THERMO NUTECH

A ThermoRetec Company
4501 Indian School Road NE, Suite G105
Albuquerque, NM 87110

SEGMENTED GATE SYSTEM
ER SITE 228A REMEDIATION PROJECT

SANDIA NATIONAL LABORATORIES

Final Report

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A Subsidiary of Thermo TerraTech, Inc.,
a Thermo Electron Company

SUMMARY

Thermo NUtech conducted a radioactive material volume reduction project for Sandia National Laboratories (Contract Number BC-0276) at ER Site 228A located east of TA-II complex on the northern rim of the arroyo. The goal of the project was to reduce the volume of contaminated soil that would require off-site storage and disposal. The soil at the site was contaminated with depleted uranium (DU).

The Thermo NUtech Segmented Gate System (SGS) was mobilized to ER Site 228A on November 2, 1998, to an area that had been previously prepared by Thermo NUtech personnel in August 1998. Excavation and pre-screening of the soil to remove the large debris was accomplished in August. Assembly and calibration were accomplished over a four-day period. Soil processing began on Friday, November 6, 1998. Soil was processed from November 6th through November 17th, with actual processing taking place on 11 of those days. A total of 49.18 hours of processing time were logged.

A total of 1,352 cubic yards were processed through the SGS. Total volume reduction reported by the SGS was 99.56 percent. Actual volume reduction for the first pass was still in excess of 99 percent after accounting for the volume of soil that was sent to the above-criteria path due to unscheduled operational halts. Total volume of the above-criteria soil pile was 4.68 cubic yards diverted by SGS between November 6–17 plus approximately 11.68 cubic yards due to unscheduled halts. The approximately 16 cubic yards in the above-criteria pile was processed again on November 17 to remove the soil generated from unscheduled operational halts, and resulted in approximately 5 cubic yards of above-criteria soil (contents of 21 55-gallon drums) requiring off-site disposal. An estimated 5.9 percent volume (or 80 cubic yards: 10 cubic yards in August pre-screening, and 70 cubic yards during SGS processing) in oversize material, was not sorted through the SGS.

Demobilization of the system was completed on November 24, 1998 when the equipment was shipped to the Thermo NUtech Laboratory Facility at 7021 Pan American HWY NE, Albuquerque, NM.

Total cost of SGS operations at Sandia National Laboratories was $220,040 including $29,400 for excavation and pre-screening, $41,300 for mobilization, $117,000 for operations and $32,340 for demobilization.

SECTION 1

1.0 SITE INFORMATION

1.1 GENERAL

This report provides the results of Thermo NUtech's soil remediation project for the DU contaminated soil at the Sandia National Laboratories using the Segmented Gate System (SGS). Thermo NUtech performed this work as a subcontractor to Sandia National Laboratories (SNL) as a contaminated soil volume reduction project in the remediation of Environmental Restoration (ER) Site 228A.

1.2 SITE BACKGROUND

Environmental Restoration Site 228A, the Centrifuge Dump Site and Tijeras Arroyo Operative Unit-ADS 1309, is located about 500 ft east of Technical Area II (TA-II). This site is on the northern rim of Tijeras Arroyo within the boundaries of Kirtland Air Force Base immediately southwest of Albuquerque, New Mexico. In July 1997 heavy rains eroded a portion of a depleted-uranium burial from the Tijeras Arroyo rim. Depleted uranium mixed with soil and some debris washed down the slope creating an alluvial fan deposit that extended as far as 300 feet from its original source.

1.3 SITE CHARACTERISTICS

Characterization of the site indicated that depleted uranium was the only contaminant present at the site. The volume of possibly contaminated soil was estimated at around 1800 cubic yards, including an estimated 20 percent of oversize material. This soil was excavated from 4 tenths of an acre from the arroyo side and bottom, followed by the removal of the larger debris elements using a pre-screen. Characterization of the site included the removal by hand of visible depleted uranium fragments.

1.4 SITE CONTACTS

Site management is provided by the DOE Albuquerque Operations Office (DOE/AL). The Managing and Operating contractor for SNL is the Sandia Corporation, a subsidiary of Lockheed Martin Corporation. The technical contact for the SNL segmented gate project is Sue Collins at Sandia National Laboratories [(505) 284-2546)].

SECTION 2

2.0 MATRIX AND CONTAMINANT DESCRIPTION

The type of matrix treated by the SGS at ER Site 228A was DU contaminated soil (ex situ) mixed with sands and river rock. Most concrete and metal debris was removed by others for SNL. On November 16, Sandia National Laboratories asked Thermo NUtech to process approximately 5 cubic yards of DU contaminated soil from the SNL Burn Site. The Burn Site soil was similar to that at this site except void of the large oversized rocks.

