SITE NEED STATEMENT

General Reference Information

Need Title:	**Long-Term Management of Void Space, Containers, and Cover Subsidence of Disposed Waste**
Need Code:	NV11-0200-09
Need Summary:	Subsidence within waste disposal cells is expected to occur over hundreds of years. Subsidence will occur because of the presence and collapse of void space within and between containers, and because of degradation/compaction of waste and containers. Subsidence within the disposal cells could lead to depressions or fractures of closure covers over the waste cells.
Origination Date:	August 1, 2001
Need Type:	Technology
Operations Office:	NNSA/NV
Geographic Site Name:	Nevada Test Site
Project:	NV370/Low-Level Waste
National Priority:	Medium
Operations Office Priority:	9 of 13

Problem Description Information

Operations Office Program Description:

The primary mission of the National Nuclear Security Administration Nevada Operations Office (NNSA/NV), Waste Management (WM) Program is to manage radioactive and hazardous waste generated by DOE and defense industry activities that is stored or disposed at the Nevada Test Site. The Waste Management Program must ensure that the acceptance, treatment, storage, and/or disposal of waste is carried out in accordance with federal, state, and local regulations.

Need/Problem Description:

Methods need to be developed to better predict the dynamics of collapse of void space, container/waste form degradation, and subsidence of closure materials in waste disposal cells. An increased understanding on the dynamics of subsidence would lead to more realistic estimates of the magnitude and timing of subsidence. Moreover, if subsidence can be accelerated during the operational period, or the period of institutional control (100 to 250 years), the effect on closure covers over waste cells can be more readily mitigated through periodic maintenance.

Three primary objectives for implementation of Long-Term Management of Void Space, Containers, and Cover Subsidence of Disposed Waste are:

- Measure and develop predictive models of the processes of subsidence including void space collapse, collapse of cover materials, and degradation and collapse of waste forms.
- Promote implementation of processes to mitigate subsidence prior to disposal cell closure, as well as assess viable processes that could be proposed to accelerate subsidence during the institutional control period after closure.
- Assess the potential for impact to monitoring instruments from subsidence, including the subsequent reliability issues that may arise with data collection from potentially damaged equipment, or data from cover material whose properties have changed because of subsidence.

Functional Performance Requirements:

While the integrity of disposal cells is sure to be adequate for the short term, the long-term impacts of waste zone subsidence on the containment capability is uncertain and needs further study. There is limited information on the dynamics of subsidence, and the relations between subsidence and processes of moisture accumulation, focused infiltration, and biointrusion.

Studies on subsidence related issues must:

- More accurately measure subsidence and void space collapse
- Lead to the development of more accurate and useful predictive models
- Provide more detailed information on waste form degradation and collapse
- Assess and provide subsidence impact probabilities on monitoring instruments and the associated reliability of collected data

Proposed alternative methods for mitigating subsidence and the resulting impacts to closure covers must:

- Provide viable methods for mitigating subsidence prior to disposal cell closure
- Provide viable methods for accelerating subsidence during the post-closure institutional control period

Definition of Solution: More accurate predictive modeling data, further mitigation efforts, and/or more detailed modeling data are needed for future long-term care of NTS disposal cells relating to the repair of subsidence caused impacts.

Targeted Focus Area: Subsurface Contaminants

Potential Benefits: If Long-Term Management of Void Space, Containers, and Cover Subsidence of Disposed Waste is not initiated, there will be a high probability for increased regulator and stakeholder concern for the viability of long-term stewardship of disposed radioactive waste. In addition, because the lack of subsidence knowledge results in conservative modeling parameters, there may be a need for more robust caps, increased closure cap maintenance, and vadose zone monitoring. These enhancements will lead to higher costs for management of the NTS disposal facilities in the near-term and in the long-term.

Potential Cost Savings: $12 million over 100 years

Potential Cost Savings Narrative: The estimated conceptual cost for the addition of a stabilizing technology (grout-like material injection was used for the purpose of cost estimating) is $8 per cubic foot. Based on this estimated unit cost and the assumption that 1million cubic feet of disposal space will be stabilized, a total one-time cost of $8 million would be incurred to deploy the stabilizing technology. Deployment of a stabilizing technology is conservatively estimated to reduce the amount of closure cover that would require maintenance and repair by 50 percent. The net cost for deployment ($8 million) would be recouped over the life expectancy of the closure cover due to the 50 percent reduction in repair costs. The estimated cost savings potential for the deployment of a stabilizing technology is approximately $12 million over 100 years. This basic cost savings estimate does not take into account potential savings that may be realized from a reduction of the impacts to monitoring equipment that may result from an overall reduction in subsidence.

