

ATTACHMENTS
Documents Provided by Intel

Intel provided most of the documents in this attachment in a submittal to the NMED dated December 31, 2003. These documents are summarized in the cover page of this submittal (next page). The documents listed below were provided to the NMED after the December 31, 2003 submittal. These documents form the final group in this attachment and can be found after Item J referenced in the December 31, 2003 submittal cover page:

1. Email from Debra McElroy of NMED to Robert Samaniego of NMED, forwarding an email from Mindy Koch of Intel, dated June 21, 2004
2. Email from Mindy Koch of Intel, dated September 15, 2004
3. Purchase documents for Fab 11 North, 6/7/00 to 7/31/00 (13 documents)
4. Material Data Safety Sheets for Megaposit 501 and Megaposit 510A



To: Debra McElroy
From: Mindy Koch
Subject: Additional documents for review
Date: 12/31/03

Per your request for additional documents to complete the analysis of questions raised by two former employees, enclosed please find the following:

- A. Report titled "Summary Report for Ambient Air Monitoring"; although "draft" was not removed from the document, this was the final version of this report generated on 1/28/03.
- B. Letter to the Corrales Air Quality Study Task Force Members from Mindy Koch, dated April 24, 2003; this is the publication of the results from the above study.
- C. Report titled "Fab 11 CUB Scrubber Plume Report"; this appears to be the same report that NMED already has. The intern conducting this project was not able to complete the report before his assignment ended.
- D. A report on the Fab 12 CUB scrubber testing from Radian International; this is the study that was referenced by the intern in the project above.
- E. A report titled "CUB Ammonia Scrubber"; this appears to be the same report that NMED already has, however the bottom of the first page is intact and pages 4 and 5 were not duplicated. The document was generated for an internal discussion to review options for eliminating the visible plume and potential for odors.
- F. A presentation titled "F11S 6/2/00 Odor Evacuation Update"; this is the presentation that was made to management with the investigation outcomes and recommendations. The activated carbon filters suggested in the recommendations were installed. Changes were not made to water treatment given the uncertainty of water treatment as the source of the odor and the safety/environmental considerations for alternative treatment.
- G. A document titled "Project Scope of Work, PR-2-0091, CUB Ammonia Scrubber"; this is a complete rev of the document NMED already has and was used for the project estimate. The attachments provided to NMED appeared to be a capital projects lists and portions of the estimate details, neither of which further explain the project. If additional information is needed please let me know and I will obtain the construction documents for your review.
- H. Four reports titled "ERT Postmortem, Emergency Response Team Incident"; these are the reports of CUB evacuations between January 1, 2000 and December 31, 2003. I have also included a summary of evacuations that occurred due to on property and off property events. This question was asked during one of the Intel Technical meetings to answer community questions about Intel that were held in February and March.
- I. An Excel spreadsheet with cooling tower sampling results
- J. Letter of submittal to NMED from Carrie Weitz, dated November 15, 2000 and an excerpt of the Stack Test Submittal for Thermal Oxidizer HAP testing conducted in Q3 2000; this included the original results obtained for ethanol and methanol and determination that the results were erroneous.

If you have any questions, please contact me at 505-794-4908.

Rev 1

INTEL CORPORATION
ENVIRONMENTAL HEALTH AND SAFETY DEPARTMENT

*4-5 pages
+
back up*

**SUMMARY REPORT FOR
AMBIENT AIR MONITORING**

PREPARED BY:

**GEORGE EVANS
KELLEY NELSON**

JANUARY 2003

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1.0 Executive Summary

This report presents results from a 3-month monitoring program performed by Intel's Environmental Health and Safety Department from October 2002 to December 2002 that collected and analyzed ambient air samples. The program was carried out in an effort to validate and augment existing boundary and community sampling data. Upwind and downwind ambient analyte concentrations were evaluated at Intel's property boundaries to determine background concentrations of ambient organics and determine if upwind concentrations are statistically different than downwind concentrations.

Sampling was performed using a highly sensitive thermal desorption method developed by Prism Analytical. The data set included seven sampling events with both upwind and downwind points, for a total of twenty-eight samples. Prism Analytical was engaged to analyze the sampling data as they have experience with analysis of samples from ambient air in urban areas, suburban areas, and indoor air environments.

Prism Analytical also performed an independent assessment, with a focus on data interpretation excluding sample placement or environmental conditions. The data was compared to applicable regulatory standards that included NIOSH -TWA₈ and EPA -IRIS inhalation references. All of the listed chemicals were detected at part per billion levels and when compared to established standards, were magnitudes of order below health effect levels. Data analysis as noted by Prism illustrates an environment that is typical of air that surrounds urban populations. Several key compounds being pervasive in the environment are characteristic of microbial metabolites, the presence of gasoline stations, dry cleaners, manufacturing, landscaping, gardening, and lawn maintenance. As stated in Prism's report, "No chemical was detected which exceeded, or even approached, the maximum allowable life time levels."

In addition to the data analysis provided by Prism, a statistical analysis using the paired t-test was performed and indicated that there was no statistical difference between upwind of Intel and downwind of Intel data. This suggests that emissions from Intel do not significantly contribute to the ambient organic levels within Intel's property boundary.

2.0 Ambient Air Monitoring

Ambient air monitoring was performed on Intel's property boundary from October thru December 2002. The purpose of the sampling was to determine the levels of ambient organics and whether there was any statistical difference between upwind and downwind analyte concentrations.

2.1 Sampling Strategy and Locations

Sampling represented ambient conditions upwind and downwind of Intel, at property boundaries. The selected sample points were determined on the day of sampling and sample placement was based on wind direction. Both upwind and downwind samples were collected simultaneously and sample events occurred at various times including day, night, weekday, weekend, etc. Appendix D details the location, time of day, and general wind direction during each sampling event. Sample points effectively covered the four major compass directions (see Figure 1). All sites were at Intel's property boundary adjacent to communities and thoroughfares.

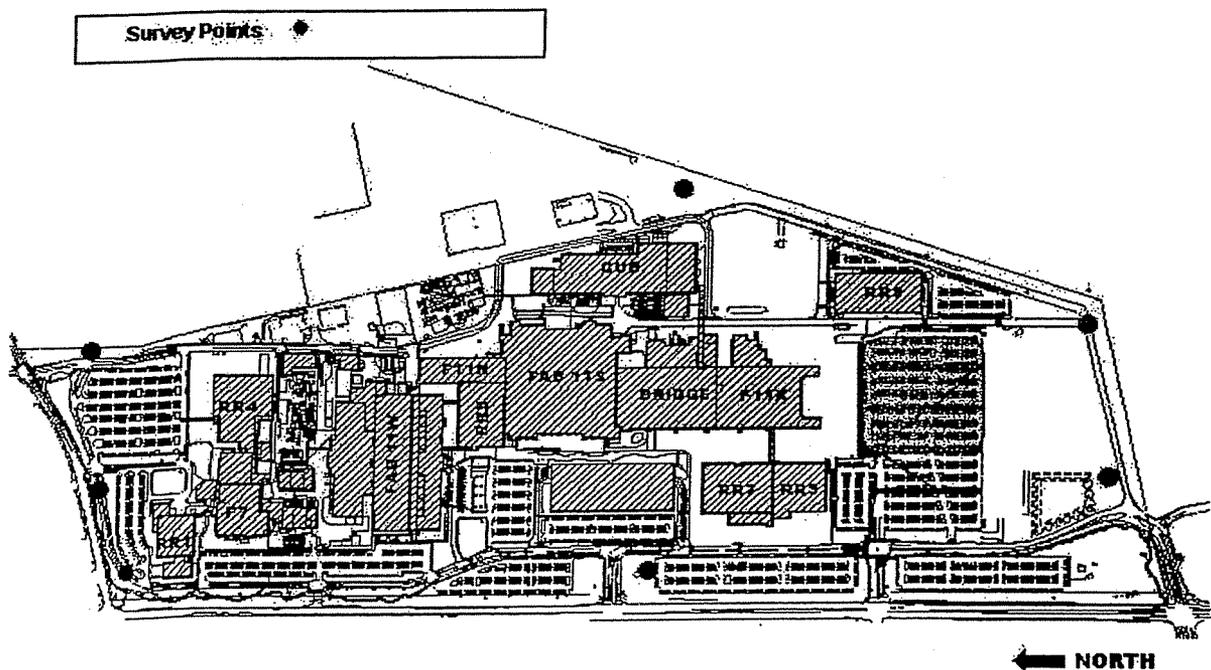


Figure 1. Ambient Air Sampling Locations at Intel's Boundary

2.2 Collection Methods

Sampling and analysis incorporated a thermal desorption method developed by Prism Analytical (As002-HS). The As002-HS method included the use of carbon filled thermal desorption tubes for sample collection and retention. The sampling method used two side-by-side samples with a target and maximum sampling volume of 40 liters, drawn over a period of four hours. Upwind and downwind sampling was performed simultaneously.

The As002-HS analytical method is highly sensitive, using GC mass spectrometry and infrared analytical techniques. Detection limits are in the 5-10 ng (0.005-0.010 ug) range, allowing for detection of ambient air organic constituents in what is normally called clean air (low ppb range). Appendix A contains Prism's analytical method along with a complete list of the chemicals that are analyzed.

2.3 Summary of Analytical Results and Statistical Analysis

Analytical results are presented in Appendix B. No chemical that was detected exceeded or even approached the maximum exposure limits. Figure 2 shows upwind and downwind concentrations in parts per billion (ppb) for all seven sampling events. As evidenced by the graph, the majority of the data is below 10 ppb. Specifically, the mean concentrations of upwind and downwind data are 0.40 ppb and 0.39 ppb, respectively. There are several outliers present in Figure 2, which are total hydrocarbons (calculated as hexane), acetone, benzene, toluene, 2-propanol, and hexamethylcyclotrioxane. These outliers are addressed in the discussion.

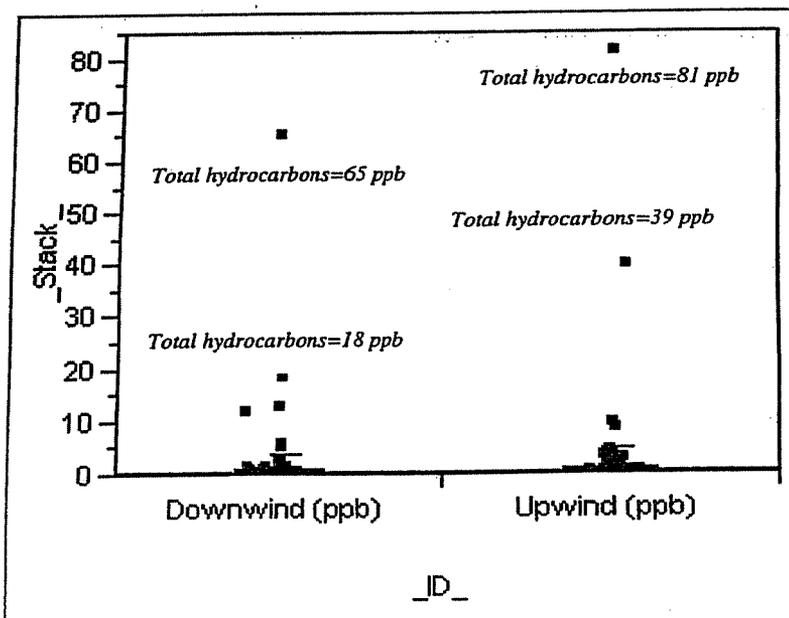


Figure 2. Concentrations of Upwind and Downwind Data

A statistical analysis was performed on air sampling data to determine if upwind and downwind sample points provided equivalent data, on average. A paired t-test was chosen because experimental data was collected at similar times at different points and because the purpose of a t-test is to test for the equality of averages. Figure 3 shows a normal distribution plot and a summary of the t-test statistics. For analytes that were below detection limits of the method, the data was not included in the statistical analysis. However, if they had been included in analysis, it would have only strengthened the conclusion. The conclusion of the t-test analysis was that there is no statistical difference between upwind and downwind ambient analyte concentration.

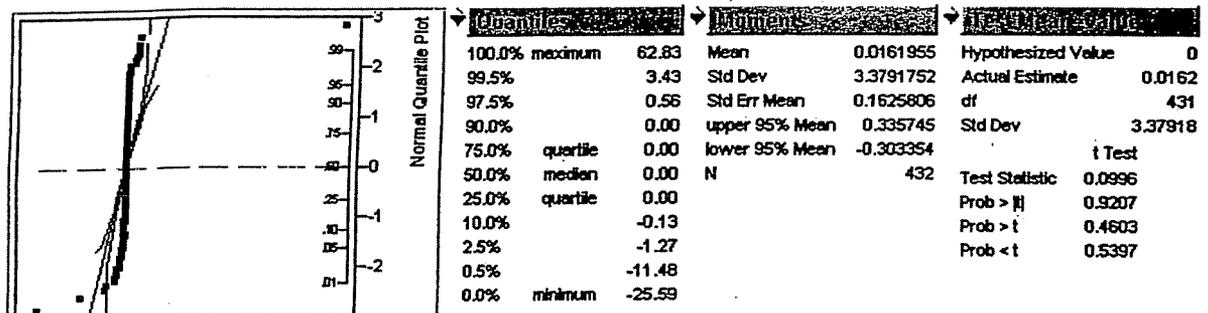


Figure 3. Summary of t-test Statistics

3.0 Discussion and Recommendations

An independent data assessment was performed by Prism Analytical. The data was compared to applicable regulatory standards including NIOSH -TWA₈ and EPA - IRIS inhalation references. Prism's findings are noted in Appendix C. Data analysis describes a breathing air environment that typifies that of an urban populace. The independent assessment notes that several of the key compounds are characteristic of microbial metabolites, the presence of gasoline stations, painting facilities, dry cleaners, manufacturing, landscaping, gardening, and lawn maintenance.

Several chemicals were noted as outliers in the sampling data but were still found at extremely low ppb levels. These included acetone, benzene, toluene, 2-propanol, total hydrocarbons and hexamethylcyclotrioxane. Sample placement may have had a significant impact on the noted sample results. For example, several of the samples demonstrated low-level gasoline byproducts to include toluene and benzene. Gasoline stations are located to north and south of Intel (two to the north of Intel and one to the south of Intel's property). Highway 528 directly west of Intel has heavy vehicle traffic with approximately 61,000 vehicles passing by per day (NM Highway Department, <http://nmshtd.state.nm.us>). A major automotive sales distributor, auto body repair operation, two automotive repair shops, and an oil lube facility are located directly south of Intel's property boundary.

Total hydrocarbons were found in all of the noted samples. The adjacent farming community, vehicle traffic, and the following all contribute to area total hydrocarbon emissions. The north property boundary is proximate to several restaurants, Sandoval County Water treatment plant and associated support shops, and a crematorium. To the west are three hotels, several restaurants, and an urgent care treatment center.

Several of the noted chemicals including 2-propanol, are reported in Intel's emissions report to NMED. These chemicals are also found as biological degradation byproducts or are used by several adjacent businesses. For instance, an urgent care center is directly west of Intel.

A statistical analysis using a paired t-test was performed and indicated that there was no statistical difference between upwind of Intel and downwind of Intel data. Thus, there is no data that suggests that emissions from Intel significantly contribute to the ambient organic levels within Intel's property boundary.

It is recommended that sampling continue year-round to capture impacts due to weather variations, and to future substantiate the noted data. It is also suggested that additional sampling using modeling data for sample placement be performed. No recommendations are forwarded from the community standpoint, as the data does not suggest health effect levels from any of the noted analytes.

Appendix A: Analytical Methods

Analytes analyzed for using AS002-ES method

ANALYTE	CAS #
Acetone	67-64-1
2-Heptanone	110-43-0
Butyl Acetate	123-86-4
Carbon Disulfide	75-15-0
Cyclohexanone	108-94-1
Ethanol	64-17-5
Ethyl Lactate	687-47-8
IPA - Treated And un	67-63-0
Methanol	67-56-1
Methyl n-amyl ketone (2-heptanone)	110-43-0
n-Butyl Acetate	123-86-4
Benzene	71-43-2
Dichloroethylene	540-59-0
Toluene	108-88-3
Xylene	95-47-6
2-Methyl Pentane	n/a
Carbon Tetrafluoride	75-73-0
1,2-Dichloroethylene	540-59-0
2 ethyl 1 hexanol; 1 butoxy 2 propanol; butylated hydroxytoluene	72968-27-5
Acetic Acid	64-19-7
Ammonia	7664-41-7
Boron Trichloride	10294-34-5
Boron Trifluoride	7637 07 2
BTBAS (BIS TERT BUTYL SILANE)	n/a
Calcium Hydroxide	1305-62-0
Carbonyl Sulfide	463-58-1
Chlorine	7782-50-5
Chromium Trioxide (precursor to Chromium Metal)	1333-83-0
Cyanide Compounds	n/a
Dichlorosilane	4109-96-0
Ethylene Glycol	107-21-1
Fluorine	7782-41-4
hexamethylcyclotrisiloxane	68583-50-6
Hexane	110-54-3
HMDS HEXAMETHYLDISILAZANE	999-97-3
Hydrochloric Acid	7647-01-0
Hydrofluoric Acid	7664-39-3
Hydrogen Bromide	10035-10-6
Hydrogen Peroxide	7722-84-1
Methylene Chloride	75-09-2
MIPA (MONO ISOPROPYLAMINE)	n/a
Nitric Acid	7697-37-2
NMP N-METHYLPYROLIDONE	452
Oxalic Acid	144-62-7
PGMEA PROPYLEGLYCOLMONOMETHYLEETHERACETATE	108-65-6
Phosphoric Acid	7664-38-2
Potassium Hydroxide	1310-58-3
Silicon Tetrahydride (Silane)	7083-62-5
Sodium Hydroxide	1310-73-2
Sulfolane 126-33-0	126-33-0
Sulfur Hexafluoride	2551-62-4
Sulfuric Acid	7664-93-9
TEOS tetraethylorthosilicate (see compound below)	n/a
Tetraethylorthosilicate	n/a
Trans 1,2-Dichloroethylene	156-60-5
Tungsten Hexafluoride	7783-82-6

TDT Air Scan® Instructions for AS002 Sampling Tubes

1. Do not remove the TDT Air Scan® tube from the capsule until you are ready to collect the sample.
2. Use the following guidelines to determine the total volume of air to be sampled:

Environment	Suggested Total Volume
Clean environment (Office areas or areas with high air turnover rate)	20 - 40 L
Noticeable odors or areas with low turnover rate	5 - 20 L
Production facility where high levels of contaminants are expected.	0.5 to 3 L
Unusual Environments	Contact Prism before sampling

3. Using the total volume to be collected (from #2 above) and the sampling time desired, determine what sampling flow rate to use. The typical flow rate through an TDT Air Scan® tube is 100 ml/min or less however, depending upon the vacuum pump used, flow rates as high as 200 ml/min can be used. Use of flow rates greater than 200 ml/min is not recommended.
4. Determine the sampling configuration to use. Typical configurations examples are given below:
 - For Personal monitoring
TDT Air Scan® tube → transfer line to monitoring pump → monitoring pump (vacuum)
 - For Static monitoring
TDT Air Scan® tube → transfer line to flow meter (or MFC) → flow meter → transfer line to vacuum pump → diaphragm or monitoring pump
5. Collect the Sample
 - a. Follow the directions on the capsule to break the capsule. Remove the TDT Air Scan® tube from the capsule. Record the number on the storage vial that accompanied the capsule. Since Prism's Quality Control System is based on tube lot number, it is important that each tube is returned to the storage vial that accompanied the capsule.
 - b. Insert the TDT Air Scan® tube into the sampling device. Be sure flow arrow on the tube is pointed in the direction of the air flow (toward the vacuum pump).
 - c. Draw the air sample through the TDT Air Scan® tube. If a flow meter/diaphragm pump combination is used, periodically check and adjust the flow meter as necessary throughout the sampling period.

6. Post Sampling

- a. Remove the TDT Air Scan® tube from the sampling device, place the red end caps onto the ends of the tube, and place the tube in the storage vial that accompanied the capsule. To provide the maximum protection during shipment, load the tube into the storage vial in the following configuration:

Bottom of vial – one section of rubber tubing – plug of glass wool – tube – cap.

Screw the cap tightly onto the storage vial. If you wish to attach your own label, put it on the storage vial. Do not attach any labels to the TDT Air Scan® tube.

- b. Record all sampling information that you need for your study together with the TDT Air Scan® tube ID from the storage vial.
- c. Fill out the Chain of Custody (COC) supplied with the TDT Air Scan® tube. **Be sure to record the tubes and the total volume of air sampled in the appropriate space.**

The Chain of Custody (COC) is an integral part of Prism's QA/QC program. It is included with all sample submissions. It is the mechanism through which Prism receives and tracks samples, performs requested analysis(es), records data, and releases data to the client.

When submitting samples, fill out the COC with the following information:

① Client information box

Client Company Name: include name of section, building, person, etc.

Address: address to which analytical results are to be sent.

Bill to: provide this information if different from above; be sure to include PO number

② Project information box

This information should also appear on the sample labels.

Project/Number: specific project name, identification, or number

Location: general location, town, building, etc.

Phone: phone number in case there are specific questions about the samples

Fax: provide if appropriate

Sampled by: person who acquired the sample or supervised the sampling

How preserved: how sample was handled from sample site to lab, for air tubes enter storage vial.

③ Sample information box

Prism Lab ID #: Leave blank

Item #: sequential numbering of samples delivered to lab

Sample identification: unique number or name of sample, be sure to include tube ID listed on the storage vial.

Date Collected: the date the sample was collected

Sample type: enter "air"

Total volume of air: enter volume

Requested analysis: Enter AS002. Include in this box any special notes, such as "Tax results", etc.

④ Signature box

Relinquished by (signature): submitter's signature, date, and time

Received by: leave blank

- d. Retain the pink copy of the COC. Return the white and yellow copies of the COC along with the tubes to Prism Analytical.

7. Ship TDT Air Scan® tubes overnight to:
Prism Analytical Technologies, Inc.
1200 N. Fancher
Mt. Pleasant, MI 48858
ATTN: Air Scan Dept.

Do not ship tubes in chilled containers. If immediate shipment is not possible, store in a solvent-free area where the temperature will not exceed 25°C (77°F). Refrigeration is not recommended. Shipment of tubes on a Friday is not recommended because delivery will not take place until the following Monday. Storage conditions and environment cannot be controlled in the interim and sample integrity may be compromised. For the same reason, ground shipment of tubes is not recommended.

Sampling Notes

- A. If desired, a trip blank or a tube blank can be included with each sampling event. A tube blank is never removed from the capsule. To generate a trip blank, the tube is removed from the capsule, capped, and placed in a storage vial after sampling is complete. Both tube blanks and trip blanks accompany the samples through delivery to PATI. The charge for blanks is half that of samples provided they are identified as such on the Chain of Custody.
- B. It is recommended that unused TDT Air Scan® tubes be stored in a solvent-free area where the temperature will not exceed 25°C (77°F). Refrigeration is not recommended.
- C. TDT Air Scan® tubes are not intended for use in sampling air with high concentrations of mineral acids or where humidity exceeds 90%.
- D. TDT Air Scan® is designed to be used as a screening method. Its utility lies in its ability to detect a wide range of compounds. Once contaminants have been identified using TDT Air Scan®, further quantitation using methods specific for those contaminants is recommended.
- E. TDT Air Scan® tubes will be replaced at no charge to the customer if the data is lost due to an instrument malfunction during analysis or other fault of PATI. However, PATI cannot be held responsible for consequential damages.

If you would like additional information or have any questions please contact:

Prism Analytical Technologies, Inc. Telephone 989-772-5088
1200 N. Fancher Fax 989-772-5870
Mt. Pleasant, MI 48858 E-mail prism@pati-air.com

Appendix B: Analytical Results

Analyte	Upwind (ng/L)	Downwind (ng/L)	MW	Upwind (mg/m3)	Down (mg/m3)	Upwind (ppb)	Downwind (ppb)
Limonene	0	0	136	0	0	0	0
Limonene	0	0	136	0	0	0	0
Limonene	0	0	136	0	0	0	0
Octanal	0	0	0	0	0	#DIV/0!	#DIV/0!
Octanal	0	0	0	0	0	#DIV/0!	#DIV/0!
Octanal	0	0	0	0	0	#DIV/0!	#DIV/0!
Octanal	0	0	0	0	0	#DIV/0!	#DIV/0!
Octanal	0	0	0	0	0	#DIV/0!	#DIV/0!
Octanal	0	0	0	0	0	#DIV/0!	#DIV/0!
Octanal	0	0	0	0	0	#DIV/0!	#DIV/0!
Phenol	0	0	94	0	0	0	0
Phenol	0	0	94	0	0	0	0
Phenol	0	0	94	0	0	0	0
Phenol	0	0	94	0	0	0	0
Phenol	0	0	94	0	0	0	0
Phenol	0	0	94	0	0	0	0
Phenol	11	0	94	0.011	0	2.861170213	0
tert-Butanol	0	0	0	0	0	0	0
tert-Butanol	0	0	0	0	0	0	0
tert-Butanol	0	0	0	0	0	0	0
tert-Butanol	0	0	0	0	0	0	0
tert-Butanol	0	0	0	0	0	0	0
tert-Butanol	0	0	0	0	0	0	0
Tetrachloroethane	0	0	167.8	0	0	0	0
Tetrachloroethane	0	0	167.8	0	0	0	0
Tetrachloroethane	0	1.1	167.8	0	0.0011	0	0.160280095
Tetrachloroethane	0	0	167.8	0	0	0	0
Tetrachloroethane	0	0	167.8	0	0	0	0
Tetrachloroethane	0	0	167.8	0	0	0	0
Tetrachloroethane	0	8.7	167.8	0	0.0087	0	1.267689845
Heptanal	0	0	114.1	0	0	0	0
Heptanal	0	0	114.1	0	0	0	0
Heptanal	0.3	0	114.1	0.0003	0	0.064285714	0
Heptanal	0	0	114.1	0	0	0	0
Heptanal	0	0	114.1	0	0	0	0
Heptanal	0	0	114.1	0	0	0	0
Hexamethylcyclotrisiloxane	0	0	222.47	0	0	0	0
Hexamethylcyclotrisiloxane	0	0	222.47	0	0	0	0
Hexamethylcyclotrisiloxane	0.5	3.8	222.47	0.0005	0.0038	0.054951225	0.417629343
Hexamethylcyclotrisiloxane	0.2	0	222.47	0.0002	0	0.021980482	0
Hexamethylcyclotrisiloxane	29.5	0	222.47	0.0295	0	3.242122533	0
Hexamethylcyclotrisiloxane	0	0	222.47	0	0	0	0
Hexamethylcyclotrisiloxane	0	0	120	0	0	0	0
n-Propylbenzene	0	0	120	0	0	0	0
n-Propylbenzene	0	0	120	0	0	0	0
n-Propylbenzene	0.2	0.3	120	0.0002	0.0003	0.04075	0.061125
n-Propylbenzene	0	0	120	0	0	0	0
n-Propylbenzene	0	0	120	0	0	0	0
n-Propylbenzene	0	0.3	120	0	0.0003	0	0.061125
2-hexanone	0	0	100	0	0	0	0
2-hexanone	0	0	100	0	0	0	0
2-hexanone	0.3	0.4	100	0.0003	0.0004	0.07335	0.0978
2-hexanone	0	0	100	0	0	0	0
2-hexanone	0	0	100	0	0	0	0
Carbon Tetrachloride	0	0	152	0	0	0	0
Carbon Tetrachloride	0	0	152	0	0	0	0
Carbon Tetrachloride	0.3	0	152	0.0003	0	0.048256579	0
Carbon Tetrachloride	0	0	152	0	0	0	0
Carbon Tetrachloride	0.3	0	152	0.0003	0	0.048256579	0
1,3,5 Trimethylbenzene	0	0	120	0	0	0	0
1,3,5 Trimethylbenzene	0	0	120	0	0	0	0
1,3,5 Trimethylbenzene	0.4	0.5	120	0.0004	0.0005	0.0815	0.101875
1,3,5 Trimethylbenzene	0	0	120	0	0	0	0
1,3,5 Trimethylbenzene	0	0	120	0	0	0	0
1,3,5 Trimethylbenzene	0	0.4	120	0	0.0004	0	0.0815
4-Methyloctane	0	0	128	0	0	0	0
4-Methyloctane	0.1	0.2	128	0.0001	0.0002	0.019101563	0.038203125
4-Methyloctane	0	0	128	0	0	0	0
4-Methyloctane	0.4	0.5	128	0.0004	0.0005	0.07640625	0.095507813
4-Methyloctane	0	2.5	128	0	0.0025	0	0.477539063
4-Methyloctane	0	0	128	0	0	0	0

Analyte	Upwind (ng/L)	Downwind (ng/L) MW	Upwind (mg/m3)	Down (mg/m3)	Upwind (ppb)	Downwind (ppb)
4-Methyloctane	0	0	128	0	0	0
Methyl ethyl ketone (MEK)	0	0	72	0	0	0
Methyl ethyl ketone (MEK)	0	0	72	0	0	0
Methyl ethyl ketone (MEK)	0	1	72	0	0.001	0.339583333
Methyl ethyl ketone (MEK)	0.4	0.3	72	0.0004	0.0003	0.135833333
Methyl ethyl ketone (MEK)	0	0	72	0	0	0
Methyl ethyl ketone (MEK)	0	0	72	0	0	0
Methyl ethyl ketone (MEK)	0	0	72	0	0	0
Methyl ethyl ketone (MEK)	0	0	72	0	0	0
a Pinene	0	0	136	0	0	0
a Pinene	0	0	136	0	0	0
a Pinene	0	0	136	0	0	0
a Pinene	0.5	0.3	136	0.0005	0.0003	0.089889706
a Pinene	0	0	136	0	0	0
a Pinene	0	0	136	0	0	0
a Pinene	0	0	136	0	0	0
a Pinene	0	0	136	0	0	0
Naphthalene	0	0	128	0	0	0
Naphthalene	0	0	128	0	0	0
Naphthalene	0	0	128	0	0	0
Naphthalene	0.5	0.5	128	0.0005	0.0005	0.095507813
Naphthalene	0	0	128	0	0	0
Naphthalene	0	0	128	0	0	0
Naphthalene	0.5	0.4	128	0.0005	0.0004	0.095507813
Naphthalene	0	0	90.912	0	0	0
dimethylhexane	0	0	90.912	0	0	0
dimethylhexane	0	0	90.912	0	0	0
dimethylhexane	0.6	0.6	90.912	0.0006	0.0006	0.161364836
dimethylhexane	0	0	90.912	0	0	0
dimethylhexane	0	0	90.912	0	0	0
dimethylhexane	0	0.7	90.912	0	0.0007	0.188258976
dimethylhexane	0	0	120.91	0	0	0
Dichlorodifluoromethane	0	0	120.91	0	0	0
Dichlorodifluoromethane	0	0	120.91	0	0	0
Dichlorodifluoromethane	0.8	0.9	120.91	0.0008	0.0009	0.16177322
Dichlorodifluoromethane	0	0	120.91	0	0	0
Dichlorodifluoromethane	0	0	120.91	0	0	0
Dichlorodifluoromethane	1.2	0.9	120.91	0.0012	0.0009	0.24265983
Dichlorodifluoromethane	0	0	120	0	0	0
Ethylmethylbenzene	0	0	120	0	0	0
Ethylmethylbenzene	0	0	120	0	0	0
Ethylmethylbenzene	0	0	120	0	0	0
Ethylmethylbenzene	4.5	0	120	0.0045	0	0.916875
Ethylmethylbenzene	0	0	120	0	0	0
Ethylmethylbenzene	0.8	2	120	0.0008	0.002	0.163
Ethylmethylbenzene	0	0	106	0	0	0
Ethylbenzene	0	0	106	0	0	0
Ethylbenzene	0	0	106	0	0	0
Ethylbenzene	0	0	106	0	0	0
Ethylbenzene	0	0	106	0	0	0
Ethylbenzene	0.5	0	106	0.0005	0	0.115330189
Ethylbenzene	0.2	1.3	106	0.0002	0.0013	0.046132075
Ethylbenzene	0	0	86	0	0	0
Pentanol	0	0	86	0	0	0
Pentanol	0.1	4	86	0.0001	0.004	0.028430233
Pentanol	0	0	86	0	0	0
Pentanol	0	0	86	0	0	0
Pentanol	0	0	86	0	0	0
Pentanol	0	0	86	0	0	0
o-Xylene	0	0	106	0	0	0
o-Xylene	0	0	106	0	0	0
o-Xylene	0	0	106	0	0	0
o-Xylene	0	0	106	0	0	0
o-Xylene	0	0	106	0	0	0
o-Xylene	0.5	0	106	0.0005	0	0.115330189
o-Xylene	0.2	1.6	106	0.0002	0.0016	0.046132075
o-Xylene	0	0	120	0	0	0
1,2,4 Trimethylbenzene	0	0	120	0	0	0
1,2,4 Trimethylbenzene	0	0	120	0	0	0
1,2,4 Trimethylbenzene	0	0	120	0	0	0
1,2,4 Trimethylbenzene	0	0	120	0	0	0
1,2,4 Trimethylbenzene	0	0	120	0	0	0
1,2,4 Trimethylbenzene	0.9	0	120	0.0009	0	0.183375
1,2,4 Trimethylbenzene	0.9	1.8	120	0.0009	0.0018	0.183375
1,2,4 Trimethylbenzene	0	0	84	0	0	0
Methylene Chloride	0.23	0.24	84	0.00023	0.00024	0.066946429
Methylene Chloride	0	0	84	0	0	0
Methylene Chloride	0	0	84	0	0	0
Methylene Chloride	0	0	84	0	0	0
Methylene Chloride	0	0	84	0	0	0
Methylene Chloride	0	1.5	84	0	0.0015	0.436607143
Methylene Chloride	0	0	84	0	0	0
Cyclohexane	0	0	0	0	0	0

Analyte	Upwind (ng/L)	Downwind (ng/L) MW	Upwind (mg/m3)	Down (mg/m3)	Upwind (ppb)	Downwind (ppb)	
Cyclohexane	0	0	0	0	0	0	
Cyclohexane	0	0	0	0	0	0	
Cyclohexane	0	0	0	0	0	0	
Cyclohexane	0	0	0	0	0	0	
Cyclohexane	0	0	0	0	0	0	
Cyclohexane	0	0	0	0	0	0	
c7	0	0	0	0	0	0	
c7	0	0	0	0	0	0	
c7	0	0	0	0	0	0	
c7	0	0	0	0	0	0	
c7	0	0	0	0	0	0	
c7	0	0	0	0	0	0	
Trichlorofluoromethane	0	0	136	0	0	0	
Trichlorofluoromethane	0	0	136	0	0	0	
Trichlorofluoromethane	0	0	136	0	0	0	
Trichlorofluoromethane	0	0	136	0	0	0	
Trichlorofluoromethane	8.5	9	136	0.0085	0.009	1.528125	1.818014706
Trichlorofluoromethane	1.2	1.4	136	0.0012	0.0014	0.215735294	0.251691176
Trichlorofluoromethane	0	0	136	0	0	0	0
Benzene	0	0	78	0	0	0	0
Benzene	0	0	78	0	0	0	0
Benzene	0	0	78	0	0	0	0
Benzene	0	0	78	0	0	0	0
Benzene	1.1	0.6	78	0.0011	0.0006	0.344807692	0.188076923
Benzene	0.4	4.5	78	0.0004	0.0045	0.125384615	1.410578923
Acetone	0	0	58	0	0	0	0
Acetone	0	0	58	0	0	0	0
Acetone	0	0	58	0	0	0	0
Acetone	0	0	58	0	0	0	0
Acetone	22.5	28	58	0.0225	0.028	9.484913793	11.80344828
Acetone	0	2.2	58	0	0.0022	0	0.927413793
Acetone	1.1	3.5	58	0.0011	0.0035	0.463706897	1.475431034
Acetone	0	0	84	0	0	0	0
Methylcyclopentane	0	0	84	0	0	0	0
Methylcyclopentane	0	0	84	0	0	0	0
Methylcyclopentane	0	0	84	0	0	0	0
Methylcyclopentane	0	0	84	0	0	0	0
Methylcyclopentane	0.2	0	84	0.0002	0	0.058214286	0
Methylcyclopentane	1.2	0.8	84	0.0012	0.0008	0.349285714	0.232857143
Benzo[h]azole	0	0	0	0	0	0	0
Benzo[h]azole	0	0	0	0	0	0	0
Benzo[h]azole	0	0	0	0	0	0	0
Benzo[h]azole	0	0	0	0	0	0	0
Benzo[h]azole	0	0	0	0	0	0	0
Benzo[h]azole	0	0	0	0	0	0	0
Benzo[h]azole	0	0	0	0	0	0	0
2,3-Dimethylbutane	0	0	0	0	0	0	0
2,3-Dimethylbutane	0	0	0	0	0	0	0
2,3-Dimethylbutane	0	0	0	0	0	0	0
2,3-Dimethylbutane	0	0	0	0	0	0	0
2,3-Dimethylbutane	0	0	0	0	0	0	0
2,3-Dimethylbutane	0	0	0	0	0	0	0
2,3-Dimethylbutane	0	0	0	0	0	0	0
m,p-Xylene	0	0	106	0	0	0	0
m,p-Xylene	0	0	106	0	0	0	0
m,p-Xylene	0	0	106	0	0	0	0
m,p-Xylene	0	0	106	0	0	0	0
m,p-Xylene	1.5	0.3	106	0.0015	0.0003	0.345990566	0.069198113
m,p-Xylene	0.6	4.3	106	0.0006	0.0043	0.138396226	0.991839623
m,p-Xylene	0	0	86	0	0	0	0
C6	0	0	86	0	0	0	0
C6	0	0	86	0	0	0	0
C6	0	0	86	0	0	0	0
C6	12	2.5	86	0.012	0.0025	3.411627907	0.710755814
C6	0.3	0.7	86	0.0003	0.0007	0.085290698	0.199011628
C6	5.4	9.4	86	0.0054	0.0094	1.535232558	2.67244186
Toluene	0	0	92	0	0	0	0
Toluene	0	0	92	0	0	0	0
Toluene	0	0	92	0	0	0	0
Toluene	0	0	92	0	0	0	0
Toluene	8	0	92	0.008	0	2.126086957	0
Toluene	2.6	0.6	92	0.0026	0.0006	0.690978261	0.159456522
Toluene	1	11	92	0.001	0.011	0.26576087	2.923369565
Methyl Methacrylate	0	0	86	0	0	0	0
Methyl Methacrylate	0	0	86	0	0	0	0
Methyl Methacrylate	0	0	86	0	0	0	0