2.1 NATURE AND EXTENT OF CONTAMINATION

The SGS was designed to separate soils based on the radioactive contaminant content. The only radioactive contaminant found in the characterization of ER Site 228A was depleted uranium. Previous contractors removed the DU burial site in the arroyo rim and water run-off gully. Depleted uranium contamination was estimated to exist in approximately 1,385 cubic yards of soil, based on 4 tenths of an acre to a depth of 2-feet in the fan deposit. Field surveys by Sandia personnel defined the extent of contamination as the excavation progressed.

2.2 MATRIX CHARACTERISTICS AFFECTING TREATMENT COST OR PERFORMANCE

This project did not perform any sieve analysis on the soils to be treated at ER Site 228A. The soil moisture content appeared to be about optimal for SGS processing, and was estimated to be approximately 10% by weight, although actual measurements were not made for moisture content. On one windy day, water was added to the soil for processing and no drying process was used. There were some evening rain showers and some snow on November 9, which didn't cause any problems since the sandy soil drained very well.

The oversize debris and rock was estimated to be 360 cubic yards (20 percent of the volume) requiring pre-screening using a field grizzly. The field grizzly is a vertical bar grate measuring 10-feet on a side, mounted at a 45-degree angle to the plane of the ground surface. The vertical grate spacing was 6-inches center to center, and the bars were made of 2-inch by 1-inch plate steel. The soil was dropped onto the field grizzly directly from excavation, which separated debris with a minimum 6-inch dimension from the soil. Smaller debris and soil passed through the grate, while the larger debris slid down and were deposited in front of the grate. The larger debris were collected and spread out for SNL hand survey later. Actual volumes of oversize material were 10 cubic yards during pre-screening (>6 inches) and 70 cubic yards during SGS processing (>1.5 inches).

Of the debris and rocks that passed through the field grizzly, only round river rocks approximately 3-inches in diameter caused any processing difficulties. This size of rock would occasionally fall between the drag feed chain drive gear and chain, which would jam the chain and halt the flow of soil from the screen plant to the SGS. If this resulted in an emptying of the surge feed bin, the lack of soil on the conveyor would be halt the SGS operation.

2.3 TECHNOLOGY DESCRIPTION

The Thermo NUtech Segmented Gate System (SGS) is a combination of sophisticated conveyor systems, radiation detectors and computer controls that remove contaminated soil from a moving feed supply on a conveyor belt. Contaminated soil is diverted by segmented gates to a conveyor belt that deposits the soil on an appropriate ground cloth or other container system for stockpiling and later removal.

Contamination of soils by radionuclides is often heterogeneous. Excavation typically results in significant volumes of clean soil combined with the contaminated soil. The SGS provides a method of separating the clean soil from the contaminated soil based on a criterion supplied by the client.

Thermo NUtech's SGS removes a minimum amount of below-criteria soil with the above-criteria soil, significantly reducing the overall amount of material that requires disposal. The system works by conveying radionuclide-contaminated soil on moving conveyor belts under arrays of sensitive radiation detectors. The moving material is assayed and radioactivity content is logged by computer. The computer then calculates when the elevated activities will reach the end of the conveyor belt and activates the segmented gates to divert the above-criteria soil to a separate conveyor, which deposits the soil on the ground or in a container, where It can be segregated and readied for disposal.

The treatment of contaminated soils using the SGS offers the following advantages:

- the system physically surveys the entire volume of soil to be processed;
- no chemicals or other additives are used; and
- generation of secondary waste is limited to Personnel Protective Equipment (PPE) and decontamination rinse water.

The SGS is primarily a gamma detection system. The two sets of detectors allow for the radiation measurement of two gamma energy regions of interest (ROI). Beta detectors have also been installed on another Department of Energy project and were successfully used under the limited requirements of that application. Prior knowledge of the primary radioactive contaminants is required based on accurate analysis of the soil to be processed. Since the SGS currently sorts soil based on a maximum of two ROIs, these ROIs must be accurately set for the actual contaminants. Oversize rocks and cobbles cannot be processed by the SGS without pre-crushing.

2.4 SYSTEM SCHEMATIC AND OPERATION

Figure 1 depicts the process flow diagram for the SGS. During system operation, contaminated soil is excavated with standard heavy equipment and relocated to the feed point of the mobile SGS processing plant. Feed soil is screened by the SGS mobile screen/hammermill plant, and all rocks and debris with a minimum dimension greater than approximately 75 percent of the thickness of the soil layer deposited on the main conveyor belt are removed. The soil that passes through the screen/hammermill plant is stored in the feed surge bin, which is a reservoir for soil deposited on the main conveyor belt. A mechanical screed allows soil to flow out onto the conveyor belt in a thickness appropriate for the radioisotope(s) of interest and the soil characteristics.

