Pipes are cut square.

B. Surfaces are free of sharp edges and burrs.

C. End preparation weld bevel for welded pipes.

3.3 JOINING SWAGE FITTINGS - NOT APPLICABLE

A. Installer trained per LANL or manufacturer's course

B. LANL Master Specification 40 0511, Compression Fittings on Copper and Stainless Steel Tubing, followed for cutting, bending, and assembly of these.

1. Correct parts (body, nut and ferrules).

2. Tube ends cut square.

3. Clean and smooth tube ends.

4. Tube aligned straight.

5. Tube inserted into fitting body to right depth.

6. Finger tight followed by the right torque or turns (follow vendor's instructions).

7. Go/No-Go gage check where applicable (follow vendor's instructions).

3.4 THREADING

A. Pipe or tubing size.

B. Threading tool identification.

C. Cleanliness.

D. Proper thread lubricant-sealant.

E. Threads not damaged.

F. Proper alignment before joining.

G. Sufficient insertion of pipe threads.

H. Proper alignment after joining.

3.5 COLD BENDING - NOT APPLICABLE

A. Tangent point marked.

B. Bend angle and dimensions.

C. Bend free of wrinkles.

D. Pipe or tubing wall not thinned below minimum design.

E. Ovality of cross section not over eight percent (8%) of nominal diameter.

F. No deep gouges or scratches.

3.6 WELDING

A. Certified welding inspector accepts job:

1. Welder certified.
2. Correct welding procedure used.
3. Weld map documenting weld symbols (depth on penetration, type -- fillet, butt, etc.).
4. Correct base metal used.
5. Correct filler metal used.
6. Weld procedures followed.

3.7 CLEANING

A. Weld surfaces free of contaminants.

B. Inside piping surfaces free of all non-adhering material.

C. Verify no moisture in the system.

D. Special cleaning done when required (e.g. refrigerants, oxygen, tritium).

3.8 FLANGE ASSEMBLY

A. Proper support of both sides of open flange.

B. Removal of old gasket.

C. Cleanliness.

D. No flange face imperfections.

E. Verify flange face finish compatible with new gasket.

F. Verify correct gasket.

G. Verify gasket condition.

H. Verify right bolts, verify size and markings.

I. Align flange and support flange ends.

J. Lubricate bolts and nuts (unless new and coated).

K. Verify compatibility of lubricant, if used.

L. Use washers.

M. Visual verification of fastener condition.

N. Verify use of correct fastener lubrication.

O. Verify adhesive compatibility, if used.

P. Verify Installation of all bolts.

Q. Torque wrench and multiplier calibration.

R. Torque bolts in star pattern, three passes.

S. Verify bolt torque.

T. Verify full engagement of nut (bolt threads at least flush with top on nut).

3.9 LEAK TESTING

A. General – All Testing:

1. Follow LANL Master Specification Section 22 0813, Testing Piping Systems.

B. Hydrostatic Leak Test:

1. Test boundaries, valve alignment and closure.
2. Joints visible.
3. Pressure control and overpressure protection of test.
4. System relief devices isolated.
5. Water cleanliness and chemistry (ppm chloride limit on stainless).
6. Hydrotest pressure, considering changes in elevation.
7. Supports completed.
8. Temporary supports where necessary (hydro of steam or gas lines).
9. Variable springs constrained.
10. Expansion joints constrained.
11. Verification of pressure rating of components.
12. Use of strainers to protect equipment.
13. Ambient temperature above minimum.
14. Fill and venting.
15. Time at pressure.
16. Visual inspection for leaks.
17. Tightening of leaking mechanical or flange joints.
18. Flush and water disposal.

19. Dry and clean pipe.

20. System and valve alignment returned to specified condition.

C. Pneumatic Test Piping (typically Small Bore -- 2 inch and smaller -- and below 150 psi)

1. Verify component pressure rating.

2. Examine assembly of all threaded, bolted, and other mechanical joints.

3. Verify test boundaries (valve alignment).

4. Joints visible.

5. Non-flammable nontoxic gas used.

6. Test pressure per Spec 22 0813, Testing Piping Systems.

7. Test rig equipped with Code pressure relief device.

8. Approved leak detection solution.

9. Initially pressurize gradually to lesser of 25 psi or twenty-five percent (25%) of test pressure for preliminary check.

10. Gradually increase pressure in steps, allow time between steps for strain equalization.

11. Reduce pressure to the design pressure prior to checking for leaks.

12. Depressurize system following test to no more than operating level.

D. In-Service Leak Testing

1. Joints are visible.

2. System is at normal operating pressure for at least ten (10) minutes.

3. Joints covered with bubble solution (gas).

4. No visible leaks (liquid).

5. No bubbles at joints (gas).

3.10 SUPPORTS - NOT APPLICBLE

A. Hangers and Supports installation are per LANL Master Specification 22 0529, Hangers and Supports for Plumbing Piping and Equipment.

B. Verify condition of the support steel; note any corrosion, or bent or deformed parts, missing bolts or cracks in or near welds.

C. Identify any missing bolts.

D. Identify any missing grout between the anchorage and mounted concrete surface.

E. Verify that structural surfaces are in close contact in bolted connections.

3.11 INSULATION

A. Insulation installation are per LANL Master Specification 22 0713, Plumbing and HVAC Insulation.

B. Pipe surface clean and dry.

C. Type and condition of insulation.

D. Insulation thickness.

E. Type and condition of lagging (jacket).

F. Visual inspection of installation for workmanship.

3.12 QUALITY ASSURANCE

A. Additional checks or inspections performed where required by the governing QA plan (e.g., independent inspections for certain ML-1 and ML-2 systems or components).

3.13 DOCUMENTATION

A. Assembly drawing or sketch initialed at each swage joint (if required by QA plan).

B. Work package complete, signed-off, and filed.

END OF SECTION

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 40 0527 Rev. 2, dated October 5, 2009.

4 of 4

ENCLOSURE 3
Radioactive Liquid Waste Treatment Facility
Project 100761 (RLWTF-UP)
ZLD Subproject
July 13, 22011

ENV-RCRA-11-0136
LAUR-11-11041

Los Alamos
NATIONAL LABORATORY
Los Alamos NM 87545

60% Design Package: Drawings, Specifications, Calculations

UNCLASSIFIED

"Enclosere 3_CD_Test and Inspection Plan" fil

: 05194

Test and Inspection Plan

Document Reference: LANL ESM STD-342-100, Chapter 16, IBC Program, Section IBC-IP, Appendix B, Rev 4, 8/25/2010

Project: *Zero Liquid Discharge Subproject*

Location: *TA-50, TA-52, TA-63, Bldg n/a, Structures 181,182, 183*

Owner: *Los Alamos National Laboratory*

Design Professionals in Responsible Charge: Neal Schlendorf, Burns and Roe Enterprises,Inc –Structural

This *Test and Inspection Plan* (TIP) is submitted as a condition for compliance with the International Building Code 2006, Chapter 17 (IBC). It includes a schedule of Special Inspection services applicable to this project as well as the names of testing agencies to be retained for conducting selected tests. This TIP encompasses the following disciplines:

☒ Structural ☒ Mechanical/Electrical/Plumbing
☒ Architectural ☐ Other: ____________________

The LANL Special Inspectors on the project shall keep records of all inspections and shall furnish interim inspection reports to the LANL Chief Inspector (LCI) and the LANL Project Manager. LANL ESM Chapter 16, Section IBC-IP Appendix D – IBC/IEBC Inspection Daily Report shall be used as the basis for the report. Discovered discrepancies shall be brought to the immediate attention of the constructor (e.g., Subcontractor) for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the LCI[1]. The LANL inspection program does not relieve the constructor (e.g., Subcontractor) of their responsibilities.
A *Final Report* documenting completion of all required inspections, testing and correction of any discrepancies noted in the inspection reports shall be submitted to the LCI prior to issuance of Official Acceptance of Construction. LANL ESM Chapter 16, Section IBC-IP Appendix E – IBC Inspection Final Report shall be used as the basis for the report.

Job site safety and means and methods of construction are solely the responsibility of the constructor (e.g., Subcontractor).

Special Inspections are not required where the work is done on the premises of a fabricator registered and approved by the LBO to perform such work without special inspection in accordance with IBC Section 1704.2.2 and ESM Chapter 16.

Structural Observations shall be provided per the provisions of IBC Section 1709.1 and shall consist of visual observations of the structural systems by a registered design professional (Engineer of Record unless otherwise approved by LANL) for conformance to the approved construction documents at significant construction stages and at completion of the structural system.

Interim Report Frequency: *Daily as inspections are performed*

[1] 1704.1.2. Goal is to not have any open discrepancies that are turned over to the facility unless we can show that the LBO and the engineer-of-record are aware of them and will accept them.

Signature Page

Statement of Special Inspections Prepared By:

(type or print name)

Signature Date

Statement of Special Inspections Submitted By:

(type or print name)

Signature Date

Design Professional Seal *Structural*	
Design Professional Seal *Mechanical*	*Design Professional Seal* *Electrical*

LBO stamp applied by LANL Design Eng.

LANL Inspection Group (CM-CE)

Signature Date

Schedule of Inspection and Testing Agencies

This Statement of Special Inspections includes the following building systems:

- ☒ Soils and Foundations
- ☒ Cast-in-Place Concrete
- ☐ Precast Concrete
- ☐ Masonry
- ☐ Structural Steel
- ☒ Cold-Formed Steel Framing
- ☐ Fabricators of Structural Load Bearing Members
- ☐ Spray Fire Resistant Material
- ☐ Wood Construction
- ☒ Exterior Insulation and Finish System
- ☒ Mechanical & Electrical Systems
- ☒ Architectural Systems
- ☒ Special Cases

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. IBC Special Inspector	*LANL*	*LANL*
2. Soils Testing Agency	*TBD*	*TBD*
3. Concrete Testing Agency	*TBD*	*TBD*
4. Masonry Testing Agency	*N/A*	*N/A*
5. Steel/Rebar Testing Agency	*TBD*	*TBD*
6. Other *Special inspection for MWRS, Seismic system, lightning protection*	*TBD*	*TBD*
7. Engineer of Record	*Burns and Roe Enterprises, Inc*	*800 Kinderkamack Road* *Oradell, NJ 07649* *201-265-2000*

TBD: To Be Determined

Note: The inspectors shall be engaged by the LANL or LANL's Agent, and not by a Subcontractor whose work is to be inspected. The testing agencies shall be engaged by the Subcontractor but must be approved by the LANL Building Official (LBO). Any conflict of interest must be disclosed to the LANL Chief Inspector prior to commencing work.

Seismic Resistance Plan

Systems for Seismic Resistance

Seismic Design Category *D*

Statement of Responsibility Required (Y/N) Y

Description of seismic force resisting system and designated seismic systems:

Seismic Force Resisting System:

- *Pump House: light-framed steel shear walls (w/ flat strap bracing) – to be confirmed by vendor*
- *Tanks: flat bottomed, reinforced concrete*

Designated Seismic System Components:
Mechanical

- *NONE*

Electrical

- *Lightning Protection System*

Architectural (as part of pre-fabricated pump house enclosure)

- *Exterior Doors*
- *Shaft Walls Panel System*

- No Special Testing required by AISC-341 associated with seismic-resistant design
- No "Demand-Critical" welding is required of fabricator

Wind Resistance Plan

Basic Wind Speed (3 second gust) *90*

Wind Exposure Category *C*

Statement of Responsibility Required (Y/N) *N*

Description of wind force resisting system and designated wind resisting components:

- *Pump House: light-framed steel shear walls (w/ flat strap bracing) – to be confirmed by vendor*

Statement of Responsibility

Each Subcontractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility in accordance with IBC Sections 1705 and 1706.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing testing activities are subject to the approval of the LANL Building Official. The credentials of all testing technicians shall be provided if requested.

Key for Inspector Qualifications:

LANL IBC Inspector Qualification Guidelines are found in the LANL Engineering Standards Manual (ESM) Chapter 16 – IBC Program, Section IBC-TIA – IBC Test and Inspection Agency Approval Process – Attachment B – LANL IBC Inspector Qualification Guidelines. Only approved inspectors may perform IBC or IEBC inspections at LANL. The approval authority shall be the LANL Chief Inspector.

Note: Qualification to a main category listed with a single-letter designation implies qualification to all subcategories listed with a double-letter designation where the first letter of the subcategory designator is the same as the main category designator (e.g., a "B" masonry inspector can perform both "BC" structural inspection and witness "BT" masonry testing; however, a BC inspector cannot do BT unless specifically indicated).

Steel Fabricators: (A)

Masonry: (B)
- Masonry Structures: (BC)
- Masonry Testing: (BT)

Concrete: (C)
- Footings and Foundations: (CF)
- Concrete Slab and Under-floor: (CS)
- Other Concrete Construction: (CC)
- Concrete Testing: (CT)

Electrical: (E)
- Electrical within concrete slab or under-floor: (EC)
- Electrical within wall framing: (EF)

Fireproofing: (F)
- Sprayed Fire Resistant Materials: (FS)
- Fire Resistant Penetrations: (FP)

Soils: (G)
- Soils Placement: (GS)
- Soils Testing: (GT)

Special Cases: (H)
- Expansion Anchors: (HA)
- Epoxy Anchors: (HE)
- Undercut Anchors: (HU)
- Welding (HW)

Exterior Insulation and Finish Systems: (I)

Smoke Control: (K)

Lath and Gypsum Board Inspection: (L)

Mechanical: (M)
- Plumbing within concrete slab or under-floor:
- Plumbing within wall framing: (MF)
- Plumbing (Final Inspection): (MP)
- Mechanical (Final Inspection): (MM)
- Mechanical Welding: (MW)

Energy Efficiency: (N)

Piles: (P)

Piers: (R)

Steel: (S)
- High Strength Bolted Steel: (SB)
- Welded Steel: (SW)
- Other Steel: (SO)

Wall and Panel Veneers: (V)

Wood Construction: (W)

Soils and Foundations

Item		Agency # (Qualif)	Scope	Monitoring*		Hold** Point
				Continuous	Periodic	
1.	Shallow Foundations	*7 (Civil PE)*	*Inspect soils below footings for adequate bearing capacity and consistency with geotechnical report.*		*X*	Y
2.	Controlled Structural Fill	*1 (G/GS)*	*Prior to placement of the prepared fill, the special inspector shall determine that the site has been prepared in accordance with the approved soils report, including check of depth and bearing material.*		*X*	Y
			Inspect removal of unsuitable material and preparation of subgrade prior to placement of controlled fill		*X*	Y
			Inspect material, placement, lift thickness and compaction of controlled fill.	*X*		Y
			Verify extent and slope of fill placement.		*X*	N
3.	Controlled Structural Fill	*2*	*Perform sieve tests (ASTM D422 & D1140) and modified Proctor tests (ASTM D1557) of each source of fill material.*		*X*	Y
			Test density of each lift of fill by nuclear methods (ASTM D2922)	*X*		Y

Note:

- Footing and foundation inspections shall be made after excavations for footings are complete and any required reinforcing steel is in place. For concrete foundations, any required forms shall be in place prior to inspection. Materials for the foundation shall be on the job, except where concrete is ready mixed in accordance with ASTM C 94, the concrete need not be on the job.

Key to Monitoring and Hold Points

*Monitoring:

Continuous - Full-time observation of work by approved special inspector who is present in area where the work is being done;

Periodic – Part-time/intermittent observation by approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

**Hold Point:

A mandatory inspection point beyond which work shall not proceed until the constructor's (e.g., Subcontractor's) QC representative has conducted the inspection and documented that the inspection results are acceptable and has obtained a sign-off by the above noted agency for that particular item. Do not cover items with other work until inspection is completed. Hold Points occur at significant junctures during the project to provide an opportunity for LANL or its representatives (at its option) to witness, review, or conduct additional inspections or tests for hold point activities. Hold points do not relieve the constructor (e.g., Subcontractor) from its obligation to meet requirements, including acceptance testing and/or inspections cited in project specifications. The constructor (e.g., Subcontractor) shall notify the LBO 48 hours prior to reaching a hold point. Delays, damages or time extensions will not be allowed if the Subcontractor fails to make this notification.

Cast-in-Place Concrete

Item		Agency # (Qualif.)	Scope	Monitoring* Continuous	Monitoring* Periodic	Hold** Point
1.	Mix Design	*1 (C/CS/CC)*	*Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design.*		*X*	N
2.	Material Certifications	*1 (C/CS/CC)*	*Review certified mill test reports and identification markings on reinforcing bars. The special inspector shall determine conformance with construction documents. Applicable ASTM material specification.*		*X*	N
3.	Reinforcement installation	*1 (C/CS/CC)*	*Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters*		*X*	N
4.	Concrete Placement	*1 (C/CS/CC)*	*Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.*	*X*		Y
5.	Sampling and Testing of Concrete	*3*	*Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231 or C173) and temperature (ASTM C1064).*	*X*		N
6.	Curing and protection	*1 (C/CS/CC)*	*Inspect curing, cold weather protection and hot weather protection procedures.*		*X*	N
7.	Formwork	*1 (C/CS/CC)*	*Inspect formwork for shape, location and dimensions of concrete member being formed.*		*X*	Y

Notes:

- Concrete slab and under-floor inspections shall be made after in-slab or under-floor reinforcing steel and building service equipment, conduit, piping accessories and other ancillary equipment items are in place, but before any concrete is placed or floor sheathing installed, including the subfloor.

