APPENDIX G

Technical Approach and Cost Estimate for Excavation of the Classified Area Using Robotics

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Technical Approach and Cost Estimate for Excavation of the Classified Area Using Robotics

1. Introduction

1.1 Purpose of this Summary

The intent of this evaluation is to outline the technical approach, equipment required, and resulting cost associated with the remote and/or robotics excavation and characterization of the classified area of the Mixed Waste Landfill at Sandia National Laboratories, New Mexico. The classified area is 100 ft. by 215 ft. in dimension. The proposed excavation would be to 30 ft. in depth. The total volume of the excavation including sloping (3:1) of the pit walls is estimated to be 27,354 yd^3. This area of the landfill includes multiple waste disposal pits containing a wide range of radiologically contaminated items, some of which have been incased in concrete resulting is several very large and heavy objects which may have to be broken up in-situ prior to removal.

1.2 Background (Previous Projects)

The foundation for this technical approach and cost proposal for remote and/or robotics excavation of the classified area is based on several projects that have completed within the DOE complex, which required remote operations for removal and characterization of contaminated soil and debris.

1.2.1 Remote Excavation of Material Disposal Area-P, Los Alamos National Laboratory, Los Alamos, New Mexico

Material Disposal Area-P was operated from 1950 to 1984 and received materials from the burning of high explosives (HE), HE-contaminated equipment and material, barium nitrate, construction debris from the D&D of Manhattan-era buildings, as well as trash, vehicles, empty drums, and miscellaneous containers.

To mitigate the dangers of a detonation during excavation of the disposal area, all initial excavation operations were performed remotely. A computer-controlled, 62,000 lb. tracked excavator coupled with a hydraulic manipulator was used for all initial excavation and sorting of disposal debris. Over a 23-month period, approximately 32,000 yds^3 of explosive contaminated soil, including 607 tons of steel, and 500 tons of concrete were remotely excavated from the landfill.

1.2.2 Technical Area II Landfill Remediation, Sandia National Laboratories, Albuquerque, New Mexico

During remediation of the landfills contained within Sandia National Laboratories' Technical Area II, there was a risk of site personnel encountering several potentially high hazardous materials. A remote robotic manipulation and excavation system was deployed for characterization and retrieval of buried chemical, explosive, and radioactive materials discovered during excavation operations.
Remote operations were conducted for approximately 85 days during the course of this project. During daily operations, surface material was removed in six- to twelve-inch lifts until a suspicious object was visually detected. The excavator bucket was then curled under the boom and placed on the ground. The robotic manipulator was deployed and used to scan, inspect, and retrieve the object.

1.2.3 Historical Radioactive and Mixed Waste Disposal Request Validation and Disposal Project (HDRV), Sandia National Laboratories, Albuquerque, New Mexico

A remote robotic system was developed, deployed, and operated to perform drilling, cutting, and manipulation tasks on 34 unknown radioactive contaminated cylindrical objects. A fully integrated robotic system was developed and deployed. The system consisted of robot manipulator, a tool rack, and a workbench. Site operations were conducted for approximately 11 days, followed by removal of the system over a two-day period.

During site operations, individual cylindrical objects were robotically retrieved and placed in the vise. A hole was drilled into the end of the object, and Tritium, O_2, and lower explosive level (LEL) sensors were utilized by the robotic system to characterize the contents. In Addition, the robotic system was used to consolidate the contents of the cylinders into a single 5-gallon container.

2. Assumptions

- Based on previous remote excavation activities, a soil and debris removal rate of 300 yd^3 per week is assumed to be achievable for the classified area.

- Using a total estimated soil volume of 27,354 yd^3 and the above mentioned removal rate of 300 yd^3 per week, the total time for remote excavation of the classified area of the MWL is 91 weeks.

- All initial excavation and removal of soil and debris would be accomplished remotely.

- All initial characterization and sampling of debris would be accomplished remotely in close proximity to the point of excavation.

- All initial characterization and sampling of soil would be under taken at an adjacent staging area.

- The radiological contamination levels in the excavated soil would not be high enough to preclude the use of personnel to operate the equipment required to characterize and sample the soil.

3. Technical Approach

3.1 Remote Excavation

Prior to the start of remote operations, a project trailer would be setup with direct line of site to the classified area. Housed within the trailer will be the Operator Control Console (OCC) for all the remote equipment. The distance between the points of excavation and all project support buildings would be determined by a hazard analysis to ensure all site personnel would maintain a safe distance during the removal activities. In addition, any obstructions between the OCC and the excavation, which could cause radio interference with the remote equipment, would be removed.