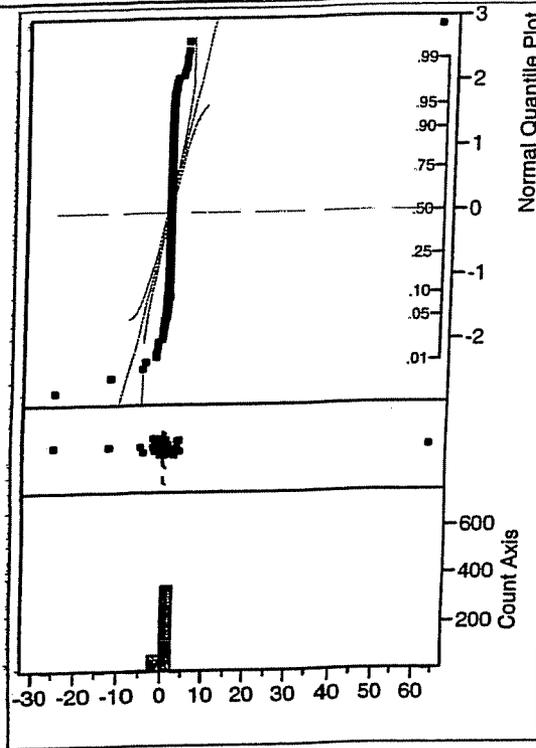
Analyte	Upwind (ng/L)	Downwind (ng/L) MW	Upwind (mg/m3)	Down (mg/m3)	Upwind (ppb)	Downwind (ppb)
Methyl Methacrylate	0	0	86	0	0	0
Methyl Methacrylate	29.5	19	86	0.0295	0.019	8.386918605
Methyl Methacrylate	2.5	20	86	0.0025	0.02	0.710755814
Methyl Methacrylate	0	20	86	0	0.02	0
Methyl Methacrylate	0	0	86	0	0	0
Total hydrocarbons	0	0	86	0	0	0
Total hydrocarbons	0	0	86	0	0	0
Total hydrocarbons	0	0	86	0	0	0
Total hydrocarbons	0	0	86	0	0	0
Total hydrocarbons	285	64	86	0.285	0.064	81.02616279
Total hydrocarbons	0	0	86	0	0	0
Total hydrocarbons	140	230	86	0.14	0.23	39.80232558
Total hydrocarbons	0	0	86	0	0	0
C 11	0	0	86	0	0	0
C 11	0	0	86	0	0	0
C 11	0	0	86	0	0	0
C 11	0	0	86	0	0	0
C 11	0	0	86	0	0	0
C 11	0	0	86	0	0	0
C 11	0	0	86	0	0	0
Tetrachloroethene	0	0	86	0	0	0
Tetrachloroethene	0	0	86	0	0	0
Tetrachloroethene	0	0	86	0	0	0
Tetrachloroethene	0	0	86	0	0	0
Tetrachloroethene	0	0	86	0	0	0
Tetrachloroethene	0	0	86	0	0	0
Tetrachloroethene	0	0	86	0	0	0
Acetaldehyde*	0	0	86	0	0	0
Acetaldehyde*	0	0	86	0	0	0
Acetaldehyde*	0	0	86	0	0	0
Acetaldehyde*	0	0	86	0	0	0
Acetaldehyde*	0	0	86	0	0	0
Acetaldehyde*	0	0	86	0	0	0
Acetaldehyde*	0	0	86	0	0	0
Acetophenone	0	0	86	0	0	0
Acetophenone	0	0	86	0	0	0
Acetophenone	0	0	86	0	0	0
Acetophenone	0	0	86	0	0	0
Acetophenone	0	0	86	0	0	0
Acetophenone	0	0	86	0	0	0
Acetophenone	0	0	86	0	0	0
Acetophenone	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrolein	0	0	86	0	0	0
Acrylonitrile	0	0	86	0	0	0
Acrylonitrile	0	0	86	0	0	0
Acrylonitrile	0	0	86	0	0	0
Acrylonitrile	0	0	86	0	0	0
Acrylonitrile	0	0	86	0	0	0
Acrylonitrile	0	0	86	0	0	0
Acrylonitrile	0	0	86	0	0	0
Acrylonitrile	0	0	86	0	0	0
Allyl alcohol (2-Propenol)	0	0	86	0	0	0
Allyl alcohol (2-Propenol)	0	0	86	0	0	0
Allyl alcohol (2-Propenol)	0	0	86	0	0	0
Allyl alcohol (2-Propenol)	0	0	86	0	0	0
Allyl alcohol (2-Propenol)	0	0	86	0	0	0
Allyl alcohol (2-Propenol)	0	0	86	0	0	0
Allyl alcohol (2-Propenol)	0	0	86	0	0	0
Allyl alcohol (2-Propenol)	0	0	86	0	0	0
Allyl chloride	0	0	86	0	0	0
Allyl chloride	0	0	86	0	0	0
Allyl chloride	0	0	86	0	0	0
Allyl chloride	0	0	86	0	0	0
Allyl chloride	0	0	86	0	0	0
Allyl chloride	0	0	86	0	0	0
Allyl chloride	0	0	86	0	0	0
Allyl chloride	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Ammonia†	0	0	86	0	0	0
Benzaldehyde	0	0	86	0	0	0
Benzaldehyde	0	0	86	0	0	0
Benzaldehyde	0	0	86	0	0	0
Benzaldehyde	0	0	86	0	0	0

Analyte	Upwind (ng/L)	Downwind (ng/L)	MW	Upwind (mg/m3)	Down (mg/m3)	Upwind (ppb)	Downwind (ppb)
Benzaldehyde	0	4		0	0.004	0	0
Benzaldehyde	0	0		0	0	0	0
Bromofom	0	0		0	0	0	0
Bromofom	0	0		0	0	0	0
Bromofom	0	0		0	0	0	0
Bromofom	0	0		0	0	0	0
Bromofom	0	0		0	0	0	0
Bromofom	0.3	0		0.0003	0	0	0
Bromofom	0	0	168	0	0	0	0
C 14	0	0	168	0	0	0	0
C 14	0	0	168	0	0	0	0
C 14	0	0	168	0	0	0	0
C 14	0	0	168	0	0	0	0
C 14	0.7	4	168	0.0007	0.004	0.101875	0.582142857
C 14	0	0	168	0	0	0	0
C 3	0	0		0	0	0	0
C 3	0	0		0	0	0	0
C 3	0	0		0	0	0	0
C 3	0	0		0	0	0	0
C 3	0	0		0	0	0	0
C 3	0	0		0	0	0	0
C 3	0	0		0	0	0	0
C 9	0	0	98	0	0	0	0
C 9	0	0	98	0	0	0	0
C 9	0	0	98	0	0	0	0
C 9	0	0	98	0	0	0	0
C 9	0	4.5	98	0	0.0045	0	1.122704082
C 9	0	0	98	0	0	0	0
C 9	0	0	98	0	0	0	0
C 9	0	0	98	0	0	0	0
Dibromo-3-chloropropane	0	0	236.25	0	0	0	0
Dibromo-3-chloropropane	0	0	236.25	0	0	0	0
Dibromo-3-chloropropane	0	0	236.25	0	0	0	0
Dibromo-3-chloropropane	0	0	236.25	0	0	0	0
Dibromo-3-chloropropane	0	0	236.25	0	0	0	0
Dibromo-3-chloropropane	0.4	0	236.25	0.0004	0	0.041396825	0
Dibromo-3-chloropropane	0	0	147	0	0	0	0
Dichlorobenzene	0	0	147	0	0	0	0
Dichlorobenzene	0	0	147	0	0	0	0
Dichlorobenzene	0	0	147	0	0	0	0
Dichlorobenzene	0	0	147	0	0	0	0
Dichlorobenzene	0	0	147	0	0	0	0
Dichlorobenzene	0.3	0	147	0.0003	0	0.049897959	0
Dichlorobenzene	0	0	102.92	0	0	0	0
Dichlorofluoromethane	0	0	102.92	0	0	0	0
Dichlorofluoromethane	0	0	102.92	0	0	0	0
Dichlorofluoromethane	0	0	102.92	0	0	0	0
Dichlorofluoromethane	0	0	102.92	0	0	0	0
Dichlorofluoromethane	0.2	1.2	102.92	0.0002	0.0012	0.047512631	0.285075787
Dichlorofluoromethane	0	0	102.92	0	0	0	0
Ethylacetate	0	0	88.11	0	0	0	0
Ethylacetate	0	0	88.11	0	0	0	0
Ethylacetate	0	0	88.11	0	0	0	0
Ethylacetate	0	0	88.11	0	0	0	0
Ethylacetate	0	0	88.11	0	0	0	0
Ethylacetate	1	0.5	88.11	0.001	0.0005	0.277494042	0.138747021
Hexene	0	0	84.16	0	0	0	0
Hexene	0	0	84.16	0	0	0	0
Hexene	0	0	84.16	0	0	0	0
Hexene	0	0	84.16	0	0	0	0
Hexene	0	0	84.16	0	0	0	0
Hexene	0	0	84.16	0	0	0	0
Hexene	0	0.7	84.16	0	0.0007	0	0.203362643
Isobutane	0	0	58.12	0	0	0	0
Isobutane	0	0	58.12	0	0	0	0
Isobutane	0	0	58.12	0	0	0	0
Isobutane	0	0	58.12	0	0	0	0
Isobutane	0	0	58.12	0	0	0	0
Isobutane	0	30	58.12	0	0.03	0.012605042	12.62044047
Isopropanol (2-Propanol)	0	0	60	0	0	0	0
Isopropanol (2-Propanol)	0	0	60	0	0	0	0
Isopropanol (2-Propanol)	0	0	60	0	0	0	0
Isopropanol (2-Propanol)	0	0	60	0	0	0	0
Isopropanol (2-Propanol)	10.5	2	60	0.0105	0.002	4.27875	0.815
Isopropanol (2-Propanol)	0	0	60	0	0	0	0
Isopropanol (2-Propanol)	1.1	0	60	0.0011	0	0.44825	0

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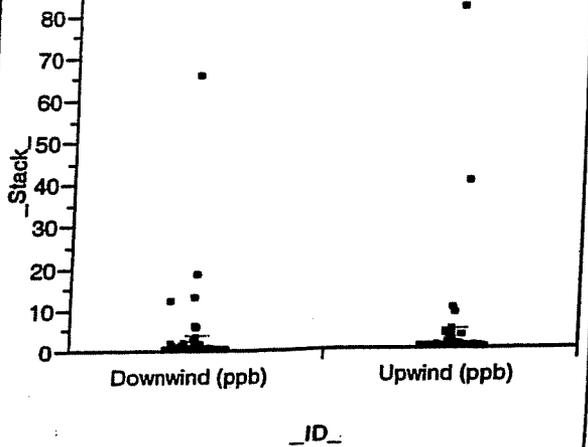
Distributions

Delta



Quantiles		Moments		Test Mean=value		
100.0%	maximum	62.83	Mean	0.0161955	Hypothesized Value	
99.5%		3.43	Std Dev	3.3791752	Actual Estimate	0.016
97.5%		0.56	Std Err Mean	0.1625806	df	43
90.0%		0.00	upper 95% Mean	0.335745	Std Dev	3.3791
75.0%	quartile	0.00	lower 95% Mean	-0.303354		t Test
50.0%	median	0.00	N	432	Test Statistic	0.0996
25.0%	quartile	0.00			Prob > t	0.9207
10.0%		-0.13			Prob > t	0.4603
2.5%		-1.27			Prob < t	0.5397
0.5%		-11.48				
0.0%	minimum	-25.59				

Oneway Analysis of Stack By ID



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Downwind (ppb)	432	0.388951	3.40233	0.16369	0.0672	0.71069
Upwind (ppb)	432	0.405147	4.39121	0.21127	-0.0101	0.82040

communitysample

Rows	Analyte	Upwind (ppb)	Downwind (ppb)	Delta
1	2-Ethyl-1-hexanol	0.356715043	0.50691085	-0.1501958
2	2-Ethyl-1-hexanol	0	0	0
3	2-Ethyl-1-hexanol	0	2.252937111	-2.2529371
4	2-Ethyl-1-hexanol	0.112646856	0.244068187	-0.1314213
5	2-Ethyl-1-hexanol	0	0	0
6	2-Ethyl-1-hexanol	0	2.62842663	-2.6284266
7	2-Ethyl-1-hexanol	3.003916148	0.675881133	2.32803502
8	Nonanol	0	0	0
9	Nonanol	0	0.05165493	-0.0516549
10	Nonanol	0.292711268	0.430457746	-0.1377465
11	Nonanol	0.086091549	0.172183099	-0.0860916
12	Nonanol	0	0	0
13	Nonanol	0	0	0
14	Nonanol	0	0	0
15	1,2,3-Trimethylbenzene	0.4075	0.36675	0.04075
16	1,2,3-Trimethylbenzene	0	0	0
17	1,2,3-Trimethylbenzene	0	0	0
18	1,2,3-Trimethylbenzene	0	0	0
19	1,2,3-Trimethylbenzene	0	0	0
20	1,2,3-Trimethylbenzene	0	0	0
21	1,2,3-Trimethylbenzene	0	0	0
22	1-Hexene	0.231283784	0.231283784	0
23	1-Hexene	0	0	0
24	1-Hexene	0	0	0
25	1-Hexene	0	0	0
26	1-Hexene	0	0	0
27	1-Hexene	0	0	0
28	1-Hexene	0	0.297364865	-0.2973649
29	2,3 Dimethyl pentane	0.106304348	0.106304348	0
30	2,3 Dimethyl pentane	0	0	0
31	2,3 Dimethyl pentane	0	0	0
32	2,3 Dimethyl pentane	0	0	0
33	2,3 Dimethyl pentane	0	0	0
34	2,3 Dimethyl pentane	0	0	0
35	2,3 Dimethyl pentane	0	0	0
36	2-Methylfuran	0	0.536053593	-0.5360536
37	2-Methylfuran	0	0	0
38	2-Methylfuran	0	0	0
39	2-Methylfuran	0	0	0
40	2-Methylfuran	0	0	0
41	2-Methylfuran	0	0	0
42	2-Methylfuran	0	0	0
43	2-methylpentane	0	0	0
44	2-methylpentane	0	0	0
45	2-methylpentane	0	0	0
46	2-methylpentane	0	0	0
47	2-methylpentane	0	0	0
48	2-methylpentane	0.085290698	0.170581395	-0.0852907
49	2-methylpentane	0.22744186	1.137209302	-0.9097674
50	Acetonitrile	0.357369062	0.357369062	0
51	Acetonitrile	0	0	0
52	Acetonitrile	0	0	0
53	Acetonitrile	0	0	0
54	Acetonitrile	0	0	0
55	Acetonitrile	0	0	0
56	Acetonitrile	0	0	0
57	Beta Pinene	0	0	0
58	Beta Pinene	0.539338235	0.053933824	0.48540441
59	Beta Pinene	0	0.053933824	-0.0539338
60	Beta Pinene	0	0	0
61	Beta Pinene	0	0	0
62	Beta Pinene	0	0	0

communitysample

Rows	Analyte	Upwind (ppb)	Downwind (ppb)	Delta
63	Beta Pinene	0	0	0
64	Butanol	0	0	0
65	Butanol	0.20375	0.169791667	0.03395833
66	Butanol	0.033958333	0.305625	-0.2716667
67	Butanol	0	0	0
68	Butanol	0.679166667	0	0.67916667
69	Butanol	0	0	0
70	Butanol	0.135833333	0.441458333	-0.305625
71	C 10	0	0	0
72	C 10	0	0	0
73	C 10	0.224125	0.20375	0.020375
74	C 10	0	0	0
75	C 10	0	0	0
76	C 10	0	0	0
77	C 10	0	0	0
78	C 8	0	0	0
79	C 8	0.0509375	0.101875	-0.0509375
80	C 8	0.0509375	0.17828125	-0.1273438
81	C 8	0	0	0
82	C 8	0	0	0
83	C 8	0	0	0
84	C 8	0	0	0
85	C5	0	0	0
86	C5	0.163	0.28525	-0.12225
87	C5	0.163	1.01875	-0.85575
88	C5	0	0	0
89	C5	0	0	0
90	C5	0	0	0
91	C5	0	0	0
92	Cyclohexanone	0	0	0
93	Cyclohexanone	0	0	0
94	Cyclohexanone	0	0.124566945	-0.1245669
95	Cyclohexanone	0	0	0
96	Cyclohexanone	0	0	0
97	Cyclohexanone	0	0	0
98	Cyclohexanone	0	0	0
99	Ethanol*	0	0	0
100	Ethanol*	0	0	0
101	Ethanol*	0	0	0
102	Ethanol*	0	0	0
103	Ethanol*	0	0	0
104	Ethanol*	0.212608696	0.531521739	-0.318913
105	Ethanol*	0	0	0
106	Hexanal	0	0.07335	-0.07335
107	Hexanal	0	0	0
108	Hexanal	0.31785	0.1467	0.17115
109	Hexanal	0	0	0
110	Hexanal	0	0	0
111	Hexanal	0.0978	0.1467	-0.0489
112	Hexanal	0.22005	0.75795	-0.5379
113	Limonene	0	0	0
114	Limonene	0.161801471	0.161801471	0
115	Limonene	0	0.089889706	-0.0898897
116	Limonene	0	0	0
117	Limonene	0	0	0
118	Limonene	0	0	0
119	Limonene	0	0	0
120	Phenol	0	0	0
121	Phenol	0	0	0
122	Phenol	0	0	0
123	Phenol	0	0	0
124	Phenol	0	0	0

communitysample

Rows	Analyte	Upwind (ppb)	Downwind (ppb)	Delta
125	Phenol	0	0	0
126	Phenol	2.861170213	0	2.86117021
127	Tetrachloroethane	0	0	0
128	Tetrachloroethane	0	0	0
129	Tetrachloroethane	0	0.160280095	-0.1602801
130	Tetrachloroethane	0	0	0
131	Tetrachloroethane	0	0	0
132	Tetrachloroethane	0	0	0
133	Tetrachloroethane	0	1.267669845	-1.2676698
134	Heptanal	0	0	0
135	Heptanal	0	0	0
136	Heptanal	0	0	0
137	Heptanal	0.064285714	0	0.06428571
138	Heptanal	0	0	0
139	Heptanal	0	0	0
140	Heptanal	0	0	0
141	Hexamethylcyclotrisiloxane	0	0	0
142	Hexamethylcyclotrisiloxane	0	0	0
143	Hexamethylcyclotrisiloxane	0.054951229	0.417629343	-0.3626781
144	Hexamethylcyclotrisiloxane	0.021980492	0	0.02198049
145	Hexamethylcyclotrisiloxane	3.242122533	0	3.24212253
146	Hexamethylcyclotrisiloxane	0	0	0
147	Hexamethylcyclotrisiloxane	0	0	0
148	n-Propylbenzene	0	0	0
149	n-Propylbenzene	0	0	0
150	n-Propylbenzene	0	0	0
151	n-Propylbenzene	0.04075	0.061125	-0.020375
152	n-Propylbenzene	0	0	0
153	n-Propylbenzene	0	0	0
154	n-Propylbenzene	0	0.061125	-0.061125
155	2-hexanone	0	0	0
156	2-hexanone	0	0	0
157	2-hexanone	0	0	0
158	2-hexanone	0.07335	0.0978	-0.02445
159	2-hexanone	0	0	0
160	2-hexanone	0	0	0
161	2-hexanone	0	0	0
162	Carbon Tetrachloride	0	0	0
163	Carbon Tetrachloride	0	0	0
164	Carbon Tetrachloride	0	0	0
165	Carbon Tetrachloride	0.048256579	0	0.04825658
166	Carbon Tetrachloride	0	0	0
167	Carbon Tetrachloride	0.048256579	0	0.04825658
168	Carbon Tetrachloride	0	0	0
169	1,3,5 Trimethylbenzene	0	0	0
170	1,3,5 Trimethylbenzene	0	0	0
171	1,3,5 Trimethylbenzene	0	0	0
172	1,3,5 Trimethylbenzene	0.0815	0.101875	-0.020375
173	1,3,5 Trimethylbenzene	0	0	0
174	1,3,5 Trimethylbenzene	0	0	0
175	1,3,5 Trimethylbenzene	0	0.0815	-0.0815
176	4-Methyloctane	0	0	0
177	4-Methyloctane	0.019101563	0.038203125	-0.0191016
178	4-Methyloctane	0	0	0
179	4-Methyloctane	0.07640625	0.095507813	-0.0191016
180	4-Methyloctane	0	0.477539063	-0.4775391
181	4-Methyloctane	0	0	0
182	4-Methyloctane	0	0	0
183	Methyl ethyl ketone (MEK)	0	0	0
184	Methyl ethyl ketone (MEK)	0	0	0
185	Methyl ethyl ketone (MEK)	0	0.339583333	-0.3395833
186	Methyl ethyl ketone (MEK)	0.135833333	0.101875	0.03395833

communitysample

Rows	Analyte	Upwind (ppb)	Downwind (ppb)	Delta
187	Methyl ethyl ketone (MEK)	0	0	0
188	Methyl ethyl ketone (MEK)	0	0	0
189	Methyl ethyl ketone (MEK)	0	0	0
190	a Pinene	0	0	0
191	a Pinene	0	0	0
192	a Pinene	0	0	0
193	a Pinene	0.089889706	0.053933824	0.03595588
194	a Pinene	0	0	0
195	a Pinene	0	0	0
196	a Pinene	0	0	0
197	Naphthalene	0	0	0
198	Naphthalene	0	0	0
199	Naphthalene	0	0	0
200	Naphthalene	0.095507813	0.095507813	0
201	Naphthalene	0	0	0
202	Naphthalene	0	0	0
203	Naphthalene	0.095507813	0.07640625	0.01910156
204	dimethylhexane	0	0	0
205	dimethylhexane	0	0	0
206	dimethylhexane	0	0	0
207	dimethylhexane	0.161364836	0.161364836	0
208	dimethylhexane	0	0	0
209	dimethylhexane	0	0	0
210	dimethylhexane	0	0.188258976	-0.188259
211	Dichlorodifluoromethane	0	0	0
212	Dichlorodifluoromethane	0	0	0
213	Dichlorodifluoromethane	0	0	0
214	Dichlorodifluoromethane	0.16177322	0.181994872	-0.0202217
215	Dichlorodifluoromethane	0	0	0
216	Dichlorodifluoromethane	0	0	0
217	Dichlorodifluoromethane	0.24265983	0.181994872	0.06066496
218	Ethylmethylbenzene	0	0	0
219	Ethylmethylbenzene	0	0	0
220	Ethylmethylbenzene	0	0	0
221	Ethylmethylbenzene	0	0	0
222	Ethylmethylbenzene	0.916875	0	0.916875
223	Ethylmethylbenzene	0	0	0
224	Ethylmethylbenzene	0.163	0.4075	-0.2445
225	Ethylbenzene	0	0	0
226	Ethylbenzene	0	0	0
227	Ethylbenzene	0	0	0
228	Ethylbenzene	0	0	0
229	Ethylbenzene	0	0	0
230	Ethylbenzene	0.115330189	0	0.11533019
231	Ethylbenzene	0.046132075	0.299858491	-0.2537264
232	Pentanol	0	0	0
233	Pentanol	0	0	0
234	Pentanol	0.028430233	1.137209302	-1.1087791
235	Pentanol	0	0	0
236	Pentanol	0	0	0
237	Pentanol	0	0	0
238	Pentanol	0	0	0
239	o-Xylene	0	0	0
240	o-Xylene	0	0	0
241	o-Xylene	0	0	0
242	o-Xylene	0	0	0
243	o-Xylene	0	0	0
244	o-Xylene	0.115330189	0	0.11533019
245	o-Xylene	0.046132075	0.369056604	-0.3229245
246	1,2,4 Trimethylbenzene	0	0	0
247	1,2,4 Trimethylbenzene	0	0	0
248	1,2,4 Trimethylbenzene	0	0	0

communitysample

Rows	Analyte	Upwind (ppb)	Downwind (ppb)	Delta
249	1,2,4 Trimethylbenzene	0	0	0
250	1,2,4 Trimethylbenzene	0	0	0
251	1,2,4 Trimethylbenzene	0.183375	0	0.183375
252	1,2,4 Trimethylbenzene	0.183375	0.36675	-0.183375
253	Methylene Chloride	0	0	0
254	Methylene Chloride	0.066946429	0.069857143	-0.0029107
255	Methylene Chloride	0	0	0
256	Methylene Chloride	0	0	0
257	Methylene Chloride	0	0	0
258	Methylene Chloride	0	0	0
259	Methylene Chloride	0	0.436607143	-0.4366071
260	Trichlorofluoromethane	0	0	0
261	Trichlorofluoromethane	0	0	0
262	Trichlorofluoromethane	0	0	0
263	Trichlorofluoromethane	0	0	0
264	Trichlorofluoromethane	1.528125	1.618014706	-0.0898897
265	Trichlorofluoromethane	0.215735294	0.251691176	-0.0359559
266	Trichlorofluoromethane	0	0	0
267	Benzene	0	0	0
268	Benzene	0	0	0
269	Benzene	0	0	0
270	Benzene	0	0	0
271	Benzene	0	0	0
272	Benzene	0.344807692	0.188076923	0.15673077
273	Benzene	0.125384615	1.410576923	-1.2851923
274	Acetone	0	0	0
275	Acetone	0	0	0
276	Acetone	0	0	0
277	Acetone	0	0	0
278	Acetone	9.484913793	11.80344828	-2.3185345
279	Acetone	0	0.927413793	-0.9274138
280	Acetone	0.463706897	1.475431034	-1.0117241
281	Methylcyclopentane	0	0	0
282	Methylcyclopentane	0	0	0
283	Methylcyclopentane	0	0	0
284	Methylcyclopentane	0	0	0
285	Methylcyclopentane	0	0	0
286	Methylcyclopentane	0.058214286	0	0.05821429
287	Methylcyclopentane	0.349285714	0.232857143	0.11642857
288	m,p-Xylene	0	0	0
289	m,p-Xylene	0	0	0
290	m,p-Xylene	0	0	0
291	m,p-Xylene	0	0	0
292	m,p-Xylene	0	0	0
293	m,p-Xylene	0.345990566	0.069198113	0.27679245
294	m,p-Xylene	0.138396226	0.991839623	-0.8534434
295	C6	0	0	0
296	C6	0	0	0
297	C6	0	0	0
298	C6	0	0	0
299	C6	3.411627907	0.710755814	2.70087209
300	C6	0.085290698	0.199011628	-0.1137209
301	C6	1.535232558	2.67244186	-1.1372093
302	Toluene	0	0	0
303	Toluene	0	0	0
304	Toluene	0	0	0
305	Toluene	0	0	0
306	Toluene	2.126086957	0	2.12608696
307	Toluene	0.690978261	0.159456522	0.53152174
308	Toluene	0.26576087	2.923369565	-2.6576087
309	Methyl Methacrylate	0	0	0
310	Methyl Methacrylate	0	0	0

communitysample

Rows	Analyte	Upwind (ppb)	Downwind (ppb)	Delta
311	Methyl Methacrylate	0	0	0
312	Methyl Methacrylate	0	0	0
313	Methyl Methacrylate	8.386918605	5.401744186	2.98517442
314	Methyl Methacrylate	0.710755814	5.686046512	-4.9752907
315	Methyl Methacrylate	0	5.686046512	-5.6860465
316	Total hydrocarbons	0	0	0
317	Total hydrocarbons	0	0	0
318	Total hydrocarbons	0	0	0
319	Total hydrocarbons	0	0	0
320	Total hydrocarbons	81.02616279	18.19534884	62.830814
321	Total hydrocarbons	0	0	0
322	Total hydrocarbons	39.80232558	65.38953488	-25.587209
323	C 14	0	0	0
324	C 14	0	0	0
325	C 14	0	0	0
326	C 14	0	0	0
327	C 14	0	0	0
328	C 14	0.101875	0.582142857	-0.4802679
329	C 14	0	0	0
330	C 9	0	0	0
331	C 9	0	0	0
332	C 9	0	0	0
333	C 9	0	0	0
334	C 9	0	1.122704082	-1.1227041
335	C 9	0	0	0
336	C 9	0	0	0
337	Dibromo-3-chloropropane	0	0	0
338	Dibromo-3-chloropropane	0	0	0
339	Dibromo-3-chloropropane	0	0	0
340	Dibromo-3-chloropropane	0	0	0
341	Dibromo-3-chloropropane	0	0	0
342	Dibromo-3-chloropropane	0	0	0
343	Dibromo-3-chloropropane	0.041396825	0	0.04139682
344	Dichlorobenzene	0	0	0
345	Dichlorobenzene	0	0	0
346	Dichlorobenzene	0	0	0
347	Dichlorobenzene	0	0	0
348	Dichlorobenzene	0	0	0
349	Dichlorobenzene	0	0	0
350	Dichlorobenzene	0.049897959	0	0.04989796
351	Dichlorofluoromethane	0	0	0
352	Dichlorofluoromethane	0	0	0
353	Dichlorofluoromethane	0	0	0
354	Dichlorofluoromethane	0	0	0
355	Dichlorofluoromethane	0	0	0
356	Dichlorofluoromethane	0.047512631	0.285075787	-0.2375632
357	Dichlorofluoromethane	0	0	0
358	Ethylacetate	0	0	0
359	Ethylacetate	0	0	0
360	Ethylacetate	0	0	0
361	Ethylacetate	0	0	0
362	Ethylacetate	0	0	0
363	Ethylacetate	0	0	0
364	Ethylacetate	0.277494042	0.138747021	0.13874702
365	Hexene	0	0	0
366	Hexene	0	0	0
367	Hexene	0	0	0
368	Hexene	0	0	0
369	Hexene	0	0	0
370	Hexene	0	0	0
371	Hexene	0	0.203362643	-0.2033626
372	Isobutane	0	0	0

communitysample

Rows	Analyte	Upwind (ppb)	Downwind (ppb)	Delta
373	Isobutane	0	0	0
374	Isobutane	0	0	0
375	Isobutane	0	0	0
376	Isobutane	0	0	0
377	Isobutane	0	0	0
378	Isobutane	0	12.62044047	-12.62044
379	Isopropanol (2-Propanol)	0	0	0
380	Isopropanol (2-Propanol)	0	0	0
381	Isopropanol (2-Propanol)	0	0	0
382	Isopropanol (2-Propanol)	0	0	0
383	Isopropanol (2-Propanol)	4.27875	0.815	3.46375
384	Isopropanol (2-Propanol)	0	0	0
385	Isopropanol (2-Propanol)	0.44825	0	0.44825
386	Isopropyltoluene	0	0	0
387	Isopropyltoluene	0	0	0
388	Isopropyltoluene	0	0	0
389	Isopropyltoluene	0	0	0
390	Isopropyltoluene	0	0	0
391	Isopropyltoluene	0	0	0
392	Isopropyltoluene	0.067828741	0	0.06782874
393	n-Butylbenzene	0	0	0
394	n-Butylbenzene	0	0	0
395	n-Butylbenzene	0	0	0
396	n-Butylbenzene	0	0	0
397	n-Butylbenzene	0	0	0
398	n-Butylbenzene	0	0	0
399	n-Butylbenzene	0.061125	0	0.061125
400	Trichlorobenzene	0	0	0
401	Trichlorobenzene	0	0	0
402	Trichlorobenzene	0	0	0
403	Trichlorobenzene	0	0	0
404	Trichlorobenzene	0	0	0
405	Trichlorobenzene	0	0	0
406	Trichlorobenzene	0.040422132	0	0.04042213
407	Trichloroethane	0	0	0
408	Trichloroethane	0	0	0
409	Trichloroethane	0	0	0
410	Trichloroethane	0	0	0
411	Trichloroethane	0	0	0
412	Trichloroethane	0	0	0
413	Trichloroethane	0	0.054976765	-0.0549768
414	Trimethylpentane	0	0	0
415	Trimethylpentane	0	0	0
416	Trimethylpentane	0	0	0
417	Trimethylpentane	0	0	0
418	Trimethylpentane	0	0	0
419	Trimethylpentane	0.042812117	0	0.04281212
420	Trimethylpentane	0	0.727805988	-0.727806
421	Valeraldehyde (Pentanal)	0	0	0
422	Valeraldehyde (Pentanal)	0	0	0
423	Valeraldehyde (Pentanal)	0	0	0
424	Valeraldehyde (Pentanal)	0	0	0
425	Valeraldehyde (Pentanal)	0	0	0
426	Valeraldehyde (Pentanal)	0	0.085161964	-0.085162
427	Valeraldehyde (Pentanal)	0	0.056774643	-0.0567746
428	2-Ethyl-1-hexanol	0.356715043	0.50691085	-0.1501958
429	2-Ethyl-1-hexanol	0	0	0
430	2-Ethyl-1-hexanol	0	2.252937111	-2.2529371
431	2-Ethyl-1-hexanol	0.112646856	0.244068187	-0.1314213
432	2-Ethyl-1-hexanol	0	0	0

Appendix C: Prism Analytical Report



April 24, 2003

To: Corrales Air Quality Study Task Force Members
From: Mindy Koch, Intel Corporation
Re: Results of Ambient Air Sampling Conducted by Intel Corporation

Intel has voluntarily conducted ambient air sampling for many years to collect information for our own use and respond to requests of local citizens. Sampling has been conducted along Intel's property lines, in nearby neighborhoods and more remote locations in Corrales, Rio Rancho and Albuquerque. In 2002 Intel submitted a summary report of sampling events from 1993 to 2001 to the New Mexico Environment Department, the New Mexico Department of Health, Mayor Gary Kanin, and Fred Marsh of Corrales Residents for Clean Air and Water due to increasing public interest in ambient air quality information. That report is attached for consideration by NMED and the Task Force.

Intel has continued to conduct periodic ambient air sampling over the past year and would like to make this information also available to the Corrales Air Quality Study Task Force and the public for consideration in the Corrales Air Quality Study that is currently underway. The results of these sampling activities are summarized in the tables that follow. The sampling method for these tests was a thermal desorption method. Carbon filled thermal desorption tubes were used to collect four-hour samples, and then sent to a certified, independent analytical laboratory. This method is very sensitive, with detection limits in the low parts per billion.

Summary of Intel Ambient Air Analysis
 October 2002 - March 2003
 Analysis by Prism Analytical Technologies, Inc.