Precast Concrete – N/A

Masonry – N/A

Structural Steel – N/A

Cold-Formed Steel Framing

Item		Agency # (Qualif.)	Scope	Monitoring*		Hold** Point
				Continuous	Periodic	
1.	Member Sizes	1 (A/S/SO)	*Review certified mill test reports and identification markings on bolts, nuts, and concrete anchors. Applicable ASTM material specification.*		**X**	**Y**
2.	Material Thickness	1 (A/S/SO)	*Review material identifications that shapes are as indicted in the project drawing and/or specifications.*		**X**	**N**
3.	Material Properties	1 (A/S/SO)	*Review material certifications and identification markings for compliance with project drawings and/or specifications. Applicable ASTM material specification*		**X**	**N**
4.	Mechanical Connections	1 (A/S/SO)	*Periodic special inspections for screw attachment, bolting, anchoring, and other fastening of components within the seismic-force-resisting system, including struts, braces, and hold-downs.*		**X**	**N**
5.	Framing Details	1 (A/S/SO)	*Inspection of framing and details.*		**X**	**N**

Notes:

- Cold-formed steel framing inspections are in regard to fabrication and installation of pump house enclosure structure only. The pump house structure will be pre-fabricated in shop, and will require only minor field connections and attachment to the concrete base slab. Required inspections listed should be performed at the fabrication facility, unless a "Fabricator Exempt" tag is provided via approval of a LANL Building Official.

Exterior Insulation & Finish Systems

	Item	Agency # (Qualif.)	Scope	Monitoring*		Hold** Point
				Continuous	Periodic	
1.	Flashing and Joint Details	*1* *(I)*	*Inspection of Flashing and joint details for compliance with details and specifications.*		***X***	***Y***
2.	Sealants and Caulks	*1* *(I)*	*Inspection of seals for compliance with details and specifications.*		***X***	***Y***

Mechanical & Electrical Systems

Item		Agency # (Qualif.)	Scope	Monitoring*		Hold** Point
				Continuous	Periodic	
1.	Piping	*1 (M)*	*For inspections, testing, and special instructions for piping during installation see specifications 22 0813 "Testing Piping Systems" and 40 0526 "Piping and Tubing Inspection Checklist". For inspections and testing of the fusion welds for the HDPE pipe see specification 01 4455 "Onsite Welding and Joining Requirements".*			
2.	Electrical System	*1 (E)*	*Special inspection during the installation of Lightning Protection Systems. See specification E 26-4100 "Facility Lightning Protection"*		*X*	*Y*

Notes:

- Special Inspection shall be conducted during erection of piping and prior to concealment for the purposes of leakage testing and recording of device location.
- Special Inspection shall be conducted prior to occupancy and after sufficient completion for the purposes of pressure-difference testing, flow measurements, and detection and control verification.

Architectural Systems

Item		Agency # (Qualif.)	Scope	Monitoring*		Hold** Point
				Continuous	Periodic	
1.	Wall Panels	*1 (I/L)*	*Special inspection during the erection and fastening of exterior cladding and exterior and interior non-load baring walls.*		***X***	***N***
2.	Exterior Doors	*1 (I)*	*Special inspection during the installation of the exterior doors. Verify that door is plumb, straight and true and compliance with project specification*		***X***	***N***

Notes:

- Protection of joints and penetrations in fire-resistance-rated assemblies shall not be concealed from view until inspected and approved.

Special Cases

Item		Agency # (Qualif.)	Scope		Monitoring* Continuous	Monitoring* Periodic	Hold** Point
1.	Designated Seismic System Components	*LBO*	*Evidence of Compliance for seismic resistance by shake table testing, three dimensional analysis or use of experience data.*			X	Y
2.	Post-installed anchors	*1 (HA/HE/HU)*	*Perform special inspections of structural post-installed anchors in accordance with the ICC ESR report for the anchor being installed.*		X		Y
			Verify approved anchors are used for non-structural post-installed anchor applications			X	Y
3.	Liner Components	*61 (H/E)*	*Review material certifications and identification markings for compliance with project drawings and/or specifications. Applicable ASTM material specifications as follows:*			X	Y
			Geotextile	*ASTM D475; ASTM D4632; ASTM D4832*			
			Geomembrane	*ASTM D751, NSF Mod; ASTM D792, ASTM D1505; ASTM D1603; ASTM D2663/3015, ASTM D5596;*			
			Geomesh	*ASTM D751, ASTM D5199; ASTM D792, ASTM D1505; ASTM D1603; ASTM D4716*			
			Verify seam test results meet requirements as follows (3 peel, 3 shear per type of seam) (values in pounds/inch of width): Shear: 40mil, 80 ppi; 60 mil, 120 ppi Fusion Peel: 40mil, 65 ppi; 60 mil, 95 ppi Extrusion Peel: 40mil, 50 ppi; 60 mil, 75 ppi		X		Y
			Inspection of seams for compliance with details and specifications.			X	Y
			Verify air pressure test results for hot wedge welding.			X	Y
			Verify field logs include tracking of the following: deployment, trial seam tests results, seaming progress, repairs			X	Y

DP 1132 Blue ..
file mils

Los Alamos
NATIONAL LABORATORY
EST.1943

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, New Mexico 87545
(505) 667-7969/FAX: (505) 665-9344

Date: July 25, 2011
Refer To: ENV-RCRA-11-0141
LAUR: 11-04201

Mr. William C. Olson, Bureau Chief
Ground Water Quality Bureau
New Mexico Environment Department
Harold Runnels Building, Room N2250
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

GROUND WATER
JUL 28 2011
BUREAU

Dear Mr. Olson:

SUBJECT: GROUNDWATER DISCHARGE PLAN (DP-1132) QUARTERLY REPORT, SECOND QUARTER 2011, TA-50 RADIOACTIVE LIQUID WASTE TREATMENT FACILITY

This letter is intended to serve as Los Alamos National Laboratory's Groundwater Discharge Plan (DP-1132) quarterly report for the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) for the second quarter (April, May, and June) of 2011. Since the first quarter of 1999, Los Alamos National Laboratory (the Laboratory) has provided your agency with voluntary quarterly reports containing analytical results from effluent and groundwater monitoring.

During the second quarter of 2011, no effluent was discharged by the TA-50 RLWTF through National Pollutant Discharge Elimination System (NPDES) Outfall 051to Mortandad Canyon; all effluent was evaporated on-site. Your agency was informed of this process change in the Laboratory's August 25, 2010, Minor Modification letter (ENV-RCRA-10-166).

Quarterly Monitoring Results, Mortandad Canyon Alluvial Groundwater Wells
Table 1.0 presents the analytical results from sampling conducted at two Mortandad Canyon alluvial wells, MCO-6 and MCO-7, during the second quarter of 2011. No samples were collected from alluvial wells MCO-3 and MCO-4B because the wells were dry. Samples were submitted to General Engineering Laboratories (GEL), Charleston, SC, for analysis. All of the analytical results were below the New Mexico Water Quality Control Commission (NMWQCC) 3103 standards for nitrate-nitrogen (NO_3-N), fluoride (F), and total dissolved solids (TDS). Analytical results from the sampling of intermediate and regional aquifer wells

in Mortandad Canyon can be accessed online at the Risk Analysis, Communication, Evaluation and Reduction (RACER) Web site (www.racernm.com).

TA-50 RLWTF Effluent Monitoring Results
Table 2.0 presents the analytical results from the weekly composite sampling of RLWTF effluent discharged through NPDES Outfall 051 to Mortandad Canyon. The final weekly composite (FWC) samples are flow-proportioned composite samples prepared from each tank of effluent discharged to Mortandad Canyon during a 7-day period. Samples are submitted to GEL for analysis. In addition, the TA-50 RLWTF analytical laboratory analyzes duplicate FWC samples as part of the Laboratory's compliance monitoring program. No FWC samples were collected during the second quarter of 2011 because no RLWTF effluent was discharged to Mortandad Canyon.

Table 3.0 presents the final monthly composite (FMC) sample results for NO_3-N, ClO_4, F, and TDS for the second quarter of 2011. No FMC samples were collected during the second quarter of 2011 because no effluent was discharged to Mortandad Canyon.

Please contact me at (505) 667-7969 if you would like additional information regarding this quarterly report.

Sincerely,

Robert Beers
Water Quality & RCRA Group (ENV-RCRA)

BB/lm

Enclosures: a/s

Cy: Hai Shen, LASO-EO, A316
Gene Turner, LASO-EO, A316
Steve Yanicak, LASO-GOV, M894
Carl A. Beard, PADOPS, A102
J. Chris Cantwell, ADESHQ, K491
Randy Johnson, ENV-ES, E500
Mike Saladen, ENV-RCRA, K490, (E-File)
Robert C. Mason, TA55-DO, E583
Hugh McGovern, TA-55 RLW, E518
Pete Worland, TA-55-RLW, E518
ENV-RCRA File, K490
IRM-RMMSO, A150

Table 1.0. Mortandad Canyon Alluvial Well Sampling, 2nd Quarter, 2011.

Sampling Location	Sample Field Prep (F/UF)[1]	Sample Date	Perchlorate (ug/L)	NO_3+NO_2-N (mg/L)	TKN[2] (mg/L)	NH3-N (mg/L)	TDS (mg/L)	F (mg/L)
MCO-4B	The well was dry, no sample was collected.							
MCO-3	The well was dry, no sample was collected.							
MCO-6	F	05/18/11	4.55	1.18	0.221J	0.049J	287	0.82
MCO-7	F	05/18/11	7.93	1.14	<0.086	0.018J	321	0.78
NM WQCC 3103 Groundwater Standards			*NA* [2]	*10 mg/L* [3]	*NA* [2]	*NA* [2]	*1000 mg/L*	*1.6 mg/L*

Notes:

[1]All samples filtered with the exception of TKN.

[2]NA means that there is no NM WQCC 3103 standard for this analyte.

[3]The NM WQCC 3103 Groundwater Standard is for NO_3-N.

J- means that the reported value is expected to be more uncertain than usual with a potential negative bias.

J+ means that the reported value is expected to be more uncertain than usual with a potential positive bias.

J means the reported value is greater than the Method Detection Limit (MDL) but less than the Reporting Limit (RL).

052112

Table 2.0. RLWTF Final Weekly Composite (FWC) Effluent Sampling, 2nd Quarter, 2011.

			Analysis by RLWTF[1]		Analysis by General Engineering Laboratories, Inc.			
Monitoring Period	**Sample Composite Date**	**Sample ID#**	**NO_3-N (mg/L)**	**NO_2-N (mg/L)**	**NO_3+NO_2-N (mg/L)**	**Perchlorate (ug/L)**	**Fluoride (mg/L)**	**TDS (mg/L)**
April	4/4/11	No Discharges[2]	-----	-----	-----	-----	-----	-----
	4/11/11	No Discharges	-----	-----	-----	-----	-----	-----
	4/18/11	No Discharges	-----	-----	-----	-----	-----	-----
	4/25/11	No Discharges	-----	-----	-----	-----	-----	-----
May	5/2/11	No Discharges	-----	-----	-----	-----	-----	-----
	5/9/11	No Discharges	-----	-----	-----	-----	-----	-----
	5/16/11	No Discharges	-----	-----	-----	-----	-----	-----
	5/23/11	No Discharges	-----	-----	-----	-----	-----	-----
	5/30/11							
June	6/6/11	No Discharges	-----	-----	-----	-----	-----	-----
	6/13/11	No Discharges	-----	-----	-----	-----	-----	-----
	6/20/11	No Discharges	-----	-----	-----	-----	-----	-----
	6/27/11	No Discharges	-----	-----	-----	-----	-----	-----
2nd Quarter 2011 Averages[3]			-----	-----	-----	-----	-----	-----
NMWQCC 3103 Groundwater Standards			***10 mg/L***	***NA[5]***	***10 mg/L[4]***	***NA[5]***	***1.6 mg/L***	***1000 mg/L***

Notes:

[1]Analysis by the TA-50 Radioactive Liquid Waste Treatment Facility's analytical laboratory.

[2]No Discharges means that the RLWTF did not discharge any effluent during the 7-day period precedeing the composite date.

[3]2nd quarter 2011 averages include the results from March 2011, if applicable.

[4]The NM WQCC Regulation 3103 Groundwater Standard is for nitrate NO_3-N.

[5]NA means that there is no NM WQCC 3103 standard for this analyte.

Table 3.0. RLWTF Final Monthly Composite (FMC) Effluent Sampling, 2nd Quarter, 2011.

Monitoring Period	RLWTF FMC Results[1]			
	NO_3-N (mg/L)	Perchlorate by IC[2] (ug/L)	TDS (mg/L)	F (mg/L)
April 2011	---- No Discharges ----			
May 2011	---- No Discharges ----			
June 2011	---- No Discharges ----			
NMWQCC 3103 Groundwater Standards	*10 mg/L*	*NA[3]*	*1000 mg/L*	*1.6 mg/L*

Notes:

[1]Analysis by the TA-50 Radioactive Liquid Waste Treatment Facility's analytical laboratory.

[2]IC means EPA Method 314.0, perchlorate analysis by Ion Chromatography.

[3]NA means that there is no NM WQCC 3103 standard for this analyte.

Los Alamos
NATIONAL LABORATORY
EST. 1943

GROUND WATER

AUG 19 2011

BUREAU

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, K490
Los Alamos, New Mexico 87545
(505) 667-0666/FAX (505) 667-5224

National Nuclear Security Administration
Los Alamos Site Office, A316
3747 West Jemez Road
Los Alamos, New Mexico 87545
(505) 667-5794/FAX (505) 667-5948

Date: August 11, 2011
Refer To: ENV-RCRA-11-0136
LAUR: 11-11041

Mr. Jerry Schoeppner, Acting Chief
Ground Water Quality Bureau
New Mexico Environment Department
Harold Runnels Building, Room N2250
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Dear Mr. Schoeppner:

SUBJECT: SIXTY PERCENT DESIGN, EVAPORATION TANKS, TA- 50 RADIOACTIVE LIQUID WASTE TREATMENT FACILITY

In November 2007, Los Alamos National Laboratory (the Laboratory) submitted a notice of intent (NOI) to the New Mexico Environment Department (NMED) to discharge treated effluent from the Technical Area 50 (TA-50) Radioactive Liquid Waste Treatment Facility (RLWTF) to three proposed aboveground evaporation tanks. On June 11, 2008, the NMED replied to the Laboratory's NOI with a request for additional information on six items (Enclosure 1). In the Laboratory's September 15, 2008, reply (Enclosure 2), all six items were addressed except for item 1, listed below:

1. *Submit 60% complete plans and specifications of the facility. Include detailed information regarding the construction of the evaporation tanks.*

The lack of project funding over the past several years has delayed design and construction of the evaporation tanks. The 60% design package was finally completed on July 28, 2011, and is now available for your review. Enclosure 3 contains a compact disc (CD) with the 60% complete plans and specifications for the construction of two (2) aboveground evaporation tanks. The third tank originally proposed has been dropped from the design. The mesa top location at TA-52 has not changed.

: 05216

Given the design (concrete walls and floor with two synthetic liners and leak detection alarms) and the depth to groundwater (1260 ft), no reasonable potential exists that liquid in the evaporation tanks will move directly or indirectly into groundwater. Therefore, the evaporation tanks are not subject to the permitting requirement of 20.6.2.3104 and 3106 NMAC. Further, even if discharges to the evaporation tanks were considered a discharge subject to the permitting requirements of 20.6.2.3104 and 3106 NMAC, the effluent meets all of the listed numerical standards of 20.6.2.3103 NMAC, has a total nitrogen concentration of 10 mg/L or less, does not contain any toxic pollutant, and is therefore exempt from the permitting requirements under 20.6.2.3105.A NMAC.

Because of the accelerated design and construction schedule for this project, the Laboratory respectfully requests that the NMED review the enclosed plans and specifications and determine that no discharge permit is required. At your request and convenience, Laboratory engineers familiar with the enclosed design are available to meet with you and your staff to answer questions.

Please contact Bob Beers at (505) 667-7969 of the Water Quality and RCRA Group (ENV-RCRA) if you have questions.