For the excavation, a conventional tracked excavator equipped for remote computer controlled operations would be employed in addition to a passive screen (Grizzly) used to separate soil and debris. The Grizzly would be built so that a standard 20-yd^3 roll-off could be placed under the screen to catch the soil. An excavation plan would be developed to enable the most efficient method for removal of soil from the landfill. During site operations, the excavator and Grizzly would be placed in close proximity to the area identified for excavation, and a roll-off would be placed into position. Under remote computer control, one- to two-foot lifts of soil would be removed from the area and placed on the passive screen. Excavation would continue until a sufficient amount of debris will have accumulated on the screen. At this point, excavation would stop and the debris would be removed remotely in preparation for characterization. Soil removal activities would resume and this cycle would continue until the roll-off was filled. At that time, an initial gross radiation survey would be completed to insure "safe to move criteria" had been met. The full roll-off would be replaced and removal operations would resume.

3.2 Soil/Debris Radiation Characterization and Sampling

3.2.1 Debris

For on-site characterization of the debris removed from the classified area, a self-contained characterization system would be used to perform the remote radiological analysis of the material. The system would consist of a horizontal conveyor belt that passes into a chamber containing the detection equipment necessary to characterize the debris. The conveyor belt would continue through the detection chamber and on to a material sampling and packaging

section. At this point, two robotic manipulators and an overhead crane would be used to remove samples of the material for future analysis as well as to place the residual material into Standard Waste Boxes (SWB) or radiation shielded containers where appropriate. The debris characterization system would be skid-mounted and placed adjacent to the Grizzly during the removal operation.

3.2.2 Soils

At a staging area adjacent to the excavation site, the full roll-offs would be stored until enough material had accumulated to begin the soil and sampling process. A segmented gate counter would be employed to characterize and sort the excavated material. In this system, the contaminated material is placed on a conveyor and passed through an array of radiation detection sensors that identify the amount and type of radiation present in the soil. An active gate at the end of the conveyor is used to direct the material to several piles based on the sensor data. A soil storage area would be developed to house the separated piles prior to disposal. In this way, 100% of the excavated soil can be screened and separated in preparation for disposal. After the material has been separated, soil samples can be taken for each lot for analysis of the hazardous chemical composition.

4. Cost Estimate

Based on a soil removal rate of 300 yd^3 per week and a total excavation duration of 91 weeks, the total estimated cost to excavate, segregate, characterize, and place in interim storage the material currently contained in the classified area of the Mixed Waste Landfill is $24,923,585.00. This figure results in a per cubic yard cost of $911.15.

Cost Break Down

Item	Description	Unit Cost	Quantity	Cost
Document Preparation	Development of Operation Specific HASP, SOP, Excavation Plan, and Operations Plan. Costs based on historical data from similar projects	$63.75/hr	11,500 hr	$733,125
Mobilization	Preparation, Transportation, and setup of remote excavation systems and facilities	$500,000/ea	1	$500,000
Remote Excavation	Historical cost based on LANL MDA-P remote excavation. This cost includes personnel, equipment, and all overhead associated with remote excavation	$480/$yd^3$	27,389 yd^3	$13,146,720

Cost Break Down (Concluded)

Item	Description	Unit Cost	Quantity	Cost
System Maintenance	Maintenance of excavator, characterization systems, and all related systems	$1000/wk	91	$91,000
Mobile Crane	50-ton crane with 80-ft reach for use in conjunction with remote equipment & operator	$140/hr	4550 hr	$637,000
Remote Debris Characterization System	Remote system including conveyor belt, characterization chamber, robotic manipulators, and external power systems	$730,000/ea	1 ea	$730,000
SEGMENTED GATE COUNTER	System used to characterize all soils	$250/$yd^3$	27,389/yd^3	$6,847,250
RADIATION SAFETY/MONITORING	Entire suite of radiation detection and monitoring equipment	$142,740/ea	1 ea	$142,740
ADDITIONAL CHARACTERIZATION PERSONNEL	Staff for debris characterization system and radiation safety	$160,000/FTE	8 FTE	$1,280,000
ROLL-OFF	Temporary soil storage, 20 yd^3 ea	$5,000/ea	40	$200,000
STANDARD WASTE BOX	Storage for LLW debris	$750/ea	21	$15,750
SHIELDED CONTAINERS	Storage for high-emitting debris	$5,000/ea	20	$100,000
DEMOBILIZATION	Decontamination, shutdown, disassembly, disposal and transport of remote related equipment.	$500,000/ea	1	$500,000
TOTAL COST				$24,923,585

5. Conclusion

The above cost estimate takes into account, from previous historical project experience, the major expenses associated with the remote handling and/or robotics excavation and characterization of the soil and debris contained within the classified area of the Mixed Waste Landfill. Until a more detailed development of project operations, the special procedures associated with the nuclear materials contained within the site, and all associated site-specific requirements have been undertaken, the costs developed in this document are at best within 20% of the actual costs which might be expected for the excavation of a site with the level of complexity of the Mixed Waste Landfill.

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