The following analytes were semiquantitatively identified:

Analyte	9/27/02		10/22/02		10/09/02		10/7/02		11/06/02		11/25/02		3/20/03		Published Background Level* (ppb)	Chemical Information*
	Site #1 Conc (ppb)	Site #2 Conc (ppb)	Site #3 Conc (ppb)	Site #4 Conc (ppb)	Site #3 Conc (ppb)	Site #4 Conc (ppb)	Site #5 Conc (ppb)	Site #6 Conc (ppb)	Site #7 Conc (ppb)	Site #6 Conc (ppb)	Site #8 Conc (ppb)	Site #6 Conc (ppb)	Site #8 Conc (ppb)			
1,2,3-Trimethylbenzene	0.40	ND		Component of gasoline												
1-butanol	ND	0.10	ND	avg. 5.7, urban		Solvent for fats, waxes, and resins. In shellac, varnish, and paints. Produced and used in the synthesis of flavors, perfumes, dyes and resins										
1-Hexene	0.20	0.20	ND	0.27	ND	ND	0.002-0.7, urban		Produced and used in the synthesis of flavors, perfumes, dyes and resins							
2,2,4-Trimethylpentane	ND	0.04	ND	0.72	ND	0.08	3-15, urban		Paint solvent and/or thinner							
2,3-Dimethyl butane	ND	ND	ND	ND	ND	ND	0.91	ND	ND	ND	ND	ND	ND	2-8, urban		Produced and used as a high octane fuel and in organic synthesis. Found in vehicle exhaust. TOLU - ROUTE. Oral. DOSE: 10 mg/kg/dw
2,3-Dimethyl pentane	0.10	0.10	ND	0.73	ND	ND			Naturally occurring plant volatile that has been identified in a variety of fruits							
2-Ethyl-1-hexanol	0.40	0.50	0.22	ND	ND	2.30	0.10	0.23	2.70	ND	0.67	1.40	2.30			Was used in the past in paint and paint thinner, to make other chemical substances, and to dissolve oils and waxes. It is no longer made or used in the United States because it has harmful health effects. It is formed as a waste product resulting from ind
2-hexanone	ND	0.10	ND	ND	ND	ND	0.06	0.10	ND	ND	ND	ND	ND			Used as an intermediate of medicine and dimuron (pesticides), perfumes.
2-Methylfuran	ND	0.50	0.13	ND	1.4-6.7, urban		Gasoline marker, almost exclusively used in the blending of gasoline									
2-methylpentane	ND	0.16	ND	0.22	0.49	0.34			Produced and used as a flavoring, in perfumes, in pharmaceuticals, and in synthetic resins							
3-Methylbutanal	ND	0.40	ND			Produced and used in the synthesis of flavors, perfumes, dyes and resins										
3-hexene	ND	0.20	ND	ND			Also found in crude oil & gasoline isomer of C9H20									
4-Methylcyclohexane	ND	ND	0.02	0.03	ND	0.04	0.07	0.09	ND	ND	ND	ND	ND			Used as odorants (pine scent). Also occur naturally - given off by pine trees.
alpha Pinene	0.20	ND	0.02	0.05	ND	ND	0.08	0.05	ND	ND	ND	ND	ND	0.07-4, rural		avg. 500 in human breath, common consumer product solvent, avg 16 indoors
Acetone	1.00	5.10	0.79	0.71	0.58	0.87	1.00	0.97	0.91	ND	1.50	0.35	0.10	1-19, urban		Solvent in extractive distillation and crystallization of pharmaceutical and agricultural products and as a catalyst in chemical reactions
Acetonitrile	0.40	0.30	ND	2-7, urban		Released to the environment in emissions from combustion processes such as gasoline and diesel engines, incinerators and wood burning. Used in perfumes, also produced by some molds										
Benzaldehyde	ND	0.90	ND	ND	ND	0.69	0-2, urban		Sulfur containing compound used chiefly as a flavoring substance in foods or as an antimicrobial agent.							
Benzothiazole	ND	0.20	0.10	0.21	ND	ND	0.49	0.52	ND	ND	ND	ND	ND			Used as odorants (pine scent). Also occur naturally - given off by pine trees.
Beta Pinene	ND	ND	0.52	0.05	ND	0.05	ND	0.1-0.5, rural (forest)		Produced and used in the manufacture of rubber accelerators, synthetic resins, solvents, and plasticizers.						
Butanal	ND	ND	0.21	0.18	0.04	0.29	ND	ND	ND	ND	0.45	ND	ND	0-7, urban		Constituent in the paraffin fraction of crude oil and natural gas.
C 10 (Decane)	ND	ND	ND	ND	0.18	0.17	ND	1.3-5.4, urban		disposal of many products associated with the petroleum and gasoline industries.						
C 14 (Tetradecane)	ND	0.49	0.08	ND	0.09	ND			Tetradecane has been identified as a naturally occurring component of chickpea seed, ricinamines and fowl foot flowers. It also occurs naturally in crude oil.							
C 8 (Octane)	ND	ND	0.05	0.08	0.05	0.14	ND	0.04-5, urban		Constituent in the paraffin fraction of crude oil and natural gas. Released to the environment via the manufacture, use, and disposal of many products associated with the petroleum and gasoline industries.						

The following analytes were semiquantitatively identified:

Analyte	Minimum Detection Level (MDL) Range or Actual, ppb	9/27/02	10/2/02	10/9/02	10/10/02	11/6/02	11/25/02	3/20/03	Published Background Level* (ppb)	Chemical Information*
C11 (Undecane)	0.03	ND	ND	ND	ND	ND	ND	ND	avg 1.171 nplcu m	Produced and used in organic synthesis, jet-fuel research, manufacturing of paraffin products, the rubber industry, the paper processing industry, petroleum research, crude oil, as a solvent and distillation chaser, and in automobile exhaust may result in its release to the environment through various waste streams. Constituent in the paraffin fraction of crude oil and natural gas; released into the environment from hazardous waste disposal sites, landfills and waste incinerators; and the combustion of gasoline and diesel fueled engines.
C5, pentane	0.03 - 0.04	ND	ND	0.13	0.23	0.14	0.85	ND	1,3468.2, urban	Gasoline combustion product, common solvent in paints and varnishes
C6, hexane	0.02 - 0.20	0.50	0.60	0.06	0.24	0.09	1.50	2.70	3-28, urban	Highly volatile constituent in the paraffin fraction of crude oil and natural gas
C7 (Heptane)	0.02 - 0.10	0.20	0.10	ND	0.09	0.05	0.23	0.45	16-60, urban	Flammable, irritant, narcotic, and in petroleum research, the paper processing industry, petroleum research, crude oil, as a solvent and distillation chaser, and in automobile exhaust may result in its release to the environment through various waste streams.
Camphor ursulide	0.02 - 0.19	ND	0.40	0.14	0.09	0.05	0.72	0.10	0.02-0.4, urban	Produced and used as a solvent and present in gasoline
Cyclotrisiloxane	0.02 - 0.12	0.10	0.20	0.10	0.12	ND	ND	0.45	0-22.4, urban	Major uses are as an intermediate in the production of nylon 66 and nylon 6, respectively. Also used as a solvent for materials such as synthetic resins, polymers, lacquers, inks, paint, and spot removers and a chemical intermediate in the production of p
Cyclotrisiloxane	0.02 - 0.03	ND	ND	ND	ND	ND	0.13	ND	ND	Used as a food additive (flavor ingredient), in organic synthesis of plasticizers, rubber chemicals, dyes, synthetic resins, and insecticides, and in perfumery (alloy Calculated Concentrations)
Dihydrodichloromethane	0.02 - 0.14	0.20	0.20	0.15	0.02	0.09	0.16	0.17	0.37-4.8, urban	Used as a food additive (flavor ingredient), in organic synthesis of plasticizers, rubber chemicals, dyes, synthetic resins, and insecticides, and in perfumery (alloy Calculated Concentrations)
Dodecanal	0.05	ND	0.30	ND	ND	ND	ND	ND	29-57, urban	Flavoring agent in pharmaceuticals; artificial fruit essences; vanillin and microbial volatile, present in food and widespread in the atmosphere
Ethanol	0.11 - 0.21	ND	ND	ND	ND	ND	ND	ND	0.27-2.64, urban	Flavoring agent in pharmaceuticals; artificial fruit essences; vanillin and microbial volatile, present in food and widespread in the atmosphere
Ethylacetate	0.02 - 0.17	ND	ND	ND	ND	ND	1.70	ND	0.20-0.87, urban	Used as a food additive (flavor ingredient), in organic synthesis of plasticizers, rubber chemicals, dyes, synthetic resins, and insecticides, and in perfumery (alloy Calculated Concentrations)
Heptanal	0.02 - 0.05	ND	ND	ND	0.09	0.05	0.06	0.06	0.20-0.87, urban	Used as a food additive (flavor ingredient), in organic synthesis of plasticizers, rubber chemicals, dyes, synthetic resins, and insecticides, and in perfumery (alloy Calculated Concentrations)
Hexanal	0.02 - 0.15	ND	0.10	ND	0.10	0.31	0.13	ND	0.11-1.75, urban	Used as a food additive (flavor ingredient), in organic synthesis of plasticizers, rubber chemicals, dyes, synthetic resins, and insecticides, and in perfumery (alloy Calculated Concentrations)
Isobutane	0.17 - 0.25	ND	ND	ND	ND	ND	ND	ND	0.37-3.58, urban	Common solvent used in paints, perfumes, ink, antiperspirants, topical ointments, and pharmaceuticals. Used as a sanitizer/disinfectant by the medical field
Isopropanol (2-Propanol)	0.16 - 0.24	ND	ND	ND	ND	ND	ND	ND	1-44, urban	Lemon scent in cleaning products; may be produced by some molds
Linonene	0.01 - 0.02	ND	ND	0.15	0.16	ND	0.09	ND	0.5-7, urban	Occurs naturally as a metabolic byproduct of plants and animals and is released into the atmosphere by volcanoes and forest fires, use as a solvent for coatings, resins, rubbers, plastics, pharmaceuticals, adhesives and rubber cements
Methyl ethyl ketone (MEK)	0.02 - 0.14	0.10	2.20	0.04	0.05	ND	0.32	0.15	avg 1.67, rural	Produced and used in organic synthesis, as an extractive solvent, and in azobiotic distillation agent
Methyl Methacrylate	0.02 - 0.20	ND	ND	5.40	2.20	1.80	4.70	4.80	9-50	Produced and used in organic synthesis, as an extractive solvent, and in azobiotic distillation agent
Methylcyclohexane	0.02 - 0.20	ND	ND	0.03	0.09	0.04	0.29	0.74	4-16, urban	Used in perfumes, also produced by some molds
Nonanal	0.01 - 0.04	ND	ND	0.08	0.34	0.29	0.42	0.09	ND	Produced and used as a solvent, flavor additive and in the manufacture of perfumes.
n-propylacetate	0.02 - 0.05	ND	ND	ND	ND	0.04	0.30	0.02	ND	Occurs naturally in various plants, such as tobacco and algae, as a volatile emission product from animal waste, and in various foods
n-propylamine	0.04 - 0.05	ND	ND	0.07	ND	ND	ND	ND	ND	

Summary of Intel Ambient Air Analysis
 October 2002 - March 2003
 Analysis by Prism Analytical Technologies, Inc.

The following analytes were semiquantitatively identified:

Analyte	Minimum Detection Level (MDL) Range or Actual ppb	9/27/02		10/22/02		10/09/02		10/10/02		11/06/02		11/25/02		3/20/03		Published Background Levels (ppb)	Chemical Information*
		Site #1 Conc. (ppb)	Site #2 Conc. (ppb)	Site #3 Conc. (ppb)	Site #4 Conc. (ppb)	Site #5 Conc. (ppb)	Site #6 Conc. (ppb)	Site #7 Conc. (ppb)	Site #8 Conc. (ppb)	Site #9 Conc. (ppb)	Site #10 Conc. (ppb)	Site #11 Conc. (ppb)	Site #12 Conc. (ppb)	Site #13 Conc. (ppb)	Site #14 Conc. (ppb)		
Octanal	0.01 - 0.02	ND	ND	0.05	ND	ND	ND	ND	ND	.36-40, urban	Produced and used in the preparation of synthetic citrus oils for the perfume industry, as a flavoring, and in the synthesis of alpha-hexylcinnamaldehyde. Oxidation of water in drinking water plants may produce octylaldehyde. Naturally found in oils from navel oranges, Valencia oranges, midseason oranges, tangerines and white grapefruit, skin from lemons and limes.						
Phenol	0.02 - 0.16	ND	ND	0.39	ND	2.80	ND	ND	ND		General disinfectant, used in manufacture of colorless or light colored artificial resins.						
tert-1-butanol	0.13	ND	0.60	ND	ND	ND	ND	ND		Produced and used as a denaturant for ethanol, in the manufacture of ligation agents, flavors and perfumes, as a solvent, as an octane booster in gasoline as well as a dehydrating agent and in the manufacture of many other organic compounds.							
Valeraldehydes (Pentanal)	0.02 - 0.20	0.30	2.40	0.06	1.10	0.56	1.10	0.36	ND	0.11	ND	ND	0.08	0.17	ND	0.1-0.6, urban	Used in flavoring, resin, and as a rubber accelerator. Natural product and is emitted into the atmosphere by plants and microorganisms and from animal wastes and forest fires.

Summary of Inlet Ambient Air Analysis
 October 2002 - March 2003
 Analysis by Prism Analytical Technologies, Inc.

The following analytes were identified and quantified:

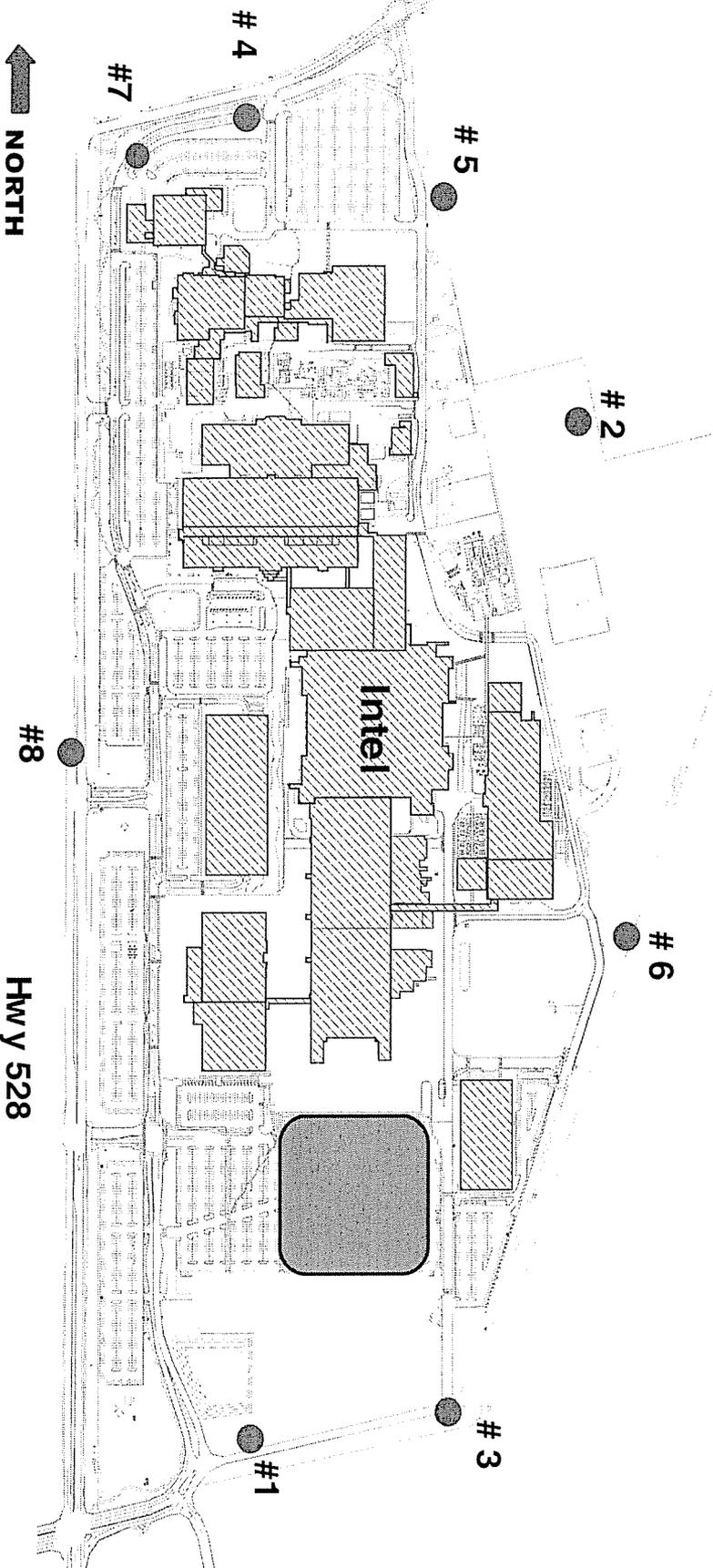
Analyte	9/27/02		10/29/02		10/30/02		10/31/02		11/05/02		11/25/02		3/20/2003		Published Background Level* (ppb)	Chemical Identifier*
	Site #1 Conc (ppb)	Site #2 Conc (ppb)	Site #3 Conc (ppb)	Site #4 Conc (ppb)	Site #5 Conc (ppb)	Site #6 Conc (ppb)										
Trichloroethene	ND	0.04	0.04	1-20, urban	Used in degreasing operations as well as in plastics, appliances, jewelry, automobile interiors, aerosols, paper, glass and other industries.											
Trichlorofluoromethane	ND	0.20	0.32	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.1-4.9, urban	Used as a refrigerant.

Intel Sampling Sites



Corrales

Sept. 2002
Kelley Nelson
EHS



NORTH

Hwy 528

Fab 11 CUB Scrubber Plume Report

The CUB scrubber at Fab 11 scrubs the exhausts from tanks in the Acid Waste Neutralization System (AWN), the Ultra Pure Water System (UPW), the Cyanide Destruct System (CDS), and HF System. The exhaust stack above the scrubber produces a visible white plume. A similar problem was noticed at Fab 12 in Chandler, AZ. A study by Radian International revealed the main source of the plume at Fab 12 to be aerosols of NH_4Cl formed by the reaction of exhausted ammonia with exhausted HCl.

Operating under the assumption that the New Mexico CUB scrubber plume was composed of either NH_4Cl or NH_4F , I looked for the potential sources of NH_3 , HCl and HF. I also searched to see if I could find the point where the plume formed. Using the TLD and Kittigawa tubes I took samples of the exhaust steams at different points that were accessible without the use of a lift.

Testing Methods

The Kittigawa tubes and TLD each had positive and negative testing attributes. The TLD allowed many samples to be taken on a single tape and the readings were given in a decimal form, which made the readings easy to take. However, the TLD's detection range was often not low enough. For example, any ammonia concentration below 2.3 ppm, which was often the case, was reported as 0.0 ppm. Also, a high flow rate within the exhaust line appeared to cause an increase in the variability of the TLD's readings. In addition, the TLD is easily damaged by moisture in the sample stream, so some points could not be measured by the TLD.

The Kitagawa tubes' readings were more qualitative than the TLD's and the upper measurement limits of the tubes were not as high as the TLD. Also, Kitagawa tubes are single use, so tube supply tends to dwindle quickly. However, the tubes measured well in the low concentration range where much of the exhaust system operates and the results were repeatable, even in the high flow exhaust lines.

Results

The only positive result for an acid source in my testing occurred in the scrubber room within the line entering the room from the UPW plant. The reading here exceeded the 20 ppm range of the Kitagawa HCl tubes. This tap was the only point in the UPW plant that I was able to test due to the height of the exhaust lines. The Radian International report and interviews with William Wood point to the HCl storage tanks as the plume's probable acid source.

Numerous ammonia sources were found during the testing. These sources are listed in the appendix. The ammonia sources were found in the cyanide destruct system (CDS), the acid waste neutralization system (AWN), and the HF reaction system (HF system). The CDS side of the basement appeared to produce the most ammonia. The CDS waste exhaust just prior to junction with the HFW Collection Tank exhaust (point 7 on the line drawings) had the highest ammonia concentration. The NH_3 concentration at this point exceeded the 75.0 ppm detection limit of the TLD ammonia tape. The addition of HF Collection Tank exhaust to the line where >75.0 ppm of NH_3 was measured at point 7 diluted should dilute the concentration prior to the basement mixing point with the AWN exhaust. The ammonia contribution of the AWN side of the basement is also

unknown, but the concentration should be less than the CDS NH_3 concentration because no Awn ammonia source concentration was greater than 13 ppm. The entire basement ammonia contribution was found to range between 0.0- 6.8 ppm at the scrubber room basement tap (point 1). The TLD reading varied quite a bit at this sample point, the likely total NH_3 concentration of the basement exhaust was around 1.5 ppm as measured by multiple Kitagawa tubes.

In addition to the basement ammonia sources, the HF neutralization system exhausts ammonia. The total contribution of the HF reaction room, a separate room adjacent to the scrubber room (point 3), was about 2.6 ppm. The total contribution of the HF system was 3.0– 3.2 ppm (point 2). The total contribution included the HF reaction room and the treated fluoride filtrate and sludge tanks. The concentration of the HF line was not diluted by the addition of the filtrate and sludge tanks' exhausts. Therefore, at least one of these tanks is assumed to exhaust ammonia.

Discussion

The Radian International Fab 12 plume report lists the main component of the plume to be NH_4Cl salt. This appears to be consistent with the results of the sampling at Fab 11. The likely source of the plume is HCl from the UPW reacting to form the salt with NH_3 from basement and the HF system. If this is the plume source, the formation is occurring in the scrubber room, between the mixing point of the three streams and the scrubber, and possibly within the scrubber.

While the formation of the plume in the scrubber room is almost definitely a source of the plume, the possibility of additional sources also exists. If an unknown acid

source were to feed into one of the exhaust lines containing ammonia, particulates of salt could have formed prior to the scrubber feed line and be carried through the scrubber.

There is also room for error in the data because the data was collected over a period of weeks rather than a single day. Conditions could have varied over this long of a time span.

Next Steps

While one source of the plume seems to have been found, others may exist. Additional testing would be required to identify every ammonia and acid source. However, Fab 12 has already isolated some ammonia sources to a separate scrubber. The list of equipment exhausted to a separate scrubber at Fab 12 is provided in the appendix. All of the equipment exhausted to the ammonia scrubber at Fab 12 came from the HF System. This would seem odd considering the ammonia sources found in the AWN and CDS at Fab 11, but according to Carrie Weitz a small plume still exists at Fab 12. So, all of the ammonia sources at Fab 12 were probably not isolated. Anna Sandoval was the owner of the ammonia scrubber installation at Fab 12. She should be able to answer questions about what was done. The project files I obtained at Fab 12 were not thorough enough to reveal why certain ammonia sources were rerouted to the new scrubber and others were not, but they do contain information about the project scope and expense.

The steps I would suggest for completing the project are:

1) Discuss the Fab 12 project with Anna Sandoval when she returns from maternity leave. Anna seems to be the only person who knows the background information on the Fab 12 Ammonia scrubber.

2) Additional testing to determine if other acid and ammonia sources exist. It's important to be sure that the salt does not form in locations other than the scrubber room.

Otherwise, the plume might not be totally eliminated by the addition of an ammonia scrubber.

3) Analyze the different types of solutions for cost effectiveness. Peter Clugston has some suggestions, such as a small local scrubber and electrostatic filters. Also, Fab 12 isolated the ammonia sources to a separate scrubber, but would it be cheaper to isolate the acid sources because there are fewer of them. Anna Sandoval might know why Fab 12 didn't isolate the acid sources to a new scrubber

Appendix

1. Equipment List
 2. Line Test Points
 3. AZ Ammonia Scrubber Feed List
 4. Basement Exhaust Line Sketch
 5. UPW Exhaust Line Sketch
 6. Scrubber Room Exhaust Line Sketch
-

Equipment Name	ID	Suspected Exhausts	TLD (ppm)	Kitagawa (ppm)
PW				
HCl Regen Sys hydrometer				
50% NaOH tank	TK-82-GH1-2	NaOH		
50% NaOH tank	TK-82-GH1-1	NaOH		
50% NaOH tank	TK-71-GH3-1	NaOH		
36% HCl tanks	TK-80-GH1-2	HCl		
36% HCl tanks	TK-80-GH1-1	HCl		
future for H2SO4		H2SO4		
sodium bisulfite		sodium metabisulfite		
Ozone Generator				
NaOH Hydrometer				
Cleaning Solution Tank				
CDS Tanks from Basement				
Basement				
AWN				
AW South Lift Tank		Fab Acid Waste?	0.0-4.4 NH3, 0 HCl	
North Lift Tank		Fab Acid Waste?	7.1-12.6 NH3, 0 HCl	
Recycle Surge Tank		>CN, NH3	3.8-0 NH3, 0 HCl	
3rd Stage Recycle Tank		Acids, >CN, NH3		
2nd Stage Recycle Tank		Acids, >CN, NH3		
1st Stage Recycle Tank		Acids, >CN, NH3	0-2.9 NH3, 0 HCl	
Dilute Caustic Storage Tank 1		NaOH		
Dilute Caustic Storage Tank 2		NaOH		
Dilute Caustic Hydrometer		NaOH		
Acid Neutralization Tank 1		Fab Acid Waste?	3.2 NH3, 0 HCl	
Acid Neutralization Tank 2		Fab Acid Waste?		
Acid Neutralization Tank 3		Fab Acid Waste?		
Acid Neutralization Tank 4		Fab Acid Waste?	0 NH3	
CDS				
Acid Hydrometer		HCl		
HFW area drn Tank	TK72-GA2-5	HF, NH3		
HFW col. Tank	TK-72-GA2-3	HF		0 HF
HFW col. Tank	TK-72-GA2-2	HF		0 HF
HFW col. Tank	TK-72-GA2-1	HF		0 HF
SREG EG Wash	TK-60-GA1-1	Ethylene Glycol		
SREG EG Wash	TK-60-GA1-2	Ethylene Glycol		
HTK 1		NH3, NaOH		
HTK 2		NH3, NaOH		
HTK 3 CDS effluent hold back	TK-52-GA8-3	NH3, NaOH		
HTK 4 CDS effluent hold back	TK-52-GA8-4	NH3, NaOH		
CDS Collection 1	TK-52-GA9-1	CN, NH3		
CDS Collection 2	TK-52-GA9-2	CN, NH3		
KD 100 Slurry Waste	TK-52-GA2-2	CN, NaOH		
pH adj tank 1	TK-52-GA1-1	CN, NaOH		
pH adj tank 2	TK-52-GA1-2	CN, NaOH		
CD Blowoff tank	TK-52-GA8-1	CN, NaOH, NH3	rarely used	
KD 100 Blowdown tank	TK-52-GA3-?	CN, NaOH, NH3		

Regen Waste H2O	TK-73-GA1-1	HCl, NaOH		
AW Reclaim Tank		H2SO4		
CDS Tanks				
CDS Tank		20% oxalic acid, 5% NaOH		
CDS Tank				
Scrubber Room				
HF Reaction Room		NH3, Colloidal Solids	2.6 NH3	
HF Collection Tanks		HF		
HF reaction tank 1		HF NH3		
HF reaction tank 2		HF NH3		
Treated Fluoride Filtrate		NH3, Colloidal Solids		
Treated Fluoride Filtrate		NH3, Colloidal Solids		
Treated Fluoride Sludge		NH3, Colloidal Solids		
Treated Fluoride Sludge		NH3, Colloidal Solids		

1.0 PROJECT DESCRIPTION

1.1 Objective

Radian International (Electronics Division) was contracted by Intel Corporation to monitor gaseous concentrations of hydrochloric acid (HCl), hydrofluoric acid (HF), and ammonia (NH₃), as well as to chemically analyze for particulates, in order to identify the source of visible plumes seen at the exhaust of Intel's Central Utilities Block (CUB) in Chandler, Arizona. The exhaust streams in this facility were laden with a mixture of chemical species, which were identified and quantified by Radian designed extractive Fourier Transform Infrared (FTIR) instruments. Since the exhaust from the various streams was combined and passed through a wet scrubber before exiting the stack, potential sources of aerosols (NH₄Cl and/or NH₄F) existed which could, under favorable temperature and humidity conditions, result in the appearance of a plume at the stack outlet. As a result, Radian was asked to identify the source of particulates emanating from the exhaust system given the array of sources containing CaO (lime), HF, HCl, and NH₃ vapors present on site. Simultaneous sampling of the scrubber inlet and outlet was also performed to determine acid scrubber efficiencies. The on-site FTIR analysis results, supported by the chemical analyses performed on particulate filters collected during FTIR sampling, could then be used to make recommendations for eliminating the visible particulates at the stack.

1.2 Radian Test Approach

Field measurements were taken by extracting a slip-stream of the exhaust gas through 50 ft. heated transfer lines into each of two heated FTIR sample cells. All compounds were analyzed on a hot/wet basis to ensure that no condensation losses occurred. Testing was performed from November 18, 1996 through November 21, 1996. To ensure that the hardware and the analysis software were performing properly and providing data of known quality, the Protocol for Extractive FTIR Monitoring¹ (included in Appendix B) was strictly followed; Section 3.0 summarizes the on-site procedures used to calibrate the systems and validate data. The testing scenario outlined in Table 1-1

¹ Protocol for Extractive FTIR Monitoring, Radian International, LLC, Revision 1.0, Oct. 1, 1996.

was performed in order to characterize the plume composition, the scrubber efficiency, and exhaust system make-up at various sampling locations. Multiple configurations were used involving both FTIR systems (labeled as FTIR1 and FTIR2) and two sampling schemes (using or bypassing a particulate filter, which traps all aerosols before measurement) were considered. If one FTIR system was employing a filter, but the other FTIR was not, the differences in NH_3 and HCl (and/or HF) concentrations reported between both instruments would be indicative of the particulate concentration. This is the case because the FTIR system provides enough thermal energy (the sample extraction line and cell were maintained at 185°C , see Section 3.3) to completely dissociate all aerosols before being analyzed. Measurements of the *total* ammonia/acid composition in the exhaust stream were thus obtained by sampling with and without the filter.

Table 1-1 - CUB Exhaust Characterization Test Matrix

Date & Test	Sampling Location and Configuration		Purpose of Test
	FTIR1	FTIR2	
11/18			
System set-up 1	scrubber outlet- with filter	scrubber outlet- without filter	to characterize plume composition
11/19			
2	scrubber inlet- with filter	scrubber inlet- without filter	verify presence of aerosols and characterize
3	scrubber inlet- with filter	scrubber inlet- without filter	characterize aerosols with HCl storage tanks dampered close
4	AWN exhaust- with filter	AWN exhaust- without filter	characterize more potential sources of HCl, NH ₃ and aerosols
5	scrubber inlet- with filter	scrubber inlet- without filter	characterize aerosols during HF processes
11/20			
6	Combined exhaust: HF process + KD100 slurry + HF storage tanks-without filter	scrubber inlet- without filter	locating major sources of NH ₃ during HF processing and KD100 Blowdown
7	HF filtrate/sludge tank exhaust- without filter	scrubber inlet- without filter	locating sources of NH ₃ and HF
8	scrubber outlet- with filter	scrubber inlet- with filter	scrubber efficiency test
11/21			
9	KD100 slurry exhaust-without filter	not used	characterize NH ₃ emissions
10	HF reaction tank exhaust- without filter	not used	characterize NH ₃ emissions

2.0 PRINCIPLES OF EXTRACTIVE FTIR MONITORING

Almost every chemical compound has a unique absorption pattern of infrared (IR) light that can be used to identify and quantify that species in a complex mixture of gases. As governed by Beer's Law, the magnitude of a compound's IR absorbance is directly proportional to the product of its concentration in the mixture and the sample cell optical path length. The extractive FTIR instrument designed by Radian is able to achieve parts-per-billion (ppb) detection levels because a cell is used that has an effective path length of up to 32 meters by repeatedly reflecting the IR beam between a series of mirrors before it reaches the detector. The optical path used can then be set to provide the desired sensitivity before measurements are taken. The path length, once field calibrated as per the Protocol, is an important parameter in the infrared spectrum analysis method used to determine compound concentrations.

2.1 Spectrum Analysis Method

An infrared spectrum analysis is performed by matching the features of an observed, or field, spectrum to reference standards. If more than one feature is present in the same region, a linear combination of references is used to match the compound feature. The standards are scaled to match the observed band intensities, and this scaling also matches the unknown concentrations. In effect, scaled references are added together to produce a composite spectrum which represents the best match with the sample. A classical least squares mathematical technique is used to determine the scaling necessary for matching the standards' absorption profiles with those of the observed spectrum in specified spectral analysis regions. The regions are chosen carefully to provide optimum detection of the compounds of interest with minimum interference by other compounds. Compounds of interest and any known compounds expected to present spectral interferences are included in the test.

The analysis produces a list of gas concentrations and their respective 95% confidence limits (errors of 1.96σ). The 95% confidence limit represents the residual of the fitting process over the spectral region where each compound absorbs, converted to an equivalent concentration. Instrumental signal-to-noise ratio, spectral line shifts, and

spectral interferences strongly influence data accuracy. Since the 95% confidence values are also influenced in a proportional fashion to data accuracy, the 95% limits can serve as a good guide to relative data accuracy over the course of the measurement period. An infrared spectrum can be collected and analyzed in approximately one second, but data is typically averaged over a five minute (or longer) integration period to produce adequate signal-to-noise and parts per billion (ppb) level detection limits.

2.2 Creating the Spectrum Analysis Method

The spectrum analysis method for these tests was built by selecting the spectral regions and sub-regions that minimize interference from other compounds, while also minimizing the detection limit for the target compounds (HCl, HF and NH₃). Typically, an analysis method will be iteratively refined by using it to analyze a representative set of infrared spectra while varying the method. The optimum method is indicated when the 95% confidence levels are minimized and the bias on the individual compounds is minimized.

A series of sample spectra containing the interferences in quantities representative of the actual test matrix, but void of the analytes (blank samples), was used to assess the minimum detectable concentrations of the target compounds (as described in the Protocol, Appendix B). This was achieved by sampling ambient air under humidity conditions slightly higher than fab room air (8000-10000 ppm H₂O and ambient levels of CO₂), as the exhaust stream tends to pick up a small amount of water after passing through the wet scrubber. When applied to this series, the analytical method should return a set of values centered about zero. The minimum detection limit (MDL) is then estimated by taking three-times the standard deviation ($3\sigma = 99.7\%$ confidence) of that data scatter. Any non-zero mean-value returned is also indicative of bias. The bias for each target compound was eliminated with sufficient bias correction functions on site.

3.0 EXPERIMENTAL PROCEDURES

3.1 Test Site

The Central Utilities Block (CUB) outside of the Intel Fab 12 factory in Chandler, AZ. was the site where emissions monitoring was performed. Various exhaust streams were sampled. The sampling ports were usually located less than 50 feet from the FTIR systems, so 50 ft. heated Teflon (PFA grade) extraction lines were used to deliver gas samples from the sample probe to the heated FTIR cell.

3.2 Analytical Method Characterization

An analytical method was developed for monitoring the analytes expected in the waste treatment exhaust streams as described in Section 2.2. Estimates of the minimum detection limits for the target compounds displayed in Table 3-1 were also determined as described in section 2.2 (and the Protocol, Appendix B). A sample set of ambient air spectra obtained on-site was analyzed to produce these values.

Table 3-1 - MDL Estimates of Fab Exhaust Target Compounds.

Compound	MDL (ppb)
HF	15
HCl	15
NH ₃	15

The MDL's were estimated considering only water and carbon dioxide as major spectroscopic interferents with no cross-correlation between other analytes. If other compounds were present in appreciable quantities, then compounds with IR absorptions in the same wavelength region may exhibit higher MDL's as a result of the additional spectral interferences.

The instrumental and source variability encountered in the field may introduce some additional data scatter, increasing a compound's actual MDL. The values listed in Table 3-1 should thus be viewed as optimistic estimates of the actual detection limits. While it is virtually impossible to precisely determine how much the on-site compound

MDL's have increased from the Table 3-1 controlled condition values (because of the target compounds' concentration variability in the emissions source), it is very doubtful that the increase is higher than a factor of two. Not only is this in accordance with recommendations set by EPA for extractive sampling, but is based on measurements that Radian has previously performed for low level acid and ammonia compounds on sources with a comparable water and carbon dioxide content to this test. As a result, a compound's reportable concentration limit (RCL) has historically been established as two times its MDL. This is the guideline chosen for this report.

3.3 Extractive FTIR System

A description of the Radian extractive FTIR systems used for this project, as well as the steps followed in validating the FTIR spectrometer/analysis method are included in the subsections that follow.

3.3.1 System Description

Radian used two fully integrated FTIR systems each consisting of a Nicolet FTIR spectrometer and a 7 liter absorption cell (with infrared path lengths nominally set to 14 and 18 meters for FTIR1 and FTIR2, respectively) mounted onto a mobile cart. Each cell had a 32 inch mirror spacing, and the cell chamber was a 4 inch ID nickel-coated aluminum tube. Gold-coated glass mirrors were used to minimize degradation of the mirror surface from moisture or any other reactive gases in the exhaust stream. The IR beam exiting each sample cell was detected by a liquid nitrogen cooled Mercury/Cadmium/Telluride detector, a photoconductive device that produces an electrical voltage proportional to the amount of IR light that strikes it. The FTIR scans were recorded using flow-through cells maintained at 185°C (365°F). The cell pressures were continuously monitored during measurement periods using Omega pressure sensors calibrated over the 0 to 30 psi range. Instrumental resolutions were set at 0.5 cm⁻¹ and signal averaging was performed over five minute intervals to aid in achieving ppb level detection limits.

A probe and extraction system similar to that described in the Protocol (Appendix B) collected the exhaust samples. The sample probe consisted of a 3/8" OD teflon tube extended to the central axis of the air flow in the exhaust duct. A validation valve (tee) assembly located after the sample probe periodically introduced certified gas standards into the sample line as close to the point of extraction as practical. The air samples were drawn through teflon membrane filters (0.45 micron pore size) to trap aerosols, which could be dissociated in the heated extraction lines thus biasing the measurements of vapor concentrations. Sampling without the filters would be performed whenever the monitoring of total acid/ammonia compositions were required as dissociation would reduce all aerosols to their constituent gaseous vapors.

A diaphragm pump at the output of each FTIR drew the samples through the probe assembly, the heated (185°C) 50 ft. Teflon (PFA grade) line and the heated FTIR cell. Sample flow was maintained at about 15-20 liters per minute during the entire testing period. The pump provided samples under slightly negative pressure to the FTIR cells, whose temperatures were also maintained at 185°C. Actual cell pressures were electronically monitored to allow for corrections based on absolute cell pressures.

3.3.2 FTIR Calibration/Validation Procedures

Both extractive FTIR systems were put through a series of field calibrations/validations to ensure data of high quality. They are listed below.