Sincerely,

AR Grieggs

Anthony R. Grieggs
Group Leader
Water Quality & RCRA Group
Los Alamos National Laboratory

Sincerely,

Gene E Turner

Gene E. Turner
Environmental Permitting Manager
Environmental Projects Office
Los Alamos Site Office
National Nuclear Security Administration

ARG:GET:BB/lm

Enclosures: a/s

Cy: Hai Shen, LASO-EO, w/o enc., A316
Gene Turner, LASO-EO, w/o enc., A316
Eric Trujillo, LASO-NSM, w/o enc., A316
Steve Yanicak, LASO-GOV, w/o enc., M894
Carl A. Beard, PADOPS, w/o enc., A102
J. Chris Cantwell, ADESHQ, w/o enc., K491
Randy Johnson, ENV-ES, w/o enc., E500
Mike Saladen, ENV-RCRA, w/o enc., K490, (E-File)
Robert Mason, TA-55-DO, w/o enc., E583
Hugh McGovern, TA-55 RLW, w/o enc., E518
Pete Worland, TA-55-RLW, w/o enc., E518
Keith Orr, PMF-FUNCT, w/o enc., M984

Cy (continued):
Roy Maestas, CM-STRS, w/o enc., P299
Joe Brophy, PMF-FUNCT, w/o enc., P137
Ed Artiglia, ES-PE, w/o enc., P137
ENV-RCRA File, w/enc., K490
IRM-RMMSO, w/enc., A150

NEW MEXICO
ENVIRONMENT DEPARTMENT

Ground Water Quality Bureau

1190 St. Francis Drive
P.O. Box 26110, Santa Fe, NM 87502
Phone (505) 827-2918 Fax (505) 827-2965
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BILL RICHARDSON
Governor
DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary
JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

June 11, 2008

Anthony R. Grieggs, Group Leader
Environmental Protection Division
Water Quality & RCRA (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, NM 87545

RE: Request for Additional Information, DP-1132, Radioactive Liquid Waste Treatment Facility

Dear Mr. Grieggs:

The New Mexico Environment Department (NMED) received a ground water Discharge Permit application from you on April 16, 1996 for the above referenced facility and a Notice of Intent for the discharge of effluent water to evaporative tanks (zero liquid discharge facility) on November 8, 2007. The application proposes the discharge of up to 3.6 million gallons per year of industrial wastewater.

NMED has reviewed the Notice of Intent in accordance with the New Mexico Water Quality Control Commission Regulations (20.6.2 NMAC). The following additional information is necessary in order for NMED to determine if the zero liquid discharge facility will require a New Mexico Environment Department Ground Water Discharge Permit:

1. Submit 60% complete plans and specifications of the facility. Include detailed information regarding the construction of the evaporation tanks.

2. Submit information regarding ground water near the facility that is most likely to be impacted should a release occur. This should include the most shallow aquifers located down gradient of the facility prior to the Rio Grande.

3. Submit procedures for the operation and maintenance of the evaporation tanks. Please include estimated cleaning timelines and methodologies.

4. Submit information on the concentration of waste in the tanks due to evaporation.

5. Submit seismic studies conducted in accordance to 40 CFR § 264.18 (a)

Following submission of the requested additional information, NMED will act upon your Notice of Intent to discharge. Your cooperation is appreciated. If you have any questions, you may reach me at (505) 827-2909.

Sincerely,

Jennifer Fullam
Environmental Scientist
Ground Water Pollution Prevention Section

cc: James Bearzi, NMED Hazardous Waste Bureau
John Young, NMED Hazardous Waste Bureau
Marcy Leavitt, NMED SWQB
Ralph Ford-Schmidt, NMED-DOE Oversight Bureau
Bob Beers, Environmental Protection Division, Water Quality & RCRA Ground, P.O. Box 1663, Mail Stop K490, Los Alamos, New Mexico 87545
Mike Saladen, ENV-RCRA, Los Alamos National Laboratory, K490, Los Alamos, NM 87545 (W/O enclosure)

Los Alamos
NATIONAL LABORATORY
EST. 1943

Environmental Protection Division
Water Quality & RCRA (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, New Mexico 87545
(505) 667-7969/FAX: (505) 665-9344

Date: September 15, 2008
Refer To: ENV-RCRA-08-169
LA-UR: 08-04520

Ms. Jennifer Fullam
Ground Water Pollution Prevention Section
Ground Water Quality Bureau
New Mexico Environment Department
Harold Runnels Building, Room N2261
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Dear Ms. Fullam:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION, DP-1132, RADIOACTIVE LIQUID WASTE TREATMENT FACILITY

I have received your June 11, 2008, letter (Enclosure 1) requesting additional information for Los Alamos National Laboratory's November 8, 2007, Notice of Intent (NOI) for the discharge of treated effluent from the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) to proposed evaporation tanks. I have listed each of your requests below, along with the Laboratory's response.

1. *Submit 60% complete plans and specifications of the facility. Include detailed information regarding the construction of the evaporation tanks.*

As the Laboratory indicated in the November 8, 2007, NOI, detailed plans and specifications for the evaporation tanks will be submitted to your agency once they become available. To date, no contract has been signed by the Laboratory for the final design of the evaporation tanks.

2. *Submit information regarding ground water near the facility that is most likely to be impacted should a release occur. This should include the most shallow aquifers located down gradient of the facility prior to the Rio Grande.*

The proposed site is a mesa top location at Technical Area (TA)-52. The approximate elevation of the proposed site is 7160 ft above mean sea level (MSL). Two regional aquifer wells are located within approximately 1500 ft of the proposed site: Los Alamos County water supply well PM-5 (7095 ft above MSL), and the Laboratory's regional aquifer monitoring well R-14 (7062 ft above MSL).

The static water level at both PM-5 and R-14 is approximately 5900 ft above MSL; this places the depth of the regional aquifer at the proposed project site at approximately 1260 ft below ground surface (bgs). No perched zone of saturation was encountered during drilling at R-14 (*Hydrologic Tests at Characterization Well R-14*, LA-14107MS, August 2004). In 2008, a new regional aquifer monitoring well will be installed on the mesa top in the vicinity of the evaporation tanks. The well, R-46, will be sited downgradient of Material Disposal Area (MDA) C and upgradient of water supply well PM-5 to ensure the safety of the supplied water.

Given the depth to ground water at the proposed project site (1260 ft bgs), the potential for impact to groundwater, should a release occur, is low. The nearest shallow aquifer (alluvial) is in Mortandad Canyon, approximately one mile away via the Ten Site Canyon watercourse. The depth to alluvial ground water in Mortandad Canyon at the Ten Site Canyon confluence is approximately 40 ft.

3. *Submit procedures for the operation and maintenance of the evaporation tanks. Please include estimated cleaning timelines and methodologies.*

In accordance with Laboratory requirements, a Standard Operating Procedure (SOP) will be prepared before the evaporation tanks are placed into service. The SOP will provide detailed instructions for the operation and maintenance of the facility. A copy of the SOP will be submitted to your agency once it is available for release.

4. *Submit information on the concentration of waste in the tanks due to evaporation.*

Treated effluent discharged to the evaporation tanks from the TA-50 RLWTF will have a composition of approximately 99.95 percent water and 0.05 percent solids; product from the reverse osmosis (RO) treatment unit has, on average, a Total Dissolved Solids (TDS) concentration of less than 500 mg/L (0.05 percent solids). Airborne dust and dirt blowing into the tanks will be the primary source of solids. When solids are removed from the tank, they will be characterized and managed in accordance with the applicable waste management requirements.

5. *Submit seismic studies conducted in accordance with 40 CFR § 264.18 (a).*

Conducting seismic studies in accordance to 40 CFR § 264.18 (a) is not a requirement of the New Mexico Water Quality Control Commission (NM WQCC) regulations. The proposed evaporation tanks will receive treated effluent from the TA-50 RLWTF. The tanks are therefore exempt from RCRA requirements as part of a Clean Water Act (CWA) wastewater treatment facility permitted by the Environmental Protection Agency (EPA) under NPDES Permit No. NM0028355. The specifications package that you will receive as part of the project's final design (see request #1) will include the seismic standards used in the engineering design of the evaporation tanks.

Please contact Bob Beers (505-667-7969) if you have any questions or need any additional information.

Sincerely,

A R Grieggs

Anthony R. Grieggs, Group Leader
Water Quality & RCRA Group (ENV-RCRA)

BB/lm

Enclosure: a/s

Cy: William Olson, NMED/GWQB, w/enc, Santa Fe, NM
Robert George, NMED/GWQB, w/enc, Santa Fe, NM
Glenn Saums, NMED/SWQB, w/enc, Santa Fe, NM
James Bearzi, NMED/HWB, w/enc, Santa Fe, NM
Steve Yanicak, NMED/OB/LASO, w/enc, J993
Hai Shen, LASO/EO, w/enc, A316
Gene Turner, LASO/EO, w/enc, A316
Michael Mallory, PADOPS, w/enc, A102
Richard S. Watkins, ADESHQ, w/enc, K491
Susan G. Stiger, ADEP, w/enc, M991
Mike Saladen, ENV-RCRA, w/enc, K490
Bob Beers, ENV-RCRA, w/enc, K490
Peter J. Rice, STO-DO, w/enc, E518
Craig Douglass, RLW, w/enc, E518
Pete Worland, EWMO-RLW, w/enc, E518
Edward Artiglia, ES-PE, w/enc, P137
Phil Wardwell, LC-LESH, w/enc, A187
Ellen Louderbough, LC-LESH, w/enc, A187
Keith R. Orr, PP-WEP, w/enc, P137
ENV-DO File, w/enc., J978
ENV-RCRA, File, w/enc., K490
IRM-RMMSO, w/enc., A150

Fullam, Jennifer, NMENV

From:	Beers, Robert S <bbeers@lanl.gov>
Sent:	Tuesday, August 30, 2011 8:14 AM
To:	Fullam, Jennifer, NMENV
Cc:	George, Robert, NMENV; Schoeppner, Jerry, NMENV; Saladen, Michael T; McGovern, Hugh A; Meadows, Jacob William; Grieggs, Anthony R; Hjeresen, Dennis L; Lamb, Melanie J; Medina, Louella B; Worland, Vincent P; Marshall, Clint, NMENV; Pearson, Bill, NMENV
Subject:	NMED-GWQB Inspection of the TA-50 RLWTF

Dear Ms. Fullam,

At the conclusion of yesterday's meeting in Santa Fe you asked if the NMED-GWQB could conduct an inspection of the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) and the site of the TA-53-939 diesel release on Thursday, September 8, 2011.

I have confirmed with LANL management that NMED-GWQB staff are welcome to conduct an inspection on that date. I'd like to suggest a starting time of 8:30am. Please let me know if this is acceptable to you.

In addition, please send me a list of those NMED staff participating in the inspection, their citizenship, and if any of the participants are badged.

I look forward to seeing you and your colleagues on Thursday morning, September 8, 2011.

Sincerely,

Bob Beers
Water Quality & RCRA Group
Los Alamos National Laboratory
505.667.7969

Field Trip Report
Ground Water Pollution Prevention Section

Start Date/Time: September 8, 2011 approximately 8:30 am
End Date/Time: September 8, 2011 approximately 12:00 pm

Facility Information
Facility Name: Los Alamos National Laboratory
Type of Operation: National Laboratory
Contact: Bob Beers
Other Individuals Present: See attached attendance list
Location: Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50,
Unauthorized Diesel Spill Site at TA-53

Inspector(s): Fullam, Jennifer; Knutson, Gerald

Activities
Samples Taken: No
Photos Taken: No

Observations and Information Obtained

Fullam and Knutson met with representatives of Los Alamos National Laboratory (LANL) at TA-59 both before and after the inspection for a pre and post-inspection briefing. During the these briefings several topics were discussed

- Fullam informed LANL that there is commitment on NMED's part to draft a permit for the RLWTF but due to ongoing upgrades and changes that consistently occur at the site, it has been difficult to for NMED to make significant progress. Fullam is working on requesting information which is pertinent for progressing with a draft Discharge Permit. The request should incorporate all the current facility components as well as potential future changes which would allow the facility to implement treatment technologies as they become available while not inhibiting compliance with the permit.
- NMED will be responding to LANL's Notice of Intent for the Zero Liquid Discharge Tanks which are currently under construction now that the requested information has been submitted to NMED.
- Knutson informed LANL that the SWWS draft Discharge Permit was being prepared and reviewed internally
- NMED is preparing a response to LANL in regards to the additional septic tank/leachfields which are not owned or operated by the Laboratory (but are located on Laboratory property).
- NMED is preparing an outline on conditions which may be included in the RLWTF Discharge Permit. This outline is being prepared for the ongoing discussions and negotiations between LANL and the NMED Hazardous Waste Bureau as part of their Hazardous Waste Permit and its requirements for the RLWTF. Fullam stated that at this time, the inspection of the RLWTF was independent from with these negotiations and the Discharge Permit outline but was rather part of a routine inspection of the facility as it pertains to the unissued Ground Water Quality Bureau's Discharge Permit (DP-1132).

RLWTF-Fullam and Knutson were escorted through the RLWTF with Beers and Hugh. No field notebooks or photographs were taken while within the treatment system area. The facility processes the liquid wastestreams produced at the Laboratory which contain transuranic wastes (TRU) and low-level radioactive wastes. The following items were noted or discussed during the inspection.

- All lines are gravity fed to the facility
- TA-50,Building 1, houses the majority of the treatment system components. The floors of the structure were observed to have bermed sides between exits and entryways to serve as secondary containment should a spill or release occur.
- The TRU is processed separately from the low-level waste.
- Low-level waste comes in generally as a caustic or an acid. Acids are neutralized using the stored caustic wastes (which are generally not treated but are stored for neutralization or processed and shipped off-site).
- There are two clarifiers. Clarifier one has been cleaned out and currently clarifier two is online
- The "bottoms" from TK8 are processed and shipped off-site

- Currently the "bottoms" are dewatered prior to sending off to another facility however, they are looking at incorporating another reverse osmosis system to concentrate the solids rather than utilizing the contractor which currently does the work.
- The microtubular filtration process has been discontinued due to infrastructural flaws causing the system to leak.
- The facility has incorporated ion exchange as part of the process for low level waste. Two types of cations are being implemented; a standard cation exchange system as well as an experimental cation exchange system.
- The final treated effluent is evaporated off through the use of a boiler system. The boiler systems are within a temporary enclosure outside TA-50, Building 1, and are being used in place of discharging to the NPDES outfall. The facility stated that they have not discharged to the outfall for almost a year (Fullam recalled LANL stating the last discharge to the outfall was around November 2010). LANL stated they were required not to obtain a permit through the Air Quality Bureau for the emissions from the boilers.
- A primary tank (believed to be after neutralization) is located outside the facility in a partially buried concrete bunker type structure. The tank has been in operation since the establishment of the facility in the early 1960's. It has not been inspected nor is the structural integrity known. It is constructed of concrete and is within a secondary concrete structure but can only be inspected on one side of the tank (LANL stated that it is known to not meet secondary containment requirements as set forth through RCRA 40 CFR 264). LANL stated that the proposed upgrades to the facility have proposed to decommission this tank.
- Since the last inspection conducted by NMED (2008), the facility has completed the emergency storage facility (previously referred to in the NMED inspection report as the "tank farm"). This facility has the ability to store up to 300,000 gallons of untreated waste in 6-50,000 gallon fiberglass tanks constructed in a subterranean concrete structure. The infrastructure has been completed, however as of the date of inspection, LANL stated that no waste has been sent to the facility. LANL is unsure of when or to what capacity the tanks will serve in the future.
- Beers escorted Fullam and Knutson to the proposed Zero Liquid Discharge (ZLD) Tank Site. It was unclear at the time of inspection, but is believed to be located in TA-63. At the time of inspection earthwork was already underway. Beers stated that they are anticipating pouring concrete prior to the winter and placing the synthetic liners in late November or early December. Fullam inquired about the designation of a ZLD "evaporative tank". Beers stated that it is referred to as a zero liquid discharge tank due to the definitions under 40 CFR 264 which require it to be constructed of man-made material, able to be self-supportive and have secondary containment. Fullam informed Beers that tanks are generally engineered for disposal or storage and not ideally designed to achieve evaporation due to depth and surface area which could potentially decrease the evaporative rates relative to an engineered evaporative lagoon. In either case, Fullam informed Beers that NMED-GWQB may view the terminology slightly differently as zero discharge pertains to surface water discharges not potential ground water discharges. Fullam will be reviewing the information submitted by LANL and discussing it with the Program Manager and Bureau Chief.

TA-53 Diesel Spill Site (Release ID#2011-206)-Fullam and Knutson were escorted through TA-53 with Meadows and a representative from the facility to the site where approximately 10 gallons of diesel was inadvertently released to the environment in October 2010. The site is primarily asphalt where heavy equipment is stored. At the time of inspection, the area had been excavated and was fortified with a make-shift wooden structure and plastic cover to prevent precipitation from entering the excavation site. Meadows informed Fullam that an additional 6" of soil had been removed (for a total of 45 cubic yards) since the last analytical sample was taken showing elevated levels of TPH (above the required 440 mg/kg required by NMED). Meadows stated that the most recent analytical tests are showing TPH levels well below the required 440 mg/kg. Due to the close of the fiscal year and potential funding constraints in the next fiscal year, LANL is interested in expediting NMED's approval to begin final closure actions which include filling the excavation site with clean soils, re-grading and repaving. Fullam requested all the current information be submitted to NMED for review along with total soil volumes removed and final deposition and pictures of the area during the excavation. Meadows will provide NMED with the requested information. LANL requested guidance and references for the TPH limits that are being required for the spill and discussed the possibility of implementing a decision tree for incidences such as the one at TA-53. Fullam will provide the references for the TPH screening limits but further discussion would be required in regards to developing a Decision Tree.