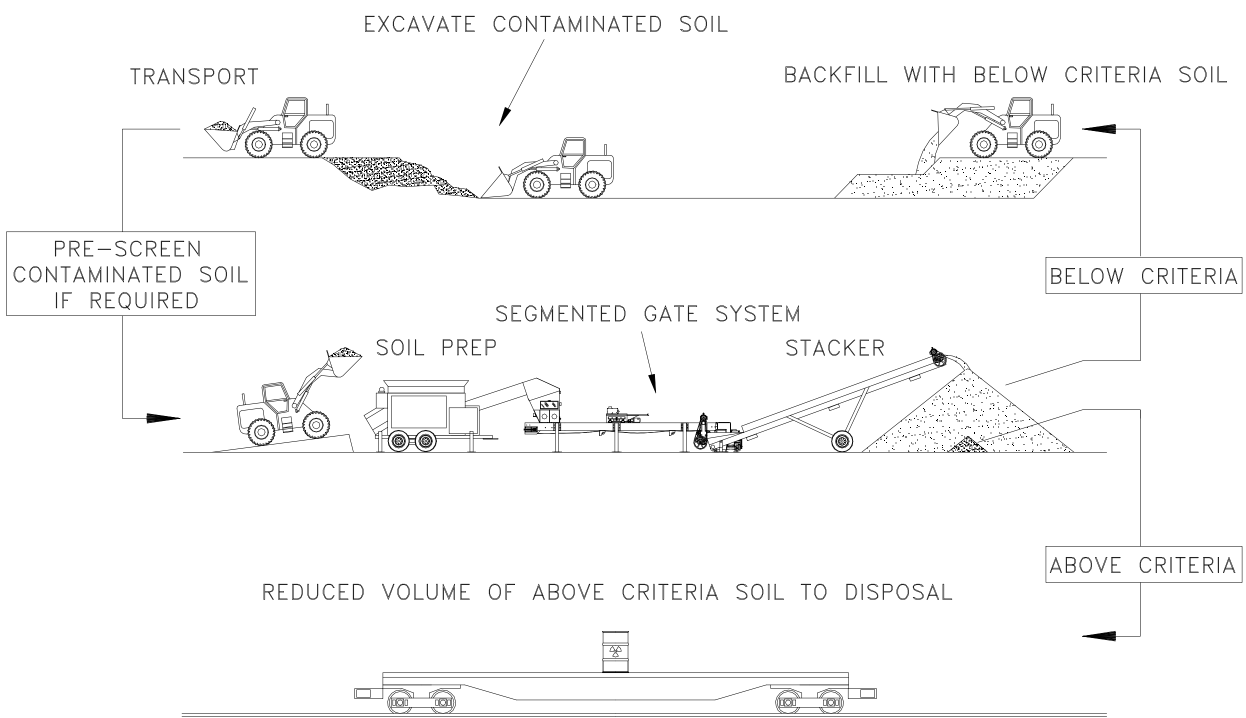


Figure 1. SGS process flow diagram

The soil is then passed under two sets of gamma radiation detector arrays housed in shielded enclosures. The thin detector array is designed for NaI detectors that are 0.160 thick, and incorporates a 0.75-inch poured lead shield fully encased by 3/16-inch thick painted steel. The thick detector array uses NaI detectors with a 2.0-inch thick crystal, and is housed in a similar shield with a 1.0-inch thick poured lead shield. Each detector array spans the width of the belt with two rows of detectors, one row containing 8 detectors and the other row containing 7 detectors in an offset arrangement. The two detector arrays operate simultaneously.

The process material is conveyed at a pre-selected speed underneath the detector arrays. Counts from the detectors are collected by an on-board computer, which actuates the pneumatic gates based on the analysis of the activity in the soil by several separate computer algorithms. Contaminated material that exceeds the separation criterion for radioactivity is diverted from the normal soil flow stream and deposited by the above-criteria stacking conveyor either in a container or on the ground where it can be packaged for disposal. The below-criteria soil is routed to another stacking conveyor and is piled on the ground, where it may be used to backfill the excavation.