Radian performed the following on-site procedures as per the Protocol (Appendix B) to validate the analysis method before exhaust sampling began:

1. Calibrated cell path length and interferometer resolution using a gas mixture of R-22, carbon monoxide, and ethylene in nitrogen with certified concentrations
2. Checked for spectrometer frequency line shifts using ambient air. No significant line shifts were observed, so line shifting algorithms were not needed in the analysis method.
3. Recorded daily cell backgrounds consisting of a dynamic fill with dry nitrogen.
4. Performed validation runs for the primary target compounds (HCl and NH₃) at multiple concentration levels by dynamically spiking a certified gas standard over

ambient air extracted through an FTIR cell. The validations were performed to verify that the analysis method would return concentrations to within 95% of expected values in the field. Results are presented in Section 4.1. The second FTIR system was considered validated when it was used in tandem with the already validated system to monitor a common source of HCl and NH₃. Simultaneous sampling of these sources would yield concentrations from both systems that would agree to within their 95% confidence limits. Examples of this are presented in Section 4.0 (done before test condition # 1 and #2 listed in Table 1-1).

3.4 FTIR Data Handling

Radian stored FTIR raw and processed data on computer hard disk and daily transferred the data onto backup storage media kept in a secure location. All quantitation routines used to process the data were backed up on floppy diskettes and on the hard drive.

4.0 RESULTS AND DISCUSSION

4.1 Validation Runs

As described by the Protocol (Appendix B), accuracy tests for each target compound were performed against the analysis method to assure the validity of the test data. This was accomplished before each compliance test by injecting measured volumes of certified gas standards into the extraction line as the FTIR system was drawing ambient air through its cell. Concentrations for HCl and NH₃ measured by the FTIR were required to be at least 95% of the expected spike values before testing proceeded. It was necessary to validate only one of the systems using this procedure since additional validations that checked the reproducibility between both instruments were performed at various sampling locations (see Section 4.2.1 and 4.2.2). Validations for HF were not necessary, since this compound was never detected at any sampling location.

At least two spiking levels per compound were run. A chemically inert compound known to possess a broad spectroscopic absorption pattern over a large range of concentrations (SF₆) was included in each gas mixture to calibrate dilution ratios. The linear behavior of the SF₆ concentrations returned by the analysis method provides a precise measure of the dilution factor associated with each analyte injection. The procedure used in calculating the concentrations expected during analyte spiking was as follows:

1. Each gas standard was introduced directly into the heated sample cell while bypassing the extraction line assembly. After the cell was sufficiently purged with the standard containing SF₆, the analysis method would return a value (called *C_{undil}*) which represents the concentration of SF₆ in the gas cylinder, as measured by the FTIR.
2. Each gas standard would then be injected at the sampling point of the extraction line (directly downstream of the teflon filter) as ambient air is drawn through the heated line and sample cell. The analyte injection flow would be maintained at a low, constant rate with the aid of a mass flow controller. After the cell was sufficiently purged with the gas standard/ambient air mix, the analysis method would return a

value (called C_{dil}) which represents the concentration of SF₆ diluted by ambient air, as measured by the FTIR.

- The expected concentration of the target compound, T_{exp} (which was also diluted by ambient air under the same proportions as SF₆), during analyte injection is thus:

$$T_{exp} = \frac{C_{dil}}{C_{undil}} \times T_{cert} \quad (2)$$

where T_{cert} is the certified concentration of the target compound in the gas cylinder.

Table 4-1 summarizes the analyte spiking data for the two target compounds (HCl and NH₃) and the expected target compound concentrations at a minimum of two spiking levels (three levels were attempted for HCl).

Table 4-1 - Spiking Data for HCl and NH₃

	HCl	NH ₃
Cnc. SF ₆ in gas cylinder (ppm), C_{undil} :	1.21	0.70
Cnc. SF ₆ returned by method after analyte injection (ppm), C_{dil} :	1st: 0.35 2nd: 0.18 3rd: 0.09	1st: 0.10 2nd: 0.05
Certified cnc. of target compound in gas cylinder (ppm), T_{cert} :	53	65
Calculated cnc. of target cpd. after analyte injection (ppm), T_{exp} :	1st: 15.33 2nd: 7.88 3rd: 3.94	1st: 9.29 2nd: 4.64

Whereas it was observed that not more than a 5 minute sampling averaging period was sufficient in purging the system after each analyte spiking event for representative SF₆ concentrations, the target compounds were expected to take longer to stabilize because of compound/extraction line interactions. Therefore, consecutive five minute sampling averages were recorded until the expected spike values were reached. Additional scans were sometimes recorded beyond that to verify the stability of the system. Table 4-1a

displays the results. Before any additional exhaust sampling was performed, ambient air was extracted through the system until concentrations for all target compounds fell below detection limits.

Table 4-1a - Validation Data for HCl and NH₃

Concentrations from FTIR (in ppm)		Amb conc	1st 5 min scan/% of <i>T_{exp}</i>	2nd 5 min scan/% of <i>T_{exp}</i>	3rd 5 min scan/% of <i>T_{exp}</i>	4th 5 min scan/% of <i>T_{exp}</i>
HCl	1st spike:	0	11.61/75.7	14.79/96.5	15.04/98.1	
	2nd spike:*	0	7.78/98.7	7.60/96.4	7.62/96.7	
	3rd spike:*	0	4.35/110	3.77/95.7	3.75/95.2	3.78/95.9
NH ₃	1st spike:	0	9.79/105	9.91/107		
	2nd spike:	0	5.12/110	5.13/110		

* These spikes were done immediately after the proceeding spike, so that concentrations were expected to fall from higher levels to the preset *T_{exp}*.

4.2 Test Results

The results and accompanying discussions pertaining to the tests conducted at Intel's CUB (summarized in Table 1-1) will be presented in subsections that follow.

4.2.1 Test #1: Plume Characterization

To ensure the relative accuracy of both FTIR systems before testing, simultaneous sampling of the scrubber outlet with filters in place was performed prior to test #1. This validation procedure verified good agreement between both instruments for the target compounds, as well as the major interferents (H₂O and CO₂). Table 4-2 displays the results over the 25 minute sampling period.

Table 4-2 - FTIR Systems Validation.*

Sampling locations and configurations were as follows:

FTIR1: Scrubber outlet, filter in

FTIR2: Scrubber outlet, filter ~~in~~ out

Timestamp	H2O-1	H2O-2	CO2-1	CO2-2	HCL-1	HCL-2	NH3-1	NH3-2	HF-1	HF-2
11/18/96 17:25	11079	10779	348.5	344.9	ND	ND	3.1418	3.4037	ND	ND
11/18/96 17:30	11099	10784	344.9	342.7	ND	ND	3.6438	3.4507	ND	ND
11/18/96 17:36	11164	10795	346	343.7	ND	ND	4.0678	4.0587	ND	ND
11/18/96 17:41	11179	10771	343.2	342.9	ND	ND	4.5828	4.3817	ND	ND
11/18/96 17:47	11260	10819	343.3	344.1	ND	ND	4.7878	4.8437	ND	ND

*All concentrations, as labeled according to which system had done the analysis (e.g., H2O-1 corresponds to water concentrations reported by FTIR1, H2O-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

Despite the fact that a visible plume was witnessed throughout the day, no vaporous HCl or HF was observed when sampling with filters. The filter was then removed from FTIR2 to achieve the test #1 configuration. The expectation was that if any HCl or HF was tied up as aerosols in the presence of excess NH₃, it would be dissociated in the FTIR2 heated extraction line and be observed in its vapor state. This was indeed observed as shown in the higher FTIR-2 values displayed in Table 4-3, which summarizes the data over the overnight testing period.

Table 4-3. Test #1 Data. *

Sampling locations and configurations were as follows:

FTIR1: Scrubber outlet, filter in

FTIR2: Scrubber outlet, filter out

Timestamp	HCL-1	HCL-2	NH3-1	NH3-2	HF-1	HF-2	dissociated HCl/dissociated NH3
11/18/96 18:03	ND	1.7623	4.8048	6.4697	ND	ND	1.058502012
11/18/96 18:08	ND	1.6533	4.9868	6.3457	ND	ND	1.216645816
11/18/96 18:14	ND	2.0143	5.4088	7.0337	ND	ND	1.239645517
11/18/96 18:19	ND	1.5403	5.7708	6.9687	ND	ND	1.285833542
11/18/96 18:25	ND	1.7793	6.1838	7.6587	ND	ND	1.206386874
11/18/96 18:30	ND	1.4953	6.4148	7.6067	ND	ND	1.254551556
11/18/96 18:36	ND	1.3473	6.1568	7.3677	ND	ND	1.112643488
11/18/96 18:41	ND	1.2993	6.1998	7.0507	ND	ND	1.526971442
11/18/96 18:47	ND	2.0633	6.2398	7.7977	ND	ND	1.524411066
11/18/96 18:52	ND	1.5403	6.2558	7.4837	ND	ND	1.254418312
11/18/96 18:57	ND	1.3083	5.5918	6.8867	ND	ND	1.010348289
11/18/96 19:03	ND	1.2993	4.2268	5.6687	ND	ND	0.901102712
11/18/96 19:08	ND	1.1483	3.2318	4.4957	ND	ND	0.908547068
11/18/96 19:14	ND	1.0433	2.5688	3.6767	ND	ND	0.941691488
11/18/96 19:19	ND	1.1843	2.1278	3.2597	ND	ND	1.046293842
11/18/96 19:25	ND	1.3733	2.0068	3.1617	ND	ND	1.189107282
11/18/96 19:30	ND	1.2483	1.8518	2.9967	ND	ND	1.090313375
11/18/96 19:36	ND	1.3673	1.6218	2.8247	ND	ND	1.136669715
11/18/96 19:41	ND	1.2613	1.4378	2.5517	ND	ND	1.132327857
11/18/96 19:46	ND	1.2663	1.2808	2.3887	ND	ND	1.142973193
11/18/96 19:52	ND	1.3193	1.1478	2.2757	ND	ND	1.169695895
11/18/96 19:57	ND	1.4213	1.0518	2.2187	ND	ND	1.21801354
11/18/96 20:03	ND	1.4403	0.9659	2.1547	ND	ND	1.211557873
11/18/96 20:08	ND	1.3533	0.9105	2.0377	ND	ND	Average after 2 hours:
11/18/96 20:14	ND	1.4003	0.8536	1.9527	ND	ND	1.155593119
11/18/96 20:19	ND	1.7933	0.9341	2.2257	ND	ND	
11/18/96 20:25	ND	1.7633	0.9823	2.3547	ND	ND	
11/18/96 20:30	ND	1.9373	0.9881	2.4787	ND	ND	
11/18/96 20:35	ND	1.9073	0.9029	2.3937	ND	ND	
11/18/96 20:41	ND	1.9493	0.8449	2.3707	ND	ND	
11/18/96 20:46	ND	3.0773	0.6873	2.9487	ND	ND	
11/18/96 20:52	ND	3.3893	0.558	3.1687	ND	ND	
11/18/96 20:57	ND	3.3613	0.5184	3.0377	ND	ND	
11/18/96 21:03	ND	3.2583	0.4636	2.9007	ND	ND	
11/18/96 21:08	ND	2.6273	0.4588	2.4957	ND	ND	
11/18/96 21:14	ND	3.3633	0.423	2.8287	ND	ND	
11/18/96 21:19	ND	3.1903	0.5154	2.8177	ND	ND	
11/18/96 21:24	ND	3.0333	0.5705	2.7967	ND	ND	
11/18/96 21:30	ND	3.0113	0.5329	2.7877	ND	ND	
11/18/96 21:35	ND	2.8243	0.5083	2.6227	ND	ND	
11/18/96 21:41	ND	2.6793	0.4966	2.4607	ND	ND	
11/18/96 21:46	ND	2.5423	0.463	2.3527	ND	ND	
11/18/96 21:52	ND	2.8533	0.5811	2.5507	ND	ND	
11/18/96 21:57	ND	2.8853	0.554	2.6837	ND	ND	
11/18/96 22:03	ND	2.7003	0.5169	2.4797	ND	ND	

11/18/96 22:08	ND	3.2003	0.4917	2.7167	ND	ND
11/18/96 22:13	ND	3.3483	0.4308	2.8007	ND	ND
11/18/96 22:19	ND	3.7633	0.445	3.1337	ND	ND
11/18/96 22:24	ND	3.8023	0.4545	3.1547	ND	ND
11/18/96 22:30	ND	3.6743	0.4358	3.0727	ND	ND
11/18/96 22:35	ND	3.5383	0.4062	2.9117	ND	ND
11/18/96 22:41	ND	3.4603	0.3518	2.8127	ND	ND
11/18/96 22:46	ND	3.5133	0.3136	2.7687	ND	ND
11/18/96 22:51	ND	3.3473	0.2758	2.6627	ND	ND
11/18/96 22:57	ND	3.6303	0.2809	2.8257	ND	ND
11/18/96 23:02	ND	3.6563	0.3286	2.9117	ND	ND
11/18/96 23:08	ND	3.6073	0.3107	2.8327	ND	ND
11/18/96 23:13	ND	3.5823	0.2832	2.8117	ND	ND
11/18/96 23:19	ND	3.5373	0.2593	2.7137	ND	ND
11/18/96 23:24	ND	3.5893	0.2433	2.7377	ND	ND
11/18/96 23:30	ND	4.0033	0.3085	3.1237	ND	ND
11/18/96 23:35	ND	3.9453	0.3553	3.0977	ND	ND
11/18/96 23:41	ND	3.4723	0.3085	2.7607	ND	ND
11/18/96 23:46	ND	3.5113	0.2864	2.7017	ND	ND
11/18/96 23:52	ND	3.7003	0.2639	2.7857	ND	ND
11/18/96 23:57	ND	4.3153	0.2436	3.1437	ND	ND
11/19/96 0:02	ND	4.4623	0.2782	3.3227	ND	ND
11/19/96 0:08	ND	4.1473	0.2486	3.1757	ND	ND
11/19/96 0:13	ND	3.3933	0.2356	2.6247	ND	ND
11/19/96 0:19	ND	3.5073	0.2312	2.6467	ND	ND
11/19/96 0:24	ND	2.9503	0.2236	2.2877	ND	ND
11/19/96 0:30	ND	3.1603	0.2618	2.4507	ND	ND
11/19/96 0:35	ND	3.3333	0.3022	2.5607	ND	ND
11/19/96 0:40	ND	3.2243	0.3304	2.5667	ND	ND
11/19/96 0:46	ND	3.4133	0.3264	2.6387	ND	ND
11/19/96 0:51	ND	3.3843	0.2875	2.6047	ND	ND
11/19/96 0:57	ND	3.4513	0.256	2.6117	ND	ND
11/19/96 1:02	ND	3.3523	0.2292	2.5187	ND	ND
11/19/96 1:08	ND	3.5613	0.2257	2.6177	ND	ND
11/19/96 1:13	ND	4.0863	0.2644	3.0287	ND	ND
11/19/96 1:19	ND	4.1473	0.2447	3.0687	ND	ND
11/19/96 1:24	ND	3.4853	0.2151	2.6257	ND	ND
11/19/96 1:30	ND	3.3273	0.2151	2.4577	ND	ND
11/19/96 1:35	ND	3.5043	0.2049	2.5737	ND	ND
11/19/96 1:40	ND	3.3253	0.3113	2.5927	ND	ND
11/19/96 1:46	ND	3.7413	0.3663	2.8287	ND	ND
11/19/96 1:51	ND	3.8603	0.3128	2.9307	ND	ND
11/19/96 1:57	ND	3.6053	0.2702	2.7087	ND	ND
11/19/96 2:02	ND	3.5563	0.2309	2.6277	ND	ND
11/19/96 2:08	ND	3.6723	0.2229	2.6687	ND	ND
11/19/96 2:13	ND	3.6213	0.2718	2.7057	ND	ND
11/19/96 2:18	ND	3.5943	0.2648	2.6787	ND	ND
11/19/96 2:24	ND	3.4293	0.251	2.5657	ND	ND
11/19/96 2:29	ND	3.3413	0.2247	2.4657	ND	ND
11/19/96 2:35	ND	3.2733	0.2003	2.3887	ND	ND
11/19/96 2:40	ND	3.3633	0.211	2.4437	ND	ND
11/19/96 2:46	ND	3.4273	0.2118	2.6137	ND	ND
11/19/96 2:51	ND	3.3823	0.1879	2.4287	ND	ND

11/19/96 2:57	ND	3.5133	0.1836	2.5457	ND	ND
11/19/96 3:02	ND	3.6503	0.1683	2.5927	ND	ND
11/19/96 3:07	ND	3.6923	0.1454	2.6167	ND	ND
11/19/96 3:13	ND	3.4403	0.1635	2.4987	ND	ND
11/19/96 3:18	ND	3.3853	0.1528	2.4537	ND	ND
11/19/96 3:24	ND	3.2133	0.1475	2.3297	ND	ND
11/19/96 3:29	ND	3.2513	0.1309	2.3237	ND	ND
11/19/96 3:35	ND	3.3103	0.1353	2.3347	ND	ND
11/19/96 3:40	ND	3.2033	0.1398	2.2527	ND	ND
11/19/96 3:46	ND	3.5073	0.1712	2.5367	ND	ND
11/19/96 3:51	ND	3.2163	0.166	2.3487	ND	ND
11/19/96 3:56	ND	2.7553	0.1611	2.0457	ND	ND
11/19/96 4:02	ND	2.6053	0.1973	1.9117	ND	ND
11/19/96 4:07	ND	2.7463	0.25	2.0497	ND	ND
11/19/96 4:13	ND	3.1303	0.1855	2.2507	ND	ND
11/19/96 4:18	ND	3.3993	0.1591	2.3957	ND	ND
11/19/96 4:24	ND	3.4873	0.1792	2.4887	ND	ND
11/19/96 4:29	ND	3.5453	0.1554	2.5147	ND	ND
11/19/96 4:35	ND	3.4923	0.1576	2.4717	ND	ND
11/19/96 4:40	ND	3.4743	0.1411	2.4477	ND	ND
11/19/96 4:45	ND	3.3983	0.1334	2.4037	ND	ND
11/19/96 4:51	ND	3.2553	0.142	2.3057	ND	ND
11/19/96 4:56	ND	3.1683	0.1531	2.2837	ND	ND
11/19/96 5:02	ND	3.6813	0.1452	2.5647	ND	ND
11/19/96 5:07	ND	3.3993	0.1306	2.4137	ND	ND
11/19/96 5:13	ND	3.3553	0.1214	2.3417	ND	ND
11/19/96 5:18	ND	2.6203	0.1443	1.9547	ND	ND
11/19/96 5:23	ND	2.6413	0.1498	1.8727	ND	ND
11/19/96 5:29	ND	2.5583	0.1531	1.8477	ND	ND
11/19/96 5:34	ND	2.4673	0.1463	1.7897	ND	ND
11/19/96 5:40	ND	3.0773	0.1406	2.0837	ND	ND
11/19/96 5:45	ND	4.6203	0.1501	3.0977	ND	ND
11/19/96 5:51	ND	4.3853	0.165	3.1287	ND	ND
11/19/96 5:56	ND	3.9603	0.1739	2.7627	ND	ND
11/19/96 6:01	ND	3.8783	0.1501	2.7407	ND	ND
11/19/96 6:07	ND	3.6443	0.1411	2.5727	ND	ND
11/19/96 6:12	ND	3.7203	0.1374	2.5787	ND	ND
11/19/96 6:18	ND	3.5563	0.14	2.4907	ND	ND
11/19/96 6:23	ND	3.4083	0.1253	2.4067	ND	ND
11/19/96 6:29	ND	3.3623	0.1238	2.3267	ND	ND
11/19/96 6:34	ND	2.9203	0.1043	2.0687	ND	ND
11/19/96 6:39	ND	2.6623	0.101	1.8957	ND	ND
11/19/96 6:45	ND	2.7063	0.1049	1.8887	ND	ND
11/19/96 6:50	ND	2.7413	0.146	1.9277	ND	ND
11/19/96 6:56	ND	2.7133	0.1198	1.9357	ND	ND
11/19/96 7:01	ND	2.7923	0.127	1.9717	ND	ND
11/19/96 7:07	ND	2.7903	0.1285	1.9777	ND	ND
11/19/96 7:12	ND	2.7313	0.1347	1.8837	ND	ND
11/19/96 7:17	ND	2.6143	0.1597	1.8367	ND	ND
11/19/96 7:23	ND	2.9133	0.1424	1.9967	ND	ND
11/19/96 7:28	ND	2.8783	0.1618	1.9957	ND	ND
11/19/96 7:34	ND	2.7913	0.1257	1.9797	ND	ND
11/19/96 7:39	ND	2.7123	0.1073	1.8907	ND	ND

11/19/96 7:45	0.0393	2.6833	0.1045	1.8787	ND	ND
11/19/96 7:50	0.0475	2.6153	0.143	1.8407	ND	ND
11/19/96 7:55	0.0602	2.4083	0.1275	1.7117	ND	ND
11/19/96 8:01	0.0445	2.6373	0.1364	1.8437	ND	ND
11/19/96 8:06	0.1202	2.7683	0.2006	1.9487	ND	ND
11/19/96 8:12	0.1308	2.9303	0.2351	2.0437	ND	ND
11/19/96 8:17	0.0491	2.9743	0.1612	2.1057	ND	ND
11/19/96 8:23	ND	3.0073	0.1506	2.1237	ND	ND
11/19/96 8:28	ND	2.9913	0.1481	2.1087	ND	ND
11/19/96 8:33	0.0362	2.9273	0.1711	2.0587	ND	ND
11/19/96 8:39	0.0487	3.0473	0.1877	2.1367	ND	ND
11/19/96 8:44	ND	2.9963	0.1647	2.0937	ND	ND
11/19/96 8:50	ND	3.0893	0.1647	2.1557	ND	ND
11/19/96 8:55	0.1176	3.0913	0.2259	2.1397	ND	ND
11/19/96 9:01	0.0342	3.5273	0.153	2.4127	ND	ND
11/19/96 9:06	0.0295	3.3703	0.1248	2.3057	ND	ND
11/19/96 9:11	0.0559	3.2763	0.1578	2.2627	ND	ND
11/19/96 9:17	0.0671	3.2163	0.1797	2.2117	ND	ND
11/19/96 9:22	0.0661	3.2903	0.1801	2.2627	ND	ND
11/19/96 9:28	0.0422	3.4543	0.146	2.3207	ND	ND

* All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

The data indicates that ammonium chloride was the primary particulate constituent in the exhaust stream. The one-to-one stoichiometric relationship associated with the aerosol formation/dissociation reaction:

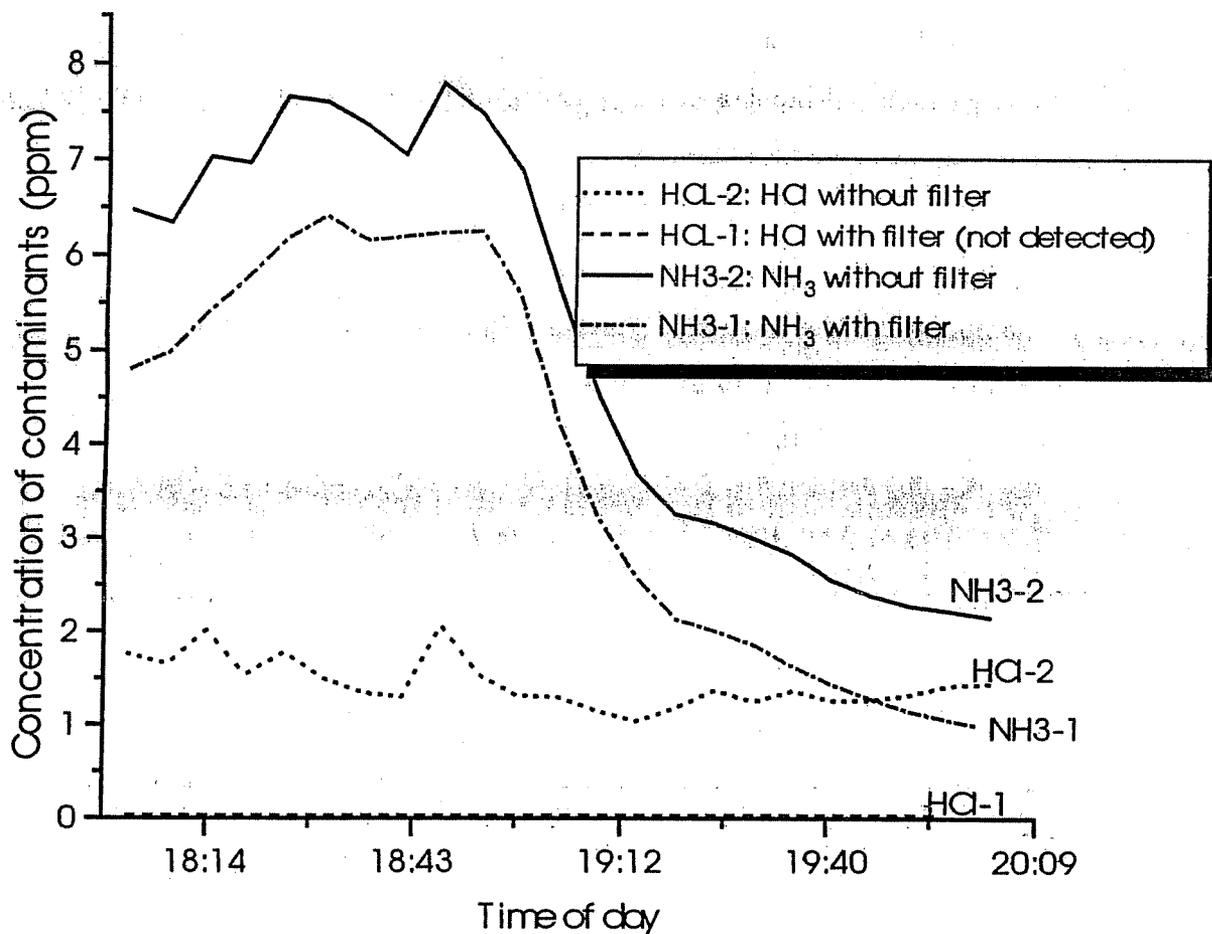


was also observed. This is displayed in the table, where the ratio of HCl dissociated from aerosols (measured by FTIR2 after subtracting the excess HCl measured by FTIR1) over NH_3 dissociated from aerosols (also measured by FTIR2 after subtracting the excess measured by FTIR1) is nearly one. After the initial two hours of sampling the ratio is observed to slowly increase over time because of interactions between the vaporous HCl and salts deposited on the filter. The HCl concentrations measured by FTIR1 will be biased low, as a result. The effect of vaporous HCl being increasingly consumed by a salt laden filter has been observed in previous studies², leading to the same type of results encountered here.

Figure 4-1 includes a graphical depiction of the first two hours of sampling during test #1. The fact that only HCl and NH_3 were observed and that HF was undetectable at the scrubber outlet is further supported by the chemical analysis of the FTIR1 particulate filter summarized in Appendix A. The particulate data (for sample #076279) indicates that the filter was loaded with a considerable amount of NH_4Cl , but negligible amounts of NH_4F and CaO (lime).

² Method 301 Validation of Extractive FTIR at Wet Scrubbers, Radian International LLC, in preparation.
Intel Confidential

Fig. 4-1: Simultaneous FTIR Sampling of Scrubber Outlet during 11/18/96



4.2.2 Test #2: Characterize Aerosols at Scrubber Inlet

As was done prior to test #1, simultaneous sampling of the scrubber inlet by both FTIR systems (with filters in place) was performed before test #2. This validation provided a quick check of the reproducibility between both instruments for the target compounds. Table 4-4 displays the results over the 25 minute sampling period, where good agreement was observed.

Table 4-4 - FTIR Systems Validation.*

Sampling locations and configurations were as follows:

FTIR1: Scrubber inlet, filter in

FTIR2: Scrubber inlet, filter in

Timestamp	HCl-1	HCl-2	NH3-1	NH3-2	HF-1	HF-2
11/19/96 11:51	1.138	1.511	ND	ND	ND	ND
11/19/96 11:56	2.339	2.574	ND	ND	ND	ND
11/19/96 12:02	2.542	2.789	ND	ND	ND	ND
11/19/96 12:07	3.03	3.228	ND	ND	ND	ND
11/19/96 12:12	3.369	3.567	ND	ND	ND	ND

* All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

As was the case for test #1, a visible plume was apparent throughout test #2 even though no vaporous NH₃ or HF was observed when sampling with filters. The filter was then removed from FTIR2 to achieve the test #2 configuration. Table 4-5 summarizes the data over the approximate one hour testing period.

Table 4-5 - Test #2 Data.

Sampling locations and configurations were as follows:

FTIR1: Scrubber inlet, filter in

FTIR2: Scrubber inlet, filter out

Timestamp	HCl-1	HCl-2	NH3-1	NH3-2	HF-1	HF-2
11/19/96 12:23	3.688	7.869	0.0406	2.796	ND	ND
11/19/96 12:28	3.204	7.467	0.0394	2.835	ND	ND
11/19/96 12:34	2.526	6.35	0.0383	2.636	ND	ND
11/19/96 12:39	2.112	6.759	0.0294	2.621	ND	ND
11/19/96 12:45	2.592	6.818	0.0326	2.602	ND	ND
11/19/96 12:50	2.243	6.217	0.0314	2.494	ND	ND
11/19/96 12:55	2.148	5.938	0.03	2.367	ND	ND
11/19/96 13:01	2.107	5.4	0.0313	2.148	ND	ND
11/19/96 13:06	2.274	5.929	0.0321	2.338	ND	ND

* All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

The data again confirmed the presence of ammonium chloride as the primary particulate constituent in the exhaust stream. The one-to-one HCl/NH₃ correspondence was not strictly followed because of the considerable aerosol loading of the FTIR1 filter before this test was conducted. The conclusion reached after tests #1 and #2 was that the visible plume can be attributed to the emission of NH₄Cl. Subsequent tests were thus geared towards isolating the primary sources of both NH₃ and HCl.

4.2.3 Test #3: Characterize Aerosols at Scrubber Inlet with HCl Storage Tanks Closed

With both FTIR systems already sampling the scrubber inlet in the test #2 configuration, the expected primary source of HCl in the exhaust stream, the HCl storage tanks, was dampered and the emissions monitored. Table 4-6 summarizes the test data, which includes 15 minutes of sampling prior to tank closing and about 45 minutes of sampling thereafter.

Table 4-6 - Test #3 Data.

Sampling locations and configurations were as follows:

FTIR1: Scrubber inlet, filter in

FTIR2: Scrubber inlet, filter out

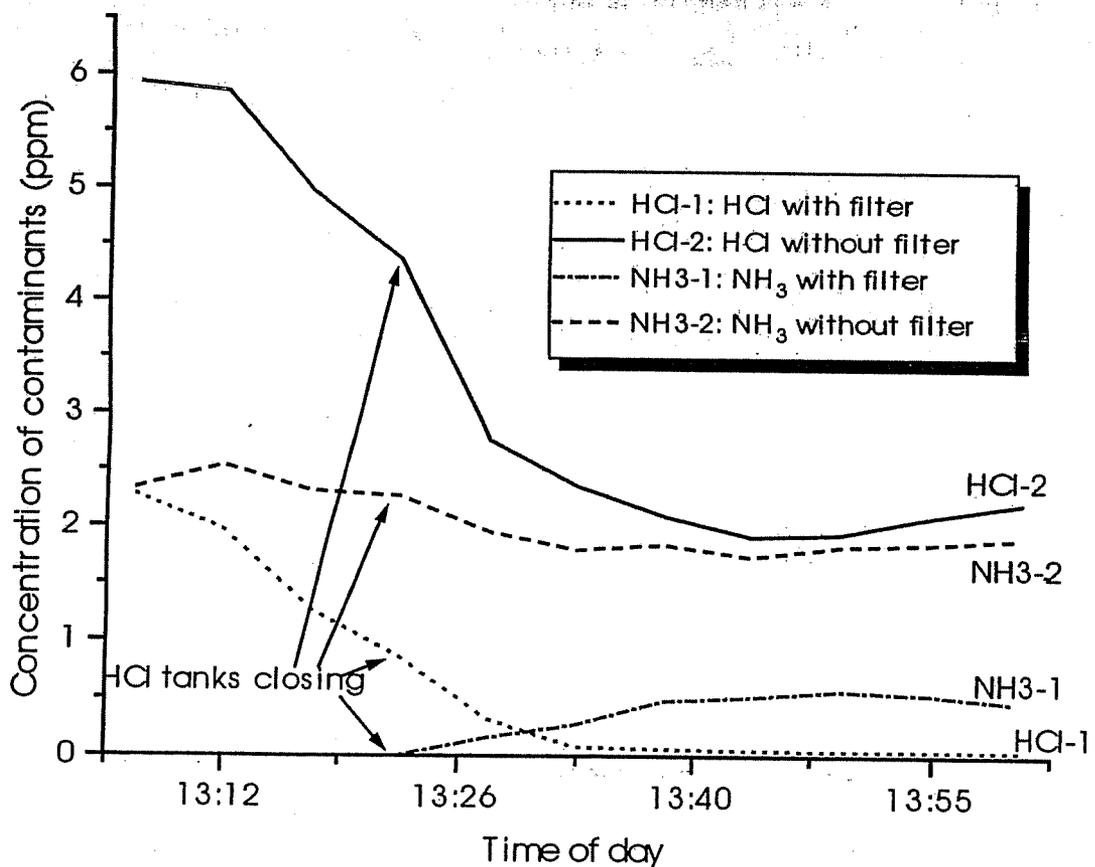
Timestamp	HCl-1	HCl-2	NH ₃ -1	NH ₃ -2	HF-1	HF-2
11/19/96 13:06	2.274	5.929	ND	2.338	ND	ND
11/19/96 13:11	1.974	5.854	ND	2.539	ND	ND
11/19/96 13:17	1.274	4.967	ND	2.312	ND	ND
Tanks being closed:						
11/19/96 13:22	0.8644	4.364	ND	2.268	ND	ND
11/19/96 13:28	0.3201	2.76	0.153	1.953	ND	ND
11/19/96 13:33	0.0785	2.352	0.2717	1.793	ND	ND
11/19/96 13:38	0.0634	2.088	0.4776	1.839	ND	ND
11/19/96 13:44	0.0516	1.906	0.5106	1.731	ND	ND
11/19/96 13:49	0.0463	1.932	0.5637	1.821	ND	ND
11/19/96 13:55	0.048	2.085	0.5287	1.846	ND	ND
11/19/96 14:00	0.0423	2.207	0.4552	1.896	ND	ND

* All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

It was apparent that excess vaporous HCl was present in the exhaust stream before the tanks were closed, as evidenced from the data reported by FTIR1 (with filter). FTIR2 (without filter) also showed considerably larger HCl concentrations than NH₃ concentrations. However, the HCl emissions were observed to be greatly reduced as the storages tanks were dampered shut. In addition, the NH₃ concentrations measured at FTIR1 became detectable at this point. As the excess HCl was being cut off, the equilibrium of the NH₄Cl formation/dissociation reaction (eqn. (1) in section 4.2.1) was

being shifted toward dissociation. Therefore, ammonia previously tied up in aerosols were being "released" back into its vapor state. Figure 4-2 graphically shows this drastic effect. It is also important to note that the visible plume witnessed during this test had begun to dissipate immediately after the HCl storage tanks were closed. The plume became invisible to the human eye roughly 2-3 hours after that. It could then be concluded that the storage tanks constituted a major source of vaporous HCl which, when combined with those exhaust streams containing significant quantities of vaporous NH_3 , produced aerosols seen as particulates exiting the stack.

Fig. 4-2: Simultaneous FTIR Sampling of Scrubber Inlet during 11/19/96



4.2.4 Test #4: Characterize More Sources of HCl and NH₃ at AWN Exhaust

The test #4 configuration was enacted to pinpoint another potential source of HCl that could contribute to the NH₄Cl formation in the exhaust system. Simultaneous sampling of the AWN exhaust with both FTIR systems was done for a 35 minute period. The results (Table 4-7) show measurable levels of HCl and NH₃, but in the sub-ppm range. Therefore, the particulate generation in the entire exhaust was not greatly influenced by this source.

Table 4-7 - Test #4 Data.

Sampling locations and configurations were as follows:

FTIR1: AWN exhaust, filter in

FTIR2: AWN exhaust, filter out

Timestamp	HCl-1	HCl-2	NH ₃ -1	NH ₃ -2	HF-1	HF-2
11/19/96 16:26	0.037	0.1416	0.3006	0.3828	ND	ND
11/19/96 16:31	0.0356	0.1227	0.2661	0.379	ND	ND
11/19/96 16:37	0.0479	0.1158	0.2911	0.3966	ND	ND
11/19/96 16:42	0.032	0.0988	0.278	0.3966	ND	ND
11/19/96 16:47	0.046	0.1079	0.2999	0.4033	ND	ND
11/19/96 16:53	0.04	0.0967	0.3443	0.4446	ND	ND
11/19/96 16:58	0.0437	0.0982	0.3664	0.4647	ND	ND

* All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

4.2.5 Test #5: Characterize Aerosols at Scrubber Inlet during HF Processing

The scrubber inlet was monitored during an HF processing run to chart the expected rise in NH₃ emissions (and possibly, aerosol formation, depending on how much HCl was present). Coincident with this event, the HCl storage tanks closed during test #3 was re-opened. Table 4-8 summarizes the data collected during the 2.5 hour sampling period. A marked rise in NH₃ was noticed at various points throughout the test. There was, of course, a large increase in HCl corresponding to when the storage tanks were opened. Much of the NH₃ already present in the exhaust (as measured by FTIR1) was consumed as aerosols after the HCl entered the exhaust system. Figure 4-3 shows these effects graphically.