Cost information related to closure cap repair will be updated as performance and cost data from the deployment of the first Evapotranspiration Cover (on U3ax/bl) becomes available.

Technical Basis: Differential subsidence of waste cells will produce depressions in the closure cover above the waste. These depressions may pond water from precipitation and run-on that could result in focused moisture infiltration and enhanced growth of plants. Under these conditions, certain plants have roots that could penetrate the closure cover, reach the waste, and create releases through preferential uptake of radionuclides. Subsidence of the closure cover could also thin and fracture the cap. A fractured cap would result in an even greater potential for focused infiltration, enhanced biointrusion, and increased rates of gaseous diffusion from the waste to the surface. Subsidence could also affect the performance of vadose zone monitoring equipment deployed at waste cells (e.g., time domain reflectometers [TDRs], neutron access tubes). In addition, the potential exists for damage to monitoring equipment from a subsidence that does not exhibit a noticeable depression on the covers. Anomalous data from damaged monitoring equipment may not be challenged without an apparent physical manifestation of subsidence on the surface.

Cultural/Stakeholder Basis: Potential release pathways are contamination of groundwater resources or direct radiological releases to the atmosphere. Impacts on vadose zone monitoring equipment could reduce instrument reliability, thereby decreasing stakeholder confidence in monitoring results.

Environment, Safety, and Health Basis: Reduction in subsidence will result in a greater margin for the protection of public health and safety relative to the performance objectives of DOE Order 435.1.

Regulatory Drivers: DOE Order 435.1, RCRA Hazardous Waste Management

Milestones: Not applicable.

Material Streams: LLW Sludge, Contaminated Soils and Liquid (1019). Technical risk score 3. Not on critical path to closure. For Industrial Sites, includes inactive tanks, drains and sumps, spill sites, material disposal sites, decontamination sites, and D&D facilities; for LLW and mixed LLW includes drums, cargo containers, crates, and "burrito sacks".

TSD System: Includes engineered caps and covers, in place solidification, and covers constructed over contaminants left in place (e.g., Greater Confinement Disposal). No other on-site treatment of waste except for sizing of material to place in waste containers (e.g., D&D wastes) is anticipated at the NTS.

Major Contaminants: For Industrial Sites, includes organic and inorganic chemicals, petroleum products, metals, unexploded ordnance and related contaminants, and radionuclides including tritium, mixed fission products, and actinides (although at levels below classification of waste as TRU waste).

Contaminated Media: Soil, concrete, construction material, sludges (e.g., at industrial sites), paper, etc. Soil and sludges are generally the waste forms not packaged in steel or wooden containers (from Soil Sites or Industrial Sites closed in place).

Volume/Size of Contaminated Media: Mixed Low Level Waste: 230 cubic meters; Low Level Waste: 365,453 cubic meters.

Earliest Date Required: 2001

Latest Date Required: 2003

Baseline Technology Information

Baseline Technology Process: Normal disposal methods and standard containers are used for the most part within the NTS radioactive waste disposal system. Some bulk waste, such as the soils from the NNSA/NV Soils Project, is transported and disposed in flexible waste containers/packaging. This current practice is assumed to be advantageous over normal container disposal as far as inhibiting future subsidence. Additional mitigation of the potential for subsidence through the use of different disposal containers, waste forms, or disposal methods is not currently included in operational plans. Deleterious impacts to the cover integrity that are anticipated from subsidence will be mitigated through inspection and closure cover maintenance during the institutional control period.

The detailed dynamics of subsidence is poorly understood. Current models used in the NTS radioactive waste management disposal site's performance assessments assume maximum subsidence. This conservative assumption is necessary without more accurate predictive modeling data. Use of this conservative assumption results in a higher estimated cost for long-term planned maintenance of the disposal cells after closure. Without further mitigation efforts and/or more detailed modeling data, estimates for future long-term care of NTS disposal cells relating to the repair of subsidence caused impacts are not likely to experience significant change.

Life-Cycle Cost Using Baseline: $40 million

Uncertainty on Baseline Life-Cycle Cost: The estimated conceptual cost for the maintenance and repair of closure covers assumes an annual repair will be necessary on 4,000 square feet of closure cover every year for 100 years, at a rough cost of $100 per square foot. This equates to the total life-cycle repair cost of $40 million (in constant dollars).

Completion Date Using Baseline: 2003

Points of Contact (POC)

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