2.5 SYSTEM REQUIREMENTS

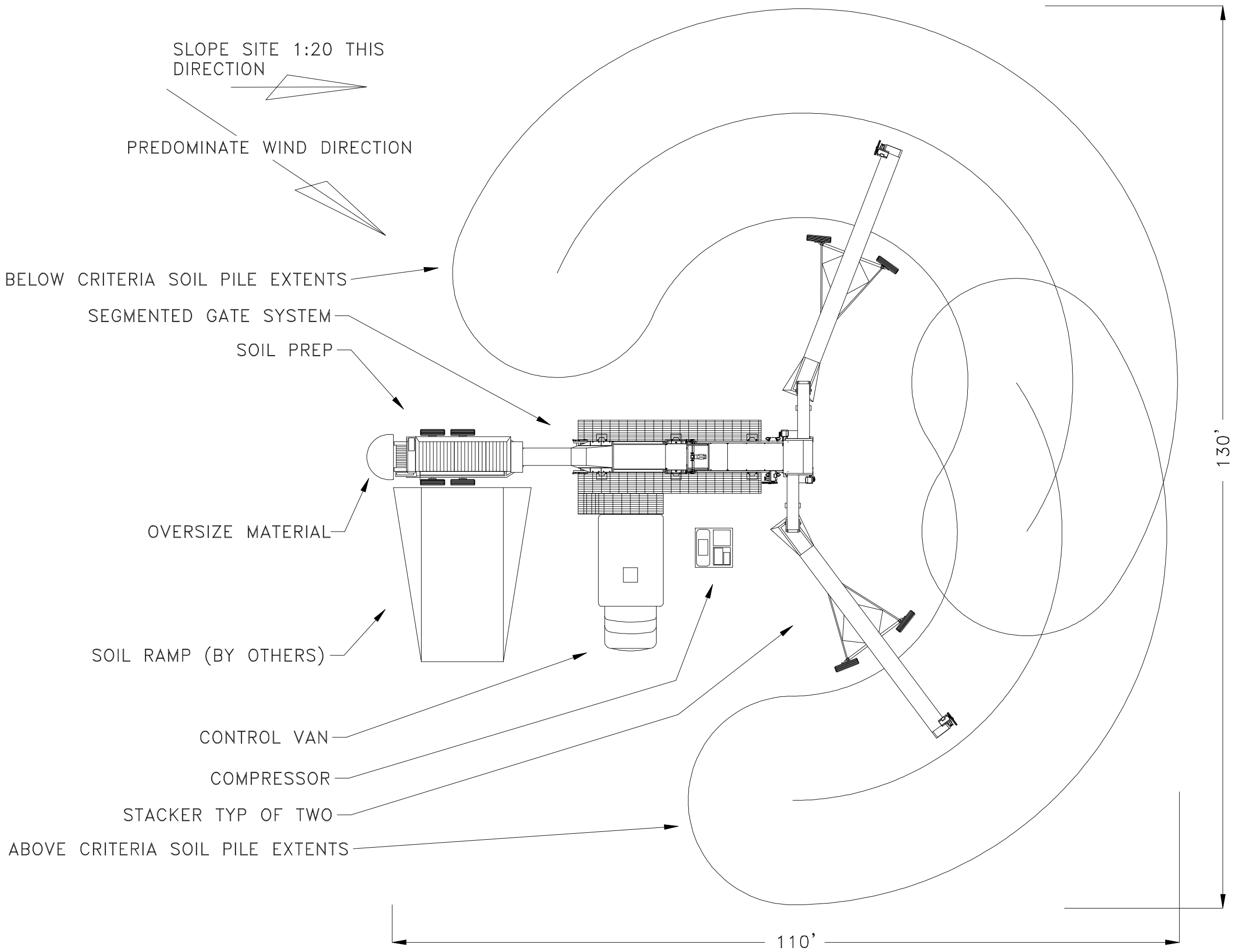
The SGS typically requires a footprint of 110 feet by 130 feet, as shown in Figure 2.

If the radial stacking conveyors are not needed, this footprint may be reduced significantly. The minimum operating surface is a flat dirt pad, free of debris and vegetation. Compaction of the surface is not normally required unless the soil is unusually soft. The screen/hammermill plant is towed into place. The remaining SGS components are removed from the flatbed trucks used to deliver the system and placed in position using a crane with a minimum capacity of 35 tons.

The SGS is completely electrically operated, requiring 208 volts, 3-phase power at approximately 200 amperes. Power can be supplied from site electrical service if available, or using fuel powered electrical generators. The SGS uses a single phase of the 3-phase power to provide any needed 115-volt single-phase service during operational hours. If generators are used, it is usually desirable to have a large generator for operating power, and a small 115-volt generator which is used during non-operating hours to supply power for the environmental control unit to maintain a constant temperature environment for the detectors.

A water source is normally required for the decontamination process. Water may also be required for dust suppression, both for the dirt pad and as an addition to the soil to be processed if necessary.

A local or temporary office building is used for project management and record keeping, as well as for breaks and relief of heat stress or other conditions caused by the local climate. Telephone and fax support are not crucial, but significantly add to the convenience of operations, allowing for the transmission of daily reports, client communications, and support from the corporate office for supplies, repairs, etc. Other required amenities are toilet facilities and a potable water supply.



SEGMENTED GATE SYSTEM FOOTPRINT

Figure 2

Soil is usually delivered to the SGS via a front-end loader. The front-end loader is often also used to excavate the site and to move any accumulated soil piles. Front-end loader operations necessitate the availability of fuel and lubrication services, as do the use of any fuel powered electrical generators.

