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Proceedings from the Remediation of Radioactive Surface Soils Workshop

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Hosted By:
U.S. Department of Energy
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Table of Contents

Table of Contents *(Continued)*

List of Acronyms and Abbreviations

Ac	Actinium
AEMP	Ashtabula Environmental Management Project
ALARA	As-low-as-reasonably-achievable
Am	Americium
ASTD	Accelerated Site Technology Deployment
BN	Bechtel Nevada
BNL	Brookhaven National Laboratory
CAB	Citizens Advisory Board
CETL	Clemson Environmental Technologies Laboratory
CFR	*Code of Federal Regulations*
Co	Cobalt
Cs	Cesium
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DRI	Desert Research Institute
EM	Environmental Management
EMSP	Environmental Management Science Program
EPA	U.S. Environmental Protection Agency
Eu	Europium
FEMP	Fernald Environmental Management Project
FFACO	*Federal Facility Agreement and Consent Order*
FY	Fiscal year
gpm	Gallons per minute
HPGD	High Purity Germanium Detector
IHSS	Individual hazardous substance sites
in.	Inch(es)
INEEL	Idaho National Engineering and Environmental Laboratory
IT	IT Corporation
M	Million
MEMP	Miamisburg Environmental Management Project
mg/Kg	Milligrams per kilogram
MPI	Multi-point injection
mRem/yr	Millirem per year

List of Acronyms and Abbreviations *(Continued)*

NETL	National Energy Technology Laboratory
NNSA/NV	National Nuclear Security Administration Nevada Operations Office
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
OST	Office of Science and Technology
PAC	Potential area of contamination
pCi/g	Picocuries per gram
PPE	Personal protective equipment
psi	Pounds per square inch
Pu	Plutonium
Ra	Radon
RFETS	Rocky Flats Environmental Technologies Sites
ROD	Record of Decision
RSAL	Radioactive soil action level
SCFA	Subsurface Contaminants Focus Area
SGS	Segmented Gate System
Sr	Strontium
SRS	Savannah River Site
SWL	Soil Washing Laboratory
Tc	Technetium
TCLP	Toxicity characteristic leaching procedure
Th	Thorium
TRU	Transuranic
U	Uranium
UNR	University of Nevada - Reno
WPI	Waste Policy Institute
yd^3	Cubic yard

1.0 Overview

The U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Operations Office (NNSA/NV), the Subsurface Contaminants Focus Area within the hosted Remediation of Radioactive Surface Soils Workshop. The Waste Policy Institute (WPI), Clemson Environmental Technologies Laboratory, Bechtel Nevada, and the Desert Research Institute (DRI) provided support for the workshop.

The workshop provided an opportunity for DOE Offices, site operators, and vendors to exchange information on related radiological surface soil problems and determine the availability of technologies for the removal, treatment, and disposal of the contaminants, and identify a path forward to resolve the problems.

Facilitator Introduction - Gerard Voos, WPI/Aiken, Gerry welcomed the group and provided necessary information on the workshop logistics. Gerry then turned the workshop over to Roger Jacobson of DRI, who then opened the workshop and introduced Rick Betteridge of the Technology Division at the NNSA/NV.

2.0 Background and Purpose

NNSA/NV Welcome - Rick Betteridge, NNSA/NV, Technology Division Director, officially welcomed vendors, site representatives, and other participants. Rick then offered an overview of the sponsors and purpose of the workshop. The purpose of the workshop was to present soil cleanup needs that have been identified - not only for Nevada, but also for other DOE sites across the weapons complex - and match those needs to potential solutions presented at the workshop. Rick also encouraged the participants to work cooperatively during and after the workshop to produce superior solutions for DOE's radionuclides in soils problems.

Purpose/Goals of Workshop - Roger Jacobson, DRI, stated that the workshop discussion of site needs, issues, successes, and potential technologies to provide solutions will help NNSA/NV establish a path forward to accomplish their goals. Roger stressed to vendors that while the focus of this particular workshop was plutonium, other contaminants of concern could be found at the Nevada site and in areas of all sizes, from small plots to large acreages. Vendors were encouraged to identify other areas where their technologies might be applied as they become apparent throughout this workshop.

Subsurface Contaminants Focus Area (SCFA) Involvement in Surface Soils - Carl Lanigan, DOE/Savannah River. Carl described the Office of Science and Technology (OST) and its role within the DOE Environmental Management (EM) program. The OST manages a national program supporting basic and applied research, as well as technology development, demonstration, and deployment assistance. This work enables OST's customers to complete timely and cost effective cleanup and enable long-term stewardship at sites across the DOE weapons complex. All 113 sites located in 30 states require some form of cleanup. Carl explained that SCFA's mission is to provide scientific and technical assistance, novel cleanup approaches, and innovative technologies that will address soil and water pollution needs, reducing the risk and cost of cleanup and stewardship. By working with other components of OST, such as the Accelerated Site Technology Deployment (ASTD), Environmental Management Science Program (EMSP), etc., SCFA pursues an integrated approach to meeting current site needs. The SCFA currently has identified five technology needs that concern the treatment, remediation, and extraction of radioactive contaminated soils. Some needs are also associated with the screening, characterization, and migration of these contaminants. For more information on current needs at all DOE sites, Carl offered the following URL: http://apps.em.doe.gov/ost/progstcg.html.

Q. What is the status of the most recent Applied Research call?

A. It is expected that the award will be made before the end of FY 2001. The budget has already been approved for this call.

Q. Are there solicitations coming up for the Science Program or Long-Term Stewardship?

A. There should be something issued early next quarter for applied research, but I'm unsure of long-term stewardship.

NETL Involvement in Surface Soils - Dave Schwartz, DOE National Energy Technology Laboratory (NETL), began his presentation with an overview of NETL and their mission. The NETL was formed in 1999 when the Federal Energy Technology Center in Morgantown, WV, and the Pittsburgh Energy Technology Center in Pittsburgh, PA, merged. NETL has facilities in both PA and WV and supports development and deployment of environmental technologies that lower the cost and reduce the risk of remediation throughout the DOE weapons complex. Solicitations, including the upcoming Clemson solicitation, are posted regularly on the NETL web site (http://www.netl.doe.gov/business/solicit/index.html). There were no questions asked of Dave. Ralph Smiecinski NNSA/NV then commended NETL's success in connecting technologies with site needs. He referenced a study of needs by site by West Virginia University. Steve Hoeffner , Clemson University, provided the reference: Cho, Eung Ha et al., *Soil Volume Reduction Technologies, Evaluation of Current Technologies*, DOE Cooperative Agreement DE-FC26-98FT40396, Deployment Leading to Implementation, Final Report, submitted by West Virginia University to U.S. DOE National Energy Technology Laboratory, July 2000. It is listed at http://www.cetl.org/nts/background.htm. The direct link is at http://www.cetl.org/nts/july2000.pdf.

Clemson Solicitation - Steve Hoeffner, Clemson University, gave an overview of the then pending Clemson Environmental Technologies Laboratory (CETL) solicitation. As part of their contract with NETL, CETL was seeking contractors that are interested in demonstrating their ability to treat plutonium-contaminated soil obtained from the Nevada Test Site (NTS). Results of the demonstrations will be evaluated by an independent review team and reported to NETL. Successful treatment could lead to pilot-scale and full-scale treatment projects. Vendors were encouraged to participate in this solicitation. The anticipated draft solicitation was available at http://www.cetl.org/nts.

Review of Survey Forms - Ralph Smiecinski, NNSA/NV. Ralph opened his presentation by saying that, prior to the workshop, he had invited sites across the DOE complex to fill out a site-needs survey form. Project personnel will summarize this information and will use it to match needs with prospective resources that meet them. Ralph then highlighted key aspects of the survey form. Key aspects of the survey include the type of contamination by site, the current baseline technology for treating that contamination, and performance criteria desired for new technologies. Ralph encouraged sites that had not submitted completed survey forms prior to the workshop to do so. Ralph also encouraged vendors to offer new and innovative technologies in order to meet these DOE site needs. A summary of the survey forms is located in Appendix A.

Q. Are the contaminants in the surveys soluble, West Valley in particular?

A. Solubility varies depending on the radionuclide and the chemical form. For example, tritium present as HTO would be completely soluble, whereas fused plutonium silicate would for all practical purposes be insoluble. At West Valley the radionuclide contaminants that are present are Strontium-90 (Sr-90), Cesium-137 (Cs-137), and various transuranic (TRU) contaminants. Sr-90 should be fairly soluble, Cs-137 is typically soluble but can be retained by clays in soils, and TRU solubility depends on the specific radionuclide.

Q. How does air sampling figure into the efforts that ensure worker/public health and safety during truck transfer of soil from the site?

A. Historically, we used air sampling and measured the levels before, during, and after soil removal. Those data support the fact that the health and safety risks are reduced in relationship to the amount of removal. Therefore, the issue is less removal, less risk.

Q. Are risk assessments available?

A. Yes, the following report is available on request "*Cost/Risk/Benefit Analysis Of Alternative Cleanup Requirements for Plutonium-Contaminated Soils On And Near The Nevada Test Site*" (DOE/NV-399, May 1995). Interested parties can contact Sean Crawford, NNSA/NV, at 702-295-3381, crawford@nv.doe.gov; or, Ralph Smiecinski, 702-295-0606, smiecins@nv.doe.gov for a copy. This document is also available online at http://www.cetl.org/nts/pu/cost_risk.PDF.

Q. What other risks exist?

A. The standard excavation/construction activities (e.g., heavy equipment use) present risks not associated necessarily with the contamination, yet must be considered in the overall project.

FY 2002 ASTD Call for Proposals - Jihad Aljayoushi, DOE/Idaho, briefly explained that OST's ASTD program provides a valuable bridge between technology developer and sites. ASTD calls for proposals funded by OST and based on needs identified by sites. There is an ASTD call for proposals pending for FY 2002. Details are posted on the ASTD web site at: http://id.inel.gov/astd.

3.0 Site Needs for Surface Soils Remediation Technologies

Nevada (NV) – Bill Wilborn, Environmental Remediation Division, NNSA/NV, provided an overview with site photos identifying the NTS and adjacent areas. In Nevada, soil remediation is required at four sites on the Tonopah Test Range and the NTS. The main radionuclide of concern is plutonium-239 (Pu-239), and the volume of soil to be remediated consists of 2.7 million (M) cubic feet. The site has a tentative cleanup start date of 2007, and innovative technologies are needed prior to the beginning of that fiscal year, but the final determination will be based on discussion between the involved agencies. The current baseline is side-dump trucks and burrito wrap. The innovative technology requirements for this site include very high throughput levels, with 70 percent volume reduction resulting in potential cost savings of $18.6M. New technologies should be portable or self-contained to withstand the harsh, remote, and arid environment. Also, water and power consumption must be limited due to the remote location of some sites.