Fullam and Knutson met with representatives at TA-59 for a post-briefing discussion (see introductory discussion points).

Fullam, Jennifer, NMENV

From:	Beers, Robert S <bbeers@lanl.gov>
Sent:	Monday, September 12, 2011 9:41 AM
To:	Fullam, Jennifer, NMENV
Cc:	George, Robert, NMENV; Knutson, Gerald, NMENV; Saladen, Michael T; Meadows, Jacob William; Turner, Gene E.; McGovern, Hugh A
Subject:	RE: NMED-GWQB Inspection of the TA-50 RLWTF
Attachments:	NMED inspection particpant list_9-8-11.pdf

Jennifer,

Los Alamos National Laboratory requests a copy of the inspection report from your September 8, 2011, inspection of the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) and the TA-53 diesel release site.

Attached, per your request, is a copy of the participant list.

Sincerely,

Bob Beers

From: Fullam, Jennifer, NMENV [mailto:Jennifer.Fullam@state.nm.us]
Sent: Friday, September 02, 2011 11:00 AM
To: Beers, Robert S
Subject: RE: NMED-GWQB Inspection of the TA-50 RLWTF

Bob,

We should be able to be at TA-59 by 8:30am. Thanks.

Jennifer Fullam
Environmental Scientist
Ground Water Quality Bureau
New Mexico Environment Department
505.827.2909
jennifer.fullam@state.nm.us

From: Beers, Robert S [mailto:bbeers@lanl.gov]
Sent: Thursday, September 01, 2011 3:35 PM
To: Fullam, Jennifer, NMENV
Cc: Saladen, Michael T; Grieggs, Anthony R; McGovern, Hugh A; Worland, Vincent P; Meadows, Jacob William; Hjeresen, Dennis L; Turner, Gene E.; Sandoval, Tina M
Subject: RE: NMED-GWQB Inspection of the TA-50 RLWTF

Jennifer—

Let's meet at TA-59 (The same technical area where we met to begin last year's septic system inspection. However, we'll meet at Building 96, a transportable, not Building 1).

From there we can go to the RLWTF in a govt vehicle. After the RLWTF, we can head over to TA-53.

What time do you expect to arrive at TA-59?

I'm assuming you will go to the Otowi Building to pick up your new badges after the inspection. I believe a picture ID is sufficient but I will confirm before next Thursday.

Please remember to wear closed toe shoes, long pants, and a sleeved shirt (short-sleeves are acceptable). Also, you may wish to wear sunscreen and bring a hat since we will be outside touring the RLWTF and the outfall.

Please let me know if you have any questions.

Sincerely,

Bob Beers
Water Quality & RCRA Group
Los Alamos National Laboratory
505.667.7969

From: Fullam, Jennifer, NMENV [mailto:Jennifer.Fullam@state.nm.us]
Sent: Thursday, September 01, 2011 1:56 PM
To: Beers, Robert S
Subject: RE: NMED-GWQB Inspection of the TA-50 RLWTF

Bob,

I apologize for not getting back to you sooner. It appears that the only attendees will be Gerald Knutson and myself. We are both US Citizens and both hold badges (which expire on Sept 12, 2011). Since our badges are expiring we will need to pick up our new badges for the coming year. I faxed our badge request form to Gene, is there any documentation we need to bring in addition to a picture ID? Where should we meet you on Thursday morning?

Jennifer Fullam
Environmental Scientist
Ground Water Quality Bureau
New Mexico Environment Department
505.827.2909
jennifer.fullam@state.nm.us

From: Beers, Robert S [mailto:bbeers@lanl.gov]
Sent: Tuesday, August 30, 2011 8:14 AM
To: Fullam, Jennifer, NMENV
Cc: George, Robert, NMENV; Schoeppner, Jerry, NMENV; Saladen, Michael T; McGovern, Hugh A; Meadows, Jacob William; Grieggs, Anthony R; Hjeresen, Dennis L; Lamb, Melanie J; Medina, Louella B; Worland, Vincent P; Marshall, Clint, NMENV; Pearson, Bill, NMENV
Subject: NMED-GWQB Inspection of the TA-50 RLWTF

Dear Ms. Fullam,

At the conclusion of yesterday's meeting in Santa Fe you asked if the NMED-GWQB could conduct an inspection of the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) and the site of the TA-53-939 diesel release on Thursday, September 8, 2011.

I have confirmed with LANL management that NMED-GWQB staff are welcome to conduct an inspection on that date. I'd like to suggest a starting time of 8:30am. Please let me know if this is acceptable to you.

In addition, please send me a list of those NMED staff participating in the inspection, their citizenship, and if any of the participants are badged.

I look forward to seeing you and your colleagues on Thursday morning, September 8, 2011.

Sincerely,

Bob Beers
Water Quality & RCRA Group
Los Alamos National Laboratory
505.667.7969

NMED INSPECTION ~ TA-50 RLWTF & TA-53

NAME	ORGANIZATION	TELEPHONE #
1. Jennifer Fullam	NMED-GWQB	827.2909
2. Gerald Knutson	NMED-GWQB	827-2996
3. BOB BEERS	LANS/EAN	667-7869
4. Hugh McGovern	LANS/RLW	6-0577
5. Jake Meadows	LANS/ENV	6-0185

	DATE	START TIME	END TIME
TA-59 START	9/8/11	8:30	8:55
RLWTF	9/8/2011	9:05	11:05
TA-63	9/8/2011	11:20	12:20
Close out	9/8/2011	12:20	1:20

05233

DP 1132 Blue file

Los Alamos
NATIONAL LABORATORY
EST. 1943

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, M704
Los Alamos, New Mexico 87545
(505) 667-0666/FAX (505) 667-5224

National Nuclear Security Administration
Los Alamos Site Office, A316
3747 West Jemez Road
Los Alamos, New Mexico 87545
(505) 667-5794/FAX (505) 667-5948

Date: October 19, 2011
Refer To: ENV-RCRA-11-0232
LAUR: 11-11761

Mr. Jerry Schoeppner, Acting Chief
Ground Water Quality Bureau
New Mexico Environment Department
Harold Runnels Building, Room N2250
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Dear Mr. Schoeppner:

SUBJECT: ADDENDUM TO THE NOTICE OF INTENT TO DISCHARGE FOR THE RADIOACTIVE LIQUID WASTE TREATMENT FACILITY'S EVAPORATION TANKS

In November 2007 Los Alamos National Security, LLC (LANS) submitted a notice of intent (NOI) to the New Mexico Environment Department (NMED) to discharge treated effluent from the Technical Area 50 (TA-50) Radioactive Liquid Waste Treatment Facility (RLWTF) to synthetically-lined evaporation tanks located at TA-52. On August 12, 2011, the U.S. Department of Energy (DOE) and LANS submitted to your agency the sixty percent (60%) complete plans and specification for the above referenced evaporation tanks. Subsequently, at an August 29, 2011, meeting in Santa Fe, you asked representatives from DOE/LANS to submit, as an addendum to the above-referenced NOI, information concerning the following question:

> *What contaminant concentrations does the Laboratory expect in the evaporation tanks during long-term evaporation?*

Characteristic to the operation of evaporation ponds and tanks is the concentration over time of dissolved solids and the eventual precipitation of salts. The rate of concentration is dependent upon a number of factors, including (1) the chemical composition of the water in the tank, (2) the temperature of the water in the tank, (3) air temperature and humidity, (4) solar radiation, (5) wind velocity, (6) precipitation, and (7) in the case of the above-referenced evaporation tanks, how often the active evaporation system (i.e., mechanical sprayers) is used. Understandably, accurately modeling contaminant concentrations over time is, as the number of variables would indicate, subject to some uncertainty. DOE/LANS staff calculated hypothetical TDS concentrations in the evaporation tanks under several scenarios using historical effluent and precipitation data. Each scenario confirmed that TDS concentrations will increase over time with seasonal oscillations above and below the groundwater standard of 1000 mg/L; calculations showed peak TDS levels potentially reaching saline concentrations.

In sum, while effluent discharged to the evaporation tanks will be treated by the TA-50 RLWTF and will comply with the listed numerical standards of §20.6.2.3103 of the New Mexico Administrative Code (NMAC), the affect of evaporation over time has the potential to increase contaminant concentrations to levels greater than the above-referenced standards. However, given the design of the evaporation tanks—concrete walls and floor with two synthetic liners and leak detection alarms—and the depth to groundwater (1260 ft), no reasonable potential exists that liquid in the evaporation tanks will move directly or indirectly into groundwater. For these reasons, DOE/LANS does not believe that the evaporation tanks are subject to the permitting requirement of §20.6.2.3104 and 3106 NMAC.

Please contact Bob Beers at (505) 667-7969 of the Water Quality and RCRA Group (ENV-RCRA) if you have questions.

Sincerely,

A R Grieggs

Anthony R. Grieggs
Group Leader
Water Quality & RCRA Group
Los Alamos National Laboratory

Sincerely,

Gene E Turner

Gene E. Turner
Environmental Permitting Manager
Environmental Projects Office
Los Alamos Site Office
National Nuclear Security Administration

ARG:GET:BB/kt

Cy: Hai Shen, LASO-EO, A316
Eric Trujillo, LASO-NSM, A316
Steve Yanicak, LASO-GOV, M894
Carl A. Beard, PADOPS, A102
J. Chris Cantwell, ADESHQ, K491
Randy Johnson, ENV-ES, E500
Mike Saladen, ENV-RCRA, K490
Bob Beers, ENV-RCRA, K490
Robert Mason, TA-55-DO, E583
Hugh McGovern, TA-55 RLW, E583
Pete Worland, TA-55-RLW, E518
Steve Hanson, TA-55-RLW, E518
Joe Brophy, ICMR-OO, P137
Ed Artiglia, ES-PE, P137
ENV-RCRA File, M704
IRM-RMMSO, A150

DP 1132 Blue File MK

Los Alamos
NATIONAL LABORATORY
EST.1943

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, New Mexico 87545
(505) 667-7969/FAX: (505) 665-9344

Date: October 21, 2011
Refer To: ENV-RCRA-11-0236
LAUR: 11-11774

Mr. Jerry Schoeppner, Acting Chief
Ground Water Quality Bureau
New Mexico Environment Department
Harold Runnels Building, Room N2250
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

GROUND WATER
OCT 27 2011
BUREAU

Dear Mr. Schoeppner:

SUBJECT: GROUNDWATER DISCHARGE PLAN (DP-1132) QUARTERLY REPORT, THIRD QUARTER 2011, TA-50 RADIOACTIVE LIQUID WASTE TREATMENT FACILITY

This letter is intended to serve as Los Alamos National Laboratory's Groundwater Discharge Plan (DP-1132) quarterly report for the Technical Area (TA)-50 Radioactive Liquid Waste Treatment Facility (RLWTF) for the third quarter (July, August, and September) of 2011. Since the first quarter of 1999, Los Alamos National Laboratory (the Laboratory) has provided your agency with voluntary quarterly reports containing analytical results from effluent and groundwater monitoring.

During the third quarter of 2011, no effluent was discharged by the TA-50 RLWTF through National Pollutant Discharge Elimination System (NPDES) Outfall 051to Mortandad Canyon; all effluent was evaporated on-site at the effluent evaporator.

Quarterly Monitoring Results, Mortandad Canyon Alluvial Groundwater Wells
Table 1.0 presents the analytical results from sampling conducted at Mortandad Canyon alluvial well MCO-7 during the third quarter of 2011. No samples were collected from alluvial wells MCO-3, MCO-4B, and MCO-6 because there was insufficient water in the wells. Samples from MCO-7 were submitted to General Engineering Laboratories (GEL), Charleston, SC, for analysis. All of the analytical results were below the New Mexico Water Quality Control Commission (NMWQCC) 3103 standards for nitrate-nitrogen (NO_3-N), fluoride (F), and total dissolved solids (TDS). Analytical results from the sampling of intermediate and

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regional aquifer wells in Mortandad Canyon can be accessed online at the Risk Analysis, Communication, Evaluation and Reduction (RACER) Web site (www.racernm.com).

TA-50 RLWTF Effluent Monitoring Results

Table 2.0 presents the analytical results from the weekly composite sampling of RLWTF effluent discharged through NPDES Outfall 051 to Mortandad Canyon. The final weekly composite (FWC) samples are flow-proportioned composite samples prepared from each tank of effluent discharged to Mortandad Canyon during a 7-day period. Samples are submitted to GEL for analysis. In addition, the TA-50 RLWTF analytical laboratory analyzes duplicate FWC samples as part of the Laboratory's compliance monitoring program. No FWC samples were collected during the third quarter of 2011 because no RLWTF effluent was discharged to Mortandad Canyon.

Table 3.0 presents the final monthly composite (FMC) sample results for NO_3-N, ClO_4, F, and TDS for the third quarter of 2011. No FMC samples were collected during the third quarter of 2011 because no effluent was discharged to Mortandad Canyon.

Please contact me at (505) 667-7969 if you would like additional information regarding this quarterly report.

Sincerely,

Robert Beers
Water Quality & RCRA Group (ENV-RCRA)

BB/lm

Enclosures: a/s

Cy: Hai Shen, LASO-EO, A316
Gene Turner, LASO-EO, A316
Steve Yanicak, LASO-GOV, M894
Carl A. Beard, PADOPS, A102
J. Chris Cantwell, ADESHQ, K491
Randy Johnson, ENV-EAQ, E500
Mike Saladen, ENV-RCRA, K490, (E-File)
Robert C. Mason, TA55-DO, E583
Hugh McGovern, TA-55 RLW, E518
Pete Worland, TA-55-RLW, E518
ENV-RCRA File, M704
IRM-RMMSO, A150

Table 1.0. Mortandad Canyon Alluvial Well Sampling, 3rd Quarter, 2011.

Sampling Location	Sample Field Prep (F/UF)[1]	Sample Date	Perchlorate (ug/L)	NO_3+NO_2-N (mg/L)	TKN[2] (mg/L)	NH3-N (mg/L)	TDS (mg/L)	F (mg/L)
MCO-4B	The well was dry, no sample was collected.							
MCO-3	The well was dry, no sample was collected.							
MCO-6	The well was dry, no sample was collected.							
MCO-7	UF	08/03/11	7.89	0.91J	<0.12	<0.05	314	0.92
NM WQCC 3103 Groundwater Standards			*NA [2]*	*10 mg/L [3]*	*NA [2]*	*NA [2]*	*1000 mg/L*	*1.6 mg/L*

Notes:

[1]All samples filtered with the exception of TKN.

[2]NA means that there is no NM WQCC 3103 standard for this analyte.

[3]The NM WQCC 3103 Groundwater Standard is for NO_3-N.

J- means that the reported value is expected to be more uncertain than usual with a potential negative bias.

J+ means that the reported value is expected to be more uncertain than usual with a potential positive bias.

J means the reported value is greater than the Method Detection Limit (MDL) but less than the Reporting Limit (RL).

Table 2.0. RLWTF Final Weekly Composite (FWC) Effluent Sampling, 3rd Quarter, 2011.

			Analysis by RLWTF[1]		Analysis by General Engineering Laboratories, Inc.			
Monitoring Period	**Sample Composite Date**	**Sample ID#**	**NO_3-N (mg/L)**	**NO_2-N (mg/L)**	**NO_3+NO_2-N (mg/L)**	**Perchlorate (ug/L)**	**Fluoride (mg/L)**	**TDS (mg/L)**
July	7/4/11	No Discharge[2]	-----	-----	-----	-----	-----	-----
	7/11/11	No Discharge	-----	-----	-----	-----	-----	-----
	7/18/11	No Discharge	-----	-----	-----	-----	-----	-----
	7/25/11	No Discharge	-----	-----	-----	-----	-----	-----
August	8/1/11	No Discharge	-----	-----	-----	-----	-----	-----
	8/8/11	No Discharge	-----	-----	-----	-----	-----	-----
	8/15/11	No Discharge	-----	-----	-----	-----	-----	-----
	8/22/11	No Discharge	-----	-----	-----	-----	-----	-----
	8/29/11	No Discharge						
September	9/5/11	No Discharge	-----	-----	-----	-----	-----	-----
	9/12/11	No Discharge	-----	-----	-----	-----	-----	-----
	9/19/11	No Discharge	-----	-----	-----	-----	-----	-----
	9/26/11	No Discharge	-----	-----	-----	-----	-----	-----
3rd Quarter 2011 Averages[3]			-----	-----	-----	-----	-----	-----
NMWQCC 3103 Groundwater Standards			*10 mg/L*	*NA[5]*	*10 mg/L[4]*	*NA[5]*	*1.6 mg/L*	*1000 mg/L*

Notes:

[1]Analysis by the TA-50 Radioactive Liquid Waste Treatment Facility's analytical laboratory.

[2]No Discharge means the RLWTF did not discharge effluent through NPDES Outfall 051 during the 7-day period preceding the composite date.

[3]3rd quarter 2011 averages include the results from June 2011, if applicable.

[4]The NMWQCC Regulation 3103 groundwater standard is for nitrate (NO_3-N).

[5]NA means that there is no NMWQCC 3103 groundwater standard for this analyte.