Table 4-8 - Test #5 Data.

Sampling locations and configurations were as follows:

FTIR1: Scrubber inlet, filter in

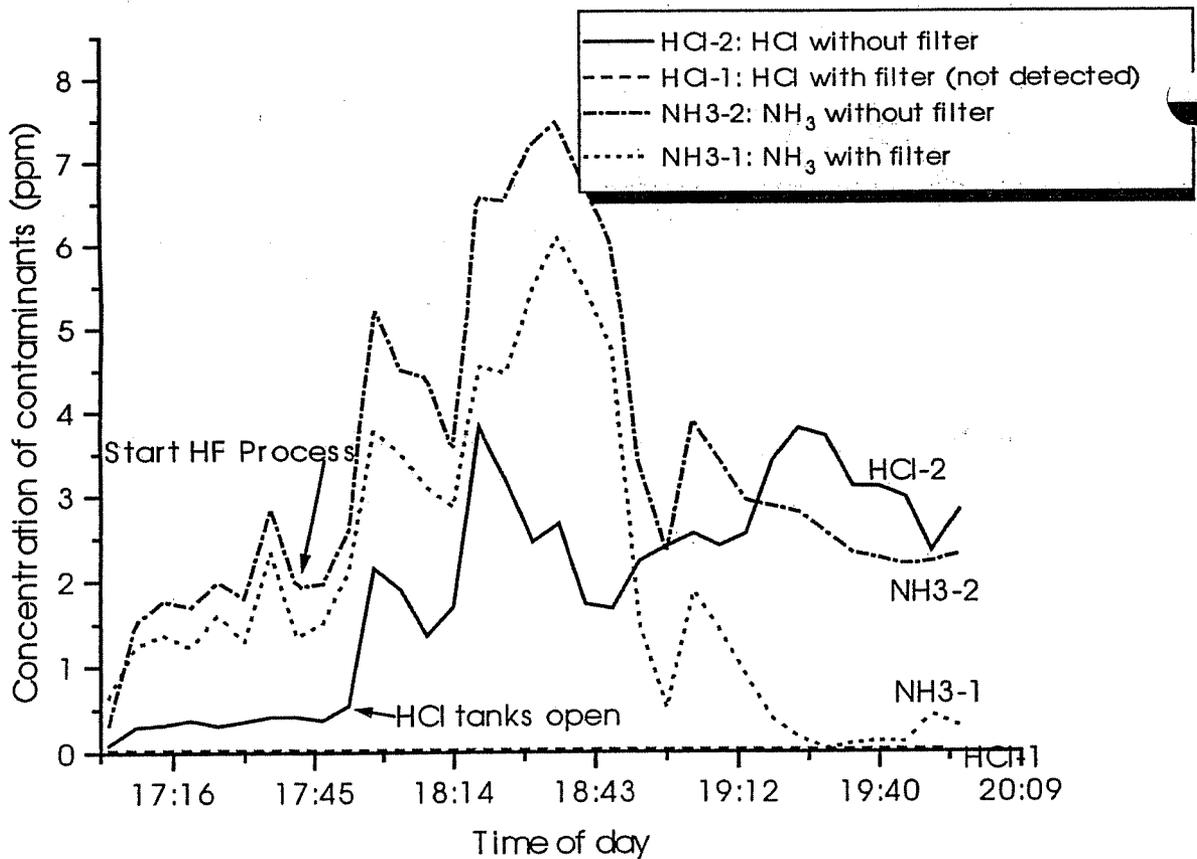
FTIR2: Scrubber inlet, filter out

Timestamp	HCl 1	HCl 2	NH3 1	NH3 2	HF 1	HF 2
11/19/96 17:04	ND	0.0978	0.6544	0.3331	ND	ND
11/19/96 17:09	ND	0.3047	1.239	1.511	ND	ND
11/19/96 17:14	ND	0.322	1.371	1.768	ND	ND
11/19/96 17:20	ND	0.3778	1.225	1.7	ND	ND
11/19/96 17:25	ND	0.3143	1.613	1.993	ND	ND
11/19/96 17:31	ND	0.363	1.279	1.794	ND	ND
11/19/96 17:36	ND	0.4178	2.343	2.848	ND	ND
HF Process Started:						
11/19/96 17:41	ND	0.4204	1.344	1.933	ND	ND
11/19/96 17:47	ND	0.3797	1.502	1.97	ND	ND
11/19/96 17:52	ND	0.5442	2.116	2.598	ND	ND
HCl Tanks Being Opened:						
11/19/96 17:58	ND	2.148	3.773	5.225	ND	ND
11/19/96 18:03	ND	1.899	3.518	4.508	ND	ND
11/19/96 18:08	ND	1.355	3.094	4.412	ND	ND
11/19/96 18:14	ND	1.695	2.871	3.551	ND	ND
11/19/96 18:19	ND	3.822	4.538	6.565	ND	ND
11/19/96 18:25	ND	3.174	4.468	6.532	ND	ND
11/19/96 18:30	ND	2.455	5.46	7.185	ND	ND
11/19/96 18:36	ND	2.671	6.098	7.483	ND	ND
11/19/96 18:41	ND	1.723	5.481	6.765	ND	ND
11/19/96 18:46	ND	1.668	4.726	6.039	ND	ND
11/19/96 18:52	ND	2.225	1.491	3.354	ND	ND

11/19/96 18:57	ND	2.396	0.512	2.337	ND	ND
11/19/96 19:03	ND	2.549	1.871	3.886	ND	ND
11/19/96 19:08	ND	2.408	1.414	3.417	ND	ND
11/19/96 19:13	ND	2.55	0.8804	2.937	ND	ND
11/19/96 19:19	ND	3.411	0.3775	2.876	ND	ND
11/19/96 19:24	ND	3.802	0.165	2.797	ND	ND
11/19/96 19:30	ND	3.71	0.0405	2.559	ND	ND
11/19/96 19:35	ND	3.113	0.0993	2.322	ND	ND
11/19/96 19:40	ND	3.104	0.124	2.262	ND	ND
11/19/96 19:46	ND	2.979	0.1169	2.186	ND	ND
11/19/96 19:51	ND	2.347	0.4377	2.222	ND	ND
11/19/96 19:57	ND	2.818	0.298	2.306	ND	ND

* All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

Fig. 4-3: Simultaneous FTIR Sampling of Scrubber Inlet during 11/19/96



4.2.6 Test #6: Locating Major Sources of NH₃ during HF Processing and KD100 Blowdown

Monitoring for major sources of ammonia began at a sampling point consisting of the combined exhausts from the HF Processing Room, the KD100 Slurry, and the HF Storage tanks. As FTIR1 analyzed the exhaust at that location (without filter), FTIR2 (also without filter) remained at the scrubber inlet to monitor the entire exhaust. An HF processing event, followed by a KD100 blowdown occurred during the 3 hour sampling period, as displayed in Table 4-9 and Figure 4-4. It should be noted that the NH₃ concentrations reported by FTIR2 was expected to be considerably lower than reported by FTIR1 because the FTIR2 sampling location included the *combined* exhaust from all available sources. Therefore, the NH₃ concentrations observed at the FTIR1 location was diluted before reaching the FTIR2 location. In addition, the HCl concentrations reported by FTIR2 was expected to be much *higher* than reported by FTIR1 because the FTIR2 location included the exhaust from the HCl storage tanks (the FTIR1 location contained no auxiliary sources of HCl). However, the NH₃ concentration trends associated with HF processing and KD100 blowdowns were expected to be precisely correlated between both sampling locations.

Table 4-9 - Test #6 Data.

Sampling locations and configurations were as follows:

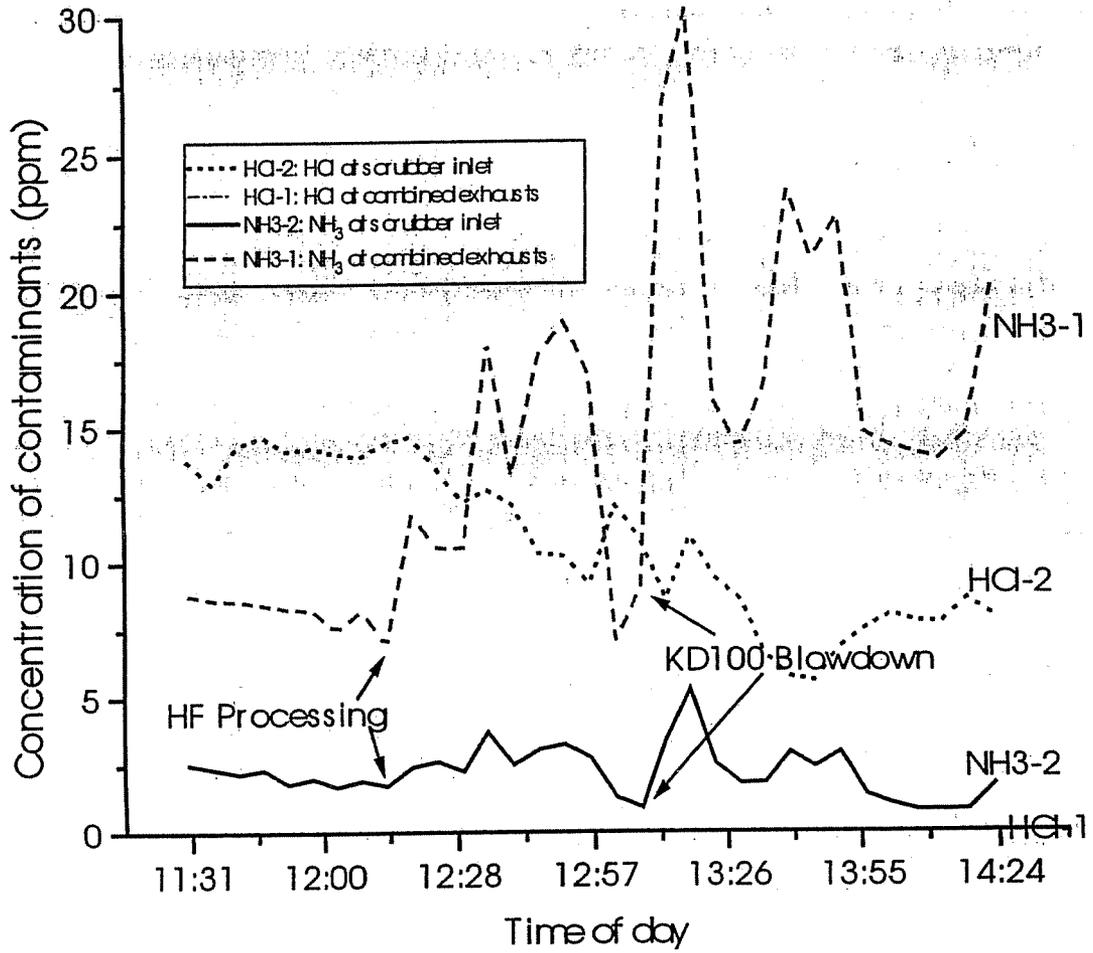
FTIR1: HF process + KD100 slurry + HF storage tanks, filter out

FTIR2: Scrubber inlet, filter out

Timestamp	HCl-1	HCl-2	NH3-1	NH3-2	HF-1	HF-2
11/20/96 11:30	ND	13.78	8.805	2.537	ND	ND
11/20/96 11:36	ND	12.89	8.632	2.357	ND	ND
11/20/96 11:41	ND	14.36	8.582	2.181	ND	ND
11/20/96 11:46	ND	14.69	8.453	2.347	ND	ND
11/20/96 11:52	ND	14.16	8.31	1.807	ND	ND
11/20/96 11:57	ND	14.27	8.226	2.006	ND	ND
11/20/96 12:03	ND	14.08	7.5	1.689	ND	ND
11/20/96 12:08	ND	13.93	8.219	1.917	ND	ND
11/20/96 12:14	ND	14.43	6.979	1.727	ND	ND
HF Process Started:						
11/20/96 12:19	ND	14.68	11.75	2.436	ND	ND
11/20/96 12:24	ND	13.49	10.54	2.619	ND	ND
11/20/96 12:30	ND	12.23	10.54	2.252	ND	ND
11/20/96 12:35	ND	12.69	18.09	3.717	ND	ND
11/20/96 12:40	ND	12.13	13.22	2.508	ND	ND
11/20/96 12:46	ND	10.32	17.65	3.08	ND	ND
11/20/96 12:51	ND	10.24	18.91	3.253	ND	ND
11/20/96 12:57	ND	9.174	16.96	2.758	ND	ND
11/20/96 13:02	ND	12.15	7.105	1.271	ND	ND
11/20/96 13:07	ND	10.82	9.074	0.8887	ND	ND
KD100 Blowdown:						
11/20/96 13:13	ND	8.632	26.95	3.408	ND	ND
11/20/96 13:18	ND	10.97	30.18	5.289	ND	ND
11/20/96 13:24	ND	9.401	15.98	2.53	ND	ND
11/20/96 13:29	ND	8.629	14.23	1.786	ND	ND
11/20/96 13:34	ND	6.567	16.49	1.841	ND	ND
11/20/96 13:40	ND	5.743	23.66	2.949	ND	ND
11/20/96 13:45	ND	5.614	21.22	2.404	ND	ND
11/20/96 13:51	ND	6.853	22.74	2.962	ND	ND
11/20/96 13:56	ND	7.536	14.82	1.374	ND	ND
11/20/96 14:01	ND	8.063	14.32	1.027	ND	ND
11/20/96 14:07	ND	7.806	14.08	0.7923	ND	ND
11/20/96 14:12	ND	7.742	13.83	0.7909	ND	ND
11/20/96 14:17	ND	8.632	14.74	0.8074	ND	ND
11/20/96 14:23	ND	8.008	20.15	1.733	ND	ND

*All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

Fig. 4-4: FTIR Sampling of NH₃ Sources and Scrubber Inlet during 11/20/96



4.2.7 Test #7: Locating More Sources of NH₃ at HF Filtrate/Sludge Tank Exhaust

FTIR1 was relocated to a sampling port servicing the HF filtrate/sludge tanks exhaust for test #7. FTIR2 continued to monitor the scrubber inlet. Table 4-10 displays the data, which show that these tanks provided only a minor contribution to the overall NH₃ emissions.

Table 4-10 - Test #7 Data.

Sampling locations and configurations were as follows:

FTIR1: HF filtrate/sludge tanks, filter out

FTIR2: Scrubber inlet, filter out

Timestamp	HCl-1	HCl-2	NH ₃ -1	NH ₃ -2	HF-1	HF-2
11/20/96 14:51	0.0156	8.255	2.106	0.4846	ND	ND
11/20/96 14:57	0.0188	7.953	2.103	0.5451	ND	ND
11/20/96 15:02	0.0164	7.883	2.083	0.4411	ND	ND
11/20/96 15:07	0.0185	8.275	2.062	0.4009	ND	ND
11/20/96 15:13	0.0178	8.889	2.029	0.362	ND	ND
11/20/96 15:18	0.0194	9.085	1.76	0.3421	ND	ND
11/20/96 15:24	0.0159	8.045	1.559	0.4063	ND	ND
11/20/96 15:29	0.0175	8.109	1.545	0.4156	ND	ND
11/20/96 15:34	0.0113	8.125	1.516	0.332	ND	ND
11/20/96 15:40	0.0118	9.201	1.495	0.285	ND	ND
11/20/96 15:45	0.0164	7.845	1.48	0.2588	ND	ND
11/20/96 15:51	0.011	8.415	1.462	0.2251	ND	ND
11/20/96 15:56	0.013	8.564	1.447	0.2112	ND	ND
11/20/96 16:01	0.0119	7.942	1.444	0.2015	ND	ND
11/20/96 16:07	0.0102	6.008	1.434	0.1883	ND	ND
11/20/96 16:12	0.0203	6.929	1.426	0.1827	ND	ND
11/20/96 16:18	0.0099	6.979	1.418	0.1824	ND	ND
11/20/96 16:23	0.0175	7.818	1.421	0.1719	ND	ND
11/20/96 16:28	0.0185	8.996	1.412	0.178	ND	ND
11/20/96 16:34	0.0188	8.803	1.405	0.3476	ND	ND
11/20/96 16:39	0.0191	9.474	1.399	0.3164	ND	ND
11/20/96 16:45	0.0109	10.03	1.397	0.2553	ND	ND
11/20/96 16:50	0.015	10.63	1.392	0.2448	ND	ND
11/20/96 16:55	0.0092	9.399	1.379	0.2352	ND	ND
11/20/96 17:01	0.016	8.66	1.373	0.2286	ND	ND
11/20/96 17:06	0.0204	9.339	1.367	0.4351	ND	ND

* All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

4.2.8 Test #8: Scrubber Efficiency

Of particular interest was the efficiency of the wet scrubber in eliminating gaseous HCl before exhausting to the atmosphere. Since aerosol emissions were not expected to be efficiently reduced by the scrubber, the simultaneous inlet/outlet sampling was performed with both FTIR systems equipped with particulate filters. That way, only vaporous HCl would be monitored. Since aerosols in considerable quantities were known to be present in the exhaust throughout the test, some HCl losses (the percentage, of which, cannot be precisely determined) were expected due to interactions with the loaded filters. Therefore, the HCl scrubber efficiencies listed in Table 4-11 and charted in Figure 4-5 are not entirely representative of the actual efficiencies that would be encountered in a segregated acid/ammonia exhaust stream, but serve as estimates.

Table 4-11. Test #8 Data.

Sampling locations and configurations were as follows:

FTIR1: Scrubber outlet, filter in

FTIR2: Scrubber inlet, filter in

Timestamp	HCl-1	HCl-2	NH3-1	NH3-2	HF-1	HF-2	HCl Scrub Eff
11/20/96 18:00	0.0375	3.53	0.0724	0.0969	ND	ND	0.989
11/20/96 18:06	0.0346	3.257	0.0515	0.0888	ND	ND	0.989
11/20/96 18:11	0.0483	2.519	0.0597	0.0865	ND	ND	0.981
11/20/96 18:16	0.0427	1.855	0.0739	0.0803	ND	ND	0.977
11/20/96 18:22	0.0449	1.376	0.0793	0.0819	ND	ND	0.967
11/20/96 18:27	0.0416	1.09	0.0951	0.0862	ND	ND	0.962
11/20/96 18:33	0.0469	1.218	0.0936	0.089	ND	ND	0.961
11/20/96 18:38	0.0435	2.226	0.0743	0.0777	ND	ND	0.980
11/20/96 18:43	0.042	2.125	0.0586	0.1089	ND	ND	0.980
11/20/96 18:49	0.0426	1.557	0.0828	0.1711	ND	ND	0.973
11/20/96 18:54	0.038	2.766	0.0659	0.0876	ND	ND	0.986
11/20/96 19:00	0.0352	3.49	ND	0.0921	ND	ND	0.990
11/20/96 19:05	0.0267	4.167	ND	0.0727	ND	ND	0.994
11/20/96 19:10	0.0333	4.34	ND	0.0685	ND	ND	0.992
11/20/96 19:16	0.0389	4.46	ND	0.0742	ND	ND	0.991
11/20/96 19:21	0.0429	4.147	ND	0.0668	ND	ND	0.990
11/20/96 19:27	0.0431	3.387	ND	0.0688	ND	ND	0.987
11/20/96 19:32	0.0306	3.403	ND	0.0618	ND	ND	0.991
11/20/96 19:37	0.0302	3.467	ND	0.0611	ND	ND	0.991
11/20/96 19:43	0.0473	4.19	ND	0.0683	ND	ND	0.989
11/20/96 19:48	0.039	3.821	ND	0.0585	ND	ND	0.990
11/20/96 19:54	0.0376	4.486	ND	0.0574	ND	ND	0.992
11/20/96 19:59	0.0414	5.196	ND	0.053	ND	ND	0.992
11/20/96 20:04	0.0435	4.319	ND	0.0627	ND	ND	0.990

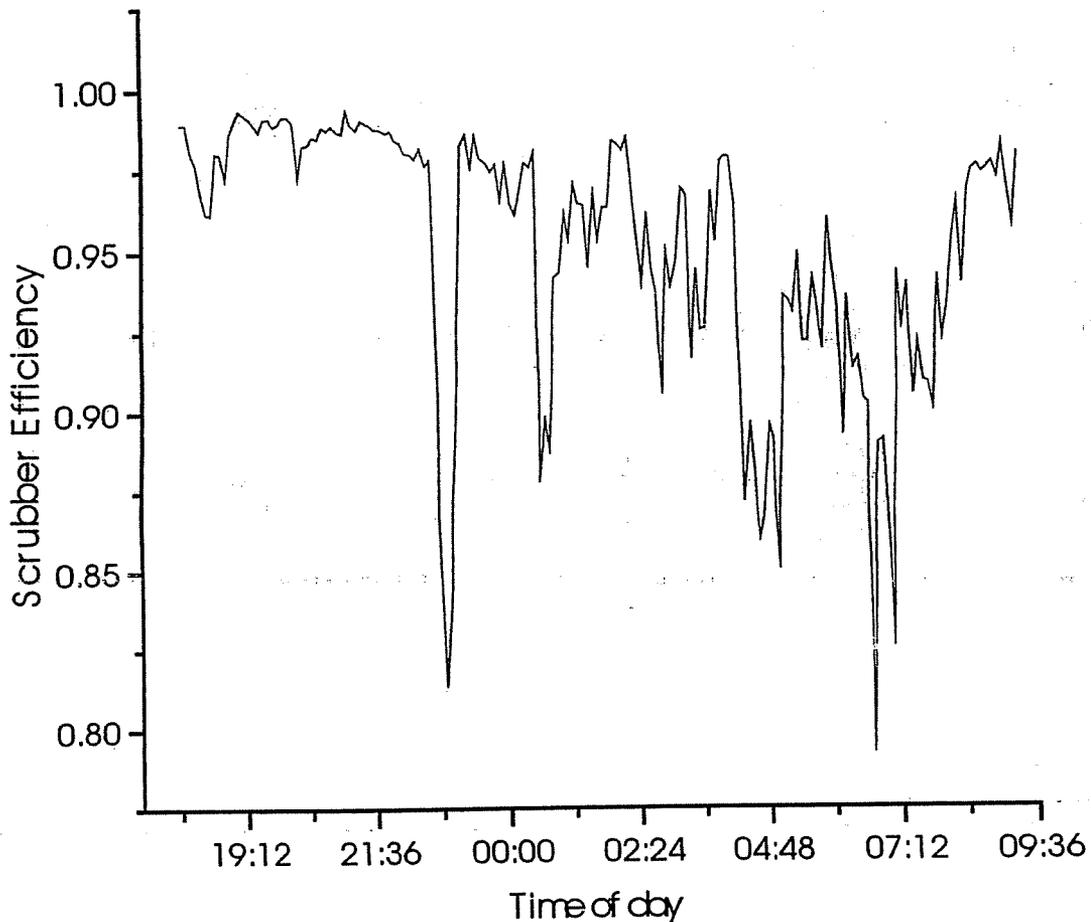
11/20/96 20:10	0.0495	1.841	ND	0.1404	ND	ND	0.973
11/20/96 20:15	0.0397	2.291	ND	0.0969	ND	ND	0.983
11/20/96 20:21	0.045	2.685	ND	0.0724	ND	ND	0.983
11/20/96 20:26	0.0432	3.007	ND	0.0674	ND	ND	0.986
11/20/96 20:31	0.0501	3.327	ND	0.0627	ND	ND	0.985
11/20/96 20:37	0.0371	3.284	ND	0.0549	ND	ND	0.989
11/20/96 20:42	0.0427	3.416	ND	0.0605	ND	ND	0.988
11/20/96 20:48	0.0422	3.835	ND	0.0606	ND	ND	0.989
11/20/96 20:53	0.0462	3.596	ND	0.0587	ND	ND	0.987
11/20/96 20:58	0.0415	3.113	ND	0.0606	ND	ND	0.987
11/20/96 21:04	0.0297	4.905	ND	0.0522	ND	ND	0.994
11/20/96 21:09	0.0451	4.209	ND	0.0588	ND	ND	0.989
11/20/96 21:15	0.0499	4.039	ND	0.0616	ND	ND	0.988
11/20/96 21:20	0.0382	4.062	ND	0.0621	ND	ND	0.991
11/20/96 21:25	0.0433	4.241	ND	0.0584	ND	ND	0.990
11/20/96 21:31	0.0511	4.716	ND	0.0605	ND	ND	0.989
11/20/96 21:36	0.0563	4.619	ND	0.0503	ND	ND	0.988
11/20/96 21:42	0.0619	5.098	ND	0.0524	ND	ND	0.988
11/20/96 21:47	0.0671	5.094	ND	0.0611	ND	ND	0.987
11/20/96 21:52	0.0685	5.414	ND	0.0542	ND	ND	0.987
11/20/96 21:58	0.0775	5.017	ND	0.0537	ND	ND	0.985
11/20/96 22:03	0.0881	5.453	ND	0.0489	ND	ND	0.984
11/20/96 22:09	0.1116	5.723	ND	0.0513	ND	ND	0.980
11/20/96 22:14	0.1124	5.7	ND	0.0538	ND	ND	0.980
11/20/96 22:19	0.1047	4.912	ND	0.0517	ND	ND	0.979
11/20/96 22:25	0.0964	5.309	ND	0.0503	ND	ND	0.982
11/20/96 22:30	0.117	4.979	ND	0.0503	ND	ND	0.977
11/20/96 22:36	0.1186	5.442	ND	0.0616	ND	ND	0.978
11/20/96 22:41	0.1024	1.519	ND	0.0623	ND	ND	0.933
11/20/96 22:46	0.0769	0.5173	ND	0.0862	ND	ND	0.851
11/20/96 22:52	0.0715	0.3837	ND	0.2467	ND	ND	0.814
11/20/96 22:57	0.056	0.3571	ND	0.2501	ND	ND	0.843
11/20/96 23:03	0.0476	0.5069	ND	0.1795	ND	ND	0.906
11/20/96 23:08	0.0415	2.433	ND	0.1088	ND	ND	0.983
11/20/96 23:13	0.0542	3.899	ND	0.086	ND	ND	0.986
11/20/96 23:19	0.0574	2.389	ND	0.0791	ND	ND	0.976
11/20/96 23:24	0.0464	3.296	ND	0.0776	ND	ND	0.986
11/20/96 23:30	0.0556	2.635	ND	0.0637	ND	ND	0.979
11/20/96 23:35	0.0539	2.398	ND	0.0696	ND	ND	0.978
11/20/96 23:40	0.0539	2.13	ND	0.0654	ND	ND	0.975
11/20/96 23:46	0.0512	2.218	ND	0.0657	ND	ND	0.977
11/20/96 23:51	0.0526	1.546	ND	0.061	ND	ND	0.966
11/20/96 23:56	0.0418	1.815	ND	0.0633	ND	ND	0.977
11/21/96 0:02	0.0511	1.454	ND	0.0549	ND	ND	0.965
11/21/96 0:07	0.065	1.681	ND	0.0511	ND	ND	0.961
11/21/96 0:13	0.0455	1.461	ND	0.1146	ND	ND	0.969
11/21/96 0:18	0.0518	2.291	ND	0.0705	ND	ND	0.977
11/21/96 0:23	0.0552	2.29	ND	0.0541	ND	ND	0.976
11/21/96 0:29	0.0446	2.294	ND	0.057	ND	ND	0.981
11/21/96 0:34	0.049	0.4014	ND	2.961	ND	ND	0.878
11/21/96 0:40	0.0349	0.3393	0.2193	5.841	ND	ND	0.897

11/21/96 0:45	0.0407	0.3655	2.912	7.797	ND	ND	0.889
11/21/96 0:50	0.029	0.4989	1.967	5.145	ND	ND	0.942
11/21/96 0:56	0.0318	0.5639	1.035	2.204	ND	ND	0.944
11/21/96 1:01	0.0232	0.6048	0.7802	1.757	ND	ND	0.962
11/21/96 1:07	0.0316	0.6828	0.5905	1.483	ND	ND	0.954
11/21/96 1:12	0.0221	0.7594	0.4171	1.152	ND	ND	0.971
11/21/96 1:17	0.0268	0.7589	0.3208	0.9318	ND	ND	0.965
11/21/96 1:23	0.027	0.7512	0.2758	0.7754	ND	ND	0.964
11/21/96 1:28	0.0404	0.7341	0.1756	0.6694	ND	ND	0.945
11/21/96 1:33	0.0206	0.6404	0.1059	0.5768	ND	ND	0.968
11/21/96 1:39	0.0287	0.6153	0.0693	0.4942	ND	ND	0.953
11/21/96 1:44	0.0242	0.6618	0.045	0.4281	ND	ND	0.963
11/21/96 1:50	0.0334	0.9147	0.0421	0.3739	ND	ND	0.963
11/21/96 1:55	0.0275	1.712	ND	0.3042	ND	ND	0.984
11/21/96 2:00	0.0266	1.574	ND	0.2779	ND	ND	0.983
11/21/96 2:06	0.0338	1.795	ND	0.2388	ND	ND	0.981
11/21/96 2:12	0.027	1.781	ND	0.2341	ND	ND	0.985
11/21/96 2:17	0.036	1.075	0.1338	0.8202	ND	ND	0.967
11/21/96 2:22	0.0251	0.5282	0.6205	2.914	ND	ND	0.952
11/21/96 2:28	0.0283	0.4709	1.854	4.642	ND	ND	0.940
11/21/96 2:33	0.0162	0.4255	1.749	4.494	ND	ND	0.962
11/21/96 2:39	0.0232	0.412	1.62	3.361	ND	ND	0.944
11/21/96 2:44	0.0243	0.3869	2.756	4.225	ND	ND	0.937
11/21/96 2:49	0.0356	0.3763	2.697	4.379	ND	ND	0.905
11/21/96 2:55	0.0191	0.379	2.965	4.249	ND	ND	0.950
11/21/96 3:00	0.0224	0.3673	1.906	2.809	ND	ND	0.939
11/21/96 3:05	0.0208	0.3902	1.449	1.806	ND	ND	0.947
11/21/96 3:11	0.0112	0.3656	2.111	2.304	ND	ND	0.969
11/21/96 3:16	0.0118	0.3586	2.228	2.651	ND	ND	0.967
11/21/96 3:22	0.0307	0.3675	2.099	2.023	ND	ND	0.916
11/21/96 3:27	0.021	0.3778	3.451	2.886	ND	ND	0.944
11/21/96 3:32	0.0273	0.3669	1.932	2.765	ND	ND	0.926
11/21/96 3:38	0.0289	0.3902	1.022	1.371	ND	ND	0.926
11/21/96 3:43	0.0126	0.3975	0.6022	0.9462	ND	ND	0.968
11/21/96 3:49	0.0195	0.4134	0.3803	0.7568	ND	ND	0.953
11/21/96 3:54	0.0118	0.5282	0.247	0.6056	ND	ND	0.978
11/21/96 3:59	0.0226	1.082	0.1666	0.5092	ND	ND	0.979
11/21/96 4:05	0.0276	1.296	0.1781	0.4259	ND	ND	0.979
11/21/96 4:10	0.0397	1.106	0.244	0.4015	ND	ND	0.964
11/21/96 4:15	0.0544	0.5669	0.6447	0.953	ND	ND	0.904
11/21/96 4:21	0.0629	0.4898	0.7725	1.125	ND	ND	0.872
11/21/96 4:26	0.0479	0.4631	1.697	2.1	ND	ND	0.897
11/21/96 4:32	0.0557	0.4639	0.9119	1.815	ND	ND	0.880
11/21/96 4:37	0.0661	0.4727	0.5943	1.108	ND	ND	0.860
11/21/96 4:42	0.0612	0.4598	0.4642	0.8339	ND	ND	0.867
11/21/96 4:48	0.0493	0.4716	0.3226	0.6726	ND	ND	0.895
11/21/96 4:53	0.0453	0.4167	1.473	1.339	ND	ND	0.891
11/21/96 4:59	0.0579	0.3867	2.357	3.272	ND	ND	0.850
11/21/96 5:04	0.0261	0.4076	3.221	4.711	ND	ND	0.936
11/21/96 5:09	0.0289	0.442	3.955	5.328	ND	ND	0.935
11/21/96 5:15	0.0302	0.438	4.215	6.37	ND	ND	0.931

11/21/96 5:20	0.0211	0.4185	3.502	5.607	ND	ND	0.950
11/21/96 5:26	0.0319	0.4082	2.854	3.952	ND	ND	0.922
11/21/96 5:31	0.0342	0.4374	1.959	2.711	ND	ND	0.922
11/21/96 5:36	0.0263	0.4496	1.264	1.918	ND	ND	0.942
11/21/96 5:42	0.032	0.4651	0.8262	1.485	ND	ND	0.931
11/21/96 5:47	0.0398	0.4939	0.674	1.231	ND	ND	0.919
11/21/96 5:53	0.0181	0.4538	2.768	1.919	ND	ND	0.960
11/21/96 5:58	0.0232	0.4233	2.029	3.372	ND	ND	0.945
11/21/96 6:03	0.0307	0.4552	1.423	2.393	ND	ND	0.933
11/21/96 6:09	0.0507	0.4717	1.1	1.793	ND	ND	0.893
11/21/96 6:14	0.0295	0.4619	1.011	1.681	ND	ND	0.936
11/21/96 6:20	0.0433	0.5007	0.8754	1.535	ND	ND	0.914
11/21/96 6:25	0.0363	0.4362	0.7365	1.368	ND	ND	0.917
11/21/96 6:30	0.0433	0.4505	0.6392	1.166	ND	ND	0.904
11/21/96 6:36	0.0447	0.4577	0.5118	1.019	ND	ND	0.902
11/21/96 6:41	0.1011	0.4868	0.4858	0.8919	ND	ND	0.792
11/21/96 6:47	0.0557	0.5048	0.3459	0.7741	ND	ND	0.890
11/21/96 6:52	0.0507	0.4654	0.317	0.698	ND	ND	0.891
11/21/96 6:57	0.0617	0.4796	0.2898	0.6558	ND	ND	0.871
11/21/96 7:03	0.0828	0.4747	0.29	0.6246	ND	ND	0.826
11/21/96 7:08	0.0296	0.5278	0.2256	0.5721	ND	ND	0.944
11/21/96 7:14	0.036	0.4949	0.2474	0.5401	ND	ND	0.927
11/21/96 7:19	0.0311	0.5196	0.2667	0.5164	ND	ND	0.940
11/21/96 7:24	0.0455	0.4798	0.2876	0.5015	ND	ND	0.905
11/21/96 7:30	0.0399	0.5098	0.2501	0.4814	ND	ND	0.922
11/21/96 7:35	0.0427	0.4718	0.2428	0.4699	ND	ND	0.909
11/21/96 7:41	0.0426	0.4671	0.1969	0.4597	ND	ND	0.909
11/21/96 7:46	0.0449	0.4552	0.1764	0.4237	ND	ND	0.901
11/21/96 7:51	0.0263	0.4555	0.1395	0.4042	ND	ND	0.942
11/21/96 7:57	0.0384	0.499	0.1078	0.3908	ND	ND	0.923
11/21/96 8:02	0.0376	0.5579	0.0954	0.3758	ND	ND	0.933
11/21/96 8:08	0.0326	0.699	0.0624	0.3613	ND	ND	0.953
11/21/96 8:13	0.0333	0.9516	0.0534	0.3321	ND	ND	0.965
11/21/96 8:18	0.0644	1.069	ND	0.3213	ND	ND	0.940
11/21/96 8:24	0.0431	1.393	ND	0.3106	ND	ND	0.969
11/21/96 8:29	0.0397	1.565	ND	0.2937	ND	ND	0.975
11/21/96 8:34	0.039	1.65	ND	0.2931	ND	ND	0.976
11/21/96 8:40	0.0487	1.869	ND	0.2764	ND	ND	0.974
11/21/96 8:45	0.0445	1.813	ND	0.2785	ND	ND	0.975
11/21/96 8:51	0.0385	1.679	ND	0.2647	ND	ND	0.977
11/21/96 8:56	0.037	1.354	ND	0.2721	ND	ND	0.973
11/21/96 9:01	0.0217	1.255	ND	0.2604	ND	ND	0.983
11/21/96 9:07	0.0327	1.105	ND	0.2563	ND	ND	0.970
11/21/96 9:12	0.0436	1.043	ND	0.2551	ND	ND	0.958
11/21/96 9:18	0.0187	0.9301	ND	0.2513	ND	ND	0.980

* All concentrations, as labeled according to which system had done the analysis (e.g., HCl-1 corresponds to hydrochloric acid concentrations reported by FTIR1, HCl-2 by FTIR-2, etc.) are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

Fig 4-5: HCl Scrubber Efficiency Starting on 11/20/96

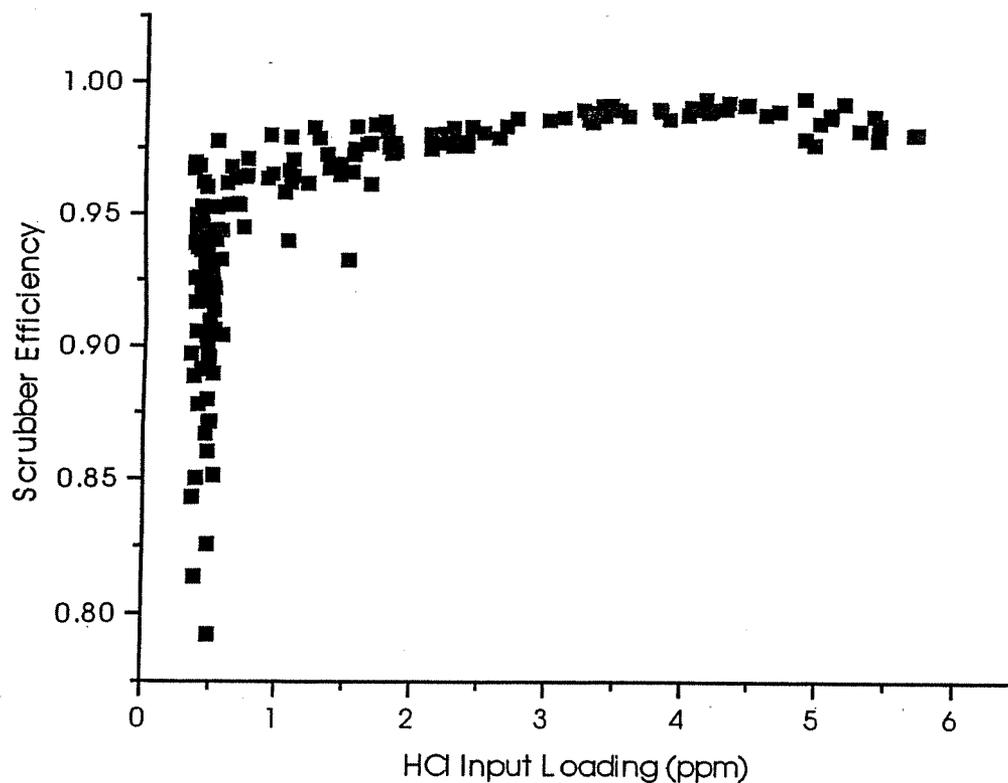


The variations in scrubber efficiency cannot be attributed to a single cause, but is probably dependent upon several factors associated with both the sampling system and the scrubber itself. For instance, it has been shown in general cases² that the scrubber efficiency is exponentially dependent on its acid loading in the vapor phase. This is depicted in Figure 4-5a, where the scrubber efficiency drastically decreased when the HCl input loading fell below 0.5 ppm. Competing with this behavior is the thermodynamics involved with aerosol formation/dissociation. Both filters used throughout test #8 were

² Method 301 Validation of Extractive FTIR at Wet Scrubbers, Radian International LLC, in preparation.

later analyzed for particulates after the overnight sampling period (the results are included in Appendix A, which indicates that NH_4Cl was the primary constituent in the exhaust stream). It was found that the inlet filter contained twice as much particulates per volume than the outlet filter, leading to an average aerosol removal efficiency of 50%. Therefore, it can be assumed that the HCl vapor entering the scrubber was not solely removed by the HCl/water interactions commonly encountered in a wet scrubber, but would interact with the aerosols being formed/removed in the scrubber, as well with the aerosols deposited on the sample filters, as previously mentioned. Unfortunately, insufficient information is available to describe a definite correlation between these effects. For the purposes of this report, an estimate of the overall scrubber efficiency was obtained by averaging all the efficiencies computed throughout test #8. That value came out to be 95%.