Q. What is the current baseline cost for this activity?

A. Currently, it is $40 to $50M.

Q. Where does the plutonium come from?

A. Safety experiment tests.

Q. How have the current technologies impacted baseline cost thus far?

A. The burrito wrap and other technologies have impacted the cost, but soil reduction of 70 percent will impact cost substantially.

Oak Ridge National Laboratory (ORNL) – Rick Dearholt, Bechtel Jacobs Company, LLC
Rick began by providing an ORNL overview. Constructed in 1943, ORNL is located 10 miles southwest of downtown Oak Ridge, TN, on approximately 3,560 acres. ORNL's subsurface contamination is at the Corehole 8 "Plume Source" and requires excavation of soil that is a continuing source of groundwater contamination. This is a major Bethel Valley Record of Decision (ROD) issue currently requiring excavation. The ROD should be signed in September 2001.

Approximately 30 pipeline leak sites at ORNL including the Tank W1-A site have been identified as "known" release sites. A relatively high potential exists for encountering "ribbons" of TRU-contaminated soils during excavation of other pipeline leak sites in the 3000 Area. The objective of the Tank W-1A Removal Project at ORNL is to reduce the discharge of radiological contamination to the environment by removing Tank W-1A and excavating the contaminated soil surrounding the tank. In 1999, ORNL issued a proposal for removal action, and selected a removal subcontractor to perform the certain tasks. The tasks include performing characterization of soil around the tank, removal and disposal of approximately 1,000 cubic yards of soil contaminated from the Tank W-1A line leak, removal and disposal of pipelines and sumps within the excavation area, and the removal and disposal of the empty Tank W-1A. There have been 12 borings completed and 48 samples obtained within the area of excavation (40 x 50 x 15 ft deep). The soil analyses showed high concentrations of a variety of radionuclides, mainly cesium, americium (Am), plutonium (Pu), and uranium (U).

Future remediation challenges at ORNL include Buildings 3026, 3019, and 3047. Building 3026 has liquid radioactive waste lines and leaks underneath the building. Contaminants at Building3026 include Sr-90, Cs-137, cobalt-60 (Co-60), plutonium, uranium, and TRU isotopes. Building 3019 was used for separating, processing, and analyzing highly radioactive samples, and is contaminated with fission products, activation products, uranium, and plutonium and TRU material. Building 3047, the Isotope Technology Building, also has needs for future remediation. While no wastes were handled in this building, contaminants found in the surrounding vegetation and, possibly the soils, include Sr-90, Cs-137, and Am.

Q. Regarding the blending of clay soils: are the contaminants adhering to soils?

A. This is currently undetermined.

Q. How is the contamination contained now?

A. Since there has been no disposal end-point determined to date, the containment consists of covering the waste until an effective removal method can be determined.

Q. Has characterization been done?

A. No. Because of the clay soils, the contamination wouldn't migrate. In order to characterize the site, sampling every square foot would have been necessary.

Q. What are personal protection equipment requirements for operators?

A. PPE would include double Tyvek® and respirators (cartridges used only once).

Q. Do you have ongoing technologies in place to deal with this, or are you looking for one?

A. ORNL currently doesn't have technology that applies to this problem, and cleanup managers are looking for one. Bioremediation or other technologies will be considered.

Q. Do you have information on the makeup of soils?

A. Will send additional information, but more strontium than cesium for sure.

Hanford – Scott Petersen, Bechtel Hanford, began his presentation on the remediation of radioactive surface soils at the DOE Hanford site by giving a logistical overview of the site and offering a site map of the area. The areas of concern at the Hanford site are the River Corridor and the Central Plateau. Liquid wastes have been discharged to the vadose zone through engineered structures (e.g., cribs, trenches), and solid wastes were buried in pits or trenches, sometimes contained in buried structures. Extremely radioactive liquid effluent was also stored in underground tanks. The remediation plan for the River Corridor requires that all the contamination be moved away from the Columbia River to prevent contamination that would impact the area's ecosystem. It also requires the excavation of 45 burial grounds over the next several years.

The Environmental Restoration Disposal Facility at Hanford currently contains over three million tons of contaminated soil and debris. Over six million tons from the River Corridor will eventually be disposed of there. The characterization of the Central Plateau is still underway, so no remediation approach has been established to date. The approach will most likely utilize a combination of the following strategies:

- Removal, treatment and disposal for all the smaller waste sites within the 200 Area, and all waste sites outside the boundary.
- Surface barriers for most waste sites within the 200 Area.
- *In situ* stabilization for filling void spaces before capping (e.g., grouting).
- Vitrification of high-level and TRU wastes.

The needs for the Hanford Site are published online at http://www.pnl.gov/stcg/fy01needs/. Most remediation efforts at the Central Plateau consist of good housekeeping methods. Some of these include the installation of berms and the decommissioning of water lines. Hanford is taking interim corrective measures, which include covers and water management control. Access to the tank farms is limited and installed covers must be flexible, repairable, and suspend the water to prevent the contamination from going deeper. While the primary need currently at Hanford is the remediation of contaminated water, there will also be a future need for soil remediation.

Q. NRC disposal sites don't allow double lining. How is that addressed?

A. Hanford is using double lining with a leachate collection system underneath. Scott also mentioned that the leachate is used for dust suppression at the landfill.

Q. How are you currently preventing additional water from getting in?

A. Berms are the method now, until a more desirable method is available.

Q. Are you looking for technologies to reduce soil contamination levels?

A. Currently, the primary need is water, but future needs will address soils.

Ohio Sites – Dick Neff, DOE/OH, initially summarized information for the DOE Ohio Operations Office sites, including the Miamisburg Environmental Management Project (MEMP), Columbus Environmental Management Project, Fernald Environmental Management Project (FEMP), Ashtabula Environmental Management Project (AEMP), and West Valley Demonstration project. Closure is scheduled for these sites between 2006-2010. This drives the need for a quick turnaround of usable technologies. The soils at the Ohio sites mentioned are made up of glacial till, clay, shale, and limestone. The groundwater is shallow and the sites are located in urban or near-urban areas. Some problems these sites have are unknowns, such as underground lines and contaminated soils. Other unknowns are the extent of the contaminants that reside under buildings and in buried pits and landfills at the Ohio sites. The current baseline technologies are box and bury, phytoremediation, and some limited chemical soil washing. The primary volume/contaminants at FEMP are 1 million cubic yards (yd^3) depleted U (On-site Cell) and 20,000 yd^3 enriched/depleted U. Primary volume/contaminants at MEMP are 60,000 yd^3 thorium/plutonium-238 (Th/Pu-238), and at AEMP they are 50,000 yd^3 Uranium/Technetium (U/Tc-99). Secondary contaminants also exist, including Europium (Eu), Pu-239, Cs, Co, Am, U-235, Actinium (Ac-227), and Radon-226 (Ra-226) in volumes of 10,000 yd^3 each.

Q. Are these soluble or insoluble contaminants?

A. Both, soluble and insoluble.

Q. What is the average depth of the contamination?

A. 20-30 ft down to 40 ft in some areas.

Rocky Flats – Lane Butler, DOE/RFETS, began his presentation with an overview of the Rocky Flats site including the 903 Lip Area Remediation Project. It is an industrial area of 400 acres with 6,100 acres of buffer zone. The production of nuclear weapons left behind a legacy of contaminated facilities, soils, and groundwater including 359 individual hazardous substance sites (IHSSs), and potential areas of contamination (PACs). The accelerated closure plan for the site includes environmental restoration of the site by 2006. The 903 Lip Area is located in the RFETS Buffer Zone and is the largest of the 95 IHSS/PACs located in the buffer zone. The IHSS boundary is identified by soils with Pu-239/240 greater than 115 picocuries per gram (pCi/g). A portion of the Lip Area (5.4 acres) is covered with six inches of artificial fill for stabilization purposes, and the remaining 9.2 acres are located within the area of undisturbed surface soils.

The 903 Drum Storage Area at RFETS is a major source of surface soil contamination in this portion of the site. The area was used for outdoor storage of drums from 1958-1967, and approximately 420 have leaked into the soil - releasing contamination that remained after drum removal activities. An asphalt pad was constructed over the contaminated soils in 1969, and remedial efforts were conducted in 1976, 1978, and 1984. The contamination at the 903 Lip Area is limited to radionuclides, and 90 percent of the activity is located in the upper 6 inches of soil. Of the 9.2 acres above 115 pCi/g of Pu-239/240, half of the area is flat and half includes gently-to-steep sloping surfaces. Characterization has determined contamination levels for surface and subsurface soils exceeding 115 pCi/g (Pu-239/240). The performance requirements for new technologies at RF include meeting the Rocky Flats Cleanup Agreement and the radionuclide soil action levels, which should be finalized in September 2001. Technologies must ensure site stream water standards and be consistent with final action. Impacts to the ecology must be kept to a minimum as well. Complete action is expected no later than December 2006. Methods and technologies currently being considered for use at Rocky Flats include precision excavation using heavy equipment, vacuum technology, and the pavement profiler.

Q. Which soil volume reduction technologies have been reviewed?

A. Segmented Gate System, soil washing, and heap leaching.

Q. What form is the Pu in?

A. Predominantly oxide.

Q. Would a screening technology work?

A. It could be an option if a technology is not available to get the top two inches.

Q. Some traditional technologies are effective in depths of six inches and some claim two inches. Has this been investigated?

A. Yes.

Q. Intended end use of land?

A. Congressional intent is for wildlife refuge, but the public would like unrestricted ranching.

Q. Are there other sites at Rocky Flats that need remediation?

A. Yes, there are others, but 903 has the largest surface area.

Q. How was site characterization performed?

A. We used a High Purity Germanium Detector (HPGD) to take direct readings of the site. This was then compared to some actual soil samples that we analyzed using alpha and gamma spectrometry. The resulting correlation indicated a very good correlation to support the HPGD.

Q. What reagents were considered for soil washing?

A. We did not look at any specific soil-washing process. However, we took a look at the overall process and made the determination that, in general, the clean side of any process would not result in low enough levels of Pu to return to the site. Therefore, since we would be looking at disposal for both the concentrated and low-level streams, it was not economical to pursue soil washing any further.

Idaho National Engineering and Environmental Laboratory (INEEL) – Robert James, INEEL, started his presentation by giving a background of the DOE Idaho site. The Environmental Restoration Program is responsible for remediation of all the INEEL contaminated sites in accordance with CERCLA and the INEEL *Federal Facility Agreement and Consent Order* (FFACO). There are 10 Waste Area Group locations at the Idaho site with varied contaminants. The varied waste types found at these sites include transuranics, high-level, low-level, hazardous, and industrial wastes. While INEEL is looking for *in situ* techniques for stabilization, the surface soils are also contaminated, making them candidates for remediation as well. The surface soil consists of silt and silty gravel. To date, baseline volume reduction methods have been unsuccessful at INEEL.