While health physics support is typically provided by the client, Thermo NUtech can provide senior health physics technicians and full radiation safety support. Personal Protective Equipment (PPE) requirements are determined by the entity providing the radiation safety support, and PPE can be provided by Thermo NUtech or the client as site conditions dictate.

2.6 OPERATING PARAMETERS

The operating parameters for the SGS at ER Site 228A were selected to provide the optimum sensitivity for the contaminant of interest, depleted uranium. The belt speed and soil layer thickness were chosen to maximize production for the sensitivity required to achieve the client specified criteria, which were developed using risk-based calculations for the anticipated future use of the site. The thick detector array was not used during the project. The operating parameters and detector settings are summarized in Tables 1 and 2 below.

Table 1. Operating parameters affecting treatment cost or performance

Parameter	Value or Specification
Processing speed	30 fpm (sorting conveyor belt speed)
Belt length from detectors to conveyor end	Thin array: 16.0 ft (4.88 m) Thick array: 18.0 ft (5.5 m)
Soil layer thickness	2 inches (5.08 cm)
Soil layer width	30.75 inches (78.1 cm)
Soil density (on the conveyor belt)	1.29 g/cm^3
Detector type	Sodium iodide (NaI) 1/16 inch thick crystal

Table 2. SGS detector settings at ER Site 228A

Contaminant	Detector Array	Gamma Energy Region of Interest	Distributed Alarm Setpoint	Multiple Hot Particle Factor
Depleted U	thin	40-110 keV	27 pCi/g	4 (108 pCi/g)

Sandia provided on-site radiation worker safety support. SGS operators were required to wear Level II PPE but were not required to wear respirators.

SECTION 3

3.0 SEGMENTED GATE SYSTEM PERFORMANCE

3.1 PROJECT OBJECTIVES AND APPROACH

The primary objectives of the Segmented Gate System project were:

- Excavate and prepare soil for segmented gate processing;
- Reduce the volume of soil at ER Site 228A requiring off-site disposal;
- Reduce the overall ER Site 228A remediation costs; and

- Provide a basis from which to estimate SGS cost/performance for similar sites projected for future operations.

The SGS was used to sort 1,352 cubic yards of soil suspected of depleted uranium contamination excavated from ER Site 228A at Sandia National Laboratories. The reduction in the volume of contaminated soil was determined based upon the total soil processed versus the amount of soil that was determined to be below the release criteria for the site. The radionuclide activity of the below-criteria soil was compared to the pre-determined risk based release criteria.

3.2 PERFORMANCE SUMMARY

The period of performance for the project demonstration was from July 22, 1998 through November 24, 1998.

Thermo NUtech completed site preparation and soil excavation the first two weeks in August prior to mobilization of the SGS. The SGS was mobilized to the SNL ER Site 228A and arrived on November 2nd. Assembly of the system started while it was being off-loaded. Mobilization and calibration of the system were accomplished by November 6, including detector and operational quality checks. This period also included any SNL site specific training necessary for Thermo NUtech personnel. There were no weather-related delays during the mobilization phase. The SGS was completely operational and ready to process soil on November 6.

A 5-day per week, 10-hour per day schedule was set for processing soil. Soil was processed until November 17, 1998. Work on Saturday and Sunday was allowed based on weather forecast and to ensure completion of soil processing before November 24th. On November 16th, a feasibility study was conducted using 5 cubic yards of soil brought in a dump truck from the SNL Burn Site. The results of that feasibility study are included in the data for ER Site 228A. The system was then decontaminated, surveyed by SNL personnel, loaded onto trucks for transportation to the Thermo NUtech Albuquerque Laboratory on November 24, 1998.

Thermo NUtech personnel using two front-end loaders began the excavation work in August 1998. Excavation included pre-screening of all the soil using a vertical bar field grizzly to remove objects whose minimum dimension was greater than 6 inches. After pre-screening, the soil was stockpiled for processing. The stockpiled soil was identified by SNL personnel as soil pile number 4. The oversize material was spread out in a single layer in preparation for hand survey by SNL personnel. Excavation and pre-screening were completed on August 14th.

Soil was processed using the SGS for 11 days in November. Figure 3 depicts the daily volumes processed.