Fig. 4-5a: Acid Scrubber Efficiency vs. Input Loading



4.2.9 Test #9: Characterize NH₃ Emissions at KD100 Slurry

The final two tests (#9 and #10) involved monitoring the NH₃ emissions at more concentrated sources. Test #9 utilized only FTIR1 and sampled the KD100 slurry exhaust. Table 4-12 summarizes the results over the 1.5 hour sampling period, where considerable amounts of NH₃ were observed without the presence of HCl. Figure 4-6 graphs the concentration trends through two KD100 blowdowns.

Table 4-12 - Test #9 Data.

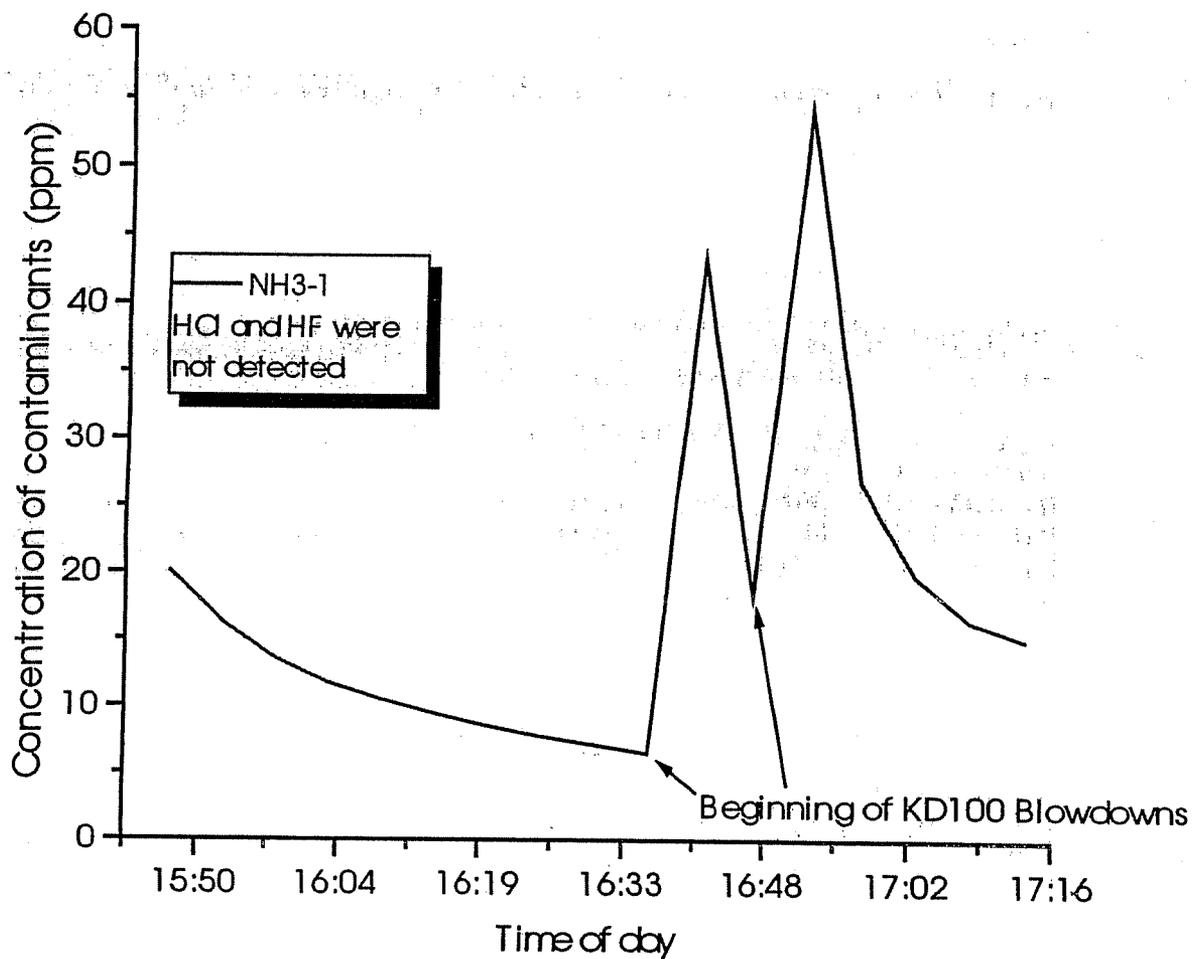
Sampling locations and configurations were as follows:

FTIR1: KD100 Slurry, filter out

Timestamp	HCl-1	NH ₃ -1	HF-1
11/21/96 15:47	ND	20.02	ND
11/21/96 15:53	ND	16.18	ND
11/21/96 15:58	ND	13.58	ND
11/21/96 16:03	ND	11.74	ND
11/21/96 16:09	ND	10.51	ND
11/21/96 16:14	ND	9.449	ND
11/21/96 16:19	ND	8.538	ND
11/21/96 16:25	ND	7.784	ND
11/21/96 16:30	ND	7.148	ND
11/21/96 16:36	ND	6.495	ND
11/21/96 16:41	ND	43.35	ND
11/21/96 16:46	ND	18.34	ND
11/21/96 16:52	ND	54.26	ND
11/21/96 16:57	ND	26.85	ND
11/21/96 17:03	ND	19.85	ND
11/21/96 17:08	ND	16.47	ND
11/21/96 17:13	ND	15.07	ND

* All concentrations are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

Fig. 4.6: FTIR Sampling of KD100 Slurry Exhaust during 11/21/96



4.2.10 Test #10: Characterize NH₃ Emissions at HF Reaction Tank

For test #10, FTIR1 was relocated to a sampling port dedicated to an HF reaction tank. A 2.5 hour monitoring period was allotted to track the NH₃ emissions from this concentrated source. Table 4-13 and Figure 4-7 include the NH₃ concentrations observed during this sampling period. It is clear that significant NH₃ concentrations are also present in this exhaust.

Table 4-13 - Test #10 Data.

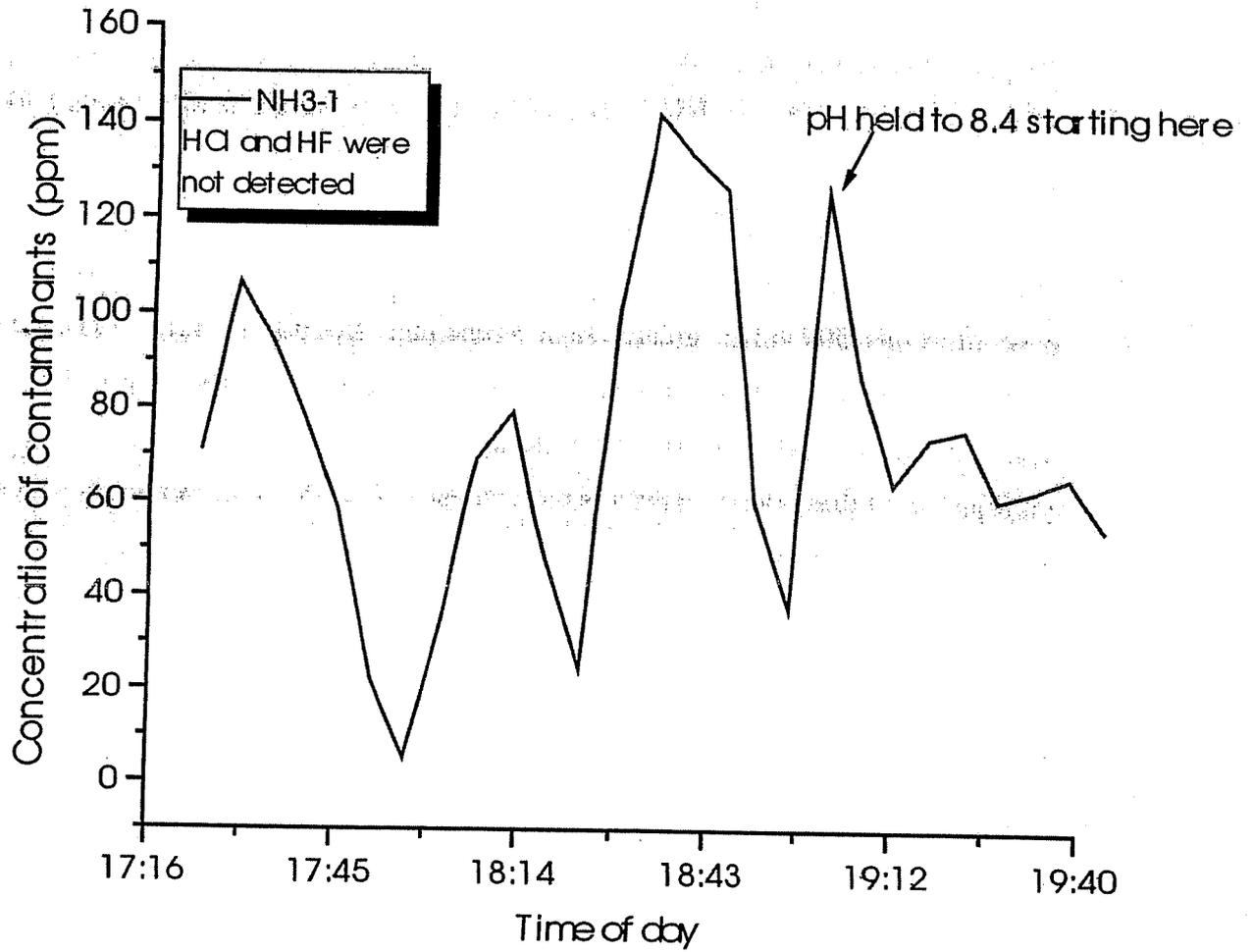
Sampling locations and configurations were as follows:

FTIR1: HF reaction tank, filter out

Timestamp	HCl	NH ₃	HF
11/21/96 17:24	ND	71.26	ND
11/21/96 17:30	ND	106.6	ND
11/21/96 17:35	ND	94.65	ND
11/21/96 17:40	ND	77.19	ND
11/21/96 17:46	ND	58.66	ND
11/21/96 17:51	ND	21.93	ND
11/21/96 17:56	ND	5.148	ND
11/21/96 18:02	ND	34.1	ND
11/21/96 18:07	ND	69.46	ND
11/21/96 18:13	ND	79.31	ND
11/21/96 18:18	ND	47.99	ND
11/21/96 18:23	ND	24.48	ND
11/21/96 18:29	ND	101.7	ND
11/21/96 18:34	ND	142.2	ND
11/21/96 18:40	ND	133.4	ND
11/21/96 18:45	ND	126.6	ND
11/21/96 18:50	ND	60.59	ND
11/21/96 18:56	ND	37.52	ND
11/21/96 19:01	ND	126	ND
11/21/96 19:07	ND	87.05	ND
pH maintained at 3.4:			
11/21/96 19:12	ND	64.23	ND
11/21/96 19:17	ND	74.24	ND
11/21/96 19:23	ND	76.03	ND
11/21/96 19:28	ND	61.06	ND
11/21/96 19:33	ND	63.09	ND
11/21/96 19:39	ND	65.99	ND
11/21/96 19:44	ND	55.07	ND

* All concentrations are in ppmv. Those compounds whose values fell below its reportable concentration limit are listed as "ND", meaning not detected. Timestamps are in central standard time.

Fig. 4.7: FTIR Sampling of HF Reaction Tank Exhaust during 11/21/96



5.0 Conclusions

Table 5-1 summarizes the results obtained from the tests described in Section 4.0, keeping in mind that the objectives of this program were to identify the primary cause of the particulates seen escaping the scrubbed exhaust system and to pinpoint all other major sources of HCl, HF and NH₃. Based on the observations made throughout this test matrix, it can be concluded that the visible plume exiting the scrubbed stack is primarily comprised of NH₄Cl aerosols. This conclusion is further supported by the results of the particulate filter analysis (Appendix A), which indicate ammonium chloride concentrations 500 times greater than ammonium fluoride or lime. The aerosols are formed before the exhaust reaches the wet scrubber, at a point where the major HCl sources (the exhaust from the HCl storage tanks) and the NH₃ sources combine. A segregation of these two exhausts is recommended in order to eliminate the appearance of a plume at the stack exit.

Table 5-1 - WTF Exhaust Characterization

Date & Test #	Purpose of test	Observations
11/18		
System set-up 1	to characterize plume composition	NH ₄ Cl identified as primary particulate; FTIR analysis supported by particulate analysis of sample filters
11/19		
2	verify presence of aerosols and characterize	NH ₄ Cl identified as primary particulate at scrubber inlet
3	characterize aerosols with HCl storage tanks dampered close	Primary source of HCl identified as HCl emissions reduced at scrubber inlet when storage tanks closed; plume dissipates
4	characterize more potential sources of HCl, NH ₃ and aerosols	Minor source (sub-ppm) of HCl, NH ₃ , and NH ₄ Cl
5	characterize aerosols during HF processes	Definite NH ₃ fluctuations at scrubber inlet; HCl emissions increased greatly when HCl storage tanks were reopened
11/20		
6	locating major sources of NH ₃ during HF processing and KD100 Blowdown	HF process + KD100 slurry + HF storage exhaust provided major source of NH ₃ which fluctuated with processes
7	locating sources of NH ₃ and HF	HF filtrate/sludge tanks exhaust provided minor source (<3 ppm) of NH ₃
8	scrubber efficiency test	Estimated avg. efficiency: 95%; significant amt. of aerosols
11/21		
9	characterize NH ₃ emissions	KD100 slurry provided major source of NH ₃
10	characterize NH ₃ emissions	HF reaction tank provided major source of NH ₃

*HF concentrations were found to be below detection limits at *all* sampling locations.

CUB Ammonia Scrubber

Objective:

Install a dedicated ammonia exhaust system (EXAM) in the CUB to address the following areas:

- 1. Visible plume from the CUB scrubber system stack.**
- 2. Potential for nuisance odors.**
- 3. Potential exhaust air entrainment into MUA intakes.**
- 4. Removal efficiencies and equipment for removal of the chemical constituents in the CUB EXSC air stream.**

Status:

Preliminary programming efforts are complete. An audit of the F12 ammonia exhaust (EXAM) system and subsequent comparison to the F11 CUB system showed similar equipment and therefore similar emission sources. Past testing performed by Radian at F12 showed that the primary source of that visible plume was Ammonium Chloride (NH_4Cl), with the HF treatment system and the Cyanide Destruct System (CDS) being the primary sources of ammonia (F12 has since ceased operation of the CDS). The bulk HCl tank and the Ultrapure Water (UPW) regeneration activities were the primary sources of HCl in the exhaust stream. The NH_4Cl forms in the ductwork when the NH_3 and HCl meet and are then passed through the ductwork and scrubber in aerosol form, causing a visible plume to exit the stack. Inspection of the F11 CUB scrubber showed large amounts of NH_4Cl in the scrubber ductwork and the scrubber inlet (results confirmed by both NM QC lab and Nalco), lending support to the theory that the F12 and F11 systems are comparable.

There was some speculation that ammonium fluoride (NH_4F) could also be part of the visible plume, but F12 testing as well as the analysis of the F11 sample show no NH_4F or free HF.

An additional source of the visible plume may also be water vapor. Based upon current velocities (230 fpm) through the F11 scrubber (from 3/18/2002 EBI report), the mist eliminator in the scrubber is passing water droplets well in excess of design size (about 10 microns). F12 experienced a similar problem and installed plates in front of the mist eliminator to effectively increase the velocity through that device. The orifice was sized so that the air velocity would be roughly 900 fpm, which allows water droplets of 10 micron and smaller to pass. Conversations with the scrubber manufacturer verify that this is a common problem for scrubbers not operating at design capacity and that the installation of the "orifice" plate is the most cost effective way to address the issue. Condensation may also be a source of water vapor exiting the stack during the colder months, but based on the height of the stack exposed to the elements, this is likely not a major contributor.

As far as the potential for nuisance odors, F12 testing showed sporadic concentrations of ammonia (NH₃) at the scrubber inlet and outlet greater than both the lower threshold value (0.038ppm) as well as the value that most people are able to detect NH₃ odors (4.68 ppm). Thus, in theory, NH₃ odors can be present at the stack outlet.

Evidence shows corrosion on metallic surfaces at the intake to the Make-up Air Units (MUAs) on the CUB roof as well as the metallic surfaces of the exhaust stacks. Based upon the current air velocities through the stack vs. the design velocities, and the NH₄Cl aerosols passing through the scrubber, it is likely that corrosive emissions are exiting the stack and are unable to enter the atmosphere and gain sufficient dilution before migrating to the adjacent surfaces. Segregation of the exhaust streams and changing the scrubber stack diameter to meet ASHRAE design criteria based upon the current exhaust load would help greatly in this regard.

The current CUB scrubber has both NH₃ and corrosive exhaust streams connected to it. The current pH (6.5-7) of the scrubber is such that only corrosive exhaust streams are being treated. In order to effectively scrub NH₃, the pH of the recirculation liquor needs to be in the pH=3 range.

Impacts/Issues:

No testing of the exhaust stream was performed on the F11 CUB scrubber. **All analysis in this report is based upon the F12 Radian testing, similarity of equipment, and chemical make-up of solids in the F11 scrubber.**

Any design activities should incorporate both a Test and Balance baseline of the system (each POC) as well as an airflow model of the exhaust emissions as influenced by proposed stack and system changes and prevailing winds.

Programming was performed under the boundary condition that no new stacks could be added to the CUB roof, nor could the existing stacks be added to in height.

“Ballpark cost” numbers are based on my personal experience and comparison to F12 and F11X EXAM install costs. Official estimates will of course need to be obtained before committing to a CPA dollar figure.

Recommendations:

Option 1:

Do nothing. Continue to operate as is.

Pros – Costs nothing. Does not impact production in any way.

Cons – Does not address visible plume or odor concerns

Ballpark cost - \$0

Option 2:

Install a point of use (POU) scrubber on the HCl bulk tank, clean out the existing NH₄Cl solids from the ductwork, clean out the Ca(OH) residue from the ductwork, install an orifice plate in front of the mist eliminator, modify stack diameter via add-on or insert cone to increase exit velocity.

Pros – Will greatly reduce the visible pluming from the scrubber, allows for exhaust emissions to dilute before contacting any adjacent surfaces or air intakes. Small POU scrubbers are onsite and available from F7 demo work.

Cons – Does not address the UPW regeneration sources of HCl and does nothing to address the potential for odors from the stack. Small amount of downtime to some equipment may be required to tie in the POU scrubber.

Ballpark cost – Probably less than \$75K

Option 3:

Install point of use (POU) scrubbers on all HCl sources (UPW regen, HCl bulk tank, AWN tanks), convert the existing CUB scrubber to an ammonia scrubber, clean out the existing NH₄Cl solids from the ductwork, clean out the Ca(OH) residue from the ductwork, install an orifice plate in front of the mist eliminator, modify stack diameter via add-on or insert cone to increase exit velocity as determined by air-flow modeling.

Pros – Will greatly reduce the visible pluming from the scrubber; addresses odor concerns.

Cons -- Very expensive. POU scrubbers typically cost about \$1K/cfm and we don't have enough salvaged from F7 demo to complete job. Will add several smaller pieces of equipment that need to be maintained. Trying to modify existing equipment may incur hidden operational concerns or reduce life expectancy. System components will have to be idled down temporarily to tie-in POU scrubbers. Many systems may be impacted in order to tie in POU scrubbers. Ammonia and HCl sources are still in the same duct, so a failure of one of the POU scrubbers could still cause buildup in the ductwork before reaching the scrubber and then pluming from the stack. May also be corrosive exhaust streams that remain on the system that are not tied to a POU scrubber and thus are not treated by the lower pH ammonia scrubber.

Ballpark cost - \$500K

Option 4:

Install a separate NH₃ exhaust system in the CUB. Segregate all ammonia sources and install new ductwork as appropriate to tie to this NH₃ system. Clean out the existing NH₄Cl solids from the ductwork, clean out the Ca(OH) residue from the ductwork, and install an orifice plate in front of the mist eliminator on the existing corrosive scrubber. Modify the stack diameter via add-on or insert cone to increase exit velocity as determined by airflow modeling

Pros – Will greatly reduce the visible pluming from the scrubber and address any potential NH₃ odor concerns. Most closely matches what F12 has done to address similar concerns. Most closely matches current POR. Can utilize existing F11X EXAM design. Physically ensures that ammonia and HCl sources are in different ducts.

Cons – Most expensive. A segregated EXAM system with appropriate ductwork, controls, and sulfuric injection will potentially be in excess of \$500K. The other items mentioned that must be done in conjunction with this option could bring the total cost to over \$600K. System impacts during construction may cause some systems to be temporarily idled.

Ballpark cost - \$600K

Option #4 is recommended by the programming team as the option that will most completely and permanently eliminates the concerns outlined in the objective section.

F11S 6/2/00 Odor Evacuation Update

⌘ Problem Statement:

F11S was evacuated on 6/2/00 from 11:30 to 13:30 due to chlorine odors inside the factory at various locations.

Cause Analysis

- ⌘ Root cause is still under investigation and may be associated with the following potential source(s):
 - ☑ *Scrubbed exhaust:* chlorine used as a biocide treatment reacts with ammonia to form gaseous chloramines, resulting in odors
 - ☑ *Cooling towers:* chlorine is used as a biocide treatment, and with high levels of evaporation, can result in chlorine odors
 - ☑ *AWS 128 duct investigation:* scrubbed exhaust duct was viewed with a boroscope on 6/5/00. No ammonia salt build up, or any other formations were noted in the duct.
- ⌘ Bottom line: atypical winds from SE to NW resulted in chlorine odors being entrained to the F11S make-up air handler intakes

Current Status

⌘ Two Make-up air handlers (MAHs) serving F11S are currently off line

These air handlers do not have odor filtration

Both of these air handlers have intakes on the NE end of the penthouse

⌘ Current odor filtration tactics

One F11S MAH, with intakes at a known recirculation zone, has odor filtration (50/50 blend C, KMnO_4)

One F11N MAH, with intake above the smoking area, has odor filtration (C only)

Proposed Solutions

- ⌘ Increase work control for Cooling Tower & Scrubber water treatment procedures
- ⌘ Investigate use of different type of biocides for water treatment
- ⌘ Adding chemical odor filtration to F11S Make-up Air Handlers

Water Treatment Changes

⌘ Work control changes

- We are evaluating the need to increase notification prior to performing water treatment activities

⌘ Chemical utilization changes

- Alternative chemicals under investigation include ClO_2 , O_3 , H_2O_2
- Alternative chemicals range from 3X-10X the cost of current chemicals
- Other safety and environmental issues exist with the use of some of the alternate chemicals

Make-up Air Chemical Filtration

- ⌘ Would include addition of 50/50 C/KMNO₄ filters to 8 remaining MAHs serving F11S
- ⌘ 50/50 Filter capability:
 - Activated carbon: excellent organic odor filtration
 - KMnO₄: excellent Chlorine/Bromine filtration
 - Not effective against every type of odor
- ⌘ Associated cost
 - Initial install: \$88K
 - Ongoing cost: \$72K to \$144K per year for materials, depending on frequency of replacement (currently being evaluated)

Summary

⌘ Recommendations

- Implement increased water treatment work control (WW/28)
- Evaluate use of different chemicals and their associated costs (WW/28)

⌘ Considerations

- Establish whether or not the frequency of evacuation events warrants further preventive action
- Funding for increased water treatment chemical costs and/or MAH odor filtration has not been

6/9/00 GSS for recasted
MRC

NM GSS

**Project Scope of Work
PR-2-0091
CUB Ammonia Scrubber**

3.1) Project Products and Results

a) Description of Work

Option 1

Provide a new ammonia scrubber in the CUB. This shall include addition of electrical, controls and LSS necessary to operate the unit. The scrubber will have a capacity of 5,000 CFM and will be located adjacent to the existing CUB scrubber unit. The work shall include but not be limited to:

Option 2

Modify the existing CUB scrubber to increase stack air velocity and provide a VFD and associated controls to allow for static pressure control.

Mechanical – Option 1

- Provide 5000 acfm ammonia vertical fume scrubber with FRP exhaust fan to be installed in existing mechanical space adjacent to CUB acid scrubber. Fan to be located overhead on exhaust platform with VFD. Fan to have integral 2" spring isolation base.
- Provide 24 dia. coated stainless steel (CSS) EXAM ductwork from fume scrubber to fan inlet with flex connection.
- Provide 24 dia. FRP exhaust ductwork from fan discharge including rectangular to round transition with flex connection and control damper through roof. Provide (2) 45 degree wye branch connection with stack. Extend stack height to be 30 LF above roof. Refer to CSA section for roof penetration and opening, stack support structure and anchoring. Refer to electrical for lightning protection.
- Provide 24" diameter CSS by-pass duct from scrubber discharge prior to ammonia scrubber fan inlet to by-pass fan inlet. Reconfigure by-pass inlet section with 45 degree wye branch for ammonia scrubber discharge tie-in. Provide backdraft damper.
- Provide stack airflow analysis to confirm stack heights.
- Provide design capacity test for fan.
- Support startup and FAT services for the ammonia scrubber system.
- New 1" PCH IRW/ICW to scrubber including isolation valves for scrubber make-up water per attached P&ID.
- New 3" QCH scrubber re-circulation water per attached P&ID.
- New 1" and 2" PCH AW drain line from scrubber to AWN system in CUB basement per attached P&ID.
- New Fire protection for the scrubber body from existing FP system.
- New ¾" 9DZ x 2" OCHN H2SO4 feed to scrubber body including manual isolation valves and containment box for pH control per attached P&ID.

Mechanical – Option 2

- Extend existing 30" dia. FRP exhaust duct discharge stack to 30 LF above roof. Refer to CSA section for roof penetration and opening, stack support structure and anchoring. Refer to electrical for lightning protection.

Electrical – Option 1

- Provide emergency power to VFD for new 25hp scrubber fan. 70A breaker, #8 wire fed to VFD. Approx run length 200ft, 1" EMT
- Provide emergency power to 2 fixed speed pumps. Approx run length 200ft each. ¾ EMT
- Provide lightning protection for stack above roof. Evaluate condition of existing lightning protection system.

Electrical – Option 2

- Tie in existing electrical to new VFD setup for scrubber. Re-utilize existing power to scrubber fan.

CSA – Option 1

Note: A/E shall provide structural engineering analysis for all structural steel modifications. Units shown in the scope below are for estimating purposes and not intended to be strictly followed by design.

- Install 4'-8" x 5'8" x 4" 6" thick concrete pad to accommodate the vertical fume scrubber. Scrubber shall be anchored to the concrete pad. Confirm sizes and bolt pattern from scrubber manufacturer.
- Install structural steel beam 8"d x 10' lg (two required) reinforcement members below the existing platform grating to support fan and isolation skid.
- Provide engineered structural steel tower as required by mechanical for support of exhaust stack above the roof. A/E shall investigate method for aesthetic blending of tall structures such that they will not be obtrusive as viewed from the village of Corrales. This will require close coordination with mechanical engineering. Stack heights will be determined by air flow analysis. Alternate methods for diagonal bracing or support shall be evaluated and considered.
- Modify existing grating on the raised platform to accommodate the install of the duct from fume scrubber to fan inlet. Provide additional structural steel to support grating around duct penetrations.
- Provide opening in ceiling/roof, structural steel frame and roof curb to accommodate duct penetrations.
- Roof modifications shall be compliant with roofing manufacturer's recommendations.

CSA – Option 2 -

Note: A/E shall provide structural engineering analysis for all structural steel modifications.

- See Option 1, lines 3, 5, 6 above.

I&C – Option 1

- Purchase and install the following instruments:
 1. Two (2) Polysonics DCT ultrasonic flowmeters.
 2. Two (2) Rosemount 3051 differential pressure transmitters with integral manifolds.
 3. Two (2) Rosemount 3051 pressure transmitters.
 4. One (1) Thornton dual channel 770 Max controller with associated PH probe and conductivity probe.
 5. One (1) Asco 1" two way solenoid valve with 24V DC coil.
 6. Two (2) Asco ¼" two way solenoid valves with 24 V DC coils.
 7. Two (2) Moore Industries TRX style temperature transmitters.
 8. One (1) Baumann 2" control valve with the following characteristics: PTFE liner, 316 SS body, Tantalum plug, Hastelloy C stem, modulating actuator, fisher 3661 positioner and Fisher 67CFR air set.
 9. Three (3) Flowline double containment leak switches.
- Run all required conduit and wire from the PLC cabinet to the instruments identified above.
- Run all conduit and wire from IPP panel to instrument (If 110 V A.C required)
 - Run all required conduit and wire from the PLC to the four (4) vendor supplied instruments, located on the scrubber body.
- Run all required conduit and wire from the PLC cabinet to the new Scrubber fan AFD.
 - Run all required conduit and wire from the PLC cabinet to the MCC's for the two (2) re-circulation pumps.
- Terminate all PLC wiring.
- Run all required instrument air piping from the POC to the instrument.
- Initiates SIPP with system owner and PLC owner during install and checkout.
- Provide necessary OAT's. The OAT shall consist of two main components, wiring check, and calibration sheets. Provide calibration sheets for every device installed. Provide factory calibration sheets for factory-calibrated devices. Provide calibration sheets for field-calibrated devices and factory-calibrated devices that do not meet operating specifications.

SWRO - Sustaining Projects

- Participate in equipment level startup and system level functional testing.
- Attend regularly scheduled project construction meetings.
- As-built contract drawings.

SI – Option 1

- Create new PLC code and CIMPLICITY screens to provide master and backup pressure control for the new scrubber fan from the two (2) new differential pressure transmitters.
- Create new PLC code and CIMPLICITY screens to provide control and indication for the blowdown system. Blowdown control for the scrubber water system will be based on conductivity.
- Create new PLC code and CIMPLICITY screens to provide full control and indication for the scrubber water PH control system.
- Create new PLC code and CIMPLICITY screens to provide re-circulation pump sequencing based on scrubber water level.
- Create all necessary CIMPLICITY alarm messages and animations.
- Create all necessary CIMPLICITY trend screens.
- Create an SOO for the CUB ammonia scrubber system.
- Provide an Intel witnessed code and screen simulation.
- Prepare SIPP's and IRN's for implementation of PLC logic changes in affected PLC's.
- Attend FIT meetings as necessary.

I&C – Option 2

- Purchase and install the Two (2) Rosemount 3051 differential pressure transmitters with integral manifolds.
- Run all required conduit and wire from the PLC cabinet to the instruments identified above.
- Terminate all PLC wiring.
- Initiates SIPP with system owner and PLC owner during install and checkout.
- Provide necessary OAT's. The OAT shall consist of two main components, wiring check, and calibration sheets. Provide calibration sheets for every device installed. Provide factory calibration sheets for factory-calibrated devices. Provide calibration sheets for field-calibrated devices and factory-calibrated devices that do not meet operating specifications.
- Participate in equipment level startup and system level functional testing.
- Attend regularly scheduled project construction meetings.
- As-built contract drawings.

SI – Option 2

- Create new PLC code and CIMPLICITY screens to provide master and backup pressure control for the new scrubber fan from the two (2) new differential pressure transmitters.
- Create all necessary CIMPLICITY alarm messages and animations.
- Create all necessary CIMPLICITY trend screens.
- Modify the SOO for the CUB scrubber system.
- Provide an Intel witnessed code and screen simulation.
- Prepare SIPP's and IRN's for implementation of PLC logic changes in affected PLC's.
- Attend FIT meetings as necessary.

Design

- A&E to provide multiple discipline construction package.
- A&E to provide long lead material list.

Field Engineering During Construction

- I&C: 80 Hours.
- Mechanical: 80 Hours.

b) WBS SUMMARY OF WORK:

The following Intel Master Specifications shall be adhered to as part of this scope of work:

1. Division 3 – Concrete Materials and Methods
 - a. Section 03317 – Cast in Place Equipment Foundations
2. Division 5 – Basic Metal Materials and Methods
 - a. Section 05100 Structural Steel
3. Division 7 – Basic Thermal and Moisture Protection Materials and Methods.
 - a. Section 07700 – Roof Specialties and Accessories
4. Division 11 – Equipment
 - a. Section 11542- Exhaust Scrubbers
5. Division 13 – Special Construction
 - a. Section 134XX- Fiber Optic Cable, Pneumatic Device Piping, Instrument Tagging, System Integration, Instruments, Command Center Control Console
 - b. Section 138XX- Instrumentation And Controls, Control Panels, Programmable Logic Controllers, SCADA Hardware/Software, Electrical And Controls Requirements For Packaged Equipment, Direct Digital Control System
 - c. Section 13930 – Fire Protection Systems
6. Division 15 – Mechanical
 - Section 15050 – Basic Mechanical Requirements
 - Section 15060 - Pipe And Pipe Fittings – General
 - Section 15061 - Piping Supports And Anchors
 - Section 15075 – Mechanical Identification
 - Section 15082 - Equipment, Vessels, And Piping Insulation
 - Section 15111 – Manual Valves
 - BA-22: (8) 1”
 - BA-22: (10) 2”
 - BF-11: (6) 3”
 - CK-78: (2) 3”
 - CK-24: (1) 2”
 - DA-13: (2) 2”
 - Section 15112 – High Purity Manual Valves
 - DA-23: (4) ¾”
 - Section 15142 – Copper Piping Systems
 - Section 15143 – PVC and CPVC Piping Systems
 - 75’ 1”-ICW-PCH
 - 40’ 3”-SCS-QCH
 - 150’ 2”-AW-PCH
 - 40’ 1”-AW-PCH
 - Section 15181 – Carbon Steel Piping Systems
 - 125’ 1”-FP-AEB
 - Section 15235 – Plastic Tubing Systems
 - 50’ ¾”-H2SO4-9DZ
 - Section 15236 –
 - 50’ 2”-OCHN (Double containment for the H2SO4 pH feed)
 - Section 15813 – Coated Stainless Steel Ductwork
 - Section 15815 – Fiberglass Reinforced Plastic (FRP) Ductwork
 - Section 15832 – Exhaust Fans
 - (1) 5000 acfm EXSC Exhaust fan, 25 hp with VFD
 - Section 15951 - Piping Systems Adjusting And Balancing
 - Section 15952 – Air Systems, Testing, Adjusting, and Balancing
 - Section 15995 – Systems Startup and Commissioning
7. Division 16 – Electrical Systems
 - a. Section 16265 – Variable Frequency Drives

c) Drawing and /or Diagrams:

1. Construction Documents to be provided by design.

d) Major Assumptions

1. Scrubber re-circulation pumps to be purchased with scrubber.
2. F11X Ammonia Scrubber design (dated 11/21/01) used as baseline for SOW.
3. Long lead equipment:
 - a. Ammonia scrubber package equipment
 - b. Exhaust fan with VFD
 - c. Coated Stainless Steel ductwork
4. Existing power for option 2 can be re-utilized and fed to new VFD setup

e) Acceptance Criteria

1. Startup/FAT of systems.

f) Applicable Specifications and Quality Standards

The project will use the Intel Master Specifications. These specifications are located at:

<http://lnd-sc01.sc.intel.com/specilib.nsf/TOC?OpenView&Start=1&Count=60&Collapse=16#16>

g) Exclusions

The project will NOT provide the following:

1. Distribution ductwork headers, laterals, and POCs from ammonia scrubber to equipment.
Drain lines, etc. associated with distribution ductwork.

h) Safety Considerations

Work shall proceed following normal safety precautions and NM EHS Site Guidelines.