Q. What is the expected end use driving the action level?

A. Desired residential use 100 years from 1995.

Q. What is the origin of contamination?

A. Liquid spills, pipelines, leaks, spills, previous disposal practices, etc.

Q. Why are strontium and cesium remaining in the soil?

A. Soil chemistry and composition (sand versus clay), and environmental conditions such as low humidity.

Q. What is the current cost of remediation?

A. Life-cycle cost of $100 per cubic yard.

Q. Surface aerosol versus leach line or landfill - aren't they two different matrices to treat?

A. Aerosols have been deemed an acceptable risk.

Q. How accurate is the estimated degree of contamination?

A. Not precise, but as accurate as possible to date.

Rocky Flats – Norma Castaneda, DOE/RF, began her presentation on the Radioactive Soil Action Levels (RSALs) status at Rocky Flats, with an overview of the RSALs. An action level is a numeric level that, when exceeded, triggers an evaluation, remedial action, and/or management action. The RSAL is expressed in terms of the amount of radioactivity per unit mass of soil (i.e., pCi/g). The current RSALs, established in 1996, were based on the action levels recommended in the Draft U.S. Environmental Protection Agency (EPA) Radiation Site Cleanup Regulation, 40 *Code of Federal Regulations* (CFR) 196. This proposed regulation stated that a radioactively contaminated site should be cleaned up such that any member of the public would receive a radiation dose no greater than 15 millirem per year (mRem/yr) controlled (institutional controls) and 85 mRem/yr uncontrolled; however, the draft rule was never finalized.

The Rocky Flats Citizens' Advisory Board (CAB) and other interested stakeholders became concerned that the proposed RSALs were too high. In 1998, the CAB requested additional funding from DOE to carry out an independent review of the interim RSALs and the process the RFCA parties used to determine them. The review was completed in February 2000, and recommended RSALs that are significantly lower than the previous levels. Still another review is underway, with the document expected to go through the public comment process in late fall 2001. Vendors were asked to keep in mind that these are action levels, not final cleanup decisions. Final cleanup decisions will be based on action levels, site-specific conditions, as-low-as-reasonably-achievable (ALARA), water quality protection, stewardship considerations, etc. The end uses being considered for Rocky Flats are wildlife refuge, rural, resident ranching, and office work. The new RSAL values must support the levels necessary for these uses.

Q. How are they proposing to measure RSALs to ensure proper levels are being met?

A. To date, we have used the sodium iodide (NaI) and laboratory methods.

Q. Are you using area averages to establish the levels?

A. Yes.

Q. Is there a precedent being set here for national plutonium standards?

A. It's possible that could happen.

Q. Are old Colorado state standards not applicable any more since they are different?

A. Not sure.

Savannah River Site (SRS) – Chris Bergren, Environmental Restoration Division, started his presentation with an overview of SRS. Located in Aiken, SC, the SRS encompasses 310 square miles and currently includes 515 waste sites (including 11 groundwater contamination areas). A risk assessment was offered for SRS. There has been progress to date at the site including the fact that 293 of the waste sites are closed or in remedial design. There are currently eight area groundwater treatment systems running. The radiological needs of the site, require that SRS use an aggressive action only to avoid aggressive risks for soil stabilization and soil cover. Overall passive actions that are less aggressive technologies coupled with institutional controls are preferred, such as the use of phytoremediation or monitored natural attenuation and others. The chemical needs at SRS will require excavation as well as soil covers/caps. The goal of SRS is to drive down the cost of remediation with the use of innovative technologies. Details were offered on remediation efforts at Old F-Area Seepage Basin and the 488-D Ash Basin areas. Both projects are completed; however, there is still a need to manage the surface water for the 488-D Ash Basin. The SRS plans to deliver cost-effective remedial actions using passive technologies, when appropriate, that also provide economic benefits to the site/company.

Chris also mentioned that, if possible, they like to use plugs in RODs. This helps streamline the process.

Q. Isn’t grouting a short-term solution?

A. No, it stabilizes the soil, which is then tested and covered. Groundwater monitoring continues long term to ensure the integrity of the remediation.

Q. The risk evaluation seems like an EPA mandate, but is this a state requirement?

A. We comply with both the federal and state regulatory requirements.

Q. Do you currently use phytoremediation?

A. Yes, in the TNX area seepage basin that is contaminated with cesium. There will be ongoing work to ensure there has been no migration there.

Q. Have you achieved any Monitored Natural Attenuation for the site?

A. There is negotiation now for the seepage basin where the radiation will be gone in 30 years, but this is still pending.

4.0 Vendor Presentations

University of Nevada-Reno (UNR) – Raj Mehta offered a presentation that included the description of volume reduction research being carried out at the DOE Soil Washing Laboratory (SWL) at the University of Nevada-Reno campus. Radionuclide-contaminated soils from different DOE/U.S. Department of Defense (DoD) sites were obtained and remediated using centrifugal gravo-magnetic separation and flotation processes at SWL. These processes reduce the soil volume for disposal and greatly reduce the associated costs. The procured soils are stored in a lead-lined room and no further contaminants are added. Dr. Mehta then offered characterization criteria for the physio-chemical and radiochemical contaminants tested. SWL is currently using three volume reduction technologies. They are centrifugal gravo-magnetic separation, flotation technology, and tall-column flotation. Since most contaminants at NTS are in small particles, the combination of centrifugal and magnetic force can separate the contaminant from the soil. The magnetic force enhances the results of centrifugal force alone. Comparison test results on soil samples from various DOE sites support the enhanced results using the magnetic method. Dr. Mehta suggested that any of the volume reduction technologies being developed at SWL could be beneficial at NTS. These technologies are based on proven mining technologies that create volume reductions of 80 percent over current baseline methods.

Q. How long does remediation take?

A. The remediation is very fast. Again, these are robust and proven mining technologies.

Brice Environmental Services Corporation – Craig Jones described Brice as primarily a soil-washing vendor. Soil washing is a water-based, volume reduction technology consisting of unit components adapted from the mining industry. The selection and array of the components is based on site-specific parameters. The process works by separating fine soils from coarse soils. Since the majority of contaminants adhere to the soil organic matter, this lowers the overall cost at very large sites. The process also uses water to reduce airborne dust. This process has met residential cleanup goals of 400 milligrams per kilogram (mg/kg) total lead (98 percent volume reduction). Brice Environmental has conducted over 50 treatability studies evaluating the technology for use on a wide array of soils and contaminants, including radionuclides, heavy metals, explosives, pesticides, polychlorinated biphenyls, and other petroleum hydrocarbons. Brice has also successfully completed eight field-scale projects to date, but none involving radioactive contamination.

Q. Can you comment about experience with soils described by sites here today?

A. Further research is necessary but, based on historical knowledge, it should lend itself to these types of applications.

Q. Is throughput variable?

A. Yes, various elements in the equation will determine the throughput time. Which unit component used is key to determining the throughput efficiency. They come in various sizes.

Q. What processes are shown in the presentation photos?

A. Feeder, conveyor, wet screen, density separation, among others. They could be assembled with whatever components are necessary for a particular site.

Q. Mining is cost efficient, but how does worker safety play in the overall cost factors?

A. Treatment price is volume driven, and large volumes should not increase or decrease worker safety.

Q. What are the effects on the water used?

A. It is recycled using lime water treatment.

Earthline – Jeff Kulpa explained that Earthline Technologies is a full service Environmental Remediation Company currently performing the remediation of a former uranium extrusion site in Ashtabula, OH, for the DOE. Their expertise includes chemical extraction soil washing. Using a 10-ton per hour chemical extraction plant, they have cleaned over 14,000 tons of contaminated soil. Treatability and pilot work showed that cost savings of at least $15 million could be realized.

The chemical extraction leaching at Ashtabula starts by heating the contaminated soil. The soil is then fed at a rate of 10 tons per hour into the hopper, where it comes into contact with the leachate for three hours. This exposure results in a pH level of around 10, a condition that causes uranium to become soluble. The clarifier then separates the uranium-containing liquid from the clean soil. The soil is tested hourly to ensure the contaminants have been removed. Only the disposal of the evaporated residue from the liquid is necessary, and this is only 1 percent of the original volume. The life-cycle cost for the removal at Ashtabula was based on $341 per ton. Innovative soil-washing methods will save an estimated $234 per ton over the original baseline estimate. Some process improvements are planned, including front-end oversize processing improvements which will totally eliminate issues of oversize waste streams. Other process modifications will allow more efficient treatment of Tc-99-contaminated soil. Some future plant changes will improve water management using oxidant resin and improved process leachate cleaning. Earthline has also evaluated the applicability of Soil Washing for Removal of Pu-238 and Th-232 for the Mound PRS-66 site in Ohio to assess the potential for successful chemical extraction soil treatment. Five leaching experiments were performed at the Mound. These experiments indicated that basic acid extraction showed promising results (approximately 50 percent volume reduction). Performance testing also indicated that extraction performance can be improved by modifying other parameters such as increasing reaction temperature (7 percent), extending contact time (4 to 7 percent), and optimizing the chemical reaction (up to 20 percent). Earthline also owns a 20-ton per hour Physical Separation Chemical Extraction Mobile Plant and a four-ton per hour Stainless-Steel Pilot Plant. For further information on any of these technologies, please contact Jeff Kulpa at (440) 993-2804, or http://www.earthlinetech.com.

Q. If you could extract technetium, what would you do with it?

A. Currently, direct disposal is used but research is ongoing for technetium treatments.

Q. Using this system, how many staff are needed to run the uranium plant?

A. It should require four to five people.

Q. What is the percentage of Pu extraction you've experienced?

A. As much as 50 percent on soil fractions extracted with sulfuric acid.

Eberline – Joe Kimbrell began his presentation by explaining that Eberline's Segmented Gate System (SGS) is a volume reduction technology that consists of transportable equipment that can be mobilized on a half-acre area and operated by five people. SGS cost effectively reduces the volume of radioactive contamination in soil and material, and sorts contaminated soil into ranges of radioactivity, all of this without generating any secondary waste streams. Components of SGS include the screen plant, front-end loader or other soil transportation method, the sorting conveyor, sorting gates, diversion belts, and stacking conveyors that stack into a pile or container, etc. SGS is a proven technology, which has been deployed at 15 DOE/DoD sites. SGS has processed > 265,000 cubic yards of soil and has achieved up to 99 percent volume reduction. Mr. Kimbrell went on to offer the results of these deployments and offered a matrix showing the proven commercial efficiency of using the SGS at those sites. Increasing the throughput by building a larger system and increasing the belt speed could accomplish additional optimization of the SGS. Plans are also underway to improve the portability/usability of the system. Some of these include mounting the SGS on a trailer as it was originally designed, and mounting a water tank to the frame of a trailer. The screen plant would be converted to a generator, and grinding will be employed for oversized materials such as bushes, grass, and rocks. Mr. Kimbrell also offered a matrix demonstrating the proven performance history of SGS, which was based on desired performance criteria for innovative technologies.