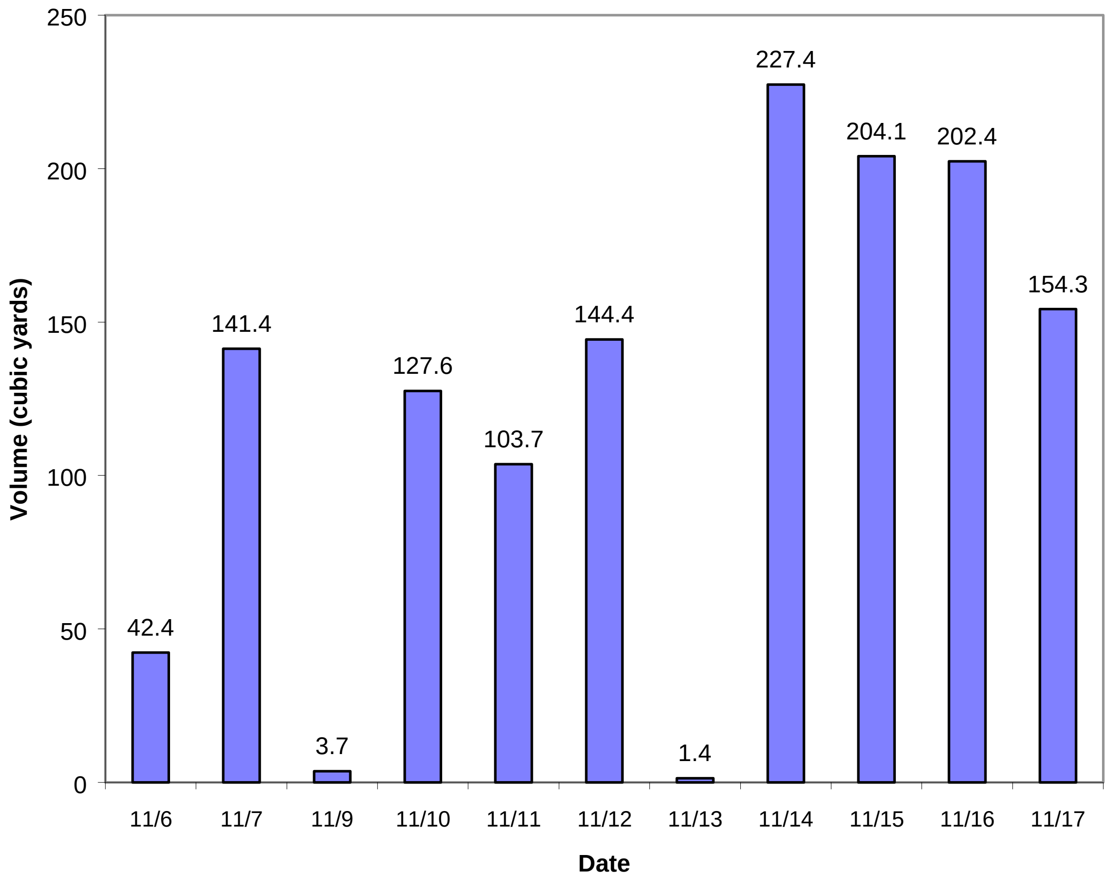


Figure 3. Daily processing volumes

Average daily operational time was 4.47 hours. The average daily operational time was impacted by provisions for a pre-job briefing, snow and wind delay on November 9th, equipment malfunctions due to rocks, concern with radon interference on November 13th, and completion of calibration on November 6th.

An overall volume reduction of 99.56 percent was realized after processing the entire volume of soil including the 5 cubic yards of Burn Site soil and approximately 4.68 cubic yards of above-criteria soil that was reprocessed. This included soil that was diverted for excessive activity (including soil that was diverted due to periodic source checks), and soil that was diverted due to unscheduled pauses in operations. Unscheduled pauses due to soil flow difficulties or other operational problems resulted in approximately 151 kg being diverted each time, with a total unrecorded mass diverted of approximately 11,200 kg (about 11.7 cubic yards). (Number of pauses 74 times 151.2 kg).

On November 17, 1998, final cleanup of the site was accomplished by processing 154 cubic yards of soil that included the reprocessing of the above-criteria pile. The above-criteria pile was approximately 16 cubic yards, consisting of 4.68 cubic yards diverted by SGS (including soil that was diverted due to periodic source checks) and soil that was diverted due to unscheduled pauses (approximately 11.68 cubic yards) in operations.

Overall volume reduction including reprocessing the hot pile was 99.56 percent, resulting in twenty-one 55-gallon drums of material requiring off-site disposal.

3.3 RADIOLOGICAL DATA

Depleted uranium was the only radionuclide processed in this project. The contamination was predicted to be very heterogeneous. SGS operations substantiated this prediction with data that indicated that the elevated activity could be removed by taking very little soil from the process and that the activities for the above and below-criteria soils exhibited dramatically different levels of activity, as shown in Table 3. While the sorting criteria for distributed contamination was set at 27 pCi/g, the below-criteria soil average was well below that level, at 14.77 pCi/g. The above-criteria soil average was 205.92 pCi/g. The above-criteria average activity excludes the large chucks of DU (see Figure 4 below) collected by hand from the ground, feed pile, or the oversize pile. Also, the above-criteria average activity excludes any activity seen by the SGS during periodic source checking of the system that verified both detector response and gate operation while soil was being processed.