Table 3.0. RLWTF Final Monthly Composite (FMC) Effluent Sampling, 3rd Quarter, 2011.

Monitoring Period	RLWTF FMC Results[1]			
	NO_3-N (mg/L)	Perchlorate by IC[2] (ug/L)	TDS (mg/L)	F (mg/L)
July 2011	---- No Discharges ----			
August 2011	---- No Discharges ----			
September 2011	---- No Discharges ----			
NMWQCC 3103 Groundwater Standards	*10 mg/L*	*NA[3]*	*1000 mg/L*	*1.6 mg/L*

Notes:

[1]Analysis by the TA-50 Radioactive Liquid Waste Treatment Facility's analytical laboratory.

[2]IC means EPA Method 314.0, perchlorate analysis by Ion Chromatography.

[3]NA means that there is no NM WQCC 3103 standard for this analyte.

Fullam, Jennifer, NMENV

From:	Davis, Jim, NMENV
Sent:	Tuesday, November 8, 2011 3:51 PM
To:	Fullam, Jennifer, NMENV
Subject:	FW: For your review
Attachments:	dnfsb000.pdf; dnfsbreport.pdf

James H. Davis, Ph.D.
Division Director
Resource Protection Division
New Mexico Environment Department
Phone: 505 827-1758
Fax: 505 827-0310

From: Martin, David, NMENV
Sent: Monday, November 07, 2011 5:09 PM
To: Tongate, Butch, NMENV; Davis, Jim, NMENV
Subject: FW: For your review

FYI.

Dave

Dave Martin
Cabinet Secretary
New Mexico Environment Department
Phone: (505) 827-2855

From: Smyth, Tiffany, GOV
Sent: Monday, November 07, 2011 3:22 PM
To: Bemis, John, EMNRD; Martin; David, NMENV
Subject: For your review

Hello,
The attached documents came to our office and we wanted to make sure you both had a copy for your information, thank you!

Tiffany Smyth
Office of Governor Susana Martinez
490 Old Santa Fe Trail | Room 400 | Santa Fe, NM 87501
505.476.2200 | tiffany.smyth@state.nm.us

Peter S. Winokur, Chairman
Jessie H. Roberson, Vice Chairman
John E. Mansfield
Joseph F. Bader

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

September 30, 2011

The Honorable Susana Martinez
Governor
Office of the Governor of New Mexico
490 Old Santa Fe Trail, Room 400
Santa Fe, NM 87501

Dear Governor Martinez:

The Defense Nuclear Facilities Safety Board (Board) is pleased to enclose a copy of our second periodic Report to Congress: Summary of Significant Safety-Related Infrastructure Issues at Operating Defense Nuclear Facilities in the Department of Energy's Aging Defense Nuclear Facilities. The Board has fashioned this report after its Quarterly Report to Congress on the Status of Significant Unresolved Issues with the Department of Energy's Design and Construction Projects. The Board believes this report provides an appropriate means to keep all parties apprised of the Board's concerns regarding aging DOE defense nuclear facilities. As such, the Board intends to issue this report to Congress and DOE on a periodic basis—once per year or more frequently, if warranted.

Sincerely,

Peter S. Winokur, Ph.D.
Chairman

Enclosure: as stated

Peter S. Winokur, Chairman
Jessie H. Roberson, Vice Chairman
John E. Mansfield
Joseph F. Bader

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

September 28, 2011

To the Congress of the United States:

This is the Defense Nuclear Facilities Safety Board's (Board) 2nd periodic report on the status of Department of Energy (DOE) facilities whose infrastructure is aging, yet continue to be relied upon to carry out the nation's national security and legacy-waste cleanup missions. Two of the most critical of these facilities are the Chemistry and Metallurgy Research Facility at Los Alamos National Laboratory (LANL) (nearly 60 years old) and the 9212 Complex at the Y-12 National Security Complex (portions of which have been in operation for more than 60 years). The Board recognizes that Congress has authorized replacements for each of these facilities, but the fact remains that both will be called upon to support essential mission work for at least another decade.

In addition, DOE's contractor completed the Seismic Analysis of Facilities and Evaluation of Risk (SAFER) Project at LANL's Plutonium Facility in May 2011. This analysis identified the potential for significant post-seismic damage that could result in breach of the facility confinement boundary; damage to the facility's nuclear material vault, ventilation system, and fire suppression system; and even collapse of the facility. LANL issued a Justification for Continued Operations on June 6, 2011, that identified compensatory measures to reduce these risks, including significant new limits on the quantity of nuclear material allowed in the building. LANL and the National Nuclear Security Administration also are aggressively pursuing structural upgrades to address these newly identified vulnerabilities.

Other facilities that merit continued attention are the high-level waste tank farms at both the Hanford Site and the Savannah River Site, the Radioactive Liquid Waste Treatment Facility at LANL, and waste treatment and packaging operations at the Hanford Site.

The Board continues to maintain a dedicated focus on these and the other facilities cited later in this report, and to urge DOE to continue to support safety and infrastructure improvements and consider ways to reduce risks to the public, workers, and the environment.

SIGNIFICANT SAFETY-RELATED INFRASTRUCTURE ISSUES

The following are the most significant safety-related infrastructure issues that exist today in the DOE defense nuclear complex. The enclosure to this letter provides additional detail.

- **Los Alamos National Laboratory, Plutonium Facility**—seismic fragility of building; seismic qualification of fire suppression and ventilation systems

- **Los Alamos National Laboratory, Chemistry and Metallurgy Research Facility**—seismic fragility of building; building end of life

- **Los Alamos National Laboratory, Radioactive Liquid Waste Treatment Facility Building and Equipment**—end of life
- **Nevada National Security Site, Device Assembly Facility**—degradation of fire suppression water tank and fire suppression system lead-ins
- **Pantex Plant, Site-Wide Fire Suppression System**—degradation of fire suppression system lead-ins
- **Y-12 National Security Complex, 9212 Complex**—seismic, high wind fragility of building; building and equipment end of life
- **Hanford Site, Single-Shell Tank Farms**—aging tanks and systems
- **Hanford Site, T Plant (Waste Treatment and Packaging Operations)**—weak structure
- **Savannah River Site, H-Canyon**—aging systems and structures
- **Savannah River Site, Concentration, Storage, and Transfer Facility (Type I, II, and IV Tanks)**—aging tanks and systems

NEW ISSUES IDENTIFIED DURING THE PERIOD

- **Los Alamos National Laboratory, Plutonium Facility**—seismically-induced failure/collapse of facility

ISSUES RESOLVED DURING THE PERIOD

None

As directed by Congress, the Board will continue to exercise its existing statutory authority in addressing these and other safety-related issues within the defense nuclear complex.

Respectfully submitted,

Peter S. Winokur, Ph.D.
Chairman

Jessie H. Roberson
Vice Chairman

Joseph F. Bader
Member

John E. Mansfield
Member

Enclosure

ENCLOSURE

SUMMARY OF SIGNIFICANT SAFETY-RELATED INFRASTRUCTURE ISSUES AT OPERATING DEFENSE NUCLEAR FACILITIES

NATIONAL NUCLEAR SECURITY ADMINISTRATION SITES					
SITE	**FACILITY**	**BEGAN SERVICE**	**REMAINING SERVICE**	**INFRASTRUCTURE WEAKNESS**	**COMMENTS**
Los Alamos National Laboratory (LANL)	Chemistry and Metallurgy Research (CMR) Facility	1952	Until replaced by CMR Replacement Facility, date to be determined (TBD)	**End of life:** There is a 1 in 55 chance of seismic collapse during a 10-year time frame, which would result in release of nuclear material and injury/death of facility workers. Reference: Letters from the Defense Nuclear Facilities Safety Board (Board) dated October 23, 2007, and December 7, 2010	The Defense Nuclear Facilities Safety Board (Board) is concerned that prolonged operations in the existing CMR Facility pose a serious safety risk. In late 2010, in response to a review by the Board's staff, LANL limited material-at-risk (MAR) in the facility to reduce the public dose consequence following an accident to a value below the Evaluation Guideline of 25 rem.
	Plutonium Facility (PF-4)	1978	Approximately 30 years	**Post-seismic facility integrity:** Seismic analysis of PF-4 found in May 2011 that seismic events could result in significant damage to the facility and more severe accidents than had previously been identified. Reference: LANL Justification for Continued Operations dated June 6, 2011	LANL has begun to implement compensatory measures, including significant new limits on the MAR allowed in the building to reduce the risk of these newly postulated seismic accidents, including facility collapse. The National Nuclear Security Administration (NNSA) is aggressively pursuing structural upgrades to address these risks and ensure that PF-4 would maintain its confinement of nuclear material during a large seismic event.
				Safety system reliability: The facility lacks a set of safety controls that would adequately protect the public and workers from the consequences associated with post-seismic accidents. Reference: The Board's Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety* dated October 26, 2009	The Board issued Recommendation 2009-2 on October 26, 2009, to communicate clearly its concern regarding the limited progress made to date in reducing the risk to the public and workers following a seismic event. The Board accepted DOE's Implementation Plan for Recommendation 2009-2 on December 17, 2010. In parallel with efforts to address the issue of potential collapse of the structure noted above, NNSA is continuing to evaluate options for seismic upgrade of the fire suppression

NATIONAL NUCLEAR SECURITY ADMINISTRATION SITES					
SITE	**FACILITY**	**BEGAN SERVICE**	**REMAINING SERVICE**	**INFRASTRUCTURE WEAKNESS**	**COMMENTS**
					system and key portions of the active confinement ventilation system.
	Radioactive Liquid Waste Treatment Facility (RLWTF)	1963	Until replaced by Radioactive Liquid Waste Treatment Upgrade Facility (currently under review)	**Building and equipment end of life:** RLWTF has reached its end of life and, despite ongoing life extension efforts, requires replacement to support future laboratory missions reliably. Reference: Letter from the Board dated March 5, 2008	Cost growth associated with the original RLWTF Upgrade Facility project has resulted in NNSA evaluating alternative approaches. This facility collects waste water from the entire LANL site, so its failure could place the mission of the entire site at risk.
Nevada National Security Site	Device Assembly Facility (DAF)	1996	Until replaced—date TBD	**Degradation of fire suppression water tank:** The water tank cannot be relied upon to provide fire suppression water in the event of a fire in DAF. Reference: Letter from the Board dated January 18, 2008	The water tank has corrosion on interior and exterior surfaces. The tank also is in violation of standards of the Occupational Safety and Health Administration and noncompliant with standards of the American Water Works Association. The tank does not meet seismic requirements. NNSA is planning to make interim repairs, but has not yet submitted a line-item budget request to replace the tank.
				Degradation of fire suppression system lead-ins: The lead-ins are susceptible to corrosion failure and cannot be relied upon to provide fire suppression water in the event of a fire. Two lead-ins are currently leaking, and the associated portion of the fire suppression system is out of service. Reference: Letter from the Board dated January 18, 2008	The lead-ins are susceptible to failure due to potential corrosion throughout the entire fire suppression system. Internal coatings of pipes failed almost immediately after installation because of improper welding, which has led to corrosion problems. The Mission Need Statement (CD-0) for the lead-in Replacement Project was approved on May 18, 2011. The replacement is undefined. Alternative evaluation and selection is ongoing. NNSA estimates completion of the project in 2017.

NATIONAL NUCLEAR SECURITY ADMINISTRATION SITES					
SITE	**FACILITY**	**BEGAN SERVICE**	**REMAINING SERVICE**	**INFRASTRUCTURE WEAKNESS**	**COMMENTS**
Pantex Plant	Site-Wide Fire Suppression System	1950s	Until replaced—date TBD	**Degradation of fire suppression system lead-ins:** The lead-ins are susceptible to corrosion failure and cannot be relied upon to provide fire suppression water to the bays and cells in the event of a fire. There have been 27 corrosion-induced leaks since 1995. Reference: Letter from the Board dated September 23, 2002	The fire suppression system's piping lead-ins to the nuclear explosive bays and cells are susceptible to failure. NNSA has not funded the replacement project. Piping lead-ins continue to fail periodically.
Y-12 National Security Complex	9212 Complex	1951	Until replaced by the Uranium Processing Facility (UPF) in 2021	**Building and equipment end of life:** The 9212 Complex has reached its end of life and cannot be relied upon to provide a safe operating environment indefinitely. Reference: Letters from the Board dated March 13, 2007, November 28, 2005, and April 20, 2005.	The 9212 Complex cannot meet existing requirements for Hazard Category 2 nuclear facilities. NNSA has taken actions to reduce the radioactive material in the facilities. NNSA also has initiated a line-item project to upgrade certain systems in the 9212 Complex based on a facility risk review; however, the facilities still have a sizable maintenance backlog. Construction of the new UPF is the long-term solution to this issue. Even if the UPF schedule undergoes no further slippage, the 9212 Complex must function at least until 2021.

: 05250

ENVIRONMENTAL MANAGEMENT SITES					
SITE	**FACILITY**	**BEGAN SERVICE**	**REMAINING SERVICE**	**INFRASTRUCTURE WEAKNESS**	**COMMENTS**
Hanford Site	Single-Shell Tank Farms	1943–1964	Until cleaned and closed: 2019–2043	**Aging tanks and systems:** The older, single-shell tanks containing high-level radioactive waste are beyond their design lives, and some have leaked. Reference: Letter from the Board dated January 6, 2010	The Department of Energy (DOE) is transferring radioactive waste from 149 older, single-shell tanks to 28 newer, double-shell tanks to reduce environmental risk. DOE plans to use single-shell tanks until at least 2041 and is evaluating options for extending the lives of the single-shell tanks. The Board issued a letter dated January 6, 2010, encouraging DOE to develop more efficient tank inspection techniques.
	T Plant (waste treatment and packaging operations)	1944	Until storage mission is complete—TBD	**Weak structure:** Portions of the T Plant structure do not meet minimum reinforcement requirements of American Concrete Institute (ACI) code ACI 318. Reference: Letter from the Board dated April 4, 2003	T Plant is more than 60 years old, and the Board is concerned about the structure's suitability for new missions that may involve treatment of significant quantities of radioactive material from the K-West basin.
Savannah River Site	H-Canyon	1955	Until processing mission is complete—TBD	**Aging systems and structures:** H-Canyon is exhibiting degradation of systems and structures that, if not addressed, could challenge safe operations. Reference: Letter from the Board dated April 29, 2010	DOE continued some processing of uranium materials in H-Canyon through fiscal year 2011, but may place H-Canyon in cold standby in fiscal year 2012 if it does not receive sufficient funding. The Board believes DOE should maintain H-Canyon in a high-state of readiness as required by Public Laws 106-398 and 108-136 to process legacy items and spent fuel. At the Board's suggestion, DOE directed the contractor to develop a resumption plan so as to be prepared for possible future operations. The Board remains concerned about how DOE will maintain aging process and safety systems in operable condition during an indeterminate shutdown period.

ENVIRONMENTAL MANAGEMENT SITES					
SITE	**FACILITY**	**BEGAN SERVICE**	**REMAINING SERVICE**	**INFRASTRUCTURE WEAKNESS**	**COMMENTS**
	Concentration, Storage, and Transfer Facility (Type I, II, and IV Tanks)	1954–1962	Until cleaned and closed: 2012–2026	**Aging systems and structures:** The Type-I, -II, and -IV tanks containing high-level radioactive waste are beyond their design lives, and some have leaked. Reference: Letter from the Board dated January 6, 2010	DOE continues to store liquid waste in some of the old, noncompliant tanks. DOE expects that these old tanks will contain waste through 2018. Support systems require increased attention for monitoring and repair. The Board issued a letter dated January 6, 2010, encouraging DOE to develop more efficient tank inspection techniques.

NEW MEXICO
ENVIRONMENT DEPARTMENT

Resource Protection Division

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James H. Davis, Ph.D.

SUSANNA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

DAVE MARTIN
Cabinet Secretary
BUTCH TONGATE
Deputy Secretary
JAMES H. DAVIS, Ph.D.
Division Director

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

November 18, 2011

Anthony R. Grieggs, Group Leader
Environmental Protection Division
Water Quality & RCRA (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, NM 87545

RE: Response to Notice of Intent to Discharge and Discharge Permit Required for Zero Liquid Discharge Tanks, AI 856: PRD20070004 and Updated Application Submittal Required for the Radioactive Liquid Waste Treatment Facility (RLWTF), DP-1132

Dear Mr. Grieggs:

The Ground Water Quality Bureau of the New Mexico Environment Department (NMED) received a Notice of Intent from Los Alamos National Laboratory (LANL) on November 8, 2007 for the facility referenced above. NMED responded in writing with a request for additional information which required LANL to submit 60% plans and specifications for the proposed structure, information pertaining to ground water which may be impacted should a release occur, operation and maintenance procedures for the tanks, information on the potential concentration of the wastestream due to evaporation, and seismic studies for the area in which the tanks are to be constructed. NMED received a response to the requested information from LANL on September 15, 2008 which provided most of the requested information and stated that plans and specifications would be submitted once available. NMED received the plans and specifications for the evaporative tanks on August 19, 2011 along with an addendum dated October 19, 2011. The notice describes LANL's intent to discharge up to 3.6 million gallons annually of treated effluent from the RLWTF to two evaporative concrete tanks equipped with synthetic liners and leak detection systems. The total operating volume of the tanks is approximately 754,036 gallons (100,800 cubic feet). The notice, along with the subsequent information submitted upon NMED's request, satisfies the requirements of Subsection A of 20.6.2.1201 New Mexico Administrative Code (NMAC) of the New Mexico Water Quality Control Commission (WQCC) Regulations, 20.6.2 NMAC. The proposed discharge is located within the boundaries of Los Alamos National Laboratory at

35°51'37"N, 106°16'57"W, approximately 2.5 miles southeast of Los Alamos in Section 23, Township 19N, Range 06E, Los Alamos County.