Q. Have you had problems with the equipment becoming contaminated?

A. We make sure that the system meets the prerelease criteria for equipment established by sites. Control charts are kept to avoid contamination of equipment.

Q. What happens if there is uniform distribution of radionuclide material?

A. Proper characterization will ensure this is not the case. If so, SGS is not the desired tool.

Q. What is the hopper-to-hopper cost per ton?

A. $80 per yard including excavation.

Q. Does rain or moisture change the efficiency of SGS?

A. Yes, mud and clay clog the SGS, so rain can idle an operation.

Q. Has sequential performance testing been done?

A. Yes, Johnston Island had multiple sorting criteria.

Q. What are the cuts of belt?

A. The belt runs at 30 feet per minute; the minimum sort is one foot per second.

Q. Have you looked at front-end methods to avoiding mixing?

A. Yes, any vehicle with a hopper can be used for that purpose.

IT Corporation – Duane Graves offered a presentation on the innovative treatment technology for the biologically-mediated removal and treatment of plutonium (Pu), other radionuclides, and heavy metals in soil developed by IT. The technology uses sulfur oxidizing bacteria and a low-volume soil leaching procedure to dissolve and remove Pu from the soil. The leachate is treated by sulfate-reducing bacteria to precipitate Pu as plutonium sulfide. Bench-scale testing with NTS soil resulted in removal of greater than 80 percent of the Pu from the soil and recovery of greater than 99 percent of the Pu from the leachate. A 100-fold volume reduction and 95 percent mass reduction in Pu-impacted material was achieved. Full-scale costs are approximately $150 per cubic yard of soil.

The soil treatment batch process begins by amending the soil with sulfur, nutrients, and sulfur-oxidizing bacteria. The soil is then placed in batch treatment pits, where it is irrigated and aerated to stimulate the biological acidification. The soil is then leached to remove solubilized Pu and other metals. The leachate is treated with a sulfate-reducing bacteria bioreactor and the residual sludge is then collected, filtered, neutralized, and contained. The effluent water is recycled for additional soil leaching and irrigation. The soil acidification and leaching steps can be repeated, as required, to meet the intended treatment goals. Once this level is achieved, the treated solid is removed from the treatment pits and lime is added to neutralize it. IT believes this technology would meet the needs identified by the Nevada Test Site with great success. This technology is ready for pilot testing and has very low manpower needs, providing additional benefit by limiting worker exposure.

Q. Do you have to add sulfur?

A. Yes.

Q. Does the 90-120 days include the reducing for precipitation?

A. Yes.

Q. Do any regulators have any trepidation about mobilization of these contaminants?

A. It is an issue that must be addressed with regulators, but we currently avoid these concerns via the containment design for the water.

Q. How much acid does the process produce?

A. It creates large amounts of sulfuric acid.

Q. How temperature-sensitive is this technology?

A. Warmer temperatures are better than cold.

Q. What are the operational cost estimates at this point?

A. It is a turnkey operation that should cost around 5-6 dollars per cubic foot.

JVI Companies – Eric Bischof started his presentation with an overview of JVI and a description of the type of technologies they have available that could meet the Nevada needs. JVI Companies provide asbestos and lead abatement, hazardous waste remediation, interior and complete demolition, site cleanup, and total plant closure. JVI's equipment can operate in soft soils and irregular terrain, and can pickup large quantities of plutonium-contaminated soils without creating environmental problems associated with dust. JVI's Vacuum Auger Scarification Technology can move across the ground at approximately 0.5 to 1.0 miles per hour, handling the soil in a dry manner without any dust problem, and is capable of collecting and packaging approximately 20 tons per hour. The equipment will follow the contour of the land, picking up soil from depths of 3/4-inch to 4 inches or more. The front section of the unit is diesel-powered; the auger system is mounted in a removable unit and uses floating head augers. The dirt is forced to move inward and upward towards the bagging station. Prior to bagging, the soil is separated using the vegetation and derocking component with finger-type blades incorporated. The bagging station holds a vacuum bladder with a 25 yd^3 capacity. Other benefits of this technology include a conveyor that operates from either side of the unit. The dust control has been extended to include the fender wells of the vehicle, and the auger bristles can be adjusted for removal at very shallow depths. Particulate releases are minimized by a vacuum – cyclone - baghouse – high-efficiency particulate air filter treatment system.

Q. Are the speeds presented based on testing?

A. Yes, the engineers have calculated that figure.

Q. In uneven terrain, how will it work?

A. The floating head augers will take care of this. They will float with the contour of the land.

Q. Have you done this before?

A. No, we haven't.

Q. How long will it take to put it together?

A. Eight months.

Q. Can you engineer the machine to pick up selective grain sizes?

A. I'm sure we could.

Q. You could almost have sensors set up to start and stop where you want, giving very precise excavation, is that correct?

A. Yes, that is correct.

Q. Would you hazard a guess how much to build it? How long will it last?

A. $1.5M, estimated. A cost analysis is in process. That will be on our web site at www.jvicompanies.com.

Q. Have you looked at the applications of your machine versus conventional techniques? How will that fit into your design?

A. We have cyclones built now, but we're still working on specifics. We will be able to follow the contour of the land. The soil we pick up will be highly concentrated with the Pu. We're not going to pick up any excess soil.

Q. Are you claiming cost savings over conventional methods?

A. Definitely, we are not going to pick up any excess soil.

Q. How will you guarantee not picking up any clean soil?

A. We expect that the sites will be characterized and mapped out, and we can specify the depth, etc.

MT2 – Mark Peters and Jim Bartell began their joint presentation with an overview of MT2 and their capabilities. MT2 maintains a broad portfolio of metal treatment processes that utilize select chemical additives and deployment methodologies to permanently and economically mitigate heavy metals environmental impacts. The MT2 EcoBond™ processes are EPA-approved, nonhazardous treatments for heavy metals. The newly formed mineral compounds virtually eliminate the leaching of metals to the environment. The strength and effectiveness of the treatment have been verified using the EPA's Toxicity Characteristic Leaching Procedure test protocols and Multiple Extraction Procedure tests for verifying durability. Deployment methods include sorting/separation of contaminants from clean material and *in situ* and *ex situ* methods. One benefit of this process includes its rapid movement, which augments cost reduction. The contamination can also be removed from under buildings and other structures using the reagent method. Details were given on the deployment at Hawthorne Army Depot in the west-central part of Nevada, approximately 140 miles southeast of Reno. The cost of separation using this technology is $50 per ton versus $15 per ton using chemical stabilization.

Q. There has been similar work done at Rocky Flats. Did you do that?

A. No, that work was done 10 years ago on a site with fairly small Pu contamination levels.

Q. In groundwater of 500 to 5,000 ft deep, how does tying up the Pu impact the risk of further groundwater contamination?

A. By minimizing the migration of Pu, the contamination risks are reduced.

Q. 1) Could you address how you propose to stabilize mercury and cesium? Is it another approach?
2) If you treat with phosphates, does it not also wash away minerals in the soil?

A. 1) Yes, we recently submitted a project to INEEL to stabilize mercury.
2) Minerals adhere to phosphates and this eliminates the washing away. We don't have any experience with strontium or cesium.

Q. If you added water to the Pu, how do you see this not transporting the Pu?

A. The phosphates do eliminate the migration even though it is necessary to use water.

ORNL – Roger Spence offered a video presentation of ground Environmental Services' Multi-Point Injection (MPI™) technology. MPI™ is a general-purpose jet delivery system designed to address the worker health and safety issues related with *in situ* remediation while achieving intimate mixing of treatment agents with waste or contaminated media. This technology has been demonstrated for *in situ* grouting of both shallow land burials and underground storage tanks and is ready for field deployment to remediate an actual site. MPI™ has converted simulated shallow buried waste tank sludge into homogenous low conductivity monoliths. After remediation, the internal core of the monolith resembles cast concrete. Closed wood, cardboard, or plastic containers are cut open and their contents incorporated into the resulting monolith. The technology is robust, using a high-pressure jet (up to 11,000 pounds per square inch [psi]) that is kept stationary during the injection phase. This allows concentrated cutting of the jets to penetrate 55-gallon steel drums in shallow land burials, but thicker tank walls and lower jet pressures (6,000 psi) prevent similar cutting and compromising of tank integrity for *in situ* tank grouting. Details were given of a cold test demonstration performed for *in situ* grouting of tank waste at ORNL (Tank TH4). However, a Pacific Northwest National Laboratory observer included a clay pod representative of Hanford tank waste in the sand bed representing zeolitic tank waste. The quantitative data supported the visual examination that the MPI was successful in creating a homogenous monolith from the bed of sand with no clay pod in the center of the tank. Another demonstration proved the technique using just the 4-in. ID tank access available for the old solvent tanks underground at the Savannah River Site. Some additional benefits of the technology are its ability to operate at a variety of depths (i.e., targeting particular depths or treating an entire column) and with any treatment agent, no returns of contaminated material to the surface, and remote operation with no personnel or expensive capital equipment in the contamination area during injection.

Q. Is cutting up required all the time or only on tanks?

A. Cutting drum walls was only required for shallow land burials, just in case a jet lance happened to be located inside a drum. This ensured the grout jet would still penetrate past the drum and interact with the buried waste and other jets to form the homogenous monolith. This technique will not cut through tank walls and, in general, typically will not cut through drum walls. To cut through drum walls requires a pressure upstream of the jet of 11,000 psi and close proximity to the drum wall (within a drum diameter).

Q. How do you determine the length of injection?

A. Soil might use a 30-second injection at a particular depth, or you could apply the injection for various times to address different depths. This is mainly determined by the estimated void volume available and amount of volume increase allowed.

Q. You describe soil injection, but how do you control the area that the grout travels?

A. The zone of influence, or distance the jet travels and mixes before dissipation, is dictated by the density and porosity of the media. The lances are spaced so that the jets interact to achieve the homogeneous mixing observed in the videotape. All of the lances are emplaced and sets of lances jetted together, hence, multipoint injection. For shallow land burials, which are loose and voidy, the zone of influence was five feet or more. On the other hand, standard construction jet grouting into compact clay produces soilcrete columns of only about

18 in. in diameter with a lot of grout returns (MPI™ generates no grout returns). The advantage grows with the depth of the contamination because there is no excavation required.