Table 3

Date	Average Above-criteria Activity (pCi/g)	Average Below-criteria Activity (pCi/g)	Distributed Sorting Criteria (pCi/g)
11/6/98	367.7	14.9	27
11/7/98	180.0	12.7	27
11/9/98	242.3	13.7	27
11/10/98	218.5	13.0	27
11/11/98	134.0	15.0	27
11/12/98	194.6	12.7	27
11/13/98	115.0	24.4	27
11/14/98	198.4	12.1	27
11/15/98	228.9	15.9	27
11/16/98	210	16.9	27
11/16/98 Burn Site	169	12.2	27
11/17/98	223.5	14.7	27

Reprocessing of the above-criteria pile resulted primarily in the removal of most of the below-criteria soil that was generated due to the unscheduled pauses in operation as previously reported. The average activity of the below-criteria soil removed from the above-criteria pile was 14.77 pCi/g, while the activity of the above-criteria soil after reprocessing remained relatively constant at 223 pCi/g.

No hazardous wastes were generated by SGS processing. Dry decontamination of the system resulted in no wastewater generation. Other wastes remaining were approximately two barrels of personal protective equipment (PPE). The soil remaining was packaged into twenty-one 55-gallon drums awaiting final disposition.

Figure 4

3.4 BURN SITE SUMMARY

In addition to the soil sorting activities for soil from ER Site 228A, a dump truck containing 5 cubic yards of soil from the Burn Site was brought to ER Site 228A for a pilot study. The contamination at the Burn Site was judged to be similar to that at ER Site 228A.

A total of 5.2 cubic yards of Burn Site soil was processed. A volume reduction of 99.4 percent was reported by the SGS. The average above-criteria activity reported by the SGS was 169 pCi/g, while the average below-criteria activity was reported as 12.2 pCi/g. The distributed contamination criteria for the Burn Site soil was set to 27 pCi/g and multiple particle factor of 4.

SECTION 4

4.0 SEGMENTED GATE SYSTEM COSTS

4.1 CONTRACTING METHOD

The SGS project was contracted by Sandia National Laboratories on a lump sum fixed price, with an optional production rate for a volume greater than 1800 cubic yards. Total invoiced cost for this project was $220,000.

4.2 COST BREAKDOWN

Excavation costs included rental of two front-end loaders, shipment of field grizzly, and labor to excavate, pre-screen and stock pile approximately 1400 cubic yards of soil (1352 CY thru SGS, 10 CY oversize from pre-screening, and 70 CY oversize from SGS).

Mobilization costs included trucking and crane costs to deliver the SGS and delivery charges for heavy equipment, mobile office space, etc. Demobilization charges included pickup charges for the various equipment and facilities, crane services to load the SGS onto the trucks, and funding for preparation of the final report. Mobilization costs for transportation of the crew to the work site were invoiced at cost plus G&A and were not included in the defined mobilization costs.

Daily operational costs included crew wages, per diem, equipment rentals, PPE and daily operating supplies. Operational days included equipment unloading, assembly and calibration, site excavation, operation during soil processing, and disassembly, decontamination and loading of the equipment for shipment to the next job site. Truck transportation charges to the next site were considered part of the mobilization charges for the next client. In cases where the SGS is not scheduled for another project, trucking charges would be considered part of the demobilization.

Table 4

Cost element	Description	Subtotals
Task 1	Excavation	$29,000
Task 2	Mobilization	$41,300
Task 3	Processing	$117,000
Task 4	Demobilization	$32,340

Additional costs incurred by Sandia included ER Site 228A gully excavation, oversight labor, health physics support, procurement of a water supply, fuel services, generator support, sample analysis, and waste disposal.

Processing costs for SGS operations provided by Thermo NUtech were approximately $82 per cubic yard ($117,000 divided by 1,432 cubic yards), including all soils. Overall costs for services provided by Thermo NUtech averaged about $154 per yard. Processing costs reflect the relatively small volume processed. Increased volumes would leverage the mobilization and demobilization costs and should result in increased daily production volumes as a daily routine develops and soil is available for processing for full days.

SECTION 5

5.0 SCHEDULE

Figure 5 shows the tasks and schedule associated with the SGS project at SNL ER Site 228A. Since only one radionuclide was processed, only one calibration interval was required. The operations interval was not increased when the soil from the Burn Site was brought in since there was no requirement to isolate the soil from the surrounding site.