NMED has reviewed the information provided in accordance with Subsection D of 20.6.2.1201 NMAC and because the proposed evaporative tanks contain an effluent or leachate which may move directly or indirectly into ground water, NMED has determined that **a Discharge Permit is required for the proposed discharge.** NMED considers the proposed evaporative tanks to be a component of the RLWTF, therefore they must be included in the Discharge Permit for this facility.

Any appeal of this determination that a Discharge Permit is required must be made to the New Mexico WQCC within 30 days of receipt of this letter, in accordance with Subsection B of 20.6.2.3112 NMAC. A copy of the WQCC Regulations, 20.6.2 NMAC, is available at http://www.nmcpr.state.nm.us/nmac/_title20/T20C006.htm.

Upon further review of the file for the RLWTF, NMED has noted the following:

- An application for a Discharge Permit was submitted to NMED on April 16, 1996 for the discharge of 41,770 gallons per day of treated low level radioactive wastewater from the RLWTF to a tributary of Mortandad Canyon (referred to as Effluent Canyon).
- The application identified potential upgrades to the system which were to enhance the treatment process and provide alternate discharge capabilities for the facility.
- The treated effluent from the RLWTF is currently authorized to be discharged to an outfall (Outfall 051) under a United States Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Permit (NM0028355) last issued on August 1, 2007, and subsequently modified on July 17, 2007, May 13, 2011, and October 11, 2011.
- Numerous Notices of Planned Changes have been submitted to EPA for treatment system upgrades and facility changes under the NPDES Permit for Outfall 051. Copies of these notices were submitted to NMED on the following dates: April 21, 1998, March 18, 1999, April 3, 2000, June 13, 2000, May 7, 2002, March 14, 2003, April 18, 2003, January 12, 2004, May 14, 2007, May 6, 2008, August 19, 2010, September 16, 2010, and February 23, 2011.
- In addition to the Notices of Planned Changes, numerous notices concerning minor modifications to the facility have been submitted to NMED as addendums to the original Discharge Permit application. NMED received copies of these submissions which were dated March 23, 1999, December 8, 2000, November 8, 2007, August 25, 2010, September 27, 2010, December 15, 2010, and March 22, 2011.
- NMED has engaged in numerous meetings, inspections and written correspondence regarding the RLWTF in order to compile accurate information on the facility in preparation for drafting a Discharge Permit that will accurately reflect the activities conducted at the RLWTF.
- In September 2003, a draft of Discharge Permit DP-1132 was sent to LANL which was subsequently Public Noticed on April 18, 2005, beginning a 30-day comment period.
- On April 27, 2005, in response to multiple requests from interested parties, a second public comment period was granted on the proposed Discharge Permit (extending the comment period for approximately 90 days, until August 4, 2005).

- NMED received comments and requests for a public hearing regarding the draft Discharge Permit from both interested parties and LANL.
- Through continued discussions with LANL, correspondence, site inspections and the above referenced Notice of Intent, it has become apparent that the facility has significantly modified treatment processes, discharge volumes and locations of the discharge when compared to the original application submitted to NMED on August 16, 1996.
- As it pertains to any future Discharge Permits to be issued by the NMED Ground Water Quality Bureau (GWQB), this *facility* has been determined to include the central influent collection lines leading to the RLWTF, all components which are part of the wastewater treatment process and all locations where the treated wastewater is disposed, including all surface discharges as well as non-surface discharges such as evaporative tanks (as described in the above referenced Notice of Intent). This determination by the NMED-GWQB is based on information provided in the original application for a Discharge Permit along with subsequent information provided to NMED by LANL.

Given the extensive and fractured exchange of information concerning this facility, along with changes at the RLWTF that have occurred during the lengthy permitting process and planned future changes, NMED views LANL's August 16, 1996 Discharge Permit application to be inconsistent with the current and planned discharge activities associated with the RLWTF. **Therefore, NMED requires that LANL submit a comprehensive and up-to-date Discharge Permit application for the RLWTF within 90 days of the date of this letter (by February 16, 2011).**

When submitted, the application (copy enclosed) should be completed in its entirety and specifically address the following:

- The estimated volumes, sources (technical area and building) and wastestream characteristics of all influent wastewater that LANL receives, or intends to receive, at the RLWTF.
- A description of the conveyance methods used to transport wastewater to the RLWTF for each source.
- A description of waste characterization and metering systems used to determine influent wastestream characteristics and volumes entering the RLWTF.
- A description of the review and amendment process for LANL's internal Waste Acceptance Criteria (WAC) for all incoming wastewater received at the RLWTF. This should include LANL's process for ensuring the WAC relates to the current treatment technologies and processes.
- A description of operational procedures for receiving wastes from each generator.
- A schematic of the treatment process in its entirety for each wastestream (from collection to final disposal).
- Descriptions, locations, construction materials and sizing for each component of the treatment processes for each type of wastestream being treated at the RLWTF.
- Descriptions, locations and designs for all secondary storage and auxillary emergency units intended to receive, treat or store wastewater received at the facility.
- Proposed processes for the operation, inspection and maintenance for the facility as it pertains to the collection lines, treatment units and effluent storage disposal units.
- Procedures and corrective actions for addressing acute failures at the facility.
- Procedures and corrective actions for addressing long-term maintenance issues at the facility.

- Record drawings for all components of the facility, if available.
- Construction plans and specifications for all components of the facility which are under construction or are proposed for construction.
- A proposed effluent monitoring plan, identifying analytes and sample locations/frequency. The proposal should consider discharge frequencies, incoming waste characteristics and the constituents listed under 20.6.2.3103 NMAC and Subsection WW of 20.6.2.7 NMAC.
- Proposed flow and metering systems used to determine effluent discharge volumes for each of the discharge locations.
- Proposed ground water monitoring locations for ground water sources most likely to be impacted by intentional and unintentional discharges from the RLWTF. The proposal should identify geohydrology of the potentially impacted areas, existing monitoring well locations and construction.
- Actions which LANL would implement should partial or full closure of the facility occur.
- A scaled facility plan showing the facility's components including influent collection lines, storage units, major treatment units and disposal units.
- All other information sought in NMED's application for Discharge Permit Sections A through C. Please note that for the purposes of public notification, the "discharge site" as it relates to this facility encompasses the central collection system lines, the treatment and storage facilities and all discharge locations for the treated effluent.

When submitting the comprehensive and up-to-date Discharge Permit application, you must complete and submit three copies along with the $100 filing fee.

If you have any questions, please contact either Jennifer Fullam at (505) 827-2909 or Clint Marshall, Acting Program Manager of the Ground Water Pollution Prevention Section, at (505) 827-0027.

Sincerely,

James H. Davis, Ph.D.
Director, Resource Protection Division

JD:JF

Enc: Applying for a Discharge Permit: General Information
Discharge Permit Application

cc: Robert Italiano, District Manager, NMED District II (w/o enclosures)
NMED Santa Fe Field Office (w/o enclosures)
DP Required File (w/o enclosures)
James Bearzi, NMED SWQB (w/o enclosures)
Richard Powell, NMED SWQB (w/o enclosures)
John Kieling, NMED HWB (w/o enclosures)
Steven Yanicak, NMED-DOE-Oversight Bureau (w/o enclosures)

05257

Hai Shen, LASO-EO, Los Alamos National Laboratory, A316, Los Alamos, NM 87545 (w/o enclosures)

Gene Turner, LASO-EO, Los Alamos National Laboratory, A316, Los Alamos, NM 87545 (w/o enclosures)

Eric Trujillo, LASO-NSM, Los Alamos National Laboratory, A316, Los Alamos, NM 87545 (w/o enclosures)

Carl A. Beard, PADOPS, Los Alamos National Laboratory, A102, Los Alamos, NM 87545 (w/o enclosures)

J. Chris Cantwell, ADESHQ, Los Alamos National Laboratory, K491, Los Alamos, NM 87545 (w/o enclosures)

Randy Johnson, ENV-ES, Los Alamos National Laboratory, E500, Los Alamos, NM 87545 (w/o enclosures)

Michael Saladen ENV-RCRA, Los Alamos National Laboratory, K490, Los Alamos, NM 87545 (w/o enclosures)

Robert Mason, TA-55-DO, Los Alamos National Laboratory, E583, Los Alamos, NM 87545 (w/o enclosures)

Hugh McGovern, TA-55-RLW, Los Alamos National Laboratory, E518, Los Alamos, NM 87545 (w/o enclosures)

Pete Worland, TA-55-RLW, Los Alamos National Laboratory, E518, Los Alamos, NM 87545 (w/o enclosures)

Keith Orr, PMF-FUNCT, Los Alamos National Laboratory, M984, Los Alamos, NM 87545 (w/o enclosures)

Roy Maestas, CM-STRS, Los Alamos National Laboratory, P299, Los Alamos, NM 87545 (w/o enclosures)

Joe Brophy, PMF-FUNCT Los Alamos National Laboratory, P137, Los Alamos, NM 87545 (w/o enclosures)

Ed Artiglia, ES-PE, Los Alamos National Laboratory, P137, Los Alamos, NM 87545 (w/o enclosures)

Bob Beers, ENV-RCRA, Los Alamos National Laboratory, K490, Los Alamos NM, 87545 (w/ enclosures)

New Mexico Environment Department
Ground Water Quality Bureau

Memorandum of Meeting or Phone Conversation

Memorandum of Meeting or Phone Conversation

☑ Telephone ☐ Meeting	Time: 818	Date: 12.01.11

Individuals Involved

Jennifer Fullam, NMED GWQB	☐ called ☑ was called by ☐ other:	Name: Bob Beers Affiliation: Contact DP: 1132 Site Name: Los Alamos National Lab Phone Number: 505.667.7969

Subject: DP Application Required Letter

Discussion: Beers called Fullam and stated they recieved the ZLD NOI Response requiring an application for the entire RLWTF. Beers proposed an informative presentation to NMED-GWQB on the ground water monitoring program. Fullam stated the presentation would be beneficial but the demonstration for monitoring in regards to the facility should be formally made in the application. Fullam and Beers will coordinate the presentation prior to the end of the year.
Beers also requested a Meeting between NMED + LANL to go over the technical items listed in the letter which are to be included

Conclusions: in the application. Fullam will discuss with Program Manager + Bureau Chief

Distribution: and schedule most likely at the beginning of January.

Initialed: JF

+ 12.14.11 @ 802 Beers called Fullam to confirm presentation on 12.15.11 @ 9:00 app for R-28 will be submitted by 12.23.11 and technical discussion after new year.

05260

Fullam Docs / 080714 / Caseloads / LANL / LANL emails

Fullam, Jennifer, NMENV

From:	Beers, Robert S <bbeers@lanl.gov>
Sent:	Thursday, December 8, 2011 4:55 PM
To:	Fullam, Jennifer, NMENV
Cc:	Saladen, Michael T
Subject:	Request for Deadline Extension
Attachments:	Request for Extension to Submit Updated Discharge Permit Application RLWTF DP-1132.pdf

Jennifer—

Attached is the Laboratory's request for an extension of the deadline to submit an updated Discharge Permit application for the RLWTF (DP-1132).

The Laboratory is requesting an additional 90 days to prepare the application.

The original hard-copy of this letter will be delivered to Mr. James Davis on Friday morning, December 9, 2011.

Please let me know if you have questions.

Sincerely,

Bob Beers
Water Quality & RCRA Group
Los Alamos National Security, LLC
505-667-7969

Los Alamos
NATIONAL LABORATORY
EST. 1943

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, Mail Stop M704
Los Alamos, New Mexico 87545
(505) 667-0666/FAX: (505) 667-5224

Date: December 7, 2011
Refer To: ENV-RCRA-11-0270
LAUR: 11-12157

Mr. James H. Davis, Director
Resource Protection Division
New Mexico Environment Department
Harold Runnels Building
1190 St. Francis Drive
P.O. Box 5469
Santa Fe, NM 87502-5469

Dear Mr. Davis:

SUBJECT: REQUEST FOR AN EXTENSION TO SUBMIT AN UPDATED DISCHARGE PERMIT APPLICATION FOR THE RADIOACTIVE LIQUID WASTE TREATMENT FACILITY (DP-1132)

The US Department of Energy and Los Alamos National Security, LLC (DOE/LANS) are in receipt of your November 18, 2011, letter (Enclosure 1) requiring a comprehensive and up-to-date Discharge Permit application for the Radioactive Liquid Waste Treatment Facility (RLWTF) within 90 days of the letter's date (by February 16, 2012). For reasons explained below, DOE/LANS request an additional 90 days to prepare a Discharge Permit application for the RLWTF.

DOE/LANS have appreciated working with you and your staff on this matter. The goal is to submit a new Discharge Permit application for the RLWTF that is complete and satisfactory at the time of submittal. Addressing each of the 19 bullets listed in the above-referenced letter will require a significant level of effort by DOE/LANS technical staff. Further, the administrative record identified in the letter will need to be carefully reviewed, and supplemented as appropriate. Meetings between our respective representatives will be needed to ensure the information provided is responsive and focused correctly. For these reasons and because the Laboratory is closed during the holiday season, DOE/LANS respectfully request an extension of the application deadline to May 16, 2012.

Please contact Bob Beers at (505) 667-7969 if you have questions regarding this request.

Sincerely,

A R Grieggs

Anthony R. Grieggs
Group Leader
Water Quality & RCRA Group

Enclosures: a/s

Cy: Hai Shen, LASO-EO, A316
Gene Turner, LASO-EO, A316
Steve Yanicak, LASO-GOV, M894
Carl A. Beard, PADOPS, A102
Michael T. Brandt, ADESH, K491
Randy Johnson, ENV-ES, E500
Mike Saladen, ENV-RCRA, K490, (E-File)
Robert Beers, ENV-RCRA, K490, (E-File)
Robert C. Mason, TA55-DO, E583
Hugh McGovern, TA-55 RLW, E518
Pete Worland, TA-55-RLW, E518
Susan L. McMichael, LC-LESH, A187
ENV-RCRA File, M704
IRM-RMMSO, A150

NEW MEXICO
ENVIRONMENT DEPARTMENT

Resource Protection Division

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1190 Saint Francis Drive (87505)
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Phone (505) 827-2855 Fax (505) 827-2836
www.nmenv.state.nm.us
James H. Davis, Ph.D.

SUSANNA MARTINEZ
Governor
JOHN A. SANCHEZ
Lieutenant Governor

DAVE MARTIN
Cabinet Secretary
BUTCH TONGATE
Deputy Secretary
JAMES H. DAVIS, Ph.D.
Division Director

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

November 18, 2011

Anthony R. Grieggs, Group Leader
Environmental Protection Division
Water Quality & RCRA (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, NM 87545

RE: Response to Notice of Intent to Discharge and Discharge Permit Required for Zero Liquid Discharge Tanks, AI 856: PRD20070004 and Updated Application Submittal Required for the Radioactive Liquid Waste Treatment Facility (RLWTF), DP-1132

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When submitting the comprehensive and up-to-date Discharge Permit application, you must complete and submit three copies along with the $100 filing fee.

If you have any questions, please contact either Jennifer Fullam at (505) 827-2909 or Clint Marshall, Acting Program Manager of the Ground Water Pollution Prevention Section, at (505) 827-0027.

Sincerely,

James H. Davis, Ph.D.
Director, Resource Protection Division

JD:JF

Enc: Applying for a Discharge Permit: General Information
Discharge Permit Application

cc: Robert Italiano, District Manager, NMED District II (w/o enclosures)
NMED Santa Fe Field Office (w/o enclosures)
DP Required File (w/o enclosures)
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Steven Yanicak, NMED-DOE-Oversight Bureau (w/o enclosures)

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Bob Beers, ENV-RCRA, Los Alamos National Laboratory, K490, Los Alamos NM, 87545 (w/ enclosures)

Los Alamos
NATIONAL LABORATORY
EST.1943

RECEIVED
DEC 9 2011
RESOURCE PROTECTION DIVISION

Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, Mail Stop M704
Los Alamos, New Mexico 87545
(505) 667-0666/FAX: (505) 667-5224

Date: December 7, 2011
Refer To: ENV-RCRA-11-0270
LAUR: 11-12157

Mr. James H. Davis, Director
Resource Protection Division
New Mexico Environment Department
Harold Runnels Building
1190 St. Francis Drive
P.O. Box 5469
Santa Fe, NM 87502-5469

Dear Mr. Davis:

SUBJECT: REQUEST FOR AN EXTENSION TO SUBMIT AN UPDATED DISCHARGE PERMIT APPLICATION FOR THE RADIOACTIVE LIQUID WASTE TREATMENT FACILITY (DP-1132)

The US Department of Energy and Los Alamos National Security, LLC (DOE/LANS) are in receipt of your November 18, 2011, letter (Enclosure 1) requiring a comprehensive and up-to-date Discharge Permit application for the Radioactive Liquid Waste Treatment Facility (RLWTF) within 90 days of the letter's date (by February 16, 2012). For reasons explained below, DOE/LANS request an additional 90 days to prepare a Discharge Permit application for the RLWTF.