Q. How might your bulk volume change in standard soil?

A. It depends how much is put in and the soil void volume. The tank at ORNL was 35 percent loaded with waste, and the *in situ* grouting designed to completely fill the tank against subsidence. Far less volume increase would be used for soil remediation. How much depends on remediation criteria. General rule of thumb is that a strong homogeneous monolith limits soil loadings to 60-weight percent or less. This may result in a significant volume increase and ground swell (10-30 volume percent), depending on compactness and void volume of the soil. If this is not acceptable, then different strategies must be considered, such as a honeycomb structure or minimal addition of stabilizing agents with little ground swell. The treated soil will remain soil-like without the strength imparted from micro encapsulation as soilcrete, but can have strong solid walls, floors, or honeycombs. In other words, it may not be advisable to form a monolith by *in situ* soil remediation, although this was easily demonstrated for shallow land burials and underground storage tanks because of the large volume of porosity in which to expand.

Q. Cost estimate?

A. One tank (50-ft diameter Gunnite tank at ORNL) costs approximately $500,000 (≈20 percent of which is fixed cost and ≈60 percent are costs associated with a DOE site and radioactivity) but, in general, the larger the area involved the lower the associated unit cost will be.

Normex International – Mike McCleavy presented a technology developed in partnership with Knelson called the Continuous Variable Discharge Concentrator, which works via fluidization, concentration, and separation. It is commercially available and 1,800 units have been sold. The concentrator has adjustable performance controlled by valves that can adjust the mass yield. This allows the machine to be fine-tuned for specific output requirements. The technology does require water, air, and power for operation. It is insulated to ensure quiet and smooth operation, and comes in 3 sizes from 5-1.5 tons per hour.

Q. How do particulates impact the particle size and results?

A. We have good results down to the 10-micron range; the narrower the size distribution, the better the result.

Q. What is the maximum amount of clay the equipment can handle?

A. The technology naturally deslimes and handles clay by the use of water.

Q. Maximum particle size of 2 millimeters?

A. Yes, depending on what distribution is desired.

Q. How can it handle organic matter?

A. That hasn't been tested.

Q. Are there special precautions to avoid contaminated water leaks?

A. They aren't necessary. The machine is properly maintained; they should not happen.

Q. Installed cost? Operating cost?

A. $220 thousand capital cost for 32-in. unit with minimal operating cost.

Q. How many operators are required?

A. No one full-time; the equipment will run maintenance free for months.

Q. Is it noisy?

A. Not at all; pitch valves make small periodic noise.

Q. What is the water consumption?

A. It varies by the size of the equipment. A 6-inch pilot unit uses 6-10 gallons per minute (gpm), a 32-inch unit uses 60-120 gpm.

URS Corp and ZYIC, LLC – Dr. Ye Yi. The underlying premise of Dr. Yi's presentation was, like other metal oxides, plutonium oxide can be concentrated and removed from soil by selective flotation. To achieve this, two prerequisites exist. First, particulates have to be fully liberated from other soil particles. For fused and locked particulates, oxides at least have to be fully exposed at the surface. Second, appropriate flotation chemicals have to be identified and used. Under this scheme, soils contaminated by plutonium oxide particles can be slurried with water. Identified chemicals are added into the slurry to selectively adsorb onto oxides surfaces, then air bubbles are introduced into the system to allow oxide particles with chemicals adsorbed at the surfaces to attach to air bubbles. Plutonium oxide particles thus can be concentrated and separated from soil by removing and collecting the bubble froth.

Although flotation technology is viable in principle, once the prerequisites (listed above) are met, critical technical issues must be resolved to achieve practical implementation. The low throughput, often characteristic of the method, combined with the high capital cost drives high initial capital costs and sustained high operational costs for flotation projects. The strategy to mitigate the high cost inherent in flotation technologies is to develop a highly selective process for flotation.

There are several high capacity flotation technologies available today including air-sparged hydrocyclone technology. In the past, Dr. Yi has identified the proper protocols and introduced the high capacity flotation separation concept in plutonium oxide removal by air-sparged hydrocyclone technology for soil remediation at the NTS. The key advantage of this technology is that it is very compact and can provide a very high processing capacity in terms of volume of soil treated per volume of flotation cell. In the meantime, due to its high capacity and low operational costs ($0.6 per cubic feet, excluding excavation, disposal, etc.), the technology can be engineered into a system that can provide multi-stage processing such as 4x, 8x, or even 12x stages of processing to achieve of the desired separation requirement.

The technology has been tested with a capacity of one ton per hour single stage system at the site with limited success. Key issues and conclusions identified from past tests include (a) the concept and protocol are approachable; (b) better separation chemicals with higher selectivity have yet to be identified; and (c) proper bench-scale tests are still needed to provide engineering designing needs with respect to flowsheet configuration such as number of stages needed to achieve desired requirements, stages involved in scavenging and cleaning, etc. In this way, a proposal that will emphasize bench-scale flotation in the current Phase I program will be submitted to answer these questions and provide solid demonstration data.

Q. What did the U.S. Air Force separation work consist of?

A. Fire fighting foam.

Q. Pu needs to be released from sand at NTS, but Pu has a tendency to resist going into solution? How does your technology address this?

A. We know the technology cannot be used on some contamination, but for NTS the chances are very good that it will work.

Roy F. WESTON, Inc. – Sayan Chakraborti and Mike Cosmos copresented, starting with an overview of a proprietary process that is currently used to separate radioactively contaminated soil, clay, and fine gravel from coarser uncontaminated material. The coarse material with radioactivity levels below the cleanup level (< 7.2 pCi/g for radium and <22 pCi/g for uranium) is used as backfill, while the finer materials are shipped to an off-site disposal facility. The unit is designed to process 80 dry short tons per hour of material, which has a moisture content of 15 percent. A process schematic was then presented and explained. For the past three years, Weston has used this technology at a full-scale level with great success for a commercial project in the Midwest with remediation goals that are similar to those at NTS. The primary remediation concerns in the current ongoing project are radium-226 and uranium-238. The goal is to clean soil containing up to 578 pCi/g of Ra-226 and 1,078 pCi/g of U-238 to acceptable levels (7.2 pCi/g for Ra-226 and 22 pCi/g for U-238).

The technology is based on combining simple and cost-effective material separation techniques commonly used in the mining industry with a SGS at the back end. Thus, the process relies on both the physical characteristics of the soil and also its radioactive characteristics to meet the cleanup criteria. The Midwest facility has been in operation since 1998 and has completed more than 80 weeks of regular operations. So far, 350,000 tons of material has been processed, of which 160,000 tons involved coarse material that met the cleanup criteria and has already been used as backfill. The technology may be modified to match NTS needs and would accomplish remediation goals of reducing soil disposal volumes by 70 percent or more. This technology offers substantial cost savings over baseline in both transportation and disposal costs because of reductions in soil disposal volumes. The reduction in soil volumes being transported for disposal should result in lower health and safety risks to workers and the public during the lifetime of the remediation period. The technology has reached full-scale maturity and Weston has operational experience with the Midwest facility since 1998. This should be an asset that can be successfully applied to any required design modifications for application at NTS.

Q. Does the system have detectors to monitor radioactive levels, and do they meet the sampling requirements?

A. Yes, we keep sampling on a regular basis as per our work plan requirements. Plus, we perform ongoing quality assurance on the SGS.

Q. With a 50 percent volume reduction, is this less expensive than excavation and removal?

A. I think it is more like 40 percent of the original volume (i.e., a 60 percent volume reduction). The volume reduction that we use in the current project is based on the total life-cycle cost of the project including transportation and disposal, not just the treatment technology. An actual measurement has not been performed in recent days, but economic analysis performed during early stages of this project had confirmed that a 60 percent volume reduction provides the lowest total life-cycle cost based on current cleanup criteria. Although the technology itself can reach volume reduction factors of up to 95 percent, the marginal increase in cost beyond a 60 percent volume reduction is currently not offset by the corresponding decrease in transportation and disposal costs to the disposal facility in Utah. Since disposal costs have been increasing at a higher rate than other costs, it is quite likely that a life-cycle cost analysis for NTS using this technology in FY 2006 would yield an optimal operating level that is much higher than 60 percent volume reduction.

Q. What is the operating cost?

A. The expected life-cycle cost is $140-$150 per ton ($7-8 per cubic foot).

Q. How much is in the feed?

A. Normally around 60 percent, but it can vary from day to day.

5.0 Poster Session

(Day One – August 14, 2001)

A poster session was held on day one of the workshop and offered vendors and attendees the opportunity to display exhibits or posters in addition to their presentations. The posters and exhibits were available for viewing throughout the workshop. Poster session participants included IT Corporation, Earthline, Eberline Services, and CETL. A copy of materials that were at the poster sessions is available from CETL.

Concluding Remarks for day 1 - Roger Jacobson, DRI, recapped information from the first day of the workshop. Roger stated that the DOE recognizes the necessity of getting new technologies out there to work on the needs at various sites. There is a fairly short time frame to get the work done. There are large volumes of soil at many sites and, to date, there has been little success with the reduction of these volumes using available technologies. The current costs and volumes are not low enough to satisfy users at those sites. There is a broad mixture of radioactive contaminants to be addressed in a variety of soil types and area sizes. Many sites are concerned with the life-cycle cost of remediation. Cleanup standards will remain an ever moving target, so the participants were urged to aim at the lowest feasible target to avoid revisiting the problem at a later date.

6.0 Summary Discussions

Ed Holman, NNSA/NV, noted that there was great participation in the workshop and a varied mix of sites and good presentations. While DOE has a variety of problems, Nevada is in the middle regarding baseline costs. Nevada is looking for technologies that are safe but less expensive than the current baseline. Technology suppliers must have knowledge of the issues specific to Nevada. The site is large and remote and everything must occur in the field, which means remotely supplying water, energy, and personnel. The extreme environment in addition to the remote location requires that Nevada use reliable technologies. The logistics also drive a need for less material handling and less water usage. Ed cautioned vendors that the cost of radioactive remediation includes the need for health physicists, protective clothing, and other economic issues that must be included in the cost of the technology.

Q. What are the requirements for staffing by vendors if their technology is used?

A. Minimum of two to three full-time staff people in additional to qualified site staff that would make up the balance of necessary manpower.

Q. What are the long-term stewardship expectations of the technology vendor?

A. This is addressed via institutional control and is not applicable to the technology vendor.

Q. What is driving the 2007 deadline?

A. That is the site cleanup target, which has been extended, and work will continue under the baseline.

Q. Based on the Clemson solicitation, the funding is limited and small businesses will have a hard time not losing money. How can we compete?

A. The money has been allotted under the solicitation. Historically, vendors entered cost-sharing agreements to develop site technologies.

Ralph Smiecinski interjected that there is a process for such agreements that includes steps such as the proof of concept, building to pilot scale, and site application. There would be some cost sharing with DOE along the way.

Q. What insurance does a vendor have that a successful project will grow to be profitable or lead to commercialization?

A. The hope is that more funding would be available based on the success of the technology performance. Vendors were encouraged to partner with Focus Areas or other entities in order to benefit from these types of development projects.