3.2) Milestone Schedule

	Start	Finish
Scope of Work Finalized:	4/19/02	4/26/02
Design:	TBD	TBD
Procurement of Construction:	TBD	TBD
Construction:	TBD	TBD
Substantial Completion:	TBD	TBD

3.3) Process

a) Applicable Government Rules, Regulations and Laws:

This work is covered under the site Construction Permit. No government approval or governmental permitting is required.

b) Project Process:

- i) This project run according to the processes outlined in the CMP Manual. This project shall meet all the CMP Manual requirements.
- ii) Redlines are required, showing routing, pipe/conduit sizes, location of valves and valve boxes, and designating all materials used.
- iii) The A/E shall incorporate redlines into (Intel) system masters and submit to Intel Document Control for CAD check to Intel/National CAD Standards. If needed, Intel may reject the submitted master drawings for rework by the A/E needed.

c) Change Control Process:

- i) Only work listed in the Project Scope will be addressed in this project. A "Change of Scope Document" will be required to add work to this project. A "Change of Scope Document" will be

required to remove work from this project. A "Change of Scope Document" will be required to change the budget and/or schedule of this project.

d) Project Team:

- i) Coordinate all construction work with, through project manager.

3.4) Budget

The budget shall be established from requestor's estimate.

3.5) Agreement/Signatures

APPROVED BY:	PRINTED NAME	SIGNATURE	DATE
Project Manager:	Keith Coffee		
Engineering:	Jennifer Ahrens (M)		
	Andy Avery (M)		
	Mike Barrett (I&C/LSS)		
	Leonard Apodaca (E)		
	Milo Chavez (CSA)		
Requester:	Jeff Kindley		
Safety:	Kevin Robideau		
System Eng:	Jeff Kindley		



ERT POSTMORTEM

EMERGENCY RESPONSE TEAM INCIDENT

ERT Number : 13028
Incident Datetime : 09/09/2000 01:36 PM **Postmortem Datetime** : 00/00/0000 00:00 AM
ERT Leader : WOOD WILLIAM.R
Incident Title : Sulfuric spill in CUB acid berm

Incident Reported Datetime : 09/08/2000 04:00 PM

Site	: NEW MEXICO	Category	: Haz Materials
Campus	: RIO RANCHO	Sub Category	: Corrosive
Building	: RIO RANCHO CUB	Severity	: 1
EHS Org	: NM SMS	ERT Labor Hours	: 17
Area	: GSS SUPPORT AREA	ERT Coordinator	: Glen Kilcup
Functional Area	: CUB (Central Utilities Building)	Physical Location	: CUB sulfuric berm
False Alarm	: <input type="checkbox"/>	Construction Related	: <input checked="" type="checkbox"/>
		Shift	: 07

Additional Details :

Equipments Involved

Associated Owners

ERT Incident Details

During the initial fill of the new sulfuric tank at the cub, a leak developed on the outlet of the tank at the valve flange. A failed gasket was the cause. The offload was stopped and the contractor who performed the tank install was called. A pump was set up to transfer the sulfuric from the new tank to the tanker in front of the CUB. The pump leaked sulfuric into the caustic berm in the caustic room, pump leak was repaired and transfer continued. When what was believed to be all the sulfuric in the tank was pumped to the tanker, the outlet flange was unloosened and sulfuric began to pour out into the sulfuric berm. Contractor evacuated the area until the stream stopped. Contractor replaced the failed gasket. SUS ERT performed confined space entry into the berm under the grating to squeegee the berm. Keers was then brought in to decon. the remainder of the berm. A water truck was commandeered and used to pump large quantity of water quickly into the berm. This was pumped down to the AWN and Keers performed the final decon of berm. ERT stands down.

List Responders : (Do not list names of injured parties)

Chronology of Response :

09/08/00 1600 Contractor notified ERT of spill
 09/08/00 1700 ERT entry to squeegee berm
 09/08/00 1900 ERT compleates major removal of sulfuric
 09/09/00 0900 ERT pumps large amounts of water into berm - pH now at 5
 09/09/00 1130 Keers preforms decon
 09/09/00 1330 Keers done - pH of berm at 8, incident closed.

List device identity codes activated :

ERT Postmortem Report

Postmortem Datetime :

< Enter Investigation Results / Closure Report (Lessons Learned) / Postmortem of Incident >

ERT Incident Related ARs



ERT POSTMORTEM

EMERGENCY RESPONSE TEAM INCIDENT

ERT Number : 10770
Incident Datetime : 05/13/2000 11:56 PM **Postmortem Datetime** : 00/00/0000 00:00 AM
ERT Leader : GRILL JAMES.E
Incident Title : SUS/UPW HRROP NaOH Spill

Incident Reported Datetime : 05/13/2000 04:15 AM

Site	: NEW MEXICO	Category	: Haz Materials
Campus	: RIO RANCHO	Sub Category	: Corrosive
Building	: RIO RANCHO CUB	Severity	: 2
EHS Org	: NM SMS	ERT Labor Hours	: 14
Area	: GSS SUPPORT AREA	ERT Coordinator	: Rick Deweese
Functional Area	: CUB (Central Utilities Building)	Physical Location	: CUB Basement
False Alarm	: <input type="checkbox"/> Construction Related	Shift	: 06
Additional Details	:		

Equipments Involved

Associated Owners

ERT Incident Details

Contributing Factors

Primary : Equipment/Component Related
Sec :

List Responders : (Do not list names of injured parties)
 Eddie Stout, Duane Stair, Ramon Carrasco, Abel Jimenez, Mike Beglau, Bill Cherryholmes, Jay Grill(Leader)

Chronology of Response :

5/13/00 Saturday morning
 0415-UPW alarm indicating high sump in the HRROP caustic containment skid
 UPW techs went to investigate.
 0422-UPW techs call ERT leader Jay Grill to respond to leak on skid.
 Evaluated situation JHA of incident. Roped off area. Called to notify security and called Rick Deweese on incident update. Two techs went in with SCBA due to airborne fumes to investigate where the leak was. Opened basement overhead doors to help ventilate area. Shut down HRROP pump and valved out leaking flange. Leak stopped at this point. No more SCBA required. Techs suited up in chemical resistant gear and proceeded to decon area outside containment berm of skid. Looked to be 5-8 gals. of 30% NaOH spilled. Skid containment area looked to have 30-50 gals. which will be pumped to AWN on day shift.
 0550-Passed down incident to day shift ERT leader and updated the progress of the cleanup.
 1800-Recieved pass down from day crew on progress of incident cleanup.
 Area deconed and cleaned up. The ERT danger tape will stay in place till the flange is repaired

List device identity codes activated :

ERT Postmortem Report

Postmortem Datetime :

< Enter Investigation Results / Closure Report (Lessons Learned) / Postmortem of Incident >

ERT Incident Related ARs



ERT POSTMORTEM

EMERGENCY RESPONSE TEAM INCIDENT

ERT Number : 10450
Incident Datetime : 04/24/2000 05:18 PM **Postmortem Datetime** : 00/00/0000 00:00 AM
ERT Leader : DEWEESE RICHARD.C
Incident Title : 2nd report, HRROP 10% Sulfuric Spill in cub basement

Incident Reported Datetime : 04/24/2000 07:30 AM

Site : NEW MEXICO	Category : Haz Materials
Campus : RIO RANCHO	Sub Category : Corrosive
Building : RIO RANCHO CUB	Severity : 1
EHS Org : NM SMS	ERT Labor Hours : 38
Area : GSS SUPPORT AREA	ERT Coordinator : Rick DeWeese
Functional Area : CUB (Central Utilities Building)	Physical Location : Cub Basement - HRROP skid
False Alarm : <input type="checkbox"/> Construction Related : <input type="checkbox"/>	Shift : 05
Additional Details : HRROP High Point Vent Flange Failure	

Equipments Involved

Contributing Factors

Associated Owners

Primary : Equipment/Component Related

ERT Incident Details

Sec :

List Responders : Rick DeWeese - IC, Leonard Torres - ERT Ldr, Responding Members: Jeanine Kinzer, Ron Garduno, Richard Perea, Brent Connolly, Dell Gutierrez, Johnny Urioste, Robert Waldron

Chronology of Response :

0238 Flange failure on HRROP Sulfuric Acid Reclaim line, releasing estimated 100 Gallons of 10% Sulfuric Acid into catch trough, and spraying onto pipes and basement floor. Stabilization measures taken to lock and tag out pumps and valves. Notifications to IC and Manager. Decision made to let situation stabilize, no impact to production.

2nd Response:

0600 passdown occurs between night shift ERT and shift 5 ERT.
 0730 IC, Leader review situation and develops action / safety plan.
 0800 Impacts: No immediate impact to HRROP shor-term, will need to affect repairs.

Area contaminated with 10% sulfuric in water. Overhead hazards dry, but possible liquid still contained in secondary containment trough. Immediate area of contaminated contained to NW corner of basement, HRROP skid, mezzanine and pipes. Below is MEWP, pallets with parts and pumps. Floor has various pools of liquid, which will be diverted to AWN sump.

PPE: Level C (APR), Full suit, boots, glasses, acid gloves, note incorporate face shield if splashing is possible.

Decon Plan: Neutralizer in buckets mixed with water. Wipe down equipment, and transfer to new pallets. Wash down floor and squeegee to AWN sump. Will bring in Keers for detail decon of pipes, mezzanine, and other contamination.

Plan of action:

- 1st step: Decon lift basket, inspect and use it to identify source of failure, check trough.
- 2nd step: remove pallets, decon equipment.
- 3rd step: Decon of floor and squeegee to AWN.
- 4th step: external decon team to clean up all contaminated areas, make arrangement with Keers for further decon on Tuesday.
- 5th step: Make repairs if possible.

Entry team: Leonard Ldr, Jeanine tech ops, Richard, Ron, Johnny, Robert, joined by Dell and Brent later.

0830 Team enters area and implements action plan. By this time all overhead liquid was gone.
 1030 IC follows up with team. Investigation on failure reveals High Point Vent Flange failed under high pressure resulting from small leak which damage seal and bolts. Flange socks minimized area of spill. Equipment deconned and will be sent to the Decon Facility for additional decon. Contaminated pallets stacked and taped off. Floor in the process of being washed down with water to the AWN sump.

11:00 Pulled team out for a break. The valve, gasket and bolts deconned for incident review. Replacement parts identified and ordered.

1300 Action plan revised to mop down floor with neutralizer, followed by mopping down with water. At the same time repairs made to the valve.

1500 Repairs complete, still getting hot spots on various sections of the basement floor. Decision made to mop again, with testing to continue through tomorrow. Area cleaned up, segregated contaminated debris, general trash and decon materials. Transferred materials up from the basement, for transfer to the Decon and HW facilities.

1600 Final review of actions and determination of further steps. Keers will continue decon Tuesday, and take care of packaging contaminated pallets for HW disposal. Immediate area still barricaded with ERT tape, and passdown to night shift will be made at



ERT POSTMORTEM

EMERGENCY RESPONSE TEAM INCIDENT

Contaminated pallets for RVV disposal. Immediate area still barricaded with ERT tape, and passdown to night shift will be made at 1800. Flange socks on order, and the HRROP system will remain locked out until investigation is complete. Lessons Learned meeting scheduled for Tuesday morning.

List device identity codes activated : HRROP containment sump pump.

ERT Postmortem Report

Postmortem Datetime :

< Enter Investigation Results / Closure Report (Lessons Learned) / Postmortem of Incident >

ERT Incident Related ARs



ERT POSTMORTEM

EMERGENCY RESPONSE TEAM INCIDENT

ERT Number : 10444
Incident Datetime : 04/24/2000 03:27 AM **Postmortem Datetime** : 00/00/0000 00:00 AM
ERT Leader : GORDON JR JOHN.E
Incident Title : Sulfuric acid leak in CUB basement.

Incident Reported Datetime : 04/24/2000 02:38 AM

Site	: NEW MEXICO	Category	: Haz Materials
Campus	: RIO RANCHO	Sub Category	: Corrosive
Building	: RIO RANCHO CUB	Severity	: 1
EHS Org	: NM SMS	ERT Labor Hours	: 3.5
Area	: GSS SUPPORT AREA	ERT Coordinator	: Rick Deweese
Functional Area	: CUB (Central Utilities Building)	Physical Location	: CUB basement NorthWest corner
False Alarm	: <input type="checkbox"/>	Construction Related	: <input type="checkbox"/>
Additional Details		Shift	: 04

Equipments Involved

Contributing Factors

Associated Owners

Primary : Equipment/Component Related

ERT Incident Details

Sec :

List Responders : (Do not list names of injured parties)
 John Gordon (leader), Mike Beglau, Andy Barela, Rick O'Roark, Richard Henry (UPW non-ert)

Chronology of Response :

0238-Mike Beglau was working in the basement when he noticed the sump pumps activate. He went to investigate why the pumps started and noticed a large puddle of liquid on the floor. He called for Andys' assistance. Mike placed PH paper in the liquid which immediately PH'd at Zero. He then called for John. Upon investigation a large leak is found raining down from the overhead in the North West corner.

0242-John calls for Rick O'Roark to bring SCBA equipment. The liquid is identified as 10% sulfuric acid. This is associated with the UPW SAR. The SAR pumps are shutdown and valves isolated. The leak has stopped. Remote isolation was possible. No entry into the hot zone was needed.

0250-John Notifies security of situation and request notices over the PA system be made every 20 minutes "to stay out of the CUB basement". Andy and Mike place ERT tape at all basement entrances. Richard Henry will perform lockout/tagout on the UPW/SAR equipment. (5 locks total 2-pumps & 3-valves).

0253-John calls Rick Deweese at Home. Informed him of what happened, that the leak is isolated, Total leak approximately 100 gallons. No foreseeable impacts to IWS or UPW operations (except HRROP regeneration). Rick makes the decision to leave everything as is based upon the isolation, preventive/safety measures already in place, and number of available personnel.

0257-John Notifies George Zuni (co-Leader) of situation.

0300-SCBA equipment returned (unused).

0303-Richard Henry calls Lew Watson and Mark Siglock at home. John and Richard have a conference call with Mark and inform him of the situation.

List device identity codes activated :

ERT Postmortem Report

Postmortem Datetime :

< Enter Investigation Results / Closure Report (Lessons Learned) / Postmortem of Incident >

ERT Incident Related ARs

Response to Corrales Comment Characterization of Intel June 21, 2003

The Corrales Comment ran an article June 21, 2003 challenging the answer to one of the questions Jeff Radford posed to Intel during the Feb/Mar Task force meetings.

As those following the NMED Corrales Task Force may recall, Intel answered close to 100 questions in writing covering a variety of emissions and operations related topics specific.

The original question was: "What are the dates and cases of Intel evacuations or other corrective measures at times when outside (ambient) air drawn into a building is deemed to be unsuitable?"

Intel interpreted the question to be outside sources that could be pulled into the factory and cause an evacuation. We reported on those incidents using that interpretation.

The Comment article calls Intel's answer an attempt to "cover-up" information and to present a "deception" to the community. That is an overstatement.

In preparing the answer for this question, three of us reviewed the summary reports. Four events were clearly noted as evacuations that were the result of "outside (ambient)" air being drawn into the building. Two reports were not included in the original answer because it was not clear the source was from outside ambient air.

These two incidents include a fan bearing overheating and causing a burning odor, and a factory tool modification causing a chlorine or ammonia odor from the scrubber. As best we can recall, these were excluded because they appeared to be events internal to the building.

Based on the interpretation outlined in the Corrales Comment we are submitting the amended answer to the original question to comprehend the data from the two additional reports.

Updated Answer to Question #15

There have been only a few such incidents over the last five years. The incidents we found in the records were caused by: Idling Diesel Truck on Hwy 528 (1998), Fan Bearing Grease Burning (1999), F11 Tool Modification Chlorine Odor (2000), Crematorium (2000), Painting Odors (2001), Off-Site Gasoline (2001).

Jim Casciano
Tim Higgs
Mindy Koch

Information on Potential Cooling Tower
 Cooling Tower Water Volatile / Odorous Compounds
 Consultants:

Analyte	Primary Source	Peak estimated mass (lb/hr)	Estimated peak emission (NEQ ppm)	Highest air monitoring results (NEC)	peak estimated CUB (ppb)	Estimated peak emission CUB (ppm)	Highest air monitoring results (CUB)	highest air monitoring (ppm)	Order Threshold (ppm)	RAW (g/mol)	Published Backg. Levels Air (ppb)	CAS	TLV (ppm)	STEL (ppm)	EPA MCL (ppm)	Year Pressure C (mmHg)	NOAEL (ppm)	ATSDR Minimal Risk Level (ppm)	Henry's Constant (ppb)	Published Background Levels in local Supplies (ppb)	pH range NEG CT	pH range CUB CT	Highest Average NEQ CT water (ppb)	Highest Average CUB CT water (ppb)	
Ammonia	Recycled water (AWN, TIW, URW)	1.59	0.063	no data	3.06	0.155	no data	<0.056	0.043-53	17.03	7.7-35	7564-41-7	25	35	none		12.5	0.3 ppm	5.11-9.57	6.45- 8.71	21,670	10,400			
Bromine (B2)	Water treatment (sodium bromide)	0.06	0.003	no data	0.02	0.001	no data	<0.0025	0.0099-0.046	159.81	7726-95-6	0.1	0.2	none	212	<.0.3	none	no data				510	90		
Chlorine (Cl2)	Water treatment (sodium hypochlorite)	0.06	0.003	no data	0.02	0.001	> or = 30 ppb	0.0038	0.021-3.4	70.91	Ambient levels in metropolitan areas such as Cincinnati or Baltimore average 20 ppb	7782-50-5	0.5	1	4	5.83x10E3							510	90	
Monochloramine	potential byproduct of water treatment	0.03	0.002	no data	0.01	0.001	no data	no data	0.65	51.4755		10559-90-3	none	4	4								n/a	n/a	
Dichloramine	potential byproduct of water treatment	0.70	0.037	no data	0.01	0.000	no data	no data		85.9205		3400-09-7	none	4	4									n/a	n/a
Trichloramine	potential byproduct of water treatment	0.01	0.001	<0.037 ppm	0.02	0.001	<0.039 ppm	<0.045		120.3657		10025-85-1	none	4	4								ND	ND	
Bromamine	potential byproduct of water treatment		0.000	no data		0.000	no data	no data															ND	ND	
Total THMs	potential byproduct of water treatment		0.000	n/a		0.000	n/a	n/a				n/a		0.1	0.1				1.28 *			ND	ND		
Chloroform	potential byproduct of water treatment		0.000	no data		0.000	no data	Kelley / Harry	0.6-1413	119.38	67-66-3	10	none	0.1	197				0.2 *			ND	ND		
Bromoform	potential byproduct of water treatment		0.000	no data		0.000	no data	0.03 ppb	0.19-15	252.8	75-25-2	0.5	none	0.1					8.5 *			ND	ND		
Dibromochloromethane	potential byproduct of water treatment		0.000	no data		0.000	no data	Harry		208.2759	124-48-1	0.1		0.1					3.2 *			ND	ND		
Bromodichloromethane	potential byproduct of water treatment		0.000	no data		0.000	no data	Harry				0.1		0.1					0.8 *			ND	ND		

Intel Corporation
4100 Sara Road
Rio Rancho, NM 87124-1025
(505) 893-7000
www.intel.com



November 15, 2000

Certified Mail No. P370 371 028
Return Receipt Requested

Mr. Robert Samaniego, Compliance Section
New Mexico Environment Department, Air Quality Bureau
2048 Galisteo Road
Santa Fe, New Mexico 87505

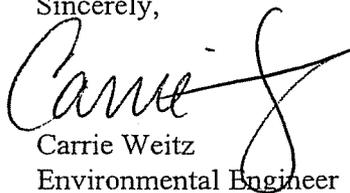
Re: Air Quality Permit 325-M-9, Condition 9.A.ii - Stack Test Submittal

Dear Mr. Samaniego,

Pursuant to Condition 7.C.i of Air Quality Permit 325-M-9, Intel conducted testing for Hazardous Air Pollutants (HAPs) ducted to the thermal oxidizers. The testing was conducted October 13-15, 2000. At the time of testing, the production equipment ducted to the stacks tested at Fab 7 were operating at approximately 100% of capacity, as currently configured, and at Fab 11 (North and South) were operating at approximately 90% of capacity, as currently configured.

Enclosed please find one copy of the test report. If you have any questions, or need additional information, please contact me at (505) 893-8695.

Sincerely,


Carrie Weitz
Environmental Engineer

Enclosure

(EHS 086)

cc: Files

Method 3 Carbon Dioxide, Oxygen, and Dry Molecular Weight Determination

A portion of the gas from the sampling train was collected into Tedlar bags. The gas in the Tedlar bags was analyzed on site for carbon dioxide (CO₂) and oxygen (O₂) with an Orsat Gas Analyzer. Dry molecular weight was calculated from CO₂ and O₂ concentrations.

Method 4 Moisture Content Determination

Water entrained in the stack gas was condensed and collected in chilled impingers in conjunction with the isokinetic sampling. The volume of gas sampled was measured with a calibrated dry gas meter. Moisture content was calculated from the gas and liquid volumes.

Method 18 Gaseous Organic Compounds Determination

See Appendix C

D. Deviation from EPA Methods or from the Original Protocol

There were no deviation from the EPA Methods.

The test program was originally performed using Summa Canisters on July 12, 13, and 14, 2000 with analysis for methanol and xylenes. This test data was voided because the results indicated methanol and xylenes were present in the Fab 11 North and Fab 7 thermal oxidizers. At no time during the test program was methanol or xylene used in the fabrication processes for Fab 11 North or Fab 7. This data is included in Appendix D as an attachment. It is apparent that the analytical data is faulty and the testing was reperformed utilizing on-site gas chromatography for methanol and xylenes. This was approved by Mr. Robert Samaniego of the NMED.

7s.8.1

D 0001

Job No: 00-1064
 Field Data % M
 Source ID No: _____

Run # 1
 Sample Box No: _____
 Filter No: Q

Impinger #	1	2	3	4	5
Contents/Vol.	<u>100ml DE</u>	<u>100ml DE</u>	<u>Dry</u>	<u>Silica Gel</u>	<u>N/A</u>
Tip Style*	<u>Mod</u>	<u>G. Sm</u>	<u>mod</u>	<u>→</u>	<u>→</u>
Final Wt.	<u>591.3</u>	<u>639.9</u>	<u>615.8</u>	<u>770.3</u>	<u>→</u>
Initial Wt.	<u>595.6</u>	<u>640.6</u>	<u>615.2</u>	<u>757.5</u>	<u>→</u>
Difference	<u>-4.3</u>	<u>-0.7</u>	<u>0.4</u>	<u>12.8</u>	<u>→</u>
Total (V _L)	<u>8.4 ✓</u>				

V _L =	_____
V _{IC} =	_____
ΔH =	_____
T _s =	_____
T _m =	_____
V _{std} =	<u>31.402</u>
% M	<u>1.25</u>
M _d =	<u>0.9875</u>
V _{w, gas} =	<u>0.396</u>
M _{w, d} =	<u>28.26</u>
M _w =	<u>28.73</u>
V _s	<u>3285</u>
acfm	_____
dscfm	_____
EA	_____
% ISO	_____

Calculations

$$V_{wc} = 0.04707(V_L)$$

$$V_{std} = \frac{(17.647)(V_m)(P_{bar} + \frac{\Delta H}{13.6})(Y)}{(460 + T_m)}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{std} + V_{w(std)}} \times 100\%$$

$$G_d = 100 - B_{ws}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2 + \%CO)$$

$$M_s = (M_d)(G_d/100) + (18)(B_{ws}/100)$$

$$P_s = (P_{bar}) - \frac{(P_g)}{(13.6)}$$

$$V_s = (K_p)(C_p)(60)(\sqrt{\Delta P}) \left(\frac{(\bar{T}_s - 460)}{(M_s)(P_s)} \right)$$

$$Q_a = (A_s)(V_s) \quad (\text{acfm})$$

$$Q_{std} = \frac{(Q_a)(P_s)(17.647) \left(\frac{G_d}{100} \right)}{(T_s + 460)}$$

$$I = \frac{K(\bar{T}_s - 460) \left(\frac{V_{m(std)}}{1} \right)}{(P_s) \left(\frac{V_s}{60} \right) \left(\frac{\pi D_n^2}{4} \right) \theta \left(\frac{D_g}{100} \right)}$$

- V_L = Volume of Liquid Collected (grams or ml)
- M_d = Dry molecular weight of sample gas (lb/lb-mole)
- M_s = Molecular weight of sample gas, wet (lb/lb-mole)
- %CO₂ = Percent by volume of CO₂ in the gas stream
- %O₂ = Percent by volume of oxygen in the gas stream
- %CO+%N₂ = Percent by volume of CO and N₂ in the gas
- G_d = Percent of dry gas by volume in the gas stream
- B_{ws} = % by volume of water vapor in the gas stream
- P_s = Absolute sample gas pressure (inches of Hg)
- P_{bar} = Barometric pressure (inches of Hg)
- P_g = Sample gas static pressure (inches of H₂O)
- 13.6 = Conversion factor (inches H₂O/inches of Hg)
- C_p = Pitot tube constant
- K_p = Velocity pressure coefficient (dimensionless) = 85.49
- 60 = Conversion factor (sec/min)
- M_s = Molecular weight of sample gas, wet (lb/lb-mole)
- P_s = Absolute sample gas pressure (inches of Hg)
- T_s = Average sample gas temperature (°F)
- V_s = Sample gas velocity (ft/sec)
- √ΔP = Average square roots of velocity heads of gas (in H₂O)
- 460 = Conversion constant (°F to °R)
- Q_a = Volumetric flow rate at actual conditions (acfm)
- A_s = Cross sectional area of sampling location (ft²)
- V_s = Sample gas velocity (ft/min)
- Q_{std} = Vol. flow rate at standard conditions, dry (dscfm)
- K = 0.09450 = constant
- D_n = Average diameter of nozzle (ft)
- θ = Total sampling time (min)

D 0003

Data Analysis Technologies, Inc.

7715 Corporate Boulevard
Plain City, OH 43064

Sample Analysis Certificate

Western Environmental
913 Foster Road
Casper, WY 82601

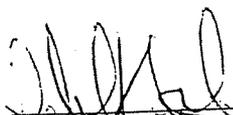
Date: 8/7/00
Project ID: 0700026
Sample Date: 7/12/00-7/14/00
Date Received: 7/18/00
Analyzed By: BEN
Date Analyzed: 8/1/00

Attn: Mike Reynolds
Project #: 00-216

Methanol & Xylenes by Method 18

See appended Data & QC Summary Tables

Reviewed and approved for release by:


President

Date:



D 0042

Data Summary Table

Analysis: Methanol & Xylenes by GC-FID

Client: Western Environmental

Project #: 0700026

Analytes	DAT ID	Analyte	Run 1 ppm	Run 2 ppm	Run 3 ppm
115.8-1a-1 (6958)	0700026-1	Methanol	6.03	6.15	
		m,p-xylene	1.15	1.09	
		o-xylene	1.06	1.02	
115.8-1a-2 (6823)	0700026-2	Methanol	6.22	6.30	6.22
		m,p-xylene	4.76	5.66	6.16
		o-xylene	4.22	5.96	5.40
115.8-1a-3 (6960)	0700026-3	Methanol	24.42	24.61	
		m,p-xylene	6.62	6.72	
		o-xylene	5.46	5.42	
105.8-1a-1 (6965)	0700026-4	Methanol	14.99	15.14	
		m,p-xylene	3.89	3.85	
		o-xylene	3.30	3.44	
105.8-1a-2 (5294)	0700026-5	Methanol	9.89	9.71	
		m,p-xylene	2.91	2.91	
		o-xylene	2.52	2.47	
105.8-1a-3 (2490)	0700026-6	Methanol	8.84	9.07	
		m,p-xylene	2.47	2.65	
		o-xylene	2.20	2.19	
75.8-1-1 (6963)	0700026-7	Methanol	6.98	6.95	
		m,p-xylene	2.03	1.96	
		o-xylene	1.74	1.76	
75.8-1-2 (4911)	0700026-8	Methanol	6.32	6.31	
		m,p-xylene	1.72	1.81	
		o-xylene	1.61	1.64	
75.8-1-3 (2492)	0700026-9	Methanol	5.48	5.59	
		m,p-xylene	1.81	1.86	
		o-xylene	1.61	1.53	
Blank (6726)	0700026-10	Methanol	2.00	2.00	ND
		m,p-xylene	1.00	1.00	ND
		o-xylene	1.00	1.00	ND

ND: Analyte not detected. Minimum detection reported.

D 0044

Robert Samaniego

From: Debra McElroy [debra_mcelroy@nmenv.state.nm.us]
Sent: Monday, June 21, 2004 3:17 PM
To: Robert Samaniego
Subject: FW: Further information regarding allegations of former employees

I finally got this
 -----Original Message-----

From: Koch, Mindy J [mailto:mindy.j.koch@intel.com]
Sent: Friday, June 18, 2004 4:53 PM
To: Debra McElroy; sandra_ely@nmenv.state.nm.us; John_Volkerding@nmenv.state.nm.us;
 robert_samaniego@nmenv.state.nm.us
Cc: Koch, Mindy J
Subject: Further information regarding allegations of former employees

Debra,

Below are the responses to your questions on both the Cooling Tower constituents and the Q3'00 Stack Testing. Additional explanation of the cooling tower evaluation is also provided to better explain how it was conducted and the limitations of the evaluation.

Cooling Towers:

The analysis of potential cooling tower (CT) emissions Intel conducted in 2002 was based on the CT water chemistry. Sodium hypochlorite and sodium bromide both are used for disinfecting the water in the Intel NM CTs. A portion of the makeup water for the CTs includes parts-per-million (ppm) quantities of ammonium ions. The pH of the CT water is in the range of 7 to 9 units. These conditions are associated with a somewhat complex chemistry that is described in the following documents (internet links provided). The first link is specific to chlorination chemistry in CTs. The second link relates to disinfection of cooling water; this link complements the discussion in the first link with information about the interrelationships between chlorine- and bromine-based disinfectants. The third link includes a useful figure showing the dependency of individual species of free chlorine with pH.

<http://myhome.hanafos.com/~criok/english/publication/chlorine/chlorine5.html>

http://www.ukmarinesac.org.uk/activities/water-quality/wq8_28.htm

<http://www.edstrom.com/DocLib/MI4148.pdf>

Q1. How were the analytes in the first column chosen?

The analytes represent volatile constituents of CT water that are known or theoretically could be present, many in trace quantities, under normal CT operation and conditions. The halogenated substances in the list are associated with the use of chloro-/bromo-disinfectants (oxidizing biocides) that are used to control microbial growth in the CT systems. Ammonia is associated with the presence of small amounts of ammonium ions in the reuse water that represents a portion of the makeup water for the CTs. Ammonium ions are weak acids that partially dissociate into ammonia dissolved gas (NH₃) and hydrogen ions. The abbreviation "THMs" in the analyte list refers to trihalomethanes that include the substances chloroform and bromoform that also are listed separately in the table. The analyte list was developed to identify possible sources of what are intermittent and short-lived odors associated with the operation of the CTs.

Q2. Was this a process chemistry derived list, or were these from actual samples taken?

The CT sump water is sampled weekly and analyzed for ammonia nitrogen, free chlorine, and total chlorine. Analysis is by spectrophotometry (Hach method numbers 8155, 8021, and 8167 for ammonia, free chlorine, and total chlorine, respectively). The 8021 and 8167 methods are equivalent to USEPA standard methods for drinking

water. All analyses of water samples have results in parts-per-million (ppm), by weight (i.e., mg / L).

By definition, free chlorine is the sum of hypochlorous acid (HOCl) and the hypochlorite ion (OCl-) that are formed when sodium hypochlorite is injected into the water. And, by definition, total chlorine is the sum of the free chlorine and what is known as combined chlorine. Combined chlorine primarily is comprised of three chloramines: monochloramine, dichloramine, and trichloramine that result from the reaction of HOCl with ammonia (NH₃). The disinfectant sodium bromide forms, in the presence of free chlorine, the substances hypobromous acid (HOBr) and hypobromite ion (OBr-). Analogous bromamines also are formed in a similar manner to that of the chloramines. The method used to measure the free and total chlorine content of water actually measures the analogous brominated substances as well. The difference between the total chlorine and the free chlorine measurements represents the haloamine content of the water. The active disinfectant species in the CT water are HOCl, HOBr, and, to a lesser degree, OCl- and OBr-.

The ammonia nitrogen method accurately measures ammonia dissolved gas (NH₃) only in the absence of free chlorine and free bromine. The basis of the Hach 8155 method is combining ammonia compounds with chlorine to form monochloramine that in turn reacts with a reagent to form a colored solution for measurement by spectrophotometry. In the CT sump water, ammonium compounds and NH₃ undergo a very rapid and quantitative reaction with the disinfectants HOCl and HOBr to form primarily monochloramine and monobromamine, as explained in the first two references above. Since these haloamines already are present in the CT water samples, they represent positive interferences in the Hach 8155 method. Hence the results of the Hach 8155 method significantly overestimate the ammonia compounds in the Intel CT water samples. Thus, the calculated emissions for ammonia in the Excel table greatly overstate actual conditions.

Chlorine dissolved gas (Cl₂) and bromine dissolved gas (Br₂) potentially are present, in parts-per-billion (ppb) or lower concentrations, in the CT water. These gases are not measured directly in the weekly samples. The Cl₂ and Br₂ gases could result from the partial dissociation of the active disinfectant species that are maintained in low-ppm concentrations. It should be understood that at the pH of the CT water (approximately 7 to 9 units), the dissociation of the active disinfectants to the Cl₂ and Br₂ gases is extremely small (see the figure in the third reference listed above). Hence, similar to ammonia, the calculated emissions for Cl₂ and Br₂ in the Excel table also greatly overstate actual conditions.

Chloramine speciation measurements were done in non-routine, limited sampling using the EPA 4500-Cl F method. Most of the samples submitted in this limited sampling were non-detectable for chloramines.

Monochloramine (NH₂Cl) and dichloramine (NHCl₂) occasionally were detected, at low-ppm concentrations in CT sump water, whereas trichloramine (NCl₃) was not detected in this sampling. However, the routine (weekly) sampling for free and total chlorine always yields a detectable haloamine content (total chlorine minus free chlorine). This apparent discrepancy is explained by the fact that the weekly Hach measurement method has a detection limit that is one-fifth that of the speciation method.

The remaining substances in the analyte list have not undergone analysis in water samples. These substances, however, potentially exist and are reported in the technical literature as trace byproducts in CTs that use chloro-/bromo-disinfectants.

Q3-4. How were the "Estimated Peak emission concentrations" for the NEC (4th column) and CUB (7th column) derived? If these are based on actual samples taken, please provide information on the sampling method utilized. Is the concentration on a volume or mass basis?

These estimated emissions in lb/hr are calculations that were based on the maximum/peak measurement of the substance in samples of the CT water and on the approximate rates of water drift/mist generation and water evaporation from the CTs. The lb/hr values then were converted to ppm, by weight, values (columns four and seven) by factoring in the amount of air blown through the falling water curtains in the NEC and CUB (i.e., 10,000 tons per hour). As discussed in Q2 above, the estimated emissions (lb/hr and ppm) for ammonia, chlorine, and bromine are greatly overstated.

All analyses of water samples have results in ppm, by weight (i.e., mg / L).

Limited air sampling was conducted of CT emissions, with results reported in columns five and eight of the table. These air sample results are in ppm, by volume.

The table shows detectable air monitoring results for Cl₂ for the CUB in column eight. That monitoring was done with equipment using a "Chlorine / Oxidizer Chemcassette" chemical detector tape. Air sampling included collection of the mists that are generated and emitted by the CTs. Such mists include small water droplets into which the oxidizing substances HOCl, HOBr, OCl⁻, and OBr⁻ (the members of the group of active disinfecting species) are dissolved. Review of the equipment manufacturer's technical documents indicated that these oxidizers are probable positive interferents with the monitoring method. A mechanism existed for mist droplets to be sampled and then to come into contact with the detector tape (no in-line filter was used to remove particulate/mist). The reported results for the Cl₂ air monitoring in the table therefore likely is an overstatement of an, as yet, undetermined magnitude.

Columns five and eight of the table show air monitoring results for trichloramine (NCl₃) for the CUB CT emissions as <0.039 ppm and for the NEC CT emissions as <0.037 ppm. NCl₃ was non-detectable in this air monitoring; the listed values represent the lower limit of detection of the sampling and analytical method. The actual concentration of NCl₃, if present, is not known. Air monitoring for monochloramine, dichloramine, and any of the bromamines was not done because Intel is unaware of any validated air monitoring methods for these substances.