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Please contact Bob Beers at (505) 667-7969 if you have questions regarding this request.

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Anthony R. Grieggs
Group Leader
Water Quality & RCRA Group

Enclosures: a/s

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✓Gene Turner, LASO-EO, A316
✓Steve Yanicak, LASO-GOV, M894
✓Carl A. Beard, PADOPS, A102
✓Michael T. Brandt, ADESH, K491
✓Randy Johnson, ENV-ES, E500
✓Mike Saladen, ENV-RCRA, K490, (E-File)
✓Robert Beers, ENV-RCRA, K490, (E-File)
✓Robert C. Mason, TA55-DO, E583
✓Hugh McGovern, TA-55 RLW, E518
✓Pete Worland, TA-55-RLW, E518
✓Susan L. McMichael, LC-LESH, A187
ENV-RCRA File, M704
IRM-RMMSO, A150

NEW MEXICO
ENVIRONMENT DEPARTMENT

Resource Protection Division

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Deputy Secretary
JAMES H. DAVIS, Ph.D.
Division Director

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

November 18, 2011

U1102277

Anthony R. Grieggs, Group Leader
Environmental Protection Division
Water Quality & RCRA (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, NM 87545

RE: Response to Notice of Intent to Discharge and Discharge Permit Required for Zero Liquid Discharge Tanks, AI 856: PRD20070004 and Updated Application Submittal Required for the Radioactive Liquid Waste Treatment Facility (RLWTF), DP-1132

Dear Mr. Grieggs:

The Ground Water Quality Bureau of the New Mexico Environment Department (NMED) received a Notice of Intent from Los Alamos National Laboratory (LANL) on November 8, 2007 for the facility referenced above. NMED responded in writing with a request for additional information which required LANL to submit 60% plans and specifications for the proposed structure, information pertaining to ground water which may be impacted should a release occur, operation and maintenance procedures for the tanks, information on the potential concentration of the wastestream due to evaporation, and seismic studies for the area in which the tanks are to be constructed. NMED received a response to the requested information from LANL on September 15, 2008 which provided most of the requested information and stated that plans and specifications would be submitted once available. NMED received the plans and specifications for the evaporative tanks on August 19, 2011 along with an addendum dated October 19, 2011. The notice describes LANL's intent to discharge up to 3.6 million gallons annually of treated effluent from the RLWTF to two evaporative concrete tanks equipped with synthetic liners and leak detection systems. The total operating volume of the tanks is approximately 754,036 gallons (100,800 cubic feet). The notice, along with the subsequent information submitted upon NMED's request, satisfies the requirements of Subsection A of 20.6.2.1201 New Mexico Administrative Code (NMAC) of the New Mexico Water Quality Control Commission (WQCC) Regulations, 20.6.2 NMAC. The proposed discharge is located within the boundaries of Los Alamos National Laboratory at

35°51'37"N, 106°16'57"W, approximately 2.5 miles southeast of Los Alamos in Section 23, Township 19N, Range 06E, Los Alamos County.

NMED has reviewed the information provided in accordance with Subsection D of 20.6.2.1201 NMAC and because the proposed evaporative tanks contain an effluent or leachate which may move directly or indirectly into ground water, NMED has determined that **a Discharge Permit is required for the proposed discharge.** NMED considers the proposed evaporative tanks to be a component of the RLWTF, therefore they must be included in the Discharge Permit for this facility.

Any appeal of this determination that a Discharge Permit is required must be made to the New Mexico WQCC within 30 days of receipt of this letter, in accordance with Subsection B of 20.6.2.3112 NMAC. A copy of the WQCC Regulations, 20.6.2 NMAC, is available at http://www.nmcpr.state.nm.us/nmac/_title20/T20C006.htm.

Upon further review of the file for the RLWTF, NMED has noted the following:

- An application for a Discharge Permit was submitted to NMED on April 16, 1996 for the discharge of 41,770 gallons per day of treated low level radioactive wastewater from the RLWTF to a tributary of Mortandad Canyon (referred to as Effluent Canyon).
- The application identified potential upgrades to the system which were to enhance the treatment process and provide alternate discharge capabilities for the facility.
- The treated effluent from the RLWTF is currently authorized to be discharged to an outfall (Outfall 051) under a United States Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Permit (NM0028355) last issued on August 1, 2007, and subsequently modified on July 17, 2007, May 13, 2011, and October 11, 2011.
- Numerous Notices of Planned Changes have been submitted to EPA for treatment system upgrades and facility changes under the NPDES Permit for Outfall 051. Copies of these notices were submitted to NMED on the following dates: April 21, 1998, March 18, 1999, April 3, 2000, June 13, 2000, May 7, 2002, March 14, 2003, April 18, 2003, January 12, 2004, May 14, 2007, May 6, 2008, August 19, 2010, September 16, 2010, and February 23, 2011.
- In addition to the Notices of Planned Changes, numerous notices concerning minor modifications to the facility have been submitted to NMED as addendums to the original Discharge Permit application. NMED received copies of these submissions which were dated March 23, 1999, December 8, 2000, November 8, 2007, August 25, 2010, September 27, 2010, December 15, 2010, and March 22, 2011.
- NMED has engaged in numerous meetings, inspections and written correspondence regarding the RLWTF in order to compile accurate information on the facility in preparation for drafting a Discharge Permit that will accurately reflect the activities conducted at the RLWTF.
- In September 2003, a draft of Discharge Permit DP-1132 was sent to LANL which was subsequently Public Noticed on April 18, 2005, beginning a 30-day comment period.
- On April 27, 2005, in response to multiple requests from interested parties, a second public comment period was granted on the proposed Discharge Permit (extending the comment period for approximately 90 days, until August 4, 2005).

- NMED received comments and requests for a public hearing regarding the draft Discharge Permit from both interested parties and LANL.
- Through continued discussions with LANL, correspondence, site inspections and the above referenced Notice of Intent, it has become apparent that the facility has significantly modified treatment processes, discharge volumes and locations of the discharge when compared to the original application submitted to NMED on August 16, 1996.
- As it pertains to any future Discharge Permits to be issued by the NMED Ground Water Quality Bureau (GWQB), this *facility* has been determined to include the central influent collection lines leading to the RLWTF, all components which are part of the wastewater treatment process and all locations where the treated wastewater is disposed, including all surface discharges as well as non-surface discharges such as evaporative tanks (as described in the above referenced Notice of Intent). This determination by the NMED-GWQB is based on information provided in the original application for a Discharge Permit along with subsequent information provided to NMED by LANL.

Given the extensive and fractured exchange of information concerning this facility, along with changes at the RLWTF that have occurred during the lengthy permitting process and planned future changes, NMED views LANL's August 16, 1996 Discharge Permit application to be inconsistent with the current and planned discharge activities associated with the RLWTF. **Therefore, NMED requires that LANL submit a comprehensive and up-to-date Discharge Permit application for the RLWTF within 90 days of the date of this letter (by February 16, 2011).**

When submitted, the application (copy enclosed) should be completed in its entirety and specifically address the following:

- The estimated volumes, sources (technical area and building) and wastestream characteristics of all influent wastewater that LANL receives, or intends to receive, at the RLWTF.
- A description of the conveyance methods used to transport wastewater to the RLWTF for each source.
- A description of waste characterization and metering systems used to determine influent wastestream characteristics and volumes entering the RLWTF.
- A description of the review and amendment process for LANL's internal Waste Acceptance Criteria (WAC) for all incoming wastewater received at the RLWTF. This should include LANL's process for ensuring the WAC relates to the current treatment technologies and processes.
- A description of operational procedures for receiving wastes from each generator.
- A schematic of the treatment process in its entirety for each wastestream (from collection to final disposal).
- Descriptions, locations, construction materials and sizing for each component of the treatment processes for each type of wastestream being treated at the RLWTF.
- Descriptions, locations and designs for all secondary storage and auxillary emergency units intended to receive, treat or store wastewater received at the facility.
- Proposed processes for the operation, inspection and maintenance for the facility as it pertains to the collection lines, treatment units and effluent storage disposal units.
- Procedures and corrective actions for addressing acute failures at the facility.
- Procedures and corrective actions for addressing long-term maintenance issues at the facility.

- Record drawings for all components of the facility, if available.
- Construction plans and specifications for all components of the facility which are under construction or are proposed for construction.
- A proposed effluent monitoring plan, identifying analytes and sample locations/frequency. The proposal should consider discharge frequencies, incoming waste characteristics and the constituents listed under 20.6.2.3103 NMAC and Subsection WW of 20.6.2.7 NMAC.
- Proposed flow and metering systems used to determine effluent discharge volumes for each of the discharge locations.
- Proposed ground water monitoring locations for ground water sources most likely to be impacted by intentional and unintentional discharges from the RLWTF. The proposal should identify geohydrology of the potentially impacted areas, existing monitoring well locations and construction.
- Actions which LANL would implement should partial or full closure of the facility occur.
- A scaled facility plan showing the facility's components including influent collection lines, storage units, major treatment units and disposal units.
- All other information sought in NMED's application for Discharge Permit Sections A through C. Please note that for the purposes of public notification, the "discharge site" as it relates to this facility encompasses the central collection system lines, the treatment and storage facilities and all discharge locations for the treated effluent.

When submitting the comprehensive and up-to-date Discharge Permit application, you must complete and submit three copies along with the $100 filing fee.

If you have any questions, please contact either Jennifer Fullam at (505) 827-2909 or Clint Marshall, Acting Program Manager of the Ground Water Pollution Prevention Section, at (505) 827-0027.

Sincerely,

James H. Davis, Ph.D.
Director, Resource Protection Division

JD:JF

Enc: Applying for a Discharge Permit: General Information
Discharge Permit Application

cc: Robert Italiano, District Manager, NMED District II (w/o enclosures)
NMED Santa Fe Field Office (w/o enclosures)
DP Required File (w/o enclosures)
James Bearzi, NMED SWQB (w/o enclosures)
Richard Powell, NMED SWQB (w/o enclosures)
John Kieling, NMED HWB (w/o enclosures)
Steven Yanicak, NMED-DOE-Oversight Bureau (w/o enclosures)

Hai Shen, LASO-EO, Los Alamos National Laboratory, A316, Los Alamos, NM 87545 (w/o enclosures)

Gene Turner, LASO-EO, Los Alamos National Laboratory, A316, Los Alamos, NM 87545 (w/o enclosures)

Eric Trujillo, LASO-NSM, Los Alamos National Laboratory, A316, Los Alamos, NM 87545 (w/o enclosures)

Carl A. Beard, PADOPS, Los Alamos National Laboratory, A102, Los Alamos, NM 87545 (w/o enclosures)

J. Chris Cantwell, ADESHQ, Los Alamos National Laboratory, K491, Los Alamos, NM 87545 (w/o enclosures)

Randy Johnson, ENV-ES, Los Alamos National Laboratory, E500, Los Alamos, NM 87545 (w/o enclosures)

Michael Saladen ENV-RCRA, Los Alamos National Laboratory, K490, Los Alamos, NM 87545 (w/o enclosures)

Robert Mason, TA-55-DO, Los Alamos National Laboratory, E583, Los Alamos, NM 87545 (w/o enclosures)

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Pete Worland, TA-55-RLW, Los Alamos National Laboratory, E518, Los Alamos, NM 87545 (w/o enclosures)

Keith Orr, PMF-FUNCT, Los Alamos National Laboratory, M984, Los Alamos, NM 87545 (w/o enclosures)

Roy Maestas, CM-STRS, Los Alamos National Laboratory, P299, Los Alamos, NM 87545 (w/o enclosures)

Joe Brophy, PMF-FUNCT Los Alamos National Laboratory, P137, Los Alamos, NM 87545 (w/o enclosures)

Ed Artiglia, ES-PE, Los Alamos National Laboratory, P137, Los Alamos, NM 87545 (w/o enclosures)

Bob Beers, ENV-RCRA, Los Alamos National Laboratory, K490, Los Alamos NM, 87545 (w/ enclosures)

New Mexico Environment Department
Ground Water Quality Bureau

Memorandum of Meeting or Phone Conversation

☐ Telephone ☐ Meeting	**Time:** 9:00am-11:00pm	**Date:** 12.15.11

Individuals Involved

Jerry Schoeppner, NMED-GWQB Bureau Chief	☐ called	Bob Beers, LANL
Clint Marshall, NMED-GWQB PPS Program Manager		Danny Katzman, LANL
Robert George, NMED-GWQB Team Leader	☐ returned call to	Gene Turner, LANL
Kim Kirby, NMED-GWQB Supervisor		
Jennifer Fullam, NMED-GWQB Environmental Scientist	☐ received call from	
Gerald Knutson, NMED-GWQB Environmental Scientist	☐ other: **MEETING**	

Subject: See Below

Discussion:

I. Ground Water Monitoring Program at Los Alamos National Laboratory

LANL met with NMED to discuss the current monitoring program and hydrogeological conditions which exist at the facility.

- Puye Formation-shedding off mountain front towards the east
- 12-15 mya lava flows which pre-date the caldera
- 1.2 mya is the lava flow from the caldera
  - Otowi member forming approximately 1.3 mya-defined with soft tuff and pinyon/juniper forest
  - Cerro Toledo- gravel deposits between the
  - Tshiregeh member forming after the Otowi member and Cerro Toledo is defined as the tuff cliffs
- Vertical fault on the west boundary
- Mesa tops tend to have a low hydrolic conductivity and are highly influenced through diurnal fluctuations in temperature and air movement.
- The behavior of the mesa tops allows for movement of vapor phase contaminants as air moves in and out of the tuff
- Migration of contaminants at the mesa top to ground water is believed by LANL to be very limited due to poor hydrologic head and dry conditions
- The canyons have tuff and older deposits from the top
-
- Groundwater is generally not found on the plateau but tends to be isolated in the canyons
- Upland canyons have a pronounced ground water
- Lower canyons have alluvial aquifers that are more effected from precipitation
- The alluvial deposits in the canyons are on bedrock and range from a few inches thick to

100' (as seen in Mortandad Canyon)

- LANL stated that there are alluvial wells in each canyon
- Studies have shown that the aquifer tends to decrease as you progress down the canyon towards the east. Water is lost through evapotranspiration or vertical movement through the bedrock into perched intermediate aquifers
- Wet canyons tend to increase infiltration while dry canyons tend to decrease or limit infiltration
- The perched intermediate zones range from 120'-900'
- The Pajarito fault is believed to cause movement from the alluvial aquifer to the perched intermediate zones providing for very complex hydrogeology especially in the HE areas of the laboratory
- The areas of infiltration from the alluvial to the intermediate are very varied and specific (the groundwater will be prominent in the alluvial aquifer for a long stretch of the canyon with little to no loss and within a small window quickly migrate vertically into a perched intermediate aquifer.
- Eventually the perched intermediate will infiltrate into the regional under very limited areas
- The directionality of the movement between the perched intermediate to the regional is not necessarily easterly as seen with most of the ground water movement on the plateau nor does it adhere to general topological watershed boundaries. Studies have shown that the perched intermediate ground water in Sandia Canyon diverts to the south before breaking through to the regional aquifer.
- The temporal scale for movement from the alluvial to the regional aquifer varies. Sandia Canyon is believed to be approximately 10-15 years, Other canyons are approximately 20-30 years and on the mesas there have been no significant study to determine the length of time but it is believed to be over 100 years.
- It is believed that wetted environments could affect the vadose zone as seen in TA-21 and MDA-T.
- Regional aquifer contamination generally derives from a combination of three factors: wetted environment, mobile contaminant and a persistent driver.
- The regional aquifer behaves fairly normal with a gradient to the east until it approaches the Rio Grande to which it trends south
- The Regional aquifer ranges from 1,400' on the west to approximately 600' on the east near the Rio Grande
- The regional aquifer is found in many formations but mostly in the Puye gravels. The area near Totavi is believed to be the best water (ancestral from the Rio Grande with quartzite from northern runoff)
- There has been nothing to indicate a hydrological connection with the Rio Grande and the regional ground water
- The supply wells for Los Alamos are all deep within the regional aquifer.
- There has been no signs of draw down on the wells causing the classical cone of depression
- LANL states they sample the County wells quarterly
- There have been wells which show contamination at the regional level such as exceedances in Chromium in Sandia Canyon to which LANL has placed a sentinel well between Sandia and the production well.
- The production well is screened at approximately 200' below water level and has a 1,000'

screen. This well pumps 300-400 gpm

- Otowi-1 is contaminated with exceedances in perchlorate and tritium.
- Studies have shown the Buckman well field to be independent of the regional aquifer that originates in the Pajarito Plateau but the aquifer for the Buckman wells does extend west of the Rio Grande

II. Hydrogeology as it pertains to the RLWTF

A formal demonstration on effective ground water monitoring for the facility is requested to be submitted with the Discharge Permit application

- LANL stated that there are monitoring wells associated with the MDA-C (material disposal area) which is located near the RLWTF and may be proposed by LANL for monitoring potential impacts of the RLWTF
- Mortandad canyon shows signatures associated with the RLWTF primarily tritium and nitrate (nitric acid)

III. Sandia Canyon and Discharges from SWWS

- Sandia canyon shows signatures of perchlorate and nitrate (associated with domestic wastewater treatment)
- There is chromium in the canyon but is believed to be stabilized in the soils in a tri-valent state. There have been issues with headcutting on the east end of the wetlands causing mobilization of the soils to lower portions of the canyon.
- LANL stated they are planning to do some stabilization work in Sandia Canyon this year to reduce erosion and contaminant movement out of the wetlands. SERF is planned to be put online which will reduce the volumes and thereby reducing mobilization of contaminants down Sandia Canyon.
- LANL stated they are planning on installing a monitoring network in the Canyon to observe wetland health.