Roger Jacobson then invited final comments from the attending site representatives, and opened the floor for discussion.

Scott Petersen from Hanford stated that they do not have an immediate need for any of these technologies; however, they are always looking ahead to characterization, remediation, and volume reduction methods and innovative technologies. Future needs will involve these types of technologies.

Recommendations were made about information available online to aid vendors in matching technologies to programs/sites and needs. A list of web links is included with the attachments of this document.

Bob James from Idaho said he felt many promising technologies had been identified that could really impact crafting a strategy and would be highly useful. He complimented the workshop content and quality, and recommended that lessons learned be shared with the vendors.

Dick Neff from Ohio said that although the Ohio site needs and the technology vendors weren't an exact match this time; he cautioned vendors not to miss opportunities to offer less costly characterization methods in addition to the types of technologies that were presented. Characterization can also greatly impact the cost of remediation. Dick also complimented the workshop for the good content.

Scott Petersen agreed with Dick on characterization needs. Much of Hanford's characterization is done as excavation takes place, and in some cases this causes more excavation than necessary.

Lane Butler from Rocky Flats mirrored Scott's statement about characterization. They have determined that their volume reduction needs to occur in excavation. Rocky Flats is interested most in remediation, not mixing. They would like to have it clean, not cleaner.

Q. Lane, are your surfaces horizontal or sloped?

A. Both, and complete excavation is not desirable.

Paula Kirk from Oak Ridge stated that there are five sites where the primary contaminants of concern are volatile organic compounds, equipment solvents discharged to ponds that now leak, etc. There is some associated radioactivity, in the secondary waste, especially at the gaseous diffusion plants. The cleanup requirements are to industrial use. The water tables are high due to the high annual rainfall average of the area. The current technology primarily in use is pump and treat, but there are some other approaches used to treat groundwater. In some cases, the contamination is going off site. Oak Ridge is working with NETL to deal with stabilization of mercury and rads at these sites. They are currently considering capping, hydrological containment, and ISV (which is the stakeholder preference). Other stabilization technologies will be considered. Oak Ridge also has tanks in need of remediation of cesium and strontium. Vendors should check the Bechtel Jacobs web site for opportunities at Oak Ridge. http://www.hanford.gov/rl/opportunities.asp

Paul Kalb from Brookhaven spoke unofficially on Brookhaven National Laboratory's (BNL's) issues of volume and cost reduction. Brookhaven has sole source aquifer and mercury-contaminated soil that is above acceptable limits. The site is trying to do TCLP that will allow off-site disposal. The contaminated soils must be at the low level prior to off-site removal. He then identified Teresa Baker at BNL as the soils point of contact.

Carl Lanigan of SCFA thanked the participants again, and said he felt it was a valuable workshop and always very useful to exchange the DOE site needs and information with the vendors at such gatherings. If the Clemson work yields positive results, it would be included in the SCFA out-year planning and could be addressed as soon as next fiscal year. SCFA intends to reduce the cost and time for remediation in all the areas discussed during this workshop.

Ralph Smiecinski commented that a report will be issued that will detail the workshop proceedings. Sites or Focus Areas sometimes use this information for out-year planning purposes. This is the very type of meeting that leads to future solicitations.

The Federal Technology Roundtable was also identified as a resource for vendors. It collects information across federal agencies, but some of its information may not be up to date. Carl Lanigan promised to address this, and commented that this is not the first time he has heard this comment. Roger Jacobson said he would follow up on that as well, and said that he would try to find some information that is more current or relevant.

Participants then discussed if the sites were being too general in their assessments of the relevant problems. For example, Oak Ridge soils are clay-like and don't respond to general soil washing technologies? Other attendees questioned if DOE was scrapping capabilities prior to considering use under other conditions?

The consensus of vendor response was that as long as cost savings is the main concern, innovative technologies cannot be developed or applied.

Roger Jacobson then stated that many vendors today presented solid information about developed and proven technologies that could be applied to DOE sites with little modification. If that is the case, then many felt the funding should adequately support other technology applications.

Ye Yi indicated that many vendors are willing to initially cost share if they see a mechanism to further their interest at maturity.

Joe Kimbrell of Eberline asked why DOE doesn't increase vendor work scope so they can bid on all the work instead of little pieces? In his opinion, this would allow more cost-cutting latitude for the vendor.

Roger Jacobson pointed out that we aren't the decision makers on this process, and it could change in the future, but for now the process at most sites seems the same.

Dick Neff said Ohio is moving in that direction and further commented that several projects are performance-based and a trend favoring this type of contract is developing. He also addressed questions about whether there will be money down the road. He stated that even if a technologyis proven, it is ultimately the project managers' decision to select the technology that will be used.

Ralph Smiecinski made the recommendation to vendors to attend shows and show their wares, and that DOE would get the proper project managers to those activities to observe what technologies are available. Ralph also recommended that they approach other agencies with their technologies (they all have technology needs, some of which are not so different from our own).

It was suggested that a comparison matrix study be developed to identify the real criteria for soil washing.

Ralph Smiecinski stated that Clemson is working on something similar. DRI has also done a report and similar studies have been done in the past.

The consensus of attendees was that there needs to be a matrix that really compares complete technology data and offers detailed results of technologies by contaminant, site criteria, and so forth.

Steve Hoeffner from Clemson encouraged vendors to check the CETL web site and reminded them that there is a considerable amount of work that has been done at the NTS. Any treatment process must address the following: (1) plutonium concentration as a function of particle size varies from soil to soil; and (2) Pu is present as a plutonium dioxide or fused plutonium silicate. Pu has been bound to the soil for many years and is weathered. More studies will be done to determine if the soil contaminants are soluble or insoluble. Currently there is a five-step process planned for just this kind of study.

Q. After bench-scale solicitation, is there a plan for pilot or full scale? What is the timeline for these steps (since vendors will assume cost sharing on the bench-scale work)?

A. Carl Lanigan explained that these decisions are made during out-year planning, which is a multi-year effort. The decisions made are based on technology performance starting at bench scale.

Ralph Smiecinski wrapped up the workshop by thanking all who attended. He reflected on the good interaction and information exchange he had seen at the meeting. He asked that people consider attending a follow-up meeting to the workshop, if one is planned. Ralph suggested

August 2002 for the followup to review and expand on the effectiveness of this workshop, and to provide further assistance in the continuing soils remediation work at Nevada and other DOE sites.

Action Items

1. The Federal Technology Roundtable was identified as a resource for vendors. It collects information across federal agencies, but often isn't up to date. Roger Jacobson agreed to find more current information to be shared with attendees.

   Status:

2. Recommendations were made about information available online to aid vendors in matching technologies to programs/sites and needs. A list of web links is included with the attachments of this document.

   Status: Complete (see Attachment A)

3. Ralph Smiecinski will work to determine if a followup meeting next year is needed; plans will be made accordingly.

   Status:

Appendix A

Site Remediation and Technology Survey Summary

Site Remediation and Technology Survey Summary

(Page 1 of 2)

Location	Fernald	Grand Junction	Nevada Test Site	Oak Ridge National Laboratory	Rocky Flats
REMEDIATION SITE INFORMATION					
Remediation Site Name	Soils Project	Moab, UT	5 sites at TTR and NTS	Core Hole 8 Plume Source (Tank W-1A) Removal Action	903 Pad; Lip Area; Am Zone
Radionuclides	U, Ra 226, Th, metals, & organics	U 238 series (Ra 226 as proxy)	Pu 239	Cs, Am, Pu, U, Sr, Co, other fission products	Pu 239, Am 241
Volume	2.8M cu. yds.	13M tons	4.9M cu. ft.	55,000 cu. ft.	5-50 acres
Concentration Level	Total U 1.0 - 90,400 mg/kg	400 pCi/g avg 1420 pCi/g high	200 - 12800 pCi/g	<100 pCi/g - >7 M pCi/g	100 pCi/g - nCi range
Cleanup Level	82 ppm for immobile U with ALARA goal of 50 ppm; 20 ppm for mobile U	5 pCi/g Ra 226	TBD - ongoing negotiations between NNSA/NV, Air Force, and NDEP	Minimize further contamination of groundwater by removing accessible soil	TBD - 200 - 50 pCi/g
Soil Characteristics	0 - 40 ft. of clay-rich glacial till overlying sand and gravel	U mill tailings; high clay; small grain	Sandy, alluvial soil with low organic matter & clay content	Mostly clay backfill with natural clay	Rocky claystone rich soils
Baseline Technology	Real-time detectors, hot spot detection/ removal/on-site and off-site disposal	Removal, then disposal via rail	Excavation/ characterize/ burrito wrap/ transport/ on-site disposal	Excavation within an enclosure for transport and off-site disposal	Standard excavation
INNOVATIVE TECHNOLOGY REQUIREMENTS					
When Required	ASAP	FY 2004	FY 2007	FY 2005	Spring 2002
Required Process Throughput	As high as possible	900 tons/hr.	As high as possible to minimize time in field	As high as possible & still minimize exposure	~ ½ acre/day
Required Volume Reduction	Treat soils to meet Waste Acceptance Criteria	>95%	>70%	Not required	80%
Portability/Self-Containment Restrictions	Portable and self-contained	15-mile one-way minimum haul via rail if waste is relocated	Portability required--operable in harsh arid climate	Work area limited by building and structures	No
Water/Power Consumption Limitations	Power to some extent	Available	Yes, both limited; utilize recycling and generators	None	Power - no; minimize water use to minimize surface contamination
Limits on Secondary Wastes	Generally unacceptable	Waste water treatment plant will be required	Secondary waste minimized; mixed or TRU waste unacceptable	Minimize to reduce handling/disposal cost	Yes - no more than baseline
Cost Savings	Yes	$50M from baseline	$33M	TBD	50% savings over baseline
POC	Robert Janke: 513.648.3124	Joel Berwick 970.248.6020	Wayne Johnson 702.295.0573	Rick Dearholt 865.241.8875	Lane Butler 303.966.5245

Site Remediation and Technology Survey Summary
(Page 2 of 2)