ID	Task Name	Start	Finish
1	**Sandia ER Site 228A**	**Mon 8/3/98**	**Wed 11/25/98**
2	**Excavation & Pre-screening**	**Mon 8/3/98**	**Fri 8/14/98**
3	Excavate site	Mon 8/3/98	Fri 8/14/98
4	Pre-screen Stockpile	Fri 8/7/98	Fri 8/14/98
5	**Mobilization**	**Mon 11/2/98**	**Thu 11/5/98**
6	Deliver Control Van and Trailer	Mon 11/2/98	Mon 11/2/98
7	Transport Equipment	Mon 11/2/98	Mon 11/2/98
8	Assemble Equipment	Mon 11/2/98	Thu 11/5/98
9	Calibrate System	Wed 11/4/98	Thu 11/5/98
10	**Operation**	**Fri 11/6/98**	**Tue 11/17/98**
11	Process Soil	Fri 11/6/98	Tue 11/17/98
12	**Demobilization**	**Wed 11/18/98**	**Wed 11/25/98**
13	Disassemble Equipment	Wed 11/18/98	Thu 11/19/98
14	Decontaminate Equipment	Fri 11/20/98	Tue 11/24/98
15	Load Equipment	Wed 11/25/98	Wed 11/25/98

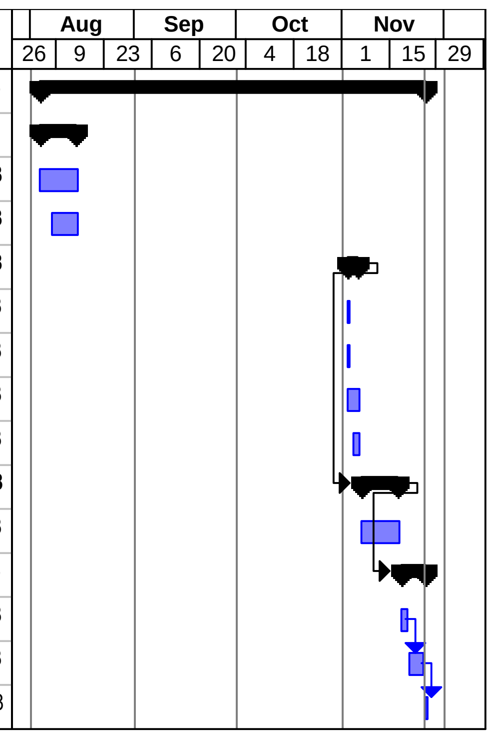


Figure 5. Project Schedule

SECTION 6

6.0 OBSERVATIONS AND LESSONS LEARNED

6.1 COST OBSERVATIONS AND LESSONS LEARNED

The unit cost for processing soil at Sandia ER Site 228A was approximately $82 per cubic yard. The average daily processing time was 4.47 hours, significantly below the target of 7 hours per 10-hour day. There were two days when more than 7 hours of processing was achieved. The major impacts were from weather delays and equipment concerns. The impact of these factors would be significantly reduced on a larger project. The soil was very heterogeneous, containing only sporadic hot spots. This was the primary reason for the excellent volume reduction, which is the primary driver for overall cost reduction.

Operating time for larger projects may be impacted by any time required to reprocess the above-criteria pile to remove soil placed there by unscheduled operational pauses. Cost benefits could be achieved by analyzing the pause records and addressing the root causes.

6.2 PERFORMANCE OBSERVATIONS AND LESSONS LEARNED

Several factors impacted the performance and throughput of the SGS at ER Site 228A. The use of the field grizzly was a positive contributor to the ease of processing soil containing large oversize debris. By removing large debris before processing the soil, many of the challenges of keeping a uniform soil flow in the system were eliminated. While use of the field grizzly can sometimes lead to homogenization of the soil, the contaminant was very localized and appeared to be in actual fragments that were not dispersed as the soil was filtered through the grizzly.

The exception to uniform soil flow was the occurrence of screen/hammermill plant jams caused by rocks approximately 3 inches in diameter. These rocks would occasionally lodge between the feed chain and the feed chain drive gear, causing a lack of soil to the SGS, which in turn caused an unscheduled pause. This event had been observed during previous operations, but measures taken to limit the occurrence of this event were not successful, and will require more research.

The moisture content of the soil was near optimum, requiring less monitoring of soil flow through the gates.

6.3 SUMMARY

The application of the SGS to the remediation of Sandia National Laboratories ER Site 228A resulted in significantly reducing the volume of radionuclide contaminated soil that would require off-site disposal. The application of the SGS to the remediation of radionuclide contaminated soils can be very effective in situations where the contaminant is heterogeneously distributed, the contaminant is well characterized and provides a suitable gamma signature for the SGS, and the soil type is amenable to processing on a conveyorized system in a layer one to two inches thick after removal of any significant debris. Figure 6 shows the clean pile in comparison to the drum of waste now requiring off-site disposal. Figure 7 shows the oversize rocks spread out in a 6-inch layer to be surveyed and released by Sandia personnel.

Figure 6

Figure 7