IV. Other Items of Discussion

- LANL requested to set up a meeting to discuss the bullet points listed in the November 18, 2011 DP required letter for the RLWTF. Fullam and Beers will coordinate a meeting for the 2nd week in January as LANL is closed from December 23rd -January 6th.
- The ZLD has been delayed for the installation of the liners. LANL anticipates they will be installed sometime in February or March. George requested LANL contact him so he can be present during the installation.
- LANL requested a tour of the facility specifically for Schoeppner and Marshall. It was discussed that the tour should coincide after the application is received to better familiarize themselves.

Conclusions:

LANL will:

1. Inform George of the timelines for installing the liner for the ZLD
2. Beers will work with Fullam on scheduling a meeting to discuss the requirements for the RLWTF application

GWB will:

1. Work with Beers to schedule a meeting to discuss the requirements for the RLWTF application

Distribution:

FILE-LANL-GWQB-Discharge Permit-TA-50-Meetings

Initialed JF

Fullam, Jennifer, NMENV

From: Beers, Robert S <bbeers@lanl.gov>
Sent: Thursday, December 22, 2011 10:05 AM
To: Fullam, Jennifer, NMENV
Cc: George, Robert, NMENV; Saladen, Michael T
Subject: NMED Inspection Report

Hi Jennifer—

With the end of the year approaching, I realized that I did not receive a copy of your inspection report for the TA-50 RLWTF on September 8, 2011.

Could you please forward a copy to me at your convenience.

Thank you and have an enjoyable holiday season.

Sincerely,

Bob Beers
Water Quality & RCRA Group
Los Alamos National Security, LLC
505-667-7969

DP-1132, Blue File

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Mr. Anthony Grieg
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CERTIFIED MAIL – RETURN RECEIPT REQUESTED

December 30, 2011

Anthony R. Grieggs, Group Leader
Environmental Protection Division
Water Quality & RCRA (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, NM 87545

RE: Denial of Time Extension to Submit Application, DP-1132, Radioactive Liquid Waste Treatment Facility (RLWTF)

Dear Mr. Grieggs:

On November 18, 2011, the New Mexico Environment Department (NMED) notified Los Alamos National Laboratory (LANL), by certified mail (copy enclosed), that a complete and current Discharge Permit application for the RLWTF was required to be submitted within 90 days (by February 16, 2011). On December 9, 2011, NMED received your request for a time extension to complete the required Discharge Permit application (copy enclosed). NMED is determined to advance the permitting process in a timely manner. With that in mind, an extension of the deadline for the submission of an application would only prolong and perhaps inhibit the facility's ability to implement and discharge to the proposed Zero Liquid Discharge Evaporative Tanks (ZLD). **NMED therefore denies the time extension for submission of the Discharge Permit application.**

In order to effectively and efficiently process the Discharge Permit application, NMED provided a list of elements which should be included in the submittal. Mr. Robert Beers, with Los Alamos National Laboratory, has requested a meeting with NMED to discuss the specific elements in NMED's November 18, 2011 letter to ensure the application is submitted in its entirety and to prevent further delays in the permitting process. NMED remains committed to working with LANL to clarify the specific elements that must be addressed in the application and is planning to meet with LANL staff within the first two weeks of January. It is anticipated that the outcome of the technical discussion will provide constructive information which will advance the application process.

If you have any questions regarding this matter, please contact Clint Marshall, Acting Program Manager of the Ground Water Pollution Prevention Section, at 505-827-0027 or Jennifer Fullam at 505-827-2909.

Sincerely,

James H. Davis, Ph.D.
Director, Resource Protection Division

JD:JF

enc: Letter from NMED to LANL requiring Discharge Permit application, dated November 18, 2011
Letter from LANL to NMED requesting extension, dated December 9, 2011, NMED

cc: James Bearzi, NMED SWQB (w/o enclosures)
Richard Powell, NMED SWQB (w/o enclosures)
John Kieling, NMED HWB (w/o enclosures)
Steven Yanicak, NMED-DOE-Oversight Bureau (w/o enclosures)
Hai Shen, LASO-EO, Los Alamos National Laboratory, A316, Los Alamos, NM 87545 (w/o enclosures)
Gene Turner, LASO-EO, Los Alamos National Laboratory, A316, Los Alamos, NM 87545 (w/o enclosures)
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Hugh McGovern, TA-55-RLW, Los Alamos National Laboratory, E518, Los Alamos, NM 87545 (w/o enclosures)
Pete Worland, TA-55-RLW, Los Alamos National Laboratory, E518, Los Alamos, NM 87545 (w/o enclosures)
Susan L. McMichael, LC-LESH, Los Alamos National Laboratory, A187, Los Alamos, NM 87545 (w/o enclosures)
Bob Beers, ENV-RCRA, Los Alamos National Laboratory, K490, Los Alamos NM, 87545 (w/ enclosures)

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Environmental Protection Division
Water Quality & RCRA Group (ENV-RCRA)
P.O. Box 1663, Mail Stop M704
Los Alamos, New Mexico 87545
(505) 667-0666/FAX: (505) 667-5224

Date: December 7, 2011
Refer To: ENV-RCRA-11-0270
LAUR: 11-12157

Mr. James H. Davis, Director
Resource Protection Division
New Mexico Environment Department
Harold Runnels Building
1190 St. Francis Drive
P.O. Box 5469
Santa Fe, NM 87502-5469

Dear Mr. Davis:

SUBJECT: **REQUEST FOR AN EXTENSION TO SUBMIT AN UPDATED DISCHARGE PERMIT APPLICATION FOR THE RADIOACTIVE LIQUID WASTE TREATMENT FACILITY (DP-1132)**

The US Department of Energy and Los Alamos National Security, LLC (DOE/LANS) are in receipt of your November 18, 2011, letter (Enclosure 1) requiring a comprehensive and up-to-date Discharge Permit application for the Radioactive Liquid Waste Treatment Facility (RLWTF) within 90 days of the letter's date (by February 16, 2012). For reasons explained below, DOE/LANS request an additional 90 days to prepare a Discharge Permit application for the RLWTF.

DOE/LANS have appreciated working with you and your staff on this matter. The goal is to submit a new Discharge Permit application for the RLWTF that is complete and satisfactory at the time of submittal. Addressing each of the 19 bullets listed in the above-referenced letter will require a significant level of effort by DOE/LANS technical staff. Further, the administrative record identified in the letter will need to be carefully reviewed, and supplemented as appropriate. Meetings between our respective representatives will be needed to ensure the information provided is responsive and focused correctly. For these reasons and because the Laboratory is closed during the holiday season, DOE/LANS respectfully request an extension of the application deadline to May 16, 2012.

Please contact Bob Beers at (505) 667-7969 if you have questions regarding this request.

Sincerely,

A R Grieggs

Anthony R. Grieggs
Group Leader
Water Quality & RCRA Group

: 05287

Enclosures: a/s.

Cy: ✓Hai Shen, LASO-EO, A316
✓Gene Turner, LASO-EO, A316
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Deputy Secretary
JAMES H. DAVIS, Ph.D.
Division Director

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November 18, 2011

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Anthony R. Grieggs, Group Leader
Environmental Protection Division
Water Quality & RCRA (ENV-RCRA)
P.O. Box 1663, Mail Stop K490
Los Alamos, NM 87545

RE: Response to Notice of Intent to Discharge and Discharge Permit Required for Zero Liquid Discharge Tanks, AI 856: PRD20070004 and Updated Application Submittal Required for the Radioactive Liquid Waste Treatment Facility (RLWTF), DP-1132

Dear Mr. Grieggs:

The Ground Water Quality Bureau of the New Mexico Environment Department (NMED) received a Notice of Intent from Los Alamos National Laboratory (LANL) on November 8, 2007 for the facility referenced above. NMED responded in writing with a request for additional information which required LANL to submit 60% plans and specifications for the proposed structure, information pertaining to ground water which may be impacted should a release occur, operation and maintenance procedures for the tanks, information on the potential concentration of the wastestream due to evaporation, and seismic studies for the area in which the tanks are to be constructed. NMED received a response to the requested information from LANL on September 15, 2008 which provided most of the requested information and stated that plans and specifications would be submitted once available. NMED received the plans and specifications for the evaporative tanks on August 19, 2011 along with an addendum dated October 19, 2011. The notice describes LANL's intent to discharge up to 3.6 million gallons annually of treated effluent from the RLWTF to two evaporative concrete tanks equipped with synthetic liners and leak detection systems. The total operating volume of the tanks is approximately 754,036 gallons (100,800 cubic feet). The notice, along with the subsequent information submitted upon NMED's request, satisfies the requirements of Subsection A of 20.6.2.1201 New Mexico Administrative Code (NMAC) of the New Mexico Water Quality Control Commission (WQCC) Regulations, 20.6.2 NMAC. The proposed discharge is located within the boundaries of Los Alamos National Laboratory at

35°51'37"N, 106°16'57"W, approximately 2.5 miles southeast of Los Alamos in Section 23, Township 19N, Range 06E, Los Alamos County.

NMED has reviewed the information provided in accordance with Subsection D of 20.6.2.1201 NMAC and because the proposed evaporative tanks contain an effluent or leachate which may move directly or indirectly into ground water, NMED has determined that a **Discharge Permit is required for the proposed discharge.** NMED considers the proposed evaporative tanks to be a component of the RLWTF, therefore they must be included in the Discharge Permit for this facility.

Any appeal of this determination that a Discharge Permit is required must be made to the New Mexico WQCC within 30 days of receipt of this letter, in accordance with Subsection B of 20.6.2.3112 NMAC. A copy of the WQCC Regulations, 20.6.2 NMAC, is available at http://www.nmcpr.state.nm.us/nmac/_title20/T20C006.htm.

Upon further review of the file for the RLWTF, NMED has noted the following:

- An application for a Discharge Permit was submitted to NMED on April 16, 1996 for the discharge of 41,770 gallons per day of treated low level radioactive wastewater from the RLWTF to a tributary of Mortandad Canyon (referred to as Effluent Canyon).
- The application identified potential upgrades to the system which were to enhance the treatment process and provide alternate discharge capabilities for the facility.
- The treated effluent from the RLWTF is currently authorized to be discharged to an outfall (Outfall 051) under a United States Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Permit (NM0028355) last issued on August 1, 2007, and subsequently modified on July 17, 2007, May 13, 2011, and October 11, 2011.
- Numerous Notices of Planned Changes have been submitted to EPA for treatment system upgrades and facility changes under the NPDES Permit for Outfall 051. Copies of these notices were submitted to NMED on the following dates: April 21, 1998, March 18, 1999, April 3, 2000, June 13, 2000, May 7, 2002, March 14, 2003, April 18, 2003, January 12, 2004, May 14, 2007, May 6, 2008, August 19, 2010, September 16, 2010, and February 23, 2011.
- In addition to the Notices of Planned Changes, numerous notices concerning minor modifications to the facility have been submitted to NMED as addendums to the original Discharge Permit application. NMED received copies of these submissions which were dated March 23, 1999, December 8, 2000, November 8, 2007, August 25, 2010, September 27, 2010, December 15, 2010, and March 22, 2011.
- NMED has engaged in numerous meetings, inspections and written correspondence regarding the RLWTF in order to compile accurate information on the facility in preparation for drafting a Discharge Permit that will accurately reflect the activities conducted at the RLWTF.
- In September 2003, a draft of Discharge Permit DP-1132 was sent to LANL which was subsequently Public Noticed on April 18, 2005, beginning a 30-day comment period.
- On April 27, 2005, in response to multiple requests from interested parties, a second public comment period was granted on the proposed Discharge Permit (extending the comment period for approximately 90 days, until August 4, 2005).

- NMED received comments and requests for a public hearing regarding the draft Discharge Permit from both interested parties and LANL.
- Through continued discussions with LANL, correspondence, site inspections and the above referenced Notice of Intent, it has become apparent that the facility has significantly modified treatment processes, discharge volumes and locations of the discharge when compared to the original application submitted to NMED on August 16, 1996.
- As it pertains to any future Discharge Permits to be issued by the NMED Ground Water Quality Bureau (GWQB), this *facility* has been determined to include the central influent collection lines leading to the RLWTF, all components which are part of the wastewater treatment process and all locations where the treated wastewater is disposed, including all surface discharges as well as non-surface discharges such as evaporative tanks (as described in the above referenced Notice of Intent). This determination by the NMED-GWQB is based on information provided in the original application for a Discharge Permit along with subsequent information provided to NMED by LANL.

Given the extensive and fractured exchange of information concerning this facility, along with changes at the RLWTF that have occurred during the lengthy permitting process and planned future changes, NMED views LANL's August 16, 1996 Discharge Permit application to be inconsistent with the current and planned discharge activities associated with the RLWTF. **Therefore, NMED requires that LANL submit a comprehensive and up-to-date Discharge Permit application for the RLWTF within 90 days of the date of this letter (by February 16, 2011).**

When submitted, the application (copy enclosed) should be completed in its entirety and specifically address the following:

- The estimated volumes, sources (technical area and building) and wastestream characteristics of all influent wastewater that LANL receives, or intends to receive, at the RLWTF.
- A description of the conveyance methods used to transport wastewater to the RLWTF for each source.
- A description of waste characterization and metering systems used to determine influent wastestream characteristics and volumes entering the RLWTF.
- A description of the review and amendment process for LANL's internal Waste Acceptance Criteria (WAC) for all incoming wastewater received at the RLWTF. This should include LANL's process for ensuring the WAC relates to the current treatment technologies and processes.
- A description of operational procedures for receiving wastes from each generator.
- A schematic of the treatment process in its entirety for each wastestream (from collection to final disposal).
- Descriptions, locations, construction materials and sizing for each component of the treatment processes for each type of wastestream being treated at the RLWTF.
- Descriptions, locations and designs for all secondary storage and auxillary emergency units intended to receive, treat or store wastewater received at the facility.
- Proposed processes for the operation, inspection and maintenance for the facility as it pertains to the collection lines, treatment units and effluent storage disposal units.
- Procedures and corrective actions for addressing acute failures at the facility.
- Procedures and corrective actions for addressing long-term maintenance issues at the facility.

- Record drawings for all components of the facility, if available.
- Construction plans and specifications for all components of the facility which are under construction or are proposed for construction.
- A proposed effluent monitoring plan, identifying analytes and sample locations/frequency. The proposal should consider discharge frequencies, incoming waste characteristics and the constituents listed under 20.6.2.3103 NMAC and Subsection WW of 20.6.2.7 NMAC.
- Proposed flow and metering systems used to determine effluent discharge volumes for each of the discharge locations.
- Proposed ground water monitoring locations for ground water sources most likely to be impacted by intentional and unintentional discharges from the RLWTF. The proposal should identify geohydrology of the potentially impacted areas, existing monitoring well locations and construction.
- Actions which LANL would implement should partial or full closure of the facility occur.
- A scaled facility plan showing the facility's components including influent collection lines, storage units, major treatment units and disposal units.
- All other information sought in NMED's application for Discharge Permit Sections A through C. Please note that for the purposes of public notification, the "discharge site" as it relates to this facility encompasses the central collection system lines, the treatment and storage facilities and all discharge locations for the treated effluent.

When submitting the comprehensive and up-to-date Discharge Permit application, you must complete and submit three copies along with the $100 filing fee.

If you have any questions, please contact either Jennifer Fullam at (505) 827-2909 or Clint Marshall, Acting Program Manager of the Ground Water Pollution Prevention Section, at (505) 827-0027.

Sincerely,

James H. Davis, Ph.D.
Director, Resource Protection Division

JD:JF

Enc: Applying for a Discharge Permit: General Information
Discharge Permit Application

cc: Robert Italiano, District Manager, NMED District II (w/o enclosures)
NMED Santa Fe Field Office (w/o enclosures)
DP Required File (w/o enclosures)
James Bearzi, NMED SWQB (w/o enclosures)
Richard Powell, NMED SWQB (w/o enclosures)
John Kieling, NMED HWB (w/o enclosures)
Steven Yanicak, NMED-DOE-Oversight Bureau (w/o enclosures)