Location	Westinghouse Savannah River Co.	West Valley	Portsmouth Gaseous Diffusion Plant	OR Y-12 National Security Complex	INEEL
REMEDIATION SITE INFORMATION					
Remediation Site Name	17 sites including C-, R-, and P-reactor seepage basins	West Valley Demonstration Project	PGDP	Y-12; Bldg 81-10 Area; UEFPC; DWI 901 and 1630 off-site properties	WAGs 1, 3, 4, & 5
Radionuclides	Am 241, Cs 137, Pu 241, Sr 90	Sr 90, TRU, Cs 127	U and its decay products; TRU and Tc-99	U-238 & other isotopes of U and Cs, Sr, Ra, Th, metals & organics	Cs-137, Sr-90
Volume	426,000 cu. yds.	Draft est. 271,000 cu. M	TBD	~300,000 cu. yds.	369,721 cu meters
Concentration Level	50 - 400 pCi/g	100 - 40,000 pCi/g Sr & Cs	U: 0 - 125 pCi/g; Tc-99: 0.1 - 575.8 pCi/g; others: 0 - 1271 pCi/g	U-238: 0.7 to 109,000 pCi/g; Cs-137: 0.01 to 14,900 pCi/g	Typically 100s of pCi/g; max. 4×10^6 pCi/g as Cs-137
Cleanup Level	TBD based on negotiations with SCDHEC	TBD	Based on risk range of 1×10^{-6} additional cancer risk	TBD; preliminary goal is U-238 at 50 pCi/g; U-234 at 700 pCi/g; Ra-226 and Th-232 at 3 pCi/g	23 pCi/g
Soil Characteristics	Fine to coarse sand with varying clay and silt	Range from silty clay to silty sand and gravel	Omulga silt loam	Mostly clays	Silts, very silty gravels
Baseline Technology	Institutional control, covers, and *in situ* stabilization	TBD	Excavate/ containerize/ transport off-site for disposal	Excavation is required; no contaminated soil left in place	Consolidation
INNOVATIVE TECHNOLOGY REQUIREMENTS					
When Required	2002 - 2007	TBD	2007	2004-2005	2002
Required Process Throughput	50 ton/hr.	TBD	As high as possible	NA	300,000 cu. yds per year
Required Volume Reduction	75%	TBD	Volume reduction is a positive outcome	NA	NA
Portability/Self-Containment Restrictions	Easily transportable	TBD	None	*In situ* characterization needed so port. & self-cont. a positive	None
Water/Power Consumption Limitations	Some sites very limited access	TBD	None	NA	None
Limits on Secondary Wastes	Must be significantly minimized	TBD	Should be minimized; mixed and TRU waste unacceptable	NA	TRU constituents <10 nCi/g
Cost Savings	N/A	TBD	TBD	Reduction over current characterization costs	None
POC	Ahmet Suer 803.952.8306	Catherine Lenter 716.942.4159	Don Wilkes	John Kubarewicz 865.241.3844	Talley Jenkins 208.526.4978

Appendix B

Vendor Technologies Survey Summary

Vendor Technologies Survey Summary

Company	UNR	Earthline Technologies	Roy F. Weston
Contact Information	Rajendra Mehta University of Nevada, Reno OSPA/Mail Stop 325 Reno, Nevada 89557 775-784-4040 mehta@mines.unr.edu	Jeff Kulpa Earthline Technologies 1800 East 21st Street Ashtabula, OH 44004 440-993-2804 jeff_kulpa@earthlinetech.com	Sayan Chakraborti Roy F. Weson, Inc. 1400 Weston Way, Bldg. 5-2 West Chester, PA 19380 610-701-3022 chakrabs@mail.rfweston.com
Technology	Centrifugal Gravo-magnetic Concentration	Soil Washing	Soil Washing
Technology Description	centrifugal gravomagnetic separation and flotation processes	smart physical separation + chemical extraction soil washing	Physical separation based on mining engineering principles combined with Segmented Gate System at the back-end
Maturity	Bench (3 inch) to Full Scale Capability	Bench to Full Scale Capability	Bench to Full Scale Capability
Amount Required for Bench Scale Demo	kg amounts	kg amounts	kg amounts
Radionuclides	U, Pu, Th at the bench	U, ?? At bench through FS	Currently used for U, Ra. Can be applied to Pu by adjusting process operating parameters
pCi/gm	22-28870	100	Input: U - ~1100 pCi/g, Ra - ~600 pC/g Output: U - <22 pCi/g, Ra - <7.2 pCi/g
Volume Reduction	70-99%	70-97%	Up to ~95% achievable by the process. Current process operates at 55-60% based on the life cycle economics of transportation and disposal cost at Envirocare[a].
Removal Efficiency	25-95%	≥50%	Not Applicable
Soil Sources	INEL, LANL, Fernald, NTS, JA	Ashtabula	Any soil within the range of sandy to moderately clay will work
Full scale throughput	40-50 tph	20-40 tph	80 tph
Portable?	Yes	Yes	Yes
Water Consumption	High, but can probably be recycled	Moderate, but can be recycled	Moderate, but can be recycled
Secondary Wastes	Spent water	<3% of the feed volume	Minimal
Treatment Costs	$1.21/ton	$75-300/ton	$7-10/ft^3
Potential for HW/MW/TRU generation?	Possible TRU in rich soil fraction	Possible TRU in concentrate	No TRU wastes are generated in the current project, and none are expected for application to NTS soils

[a] If there is a hike in these costs in the future, then it will make sense to increase volume reduction up 95% or to the extent needed to offset increase in the transportation and disposal cost per cubic foot.

Vendor Technologies Survey Summary
(Page 2 of 6)

Company	URS	ART	Retech
Contact Information	Ye Yi URS Corporation 756 East Winchester Street, # 400 Salt Lake City, Utah 84107 801-904-4000 ye_yi@urscorp.com	Carl Seward Art Engineering, LLC 12526 Leatherleaf Drive Tampa, FL 813-855-9852 cseward@tampabay.rr.com	Ronald K. Womack Retech Systems, LLC 100 Henry Station Road Ukiah, CA 95482 707-467-1721 ronald.k.womack@retechsystemsllc.com
Technology	Flotation	Soil Washing	Vitrification
Technology Description	Air-Sparged Hydrocyclone Flotation	Physical/Chemical Separation	Plasma Arc Centrifugal Treatment (PACT)
Maturity	Bench to Full Scale Capability	Bench to Full Scale Capability	Bench to Full Scale Capability
Amount Required for Bench Scale Demo	g to kg amounts	2-30 kg	kg amounts
Radionuclides	Pu	U, TH, Ra	Pu
pCi/gm	Unknown	??	1500-2500
Volume Reduction	80-90%	??	60-70% volume decrease of soil upon vitrification
Removal Efficiency	Unknown	Unknown	Not Applicable
Soil Sources	NTS	Hanford, Maywood, Ashtabula, numerous others	INEEL
Full scale throughput	10 tph per unit	10-100 tph	12 kg/hr pilot 500 - 1,000 kg/hr full scale (6,000 - 10,000 tpy)
Portable?	Yes	??	Yes?
Water Consumption	High, but can be recycled	Moderate, but can be recycled?	Minimal/none?
Secondary Wastes	Minimal	Minimal	None except for equipment components. Minor volatilization of radionuclides can occur.
Treatment Costs	\$10-13/ft^3	<18 ft^3	Unknown
Potential for HW/MW/TRU generation?	Possible TRU in concentrate	Possible TRU in concentrate	No

Vendor Technologies Survey Summary
(Page 3 of 6)

Company	IT	New Mellenium	Electropetroleum
Contact Information	Ed Alperin IT Corporation 304 Directors Drive Knoxville, TN 37923 865-694-7335 ealperin@theitgroup.com	Sue Aggarwal New Millennium Nuclear Technology 900 E. Copeland, Suite 210 Arlington, TX 76011 817-277-2427 saggarwal@nmg.org	J. Kenneth Wittle, Ph.D., Vice Pres. Electro-Petroleum, Inc. 996 Old Eagle School Rd. Wayne, PA 19087 (610) 687-9070 kwittle@electropetroleum.com
Technology	Bioremediation	Soil Washing	Electrokinetic
Technology Description	biologically-mediated removal and treatment of plutonium (Pu), other radionuclides, and heavy metals in soil	Physical/Chemical Separation	Electrphoresis, electro osmosis, ion migration
Maturity	Bench to Full Scale Capability	Bench to Full Scale Capability	Unknown
Amount Required for Bench Scale Demo	kg amounts	kg amounts	kg amounts
Radionuclides	Pu, Am	NORM	Unknown
pCi/gm	35	Unknown	Unknown
Volume Reduction	95-99%	Unknown	Unknown
Removal Efficiency	80%	Unknown	Unknown
Soil Sources	NTS	Unknown	Unknown
Full scale throughput	up to 70,000 yd^3 per biopile. 14 months duration	Unknown	Unknown
Portable?	Yes	Unknown	Unknown
Water Consumption	High (about 60 gal/yd^3), but can be recycled?	Unknown	Unknown
Secondary Wastes	Minimal	Unknown	Unknown
Treatment Costs	\$150/yd^3	Unknown	\$30/yd^3 for >100,000yd^3 of HW
Potential for HW/MW/TRU generation?	Possible TRU in concentrate	Unknown	Possible TRU in concentrate

Vendor Technologies Survey Summary

(Page 4 of 6)

Company	Brookhaven National Laboratory	Brice Environmental Services Corp.	Knelson Concentrators
Contact Information	Paul Kalb, Division Head Environ. Research & Tech. Division Environ. Sciences Department Brookhaven National Laboratory Upton NY, 11973 kalb@bnl.gov	Craig Jones Brice Environmental Services Corp. 3200 Shell Street Fairbanks, Ak 99707 907-456-1955 craigj@briceinc.com	Knelson Concentrators 19855-98 Avenue Langley, BC Canada V1M 2X5 604-888-4015 knelson@knelson.com
Technology	Sulfur Polymer Stabilization/Solidification	Soil Washing (Physical Separation)	Centrifugal Gravity Concentrator
Technology Description	chemically stabilizes and physically encapsulates the mercury in a solid matrix.	Physical Sizing, Density Sepn, Classification/Attrition, Magnetic Separation, Water Treatment/Dewatering	Centrifugal Gravity Concentrator using Continuous Variable Discharge
Maturity	Bench and Pilot capability	Bench to Full Scale Capability	Bench to Full-Scale Capability
Amount Required for Bench Scale Demo	kg amounts	kg amounts	kg amounts
Radionuclides	Cs-137, Co-60, Sr-90, Am-241	Cs, Sr, U	Unknown
pCi/gm	Tested up to 10,000 pi/gm Am-241	Unknown	Unknown
Volume Reduction	Volume of final product = volume of soil prior to treatment (i.e., no volume increase)	Variable, depending on the particular site. Based on past experience ranging from 75 - 95%	Unknown
Removal Efficiency	Not Applicable	Up to 98%	Unknown
Soil Sources	Mixed waste contaminated soil from remediation of BNL Chemical Holes	Depleted uranium firing ranges, spill sites	Unknown
Full scale throughput	Can be scaled to meet the waste demand. Production-scale process vessels up to 350 cu ft capacity are available.	4.2 tph pilot scale, 30 tph full scale	50-70 tonnes per hour
Portable?	Yes. This technology can be skid mounted and deployed in a portable mode.	Yes	Yes
Water Consumption	None	Moderate, but can be recycled?	High, but can be recycled
Secondary Wastes	PPE, off-gas residuals (which can be reprocessed by the system)	Residual soil volume in some cases (deleted spent water is treated as part of the process)	Spent water
Treatment Costs	Variable, depending on the specific waste stream, level of contaminants, etc.	Variable, based on soil quantity and treatment requirements. Treatment costs decrease with increasing soil quantity on a per-ton basis.	Unknown, expected to be low
Potential for HW/MW/TRU generation?	Yes	Possible TRU in concentrate	Possible TRU in concentrate