Q5. Was there ever an analysis conducted on potential cooling tower emissions for all (criteria, VOCs, HAPs, TAPs) regulated pollutants?

An analysis was done for those pollutants which the cooling towers can reasonably be expected to emit. For example, EPA's AP-42 document lists PM₁₀ as a potential emission from CTs. Intel estimated the PM₁₀ quantity from its cooling towers to be 0.6 tpy. Intel also estimated the potential emissions of chlorine and ammonia which could reasonably be expected to be emitted based on the treatment chemicals used and the constituents found in the water as described above. Since there are no other chemicals used in the CT process, there were no other expected emissions and no additional analysis done. The table referred to in Q2 and Q3 represented our initial and preliminary efforts to understand what emissions might exist. And, as discussed above, some of the estimates were based on extremely conservative assumptions. The technical literature does describe the presence of trihalomethanes (THMs) and haloamines at low concentrations in CT emissions, as well as other processes using oxidizing disinfectants (e.g., wastewater treatment and drinking water treatment).

Q3 2000 Testing Results:

The memo Intel submitted on 12/31/03 mistakenly referenced ethanol and methanol. It should have referenced xylene and methanol. To fulfill the HAP testing requirement in 2000, Intel tested the thermal oxidizers for methanol and xylene using summa canisters, which generated the erroneous results. These results were quickly identified as erroneous because the compounds were found in stacks where there is no use of either compound. The testing was re-performed using gas chromatography. Only methanol and xylene were tested because these were the only HAPs for which testing was required. The erroneous results would have shown individual HAP limits exceeded for methanol and xylene and total VOC limits exceeded. The results using gas chromatography indicate no exceedance of any limits.

To fulfill the Q4'00 VOC testing requirement, all VOCs were tested using an FTIR for three 8-hour periods. Four VOCs were detected during that testing period: methanol, ethanol, PGMEA, and IPA. Based on this sampling, the annual VOC emission rate was 9.45 tons/year (5.33 tons/year of this total was from ethanol). This is lower than the reported VOC emissions of 46.2 tons/year which includes untreated IPA and safety factors included in our calculations. There was never a question about the validity of these test results, all of which was submitted to NMED. All ethanol testing results were submitted to NMED.

If you have additional questions, please contact me at 505-794-4908.

Regards,

Mindy Koch

-----Original Message-----

From: Debra McElroy [mailto:debra_mcelroy@nmenv.state.nm.us]
Sent: Thursday, June 03, 2004 12:33 PM
To: Koch, Mindy J

8/18/2004

Cc: Sandra Ely; John Volkerding; Robert Samaniego
Subject: Allegations by Former Intel Employees

Mindy,

We have completed a detailed review of the above referenced documents submitted to the Air Quality Bureau on December 31, 2003. We would like some additional information regarding items I and J in the transmittal memo (attached) that served as a cover page for this submittal. Item I is an Excel spreadsheet with cooling tower sample results. Please note the following questions regarding this spreadsheet:

The spreadsheet title is "Information on Potential Cooling Tower Constituents: Cooling Tower Water Volatile/Odiferous Compounds." How were the analytes listed in the first column chosen? Was this a process chemistry derived list, or were these from actual samples taken? How were the "Estimated Peak emission concentrations" for the NEC (fourth column) and CUB (seventh column) derived? If these are based on actual samples taken, please provide information on the sampling method utilized. Is the concentration on a volume or mass basis? Was there ever an analysis conducted on potential cooling tower emissions for all (criteria, VOCs, HAPs, TAPs) regulated pollutants?

Item J refers to a letter submitted by Carrie Weitz of Intel to the NMED dated November 15, 2000. It states in relevant part, "...this included the original results obtained for ethanol and methanol determination that the results were erroneous." However, the attachments only included test data for methanol and xylene (o, m, p). This makes sense given that the attachments came from the HAP test report for the RTOs for 2000. Ethanol has been detected during the quarterly VOC testing of the RTOs (it is a VOC only). Is there any similar documentation for ethanol?

A response at your earliest convenience would be appreciated. If you have any questions, please get in touch with Robert Samaniego of my staff at (505) 955-8066, or me at (505) 955-8058. Thank you.

Debra

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8/18/2004

Robert Samaniego

From: Koch, Mindy J [mindy.j.koch@intel.com]
Sent: Wednesday, September 15, 2004 9:01 AM
To: Debra McElroy; Robert Samaniego
Cc: Koch, Mindy J
Subject: RE: Request for additional information (on Intel Q3 2000 stack testing)

Debra,

We have reviewed the chemical information and use of the chemicals in the attached purchase documents. One of the two chemicals listed, Megaposit 501, does not contain xylene or methanol. The other chemical listed, Megaposit 510A does contain a small amount of xylene.

Megaposit 510A is the only chemical used in 2000 containing xylene. Nearly all of the Megaposit 510A was used in Fab 11 South. Review of the purchase records indicates that a small portion of this chemical was used in Fab 11 North. A total of 36 gallon bottles of Megaposit 510A were consumed in Fab 11 North during the Intel calendar month of July'00 (7/2/00-7/29/00). This chemical contains 4% xylene and has a specific gravity of 1.08, which equates to 13 lbs of xylene used in Fab 11 North for the month of July.

The summa canister results from July'00 indicated that an average of 6.0 lbs/hour of xylene and 2.2 lbs/hour of methanol was emitted from Fab 11 North. Even though a small amount of xylene was used in Fab 11 North at the time, these results were clearly erroneous since these emission rates would have required a much higher chemical use than actually occurred. The testing was re-performed in October'00 using gas chromatography and both chemicals were below the detection limits in Fab 11 North. Subsequent quarterly FTIR testing continues to confirm these results.

Specific information for the two compounds is provided below.

Megaposit 510A

Volume of container = 1 gallon bottle

Specific Gravity = 1.08

Constituents = 4% xylene, 69% ethyl lactate, 4% butyl acetate, 10-20% cresol novolak resin, 0.0-0.9% cresol, 1.0-10.0% diazo photoactive compound, 0.0-1.0% organic siloxane surfactant

Megaposit 501

Volume of container = 320 gallon tote

Specific Gravity = 1.00

Constituents = 2% tetramethylammonium hydroxide, >95% water, <1% surfactant

If you have further questions, please contact me 505-794-4908.

Regards, Mindy

-----Original Message-----

From: Debra McElroy [mailto:debra_mcelroy@nmenv.state.nm.us]

Sent: Thursday, August 26, 2004 4:43 PM

To: Koch, Mindy J

Cc: Robert Samaniego

Subject: Request for additional information

Mindy,

Robert Samaniego has completed our review of your email of June 18, 2004

regarding the Department's request for additional information on the Cooling Towers and Q3 2000 Testing results. The second and third sentences in the first paragraph of the Q3 2000 Testing Results section is as follows; "To fulfill the HAP testing requirement in 2000, Intel tested the thermal oxidizers for methanol and xylene using summa canisters, which generated the erroneous results. These results were quickly identified as erroneous because the compounds were found in stacks where there is no use of either compound."

In addition, the portion of the HAP test report included in the December 31, 2003 submittal (test report originally submitted on November 15, 2000) indicated that methanol and xylene were not used in the fabrication processes for Fab 11 North or Fab 7. At that time, the Department requested the submittal of purchase documents for the period June 1999 - August 2000 to verify this claim. A review of this submittal supported this claim for Fab 7. However, there were 13 purchase documents (attached) that reference materials purchased for Fab 11 North. Could you please provide the following information regarding these documents?

Volume of each container (drum, bottle)
Density or specific gravity of each material
Weight % methanol
Weight % xylene

A response at your earliest convenience would be appreciated. If you have any questions, please contact Robert directly at (505) 955-8066, or me at (505) 955-8058.
Thank you,
Debra

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002830
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ATTN: CHERYL VANDERGRIF
4100 SARA RD
RIO RANCHO, NM , 87124

FROM:

SHIPLEY COMPANY
CUSTOMER SERVICE
455 FOREST STREET
MARLBOROUGH, MA 01752

CUST ORD #	DUE DATE	SLS #	OP ID	FREIGHT	SHIP VIA
	06/21/00	000000	REL	0.00	RINCHEM

UN ORD	UN SHP	BO HM	PACKAGE DESCRIPTION	NET	GROSS
12	✓ 12 X BTL		NOT REGULATED PER 49CFR 173.150(F)(2) , PG: PHOTO RESIST MEGAPOSIT 510A 80213	123	135
			LOT#: DD4068		
			LOC: J2A1		

Still UN SCANNABLE!

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	06/23/00	000000	CWM	0.00	RINCHEM

UN ORD	UN SHP	BO HM	PACKAGE DESCRIPTION	NET	GROSS
			NOT REGULATED PER 49CFR 173.150(F)(2) , PG: PHOTO RESIST MEGAPOSIT 510A 80213	82	90
					4230-03

8 8 X BTL LOT#: DD4068 LOC: I1E2

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	06/24/00	000000	CWM	0.00	RINCHEM		
UN ORD	UN SHP	BO	HM	PACKAGE DESCRIPTION		NET	GROSS
				NOT REGULATED PER 49CFR 173.150(F)(2) , PG: PHOTO RESIST MEGAPOSIT 510A 80213	4230-03	82	90
✓ 8		8 X BTL		LOT#: DD4068	✓		LOC: J2A1

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	06/29/00	000000	CWM	0.00	RINCHEM

UN ORD	UN SHP	BO HM	PACKAGE DESCRIPTION	NET	GROSS
			NON REGULATED MATERIAL , PG: DEVELOPER MF 501 DRUM 30049	1942	2046
4	X		DRUM LOT#:DE4601 LOC:L14I4		
			NOT REGULATED PER 49CFR 173.150(F)(2) , PG: PHOTO RESIST MEGAPOSIT 510A 80213	41	45
4	X		BTE LOT#:DF4060 LOC:J1A1		

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CUST ORD #	DUE DATE	SLS #	OP ID	FREIGHT	SHIP VIA
	07/12/00	000000	LAS	0.00	RINCHEM

UN ORD	UN SHP	BO HM	PACKAGE DESCRIPTION	NET	GROSS
			NON REGULATED MATERIAL	1942	2046

for

, PG:
DEVELOPER
MF 501 DRUM 4200-00
30049

4.00 4.00 X DRUM LOT#:DE4601 LOC:L1504

NOT REGULATED PER 49CFR 173.150(F)(2) 41 45
, PG:
PHOTO RESIST
MEGAPOSIT 510A 4230-03
80213

all

4.00 4.00 X BTL LOT#:DF4060 LOC:J201

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CUST ORD #	DUE DATE	SLS #	OR ID	FREIGHT	SHIP VIA
	07/18/00	000000	LAS	0.00	RINCHEM

UN ORD	UN SHP	BO HM	PACKAGE DESCRIPTION	NET	GROSS
			NON REGULATED MATERIAL , PG: DEVELOPER MF 501 DRUM 30049	1942	2046
4	4 X DRUM		LOT#:DE4601 / LOC:L9J4		
			NOT REGULATED PER 49CFR 173.150(F)(2) , PG: PHOTO RESIST MEGAPOSIT 510A 80213	41	45
4	4 X BTL		LOT#:DF4060 / LOC:I1B2		

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RIO RANCHO, NM , 87124

FROM:

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UST ORD #	DUE DATE	SLS #	OP ID	FREIGHT	SHIP VIA		
	07/19/00	000000	LAS	0.00	RINCHEM		
N ORD UN SHP BO HM	PACKAGE DESCRIPTION	NET	GROSS				
	NOT REGULATED PER 49CFR 173.150(F)(2) , PG: PHOTO RESIST MEGAPOSIT 510A 80213	41	45				
4	X BTL LOT#:DF4060			4230-03			LOC:I2G1

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CUST ORD #	DUE DATE	SLS #	OP ID	FREIGHT	SHIP VIA	NET	GROSS
	07/31/00	000000	CWM	0.00	RINCHEM		
UN ORD	UN SHP	BO HM	PACKAGE DESCRIPTION			NET	GROSS
			NON REGULATED MATERIAL , PG: DEVELOPER MF 501 DRUM 30049			1942	2046
4			4 X DRUM	LOT#:DF4674	LOC:L9N2		
			NOT REGULATED PER 49CFR 173.150(F)(2) , PG: PHOTO RESIST MEGAPOSIT 510A 80213			82	90
8			8 X BTL	LOT#:DF4060	LOC:J1D1		

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Date: 7/27/00 (BB)

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1. PRODUCT AND COMPANY IDENTIFICATION

MEGAPOSIT(TM) MF(TM) -501 Developer**Supplier**Rohm and Haas Electronic Materials LLC
455 Forest Street
Marlborough, MA 01752 United States of America

Revision date: 01/01/2004

For non-emergency information contact: 508-481-7950

Emergency telephone numberChemtrec 800-424-9300
Rohm and Haas Emergency 215-592-3000

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
Water	7732-18-5	> 95.0 %
Tetramethylammonium hydroxide	75-59-2	2.0%
Surfactant		< 1.0 %

3. HAZARDS IDENTIFICATION

Emergency Overview**Appearance**Form liquid
Colour clear
Odour amines**Hazard Summary****WARNING!**Alkaline liquid and vapor. Causes skin, eye, and respiratory tract irritation. Onset of symptoms may be delayed.
Prolonged, repeated contact, inhalation, ingestion, or absorption through the skin, may cause toxic effects to internal organ systems (liver, kidney, central nervous system).**Potential Health Effects**

Primary Routes of Entry: Inhalation, ingestion, eye and skin contact, absorption.

Eyes: Will cause severe conjunctival irritation, corneal damage, and may result in loss of vision. Effects may be delayed.

Skin: Material may cause irritation.

Repeated and prolonged contact may cause chemical burns.

Absorption through burns or open wounds may have the following effects:

neurotoxic effects

muscle spasms

convulsions

death

Ingestion: Swallowing may have the following effects:

irritation of mouth, throat and digestive tract

central nervous system damage

Inhalation: Exposure to vapor or mist may have the following effects:

irritation of nose, throat and respiratory tract

Higher concentrations may have the following effects:

systemic effects similar to those resulting from ingestion

Target Organs: Eye

Respiratory System

Skin

nervous system

Carcinogenicity

Not considered carcinogenic by NTP, IARC, and OSHA

4. FIRST AID MEASURES

Inhalation: Remove from exposure. If there is difficulty in breathing, give oxygen. Seek medical attention if symptoms persist.

Skin contact: Wash skin with water. Continue washing for at least 15 minutes. Obtain medical attention if blistering occurs or redness persists.

Eye contact: Immediately flush the eye with plenty of water for at least 15 minutes, holding the eye open. Obtain medical attention if soreness or redness persists.

Ingestion: Wash out mouth with water. Have victim drink 1-3 glasses of water to dilute stomach contents. Immediate medical attention is required. Never administer anything by mouth if a victim is losing consciousness, is unconscious or is convulsing.

Notes to physician

Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash point Nonflammable

Suitable extinguishing Not readily combustible.

media: Select extinguishing agent appropriate to other materials involved.

Specific hazards during fire fighting: No specific measures necessary.

Special protective equipment for fire-fighters: Wear full protective clothing and self-contained breathing apparatus.

Further information: This product may give rise to hazardous vapors in a fire.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Wear suitable protective clothing.

Environmental precautions

Prevent the material from entering drains or water courses.

Do not discharge directly to a water source.

Advise Authorities if spillage has entered watercourse or sewer or has contaminated soil or vegetation.

Methods for cleaning up

Cover with absorbent or contain. Collect and dispose.

7. HANDLING AND STORAGE

Handling

Use only in well-ventilated areas. Avoid breathing vapor. Avoid contact with eyes, skin and clothing.

Keep container tightly closed.

Further information on storage conditions: No special precautions necessary.

Storage

Storage conditions: Store in original container. Storage area should be: cool dry well ventilated out of direct sunlight away from incompatible materials

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limit(s)

Exposure limits are listed below, if they exist.

Eye protection: goggles

Hand protection: Neoprene gloves. Other chemical resistant gloves may be recommended by your safety professional.

Skin and body protection: Normal work wear.

Respiratory protection: No personal respiratory protective equipment normally required. The specific respirator selected must be based on the airborne concentration found in the workplace and must not exceed the working limits of the respirator.

Engineering measures: Engineering methods to prevent or control exposure are preferred. Methods include process or personnel enclosure, mechanical ventilation (local exhaust), and control of process conditions.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid
Colour	clear
Odour	amines
pH	13
Boiling point/range	100 °C (212 °F)
Flash point	Nonflammable
Vapour pressure	Similar to water

Component: **Tetramethylammonium hydroxide**

Vapour pressure	17.5 mmHg at 20 °C
Relative vapour density	no data available
Solubility/qualitative	completely soluble
Relative density	1.00
Evaporation rate	Slower than ether

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Hazardous reactions	Stable under normal conditions.
Conditions to avoid	contact with incompatible materials
Materials to avoid	Strong oxidizing agents acids
Hazardous decomposition products	trimethylamine, nitrogen oxides (NOx), oxides of carbon, Methanol,
polymerization	Will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicological information on this product or its components appear in this section when such data is available.

Component: **Tetramethylammonium hydroxide**

Acute dermal toxicity 2.1 %(m)
A single 4h semi-occlusive application to intact rabbit skin produced no signs of dermal irritation.
No clinical signs of toxicity were observed.
Testing complied with OECD 404 and EPA TSCA 40 CFR Part 798 standard protocols.
DOT Corrosivity testing conducted on stainless steel and laboratory animals determined that this product is not corrosive.

Component: **Tetramethylammonium hydroxide**

Acute dermal toxicity 3.5 %(m)
A single 4h semi-occlusive application to intact rabbit skin produced minimal signs of irritation (mean scores for erythema or edema less than 2).
No clinical signs of toxicity were observed.
Testing complied with OECD 404 and EPA TSCA 40 CFR Part 798 standard protocols.

Component: **Tetramethylammonium hydroxide**

Acute dermal toxicity 5 %(m)
A single 4h semi-occlusive application to intact rabbit skin produced burns (full thickness destruction of skin).
This material is corrosive.
No clinical signs of toxicity were observed.
Testing complied with OECD 404 and EPA TSCA 40 CFR Part 798 standard protocols.
Corrosive to aluminum per DOT corrosivity testing.

Component: **Tetramethylammonium hydroxide**

Acute dermal toxicity 7 %(m)
A single 4h semi-occlusive application to intact rabbit skin produced burns (full thickness destruction of skin).
This material is corrosive.
No clinical signs of toxicity were observed.
Testing complied with OECD 404 and EPA TSCA 40 CFR Part 798 standard protocols.
Corrosive to aluminum per DOT corrosivity testing.

Component: **Tetramethylammonium hydroxide**

Acute dermal toxicity <5% (w/v):
Repeated application to rat skin for 6 h/d, 5 d/wk for 4 weeks did not produce systemic toxicity.
Test material was applied continuously through a reservoir affixed to shaved animal backs.

Component: **Tetramethylammonium hydroxide**

Acute dermal toxicity >=5% (w/v):
Repeated application to rat skin for 6h/d, 5d/wk for 4 weeks produced rapid toxicity and following effects:
convulsions
death
Effects were noted after 2 hours of initial application.
Test material was applied continuously through a reservoir affixed to shaved animal backs.

Component: Tetramethylammonium hydroxide
Acute dermal toxicity LD50 guinea pig 25 mg/kg
100% (by weight).

12. ECOLOGICAL INFORMATION

Ecotoxicological information on this product or its components appear in this section when such data is available.

Tetramethylammonium hydroxide

Ecotoxicity effects

Toxicity to aquatic

invertebrates

LC50 ceriodaphnia dubia (water flea) 96 h

0.07 - 1.2 mg/l

A pH neutralized solution has been shown to be toxic to aquatic organisms.

13. DISPOSAL CONSIDERATIONS

Environmental precautions: Prevent the material from entering drains or water courses.

Do not discharge directly to a water source.

Advise Authorities if spillage has entered watercourse or sewer or has contaminated soil or vegetation.

Disposal

Dispose in accordance with all local, state (provincial), and federal regulations. Under RCRA, it is the responsibility of the product's user to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because the product uses, transformations, mixtures, processes, etc. may render the resulting materials hazardous.

Do not remove label until container is thoroughly cleaned. Empty containers may contain hazardous residues. This material and its container must be disposed of in a safe way.

14. TRANSPORT INFORMATION

DOT

Not regulated for transport

IMO/IMDG

Not regulated (Not dangerous for transport)

15. REGULATORY INFORMATION

SARA TITLE III: Section 311/312 Categorizations (40CFR370): Immediate health hazard

SARA TITLE III: Section 313 Information (40CFR372)

This product does not contain a chemical which is listed in Section 313 at or above de minimis concentrations.

U.S. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D):

U.S. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D)
This product does not contain any substances subject to Section 12(b) export notification.

US. Toxic Substances Control Act (TSCA) All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

California (Proposition 65)

This product contains a component or components known to the state of California to cause cancer and/or reproductive harm.

Components: 1,4-Dioxane 123-91-1

16. OTHER INFORMATION**Hazard Rating**

	Health	Fire	Reactivity
NFPA	3	0	0

Legend

ACGIH	American Conference of Governmental Industrial Hygienists
BAC	Butyl acetate
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
STEL	Short Term Exposure Limit (STEL):
TLV	Threshold Limit Value
TWA	Time Weighted Average (TWA):
	Bar denotes a revision from prior MSDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Print Date: 03/01/2004
Version: 2.0
Layout 304515

**1. PRODUCT AND COMPANY IDENTIFICATION****MEGAPOSIT(TM) SPR(TM) 510-A Positive Photoresist**

Revision date: 04/12/2004

Supplier

Rohm and Haas Electronic Materials LLC
 455 Forest Street
 Marlborough, MA 01752 United States of America

For non-emergency information contact: 508-481-7950

Emergency telephone number

Chemtrec 800-424-9300
 Rohm and Haas Emergency 215-592-3000

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
Ethyl lactate	97-64-3	68.0 - 73.0 %
Cresol novolak resin		10.0 - 20.0 %
Butyl Acetate	123-86-4	1.0 - 5.0 %
Xylene	1330-20-7	1.0 - 5.0 %
Cresol	1319-77-3	0.0 - 0.9 %
Diazo Photoactive Compound		1.0 - 10.0 %
Organic Siloxane Surfactant		0.0 - 1.0 %

3. HAZARDS IDENTIFICATION**Emergency Overview****Appearance**

Form viscous liquid

Colour red

Odour sweet

Hazard Summary**CAUTION!**

Combustible liquid and vapor. Causes irritation to eyes, nose, and respiratory tract.
 Prolonged, repeated contact, inhalation, ingestion, or absorption through the skin, may cause toxic effects to internal organ systems (liver, kidney, central nervous system).

Potential Health Effects

Primary Routes of Entry: Inhalation, ingestion, eye and skin contact, absorption.

Eyes: May cause pain, transient irritation and superficial corneal effects.

Skin: Material may cause irritation.

Prolonged or repeated exposure may have the following effects:

drowsiness

defatting and drying of the skin which can lead to irritation and dermatitis

central nervous system depression

kidney damage

liver damage

Ingestion: Swallowing may have the following effects:

irritation of mouth, throat and digestive tract

headache

nausea

vomiting

Repeated doses may have the following effects:

central nervous system depression

liver damage

kidney damage

Inhalation: Inhalation may have the following effects:

irritation of nose, throat and respiratory tract

Higher concentrations may have the following effects:

systemic effects similar to those resulting from ingestion

Target Organs: Eye

Respiratory System

nervous system

Liver

Kidney

Skin

Carcinogenicity

Not considered carcinogenic by NTP, IARC, and OSHA

4. FIRST AID MEASURES

Inhalation: Remove from exposure. If there is difficulty in breathing, give oxygen. Seek medical attention if symptoms persist.

Skin contact: Wash skin with water. Continue washing for at least 15 minutes. Obtain medical attention if blistering occurs or redness persists.

Eye contact: Immediately flush the eye with plenty of water for at least 15 minutes, holding the eye open. Obtain medical attention if soreness or redness persists.

Ingestion: Wash out mouth with water. Have victim drink 1-3 glasses of water to dilute stomach contents. Induce vomiting if person is conscious. Immediate medical attention is required. Never administer anything by mouth if a victim is losing consciousness, is unconscious or is convulsing.

Notes to physician

Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash point 39 - 40 °C (102.9 - 104.9 °F)

Lower explosion limit No data available

Upper explosion limit No data available

Suitable extinguishing media: Use water spray, foam, dry chemical or carbon dioxide.
Keep containers and surroundings cool with water spray.

Specific hazards during fire fighting: This product may give rise to hazardous vapors in a fire. Vapors can travel a considerable distance to a source of ignition and result in flashback.

Special protective equipment for fire-fighters: Wear full protective clothing and self-contained breathing apparatus.

Further information: Pressure may build up in closed containers with possible liberation of combustible vapors.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Wear suitable protective clothing.

Wear respiratory protection.

Eliminate all ignition sources.

Environmental precautions

Prevent the material from entering drains or water courses.

Do not discharge directly to a water source.

Advise Authorities if spillage has entered watercourse or sewer or has contaminated soil or vegetation.

Methods for cleaning up

Contain spills immediately with inert materials (e.g., sand, earth).

Transfer into suitable containers for recovery or disposal.

Finally flush area with plenty of water.

7. HANDLING AND STORAGE

Handling

Use local exhaust ventilation. Avoid contact with eyes, skin and clothing. Keep container tightly closed.

Further information on storage conditions: Keep away from heat, sparks, flame, and other sources of ignition. Practice good personal hygiene to prevent accidental exposure.

Storage

Storage conditions: Store in original container. Keep away from heat and sources of ignition. Storage area should be: cool dry well ventilated out of direct sunlight

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limit(s)

Exposure limits are listed below, if they exist.

Component	Regulation	Type of listing	Value
Ethyl lactate	Rohm and Haas	TWA	5 ppm
	Rohm and Haas	STEL	15 ppm

Component	Regulation	Type of listing	Value
Butyl Acetate	Rohm and Haas	TWA	150 ppm
	Rohm and Haas	STEL	200 ppm
	ACGIH	TWA	150 ppm
	ACGIH	STEL	200 ppm
	OSHA_TRANS	PEL	710 mg/m3 150 ppm

Component	Regulation	Type of listing	Value
Xylene	Rohm and Haas	TWA	50 ppm
	Rohm and Haas	STEL	75 ppm
	Rohm and Haas	Absorbed via skin	
	ACGIH	TWA	100 ppm
	ACGIH	STEL	150 ppm
	OSHA_TRANS	PEL	435 mg/m3 100 ppm
	Z1A	TWA	435 mg/m3 100 ppm
Z1A	STEL	655 mg/m3 150 ppm	

Component	Regulation	Type of listing	Value
Cresol	ACGIH	TWA	22 mg/m3 5 ppm
	ACGIH	SKIN_DES	
	OSHA_TRANS	PEL	22 mg/m3 5 ppm
	OSHA_TRANS	SKIN_DES	

Eye protection: goggles

Hand protection: Butyl rubber gloves. Other chemical resistant gloves may be recommended by your safety professional.

Skin and body protection: Normal work wear.

Respiratory protection: Respiratory protection if there is a risk of exposure to high vapor concentrations. The specific respirator selected must be based on the airborne concentration found in the workplace and must not exceed the working limits of the respirator.

Engineering measures: Engineering methods to prevent or control exposure are preferred. Methods include process or personnel enclosure, mechanical ventilation (local exhaust), and control of process conditions.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	viscous liquid
Colour	red
Odour	sweet
pH	ca.7
Boiling point/range	>119 °C (246 °F)
Flash point	39 - 40 °C (102.9 - 104.9 °F)
Lower explosion limit	No data available
Upper explosion limit	No data available

Component: **Ethyl lactate**

Vapour pressure 1.7 mmHg at 20 °C

Component: **n-Butyl acetate**

Vapour pressure 15.0 mmHg at 25 °C

Relative vapour density	Heavier than air.
Water solubility	slightly soluble
Relative density	1.08
Evaporation rate	Slower than ether
VOC's	842.21 g/l

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Hazardous reactions	Stable under normal conditions.
Conditions to avoid	High temperatures Static discharge
Materials to avoid	Oxidizing agents bases acids
Hazardous decomposition products	Carbon monoxide, carbon dioxide,
polymerization	Will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicological information on this product or its components appear in this section when such data is available.

Component: **Ethyl lactate**

Acute oral toxicity	LD50 rat >2,000 mg/kg
Component: <u>n-Butyl acetate</u>	
Acute oral toxicity	LD50 rat 13,100 mg/kg
Component: <u>Xylene</u>	
Acute oral toxicity	LD50 rat 4,300 mg/kg
Component: <u>Cresol</u>	
Acute oral toxicity	LD50 rat 2,737 mg/kg
Component: <u>Diazo Photoactive Compound</u>	
Acute oral toxicity	LD50 rat >2,000 mg/kg
Component: <u>Organic Siloxane Surfactant</u>	
Acute oral toxicity	LD50 rat > 5,000 mg/kg
Component: <u>Ethyl lactate</u>	
Acute inhalation toxicity	LC50 rat >5,400 mg/m3
Component: <u>n-Butyl acetate</u>	
Acute inhalation toxicity	LC50 rat 4 h 760 mg/m3
Component: <u>Xylene</u>	
Acute inhalation toxicity	LC50 rat 4 h 29.09 mg/l
Component: <u>Cresol</u>	
Acute inhalation toxicity	LC50 rat 8 h 35.38 mg/l
Component: <u>Ethyl lactate</u>	
Acute dermal toxicity	LD50 rat >5,000 mg/kg
Component: <u>Xylene</u>	
Acute dermal toxicity	LD50 rabbit >4,300 mg/kg
Component: <u>Cresol</u>	
Acute dermal toxicity	LD50 rabbit > 5,000 mg/kg
Component: <u>Diazo Photoactive Compound</u>	
Acute dermal toxicity	LD50 rat >2,000 mg/kg
Component: <u>Organic Siloxane Surfactant</u>	
Acute dermal toxicity	LD50 rat > 2,000 mg/kg
Component: <u>Ethyl lactate</u>	
Skin irritation	A single application to rabbit skin produced mild irritation.
Component: <u>Xylene</u>	
Skin irritation	rabbit Moderate irritation.
Component: <u>Organic Siloxane Surfactant</u>	
Skin irritation	A single application to rabbit skin produced mild irritation.
Component: <u>Ethyl lactate</u>	
Eye irritation	Single application to the rabbit eye produced conjunctival irritation.
Component: <u>Xylene</u>	

Eye irritation rabbit moderate to severe.

Component: **Diazo Photoactive Compound**

Eye irritation Single application to the rabbit eye produced moderate irritation.

Component: **Organic Siloxane Surfactant**

Eye irritation Single application to the rabbit eye produced no signs of ocular irritation.

Component: **Diazo Photoactive Compound**

Sensitization Skin sensitization - guinea pig: Not a sensitizer

Component: **Ethyl lactate**

Toxicity to reproduction

Studies in laboratory animals have shown no teratogenic effects in the following species:

Component: **Xylene**

Subchronic toxicity Animal studies indicate prolonged inhalation exposures may cause the following:
brain damage

Component: **Xylene**

Toxicity to reproduction

In laboratory studies, birth defects, increased fetal lethality and delayed fetal development have been observed in offspring of female animals exposed during pregnancy.

Component: **Cresol**

Toxicity to reproduction

Developmental effects were seen in laboratory animals only at dose levels that were maternally toxic.

Component: **Diazo Photoactive Compound**

Subchronic toxicity Repeated administration produced no systemic toxicity under the following study conditions:
rats
Oral

Component: **Diazo Photoactive Compound**

Mutagenicity

Not mutagenic when tested in bacterial or mammalian systems.

12. ECOLOGICAL INFORMATION

Ecotoxicological information on this product or its components appear in this section when such data is available.

Ethyl lactate

Ecotoxicity effects

Toxicity to aquatic invertebrates EC50 Daphnia magna 48 h
683 mg/l

n-Butyl acetate

Ecotoxicity effects

Toxicity to fish LC50 Bluegill sunfish (*Lepomis macrochirus*) 96 h
100 mg/l

Toxicity to fish	LC50 Fathead minnow (<i>Pimephales promelas</i>) 96 h 18 mg/l
Toxicity to algae	EC50 Algae (<i>Scenedesmus subspicatus</i>) 72 h 675 mg/l
Toxicity to aquatic invertebrates	LC50 Daphnia magna 96 h 44 - 205 mg/l

Xylene

Ecotoxicity effects	
Toxicity to fish	LC50 Rainbow trout (<i>Oncorhynchus mykiss</i>) 96 h 13.5 mg/l
Toxicity to aquatic invertebrates	EC50 Daphnia magna 150 mg/l

13. DISPOSAL CONSIDERATIONS

Environmental precautions: Prevent the material from entering drains or water courses. Do not discharge directly to a water source. Advise Authorities if spillage has entered watercourse or sewer or has contaminated soil or vegetation.

Disposal

Dispose in accordance with all local, state (provincial), and federal regulations. Incineration is the recommended method of disposal for containers. Under RCRA, it is the responsibility of the product's user to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because the product uses, transformations, mixtures, processes, etc. may render the resulting materials hazardous.

Do not remove label until container is thoroughly cleaned. Empty containers may contain hazardous residues. This material and its container must be disposed of in a safe way.

14. TRANSPORT INFORMATION

DOT

Not regulated per 49CFR 173.150(f)(2)

IMO/IMDG

Proper shipping name	RESIN SOLUTION
UN-No	UN 1866
Class	3
Packing group	III

Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations

15. REGULATORY INFORMATION

SARA TITLE III: Section 311/312 Categorizations (40CFR370): Immediate, delayed, flammability hazard

SARA TITLE III: Section 313 Information (40CFR372)

This product contains a chemical which is listed in Section 313 at or above de minimis concentrations.
SARA Title III Components: Xylene 1330-20-7

U.S. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D):

U.S. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D)
This product does not contain any substances subject to Section 12(b) export notification.

US. Toxic Substances Control Act (TSCA) All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

California (Proposition 65)

This product does not contain materials which the State of California has found to cause cancer, birth defects or other reproductive harm.

16. OTHER INFORMATION**Hazard Rating**

	Health	Fire	Reactivity
NFPA	2	2	0

Legend

ACGIH	American Conference of Governmental Industrial Hygienists
BAC	Butyl acetate
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
STEL	Short Term Exposure Limit (STEL):
TLV	Threshold Limit Value
TWA	Time Weighted Average (TWA):
	Bar denotes a revision from prior MSDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Print Date: 04/12/2004
Version: 3.0
Layout 304746

Material Safety Data Sheets (MSDS) for the product(s) you ordered from Rohm and Haas Company are enclosed.

By means of the Rohm and Haas automated MSDS distribution system, you will receive new MSDS for these products if there are any revisions within the next year. You will also receive new copies of these MSDS annually if you are a regular purchaser of these products.

It is important that these MSDS are made available to all those who handle or use these products. We wish to assist you in this effort. If there are specific individuals in your organization who are in a better position to provide effective hazard communication as required under the OSHA Standard, please send us their address information. Subsequent mailings will include these individuals.

INTEL CORP
2150 MISSION COLLEGE BLVD
SANTA CLARA, CA 95052
USA

12 April 2004

As part of our Product Stewardship Program, we provide MSDS in conformance with the OSHA Hazard Communication Standard and/or state regulations. However, you may note that not all our products are considered hazardous under the Standard. Nevertheless, these MSDS provide you and your employees with important information concerning the safe handling, use, and disposal of these products.

You may be required to submit this MSDS and others that you receive to state and local emergency response organizations (SERC and LEPC) and to your local fire department. This requirement stems from the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). In addition, the product may contain a chemical which is subject to the requirements of Section 313 of EPCRA. If a product contains one or more of these materials, they will be identified in Section 15 of the MSDS. These laws requires certain manufacturers to report their annual releases (as defined by the regulations) of specified chemicals listed in Section 313. You may be covered by other parts of the law, depending on which chemicals and the amount of the chemicals that you have at your facility. EPCRA includes the following basic requirements for facility operators:

Facilities that manufacture, process and use hazardous substances listed by the Environmental Protection Agency (EPA) in excess of designated quantities must:

- Provide emergency notification of releases;
- Submit inventory forms to the SERC, LEPC, and local fire departments;
- Submit emissions information to EPA and SERC; and
- May face penalties for noncompliance.

To assist you in complying with the U.S. Toxic Substances Control Act (TSCA), the inventory status is identified in Section 15 of the product's MSDS. If Section 15 of our MSDS cites a TSCA R&D Exemption, then:

- One or more of the constituents in our products are not listed on the TSCA inventory.
- This product may not be put into materials or devices that are placed into commerce.
- This product is provided solely for research and development (R &D) activities in accordance with regulations issued by the U.S. EPA (40 CFR 720.36 and 720.78).

These regulations require, in part, that the substance be used:

1. Solely for research and development purposes.
2. Under direction of technically qualified individuals.
3. Following documented prudent laboratory handling practices (29 CFR 1910.1450).

You may learn more about these requirements by calling the EPA Hotline 800-424-9346.

We appreciate your business and continue to strive to provide you with high quality products and effective information for their safe use.

Hazard Communication Department
Rohm and Haas Company