Vendor Technologies Survey Summary
(Page 5 of 6)

Company	Eberline Services	Metal Treatment Technologies, Inc.	Normex
Contact Information	Joseph Kimbrell Eberline Services 4501 Indian School Road NE, #105 Albuquerque, NM 87110 505-262-2694 jkimbrell@eberlineservices.com	Mark Peters Metal Treatment Technolgies, Inc. 303-456-6977 mpeters@metalstt.com	Jullien Louis Normex International 281-242-7277 kdgni@cs.com
Technology	Segmented Gate System	Solidification/Stabilization	Same as Knelson??
Technology Description	Physical separation of soil based on activity levels. Soil moisture content must be <20%	EcoBond™	Unknown
Maturity	Full Scale	Unknown	Unknown
Amount Required for Bench Scale Demo	N/A	kg amounts	Unknown
Radionuclides	Cs, Co, Ra, Th, U, Am, Pu	Cs, Sr	Unknown
pCi/gm	Unknown	Unknown	Unknown
Volume Reduction	4 - 99%	None	Unknown
Removal Efficiency	N/A	N/A	Unknown
Soil Sources	15 DOE sites	Rocky Flats	Unknown
Full scale throughput	50-200 yd^3/day	Unknown	Unknown
Portable?	Yes	Yes	Unknown
Water Consumption	Minimal	Moderate	Unknown
Secondary Wastes	None	None	Unknown
Treatment Costs	$50-1000/$yd^3$	Typically 30% to 50% less expensive than traditional methods	Unknown
Potential for HW/MW/TRU generation?	No	No	Unknown

Vendor Technologies Survey Summary

(Page 6 of 6)

Company	JVI Companies	Ground Environmental Services, Inc.
Contact Information	Joseph Messana JVI Companies 13535 S. Torrence Ave, Bldg. T, Chicago, IL 60633 773- 646-2227 Joe@JVI.Net JVIcompanies.com	Joe Kauschinger Ground Environmental Services, Inc. 770-993-3538 dkauschinger@earthlink.net OR Roger Spence Oak Ridge National Laboratory 865-574-6782 spencerd@ornl.gov
Technology	Vacuum Auger Scarification Technology.	*In situ* implementation technique
Technology Description	Precision excavation of soil surface layers. Online analysis/ measurement and data logging.	Multipoint Injection (MPI™). *In situ* implementation technique using multiple interactive jets for hydraulic mixing of soil with a variety of treatment agents to stabilize/fix in place or remove (extract/excavate). Demonstrated for shallow land burials and tanks.
Maturity	Design stage, with some pilot scale experience	Ready for field deployment
Amount Required for Bench Scale Demo	N/A, pilot is minimum scale	Not Applicable
Radionuclides	Primary: Plutonium Secondary: Undefined	This implementation technique can be combined with a variety of treatment agents for treating most, if not all, radionuclides identified as contaminants of concern by DOE. These include the actinides, transuranics, fission products and activated species most often listed, as well as the mobile species that generally create plumes (Cs-137, Sr-90, Tc-99). In addition the technique can be used to create the hydraulic barriers at targeted depths and locations to hydraulically isolate the contaminated area. This is not only a general containment strategy, but is key to most strategies attempting to contain or isolate tritium.
pCi/gm	Undefined: Online analysis/ measurement	Unknown
Volume Reduction	70+% possible	None
Removal Efficiency	Not Applicable	Not Applicable
Soil Sources	N/A	Unknown
Full scale throughput	88 LFM	40-ton monolith created with 8 minutes of actual injection time. Site preparation can be done prior to bringing high pressure pumps on site for the actual injection. Actual injection time exceeds field time (including site preparation, mixing injection fluid (aqueous solutions, slurries, grouts), opening/closing valves (that activates or inactivates sets of jet lances), with relative difference depending on job size.
Portable?	Yes, as conceptualized	Yes
Water Consumption	None	Moderate
Secondary Wastes	None	Minimal or none
Treatment Costs	$1.5 M to fabricate	$500,000 to treat a small underground storage tank, 20-40% of which is fixed cost
Potential for HW/MW/TRU generation?	None	No

[a] If there is a hike in these costs in the future, then it will make sense to increase volume reduction up 95% or to the extent needed to offset increase in the transportation and disposal cost per cubic foot.

Attachment A
Web Sites of Interest

Organizations

National Nuclear Security Administration	http://www.nnsa.doe.gov/
Subsurface Contaminants Focus Area	http://www.envnet.org/scfa
National Energy Technology Laboratory	http://www.netl.doe.gov/
CETL Solicitation	http://www.cetl.org/nts
STCG Needs	http://apps.em.doe.gov/ost/
ASTD	http://id.inel.gov/astd/
EPA Innovative Technologies	http://www.EPAreachit.org

Participating DOE Sites

Nevada	http://www.nv.doe.gov/
Oak Ridge	http://www.oakridge.doe.gov/
Hanford	http://www.hanford.gov/
Hanford Needs	http://www.pnl.gov/stcg
Ohio	http://www.ohio.doe.gov/
Rocky Flats	http://www.rfets.gov/
Idaho	http://www.id.doe.gov/
Savannah River	http://www.srs.gov/

Vendors

MT2	http://www.metalstt.com/
Oak Ridge National Laboratory	http://www.ornl.gov/
University of Nevada Reno (UNR)	http://www.unr.edu/
Brice Environmental Services Corporation	http://www.briceinc.com/
Earthline Technologies	http://www.earthlinetech.com/
Eberline Services	http://www.eberlineservices.com/
JVI Companies	http://www.jvicompanies.com/top.htm
URS Corp and ZYIC, LLC	http://www.urscorp.com/main.htm
Roy F. Weston, Inc.	http://www.rfweston.com/
Brookhaven National Laboratory	http://www.bnl.gov/
MacTec	http://www.mactec.com
IT Corporation	http://www.theitgroup.com
Knelson Concentrators	http://www.knelson.com

Attachment B
Attendees List
(Page 1 of 3)

Last Name	First Name	Affiliation	Role ID
Aljayoushi	Jihad	DOE-ID	Attendee
Alperin	Edward	IT Corporation	Attendee
Anderson	Tom	CTC	Attendee
Barthel	Jim	Metals Treatment Technologies (MT2)	Presenter
Beckley	Karen	Nevada Division of Environmental Protection	Attendee
Bergren	Chris	Bechtel Savannah River, Inc.	Presenter
Betteridge	Richard	NNSA Nevada Operations Office	Attendee
Bischof	Eric	JVI Companies	Presenter
Butler	Lane	Rocky Flats Environmental Technologies Site RFETS	Presenter
Castaneda	Norma	DOE/Rocky Flats Field Office	Presenter
Chakraborti	Sayan	Roy F. Weston, Inc.	Presenter
Cosmos	Michael	Roy F. Weston, Inc.	Attendee
Crawford	Sean	DOE/NNSA	Facilitator
Curley	August	Clark Atlanta University (HBCU/MI ETC)	Attendee
Davidson	Jeffery	U.S. EPA	Attendee
Davis	Charles	PAI Corporation	Attendee
Dearholt	Rick	Bechtel Jacobs Company, LLC	Presenter
Eastmond	Robert	IT Corporation	Attendee
Graves	Duane	IT Corporation	Presenter
Hoeffner	Steve	Clemson Environmental Technologies Laboratory CETL	Presenter
Hohman	Edward	Bechtel Nevada	Attendee
Hull	Larry	INEEL	Attendee
Jacobson	Roger	DRI	Presenter
James	Bob	INEEL	Presenter
Jenkins	Talley	DOE Idaho Operations Office	Attendee
Johnson	Nels	Eberline Services, Inc.	Attendee
Jones	Craig	Brice Environmental Services Corporation	Presenter
Jones	John	NNSA/NV TD	Attendee
Jullien	Louis	Normex International	Presenter
Kalp	Paul	Environmental Restoration & Technical Division	Attendee
Kearns	Roy	DOE-OAK	Attendee
Kimbrell	Joseph	Eberline Services	Presenter

Attachment B
Attendees List

Last Name	First Name	Affiliation	Role ID
Kirk	Paula	Bechtel Jacobs Company, LLC	Attendee
Kulpa	Jeffrey	Earthline Technologies	Presenter
Lanigan	Carl	Subsurface Contaminants Focus Area	Presenter
Laue	Carola	Lawrence Livermore National Laboratory	Attendee
Licata	Carlo	Maxim LCC	Attendee
Lorenz	Jerry	PAI Corporation	Attendee
Mattson	Earl	INEEL	Attendee
McDonald	Michael	MACTEC Constructors, Inc.	Attendee
McLeavy	Mike	Knelson Concentrators	Presenter
Mehta	Raj	University of Nevada, Reno	Presenter
Messana	Joe	JVI Companies	Presenter
Navratil	James	Clemson University	Attendee
Neff	Richard	DOE/MEMP	Presenter
Oppenborn	Tod	Lockheed Martin	Attendee
Peters	Mark	Metals Treatment Technologies (MT2)	Presenter
Petersen	Scott	Bechtel Hanford, Inc., Technology Applications	Presenter
Pflug	Dale	Argonne National Laboratory	Other
Reim	Ken	CAB	Attendee
Rawlinson	Stuart	Bechtel Nevada	Attendee
Romo	Janis	DOE/NNSA	Attendee
Schwartz	David	DOE/NETL	Presenter
Shafer	David	DRI	Attendee
Shura	Roger	US EPA	Attendee
Small	Ken	NNSA NV WMD	Attendee
Smiecinsksi	Ralph	DOE NNSA/NV O/AMEM Technology Division	Other
Smith	Robert	INEEL	Attendee
Spence	Roger	Oak Ridge National Laboratory	Presenter
Szoke	Ernest	Brice Environmental Services Corporation	Attendee
Taylor	Vernon	MACTEC Constructors, Inc.	Attendee
Tyler	Reginald	DOE-RFETS	Presenter
Vilar	Sandra	WPI	Support
Voos	Gerard	WPI	Facilitator

Last Name	First Name	Affiliation	Role ID
Wilborn	Bill	NNSA/NV/EM/ERD	Presenter
Yasek	Robert	DOE Office of River Protection	Attendee
Yi	Ye	URS Corp/ ZYIC, LLC	Presenter
Ziagos	John	LLNL	Attendee

68 Attendees Registered

Distribution List

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