

Nevada Risk Assessment/Management Program (NRAMP) – Phase 2

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Quarterly Progress Report

April 1, 2007 through June 30, 2007

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1.0 Radiological Source Characterization and Radiological Source Release Terms
(PI: Ed J. Bentz, E.J. Bentz & Associates)

1.1 Progress – Summary

Work conducted this quarter consisted of continuing the detailed data and information acquisition; review of the received document contents, and interpretation of significance in light of previous DOE documents. Much of the effort was devoted to reconciling inconsistencies and contradictions in both the primary data bases and in and among the DOE published documents. These review and reconciliation efforts included regular telephone and e-mail correspondence, as well as in-person discussions with DOE NVO personnel at the April DOE Generator Conference in Las Vegas. Reconciliation efforts continued with frequent (daily) exchanges on the inventory data sets, and the engineering descriptions of the Area 5 RWMS cells. These activities directly support the more specific listing of activities that was developed previously, and for which DOE provided a confirmatory note to HRC in March.

These efforts also reconfirm the earlier observation that there have been significant changes in data, methodologies, and baseline assumptions over the past four years since NRAMP 1. These reflect the changing conditions at the NTS RWMS and the need for an accurate disposal inventory for post closure safety assessment, and scenario development.

1.2 Progress – Technical Work

1.2.1 Area 5 Source Inventory Data Acquisition & Reconciliation

This activity continues from previous quarter, and relates to both inventory disposal data for Area 5, as well as engineering data for active and operationally closed cells. The activity is in direct support of the closure, PA, and source term tasks. The time periods considered are from individual cell opening to current status (1960 through 5/25/07 records). The acquisition is on a cell-by-cell basis for all cells (southeast 92 acre quadrant as well as the northern expansion area). A concurrent review of existing NVO documentation found conflicts among documents with regard to both engineering descriptions and data inventories. This led to a necessary, and unexpected time-consuming “bottoms-up” acquisition and review of all of the primary data records for Area 5. This detailed review and reconstruction of the data sets was developed for each cell with regard to shipments, volumes, and individual radionuclide-specific activity levels. This effort was greatly facilitated by conscientious NVO record-keeping and coordination staff, and hopefully will have unintended interim benefits in clarifying many of the historical (pre-1993) data inconsistencies in the literature.

1.2.2 Information Searches & Reviews

Technical information searches (and analyses) were continued focusing on approaches and methods utilized by DOE and non-DOE sites to achieve and demonstrate post closure safety compliance, and to develop active and passive institutional control measures to match their scenarios.

These included:

Regulatory

Regulatory framework was reviewed for post closure safety on a “top-down” basis (from enabling legislation through DOE Orders, NRC regulations, CERCLA requirements, and subsequent documentation requirements and methodologies, e.g. DOE 435.1M to PA requirements; 10CFR Part 61 to Safety Assessments; CERCLA risk requirements to BRA’s). Reviewed application of regulatory orders by DOE sites, including DOE LLW waste management disposal sites (e.g. Hanford, SRS, and INL), DOE CERCLA remediation sites (e.g. Fernald), and DOE legacy sites (e.g. FUSRAP sites) to compare approaches and methodologies to achieve post closure safety compliance. Also reviewed post closure approaches and safety assessment methodologies for non-DOE LLW disposal sites including international sites in Eastern Europe, Western Europe, and Russia utilizing IAEA generic approaches to post closure safety and scenario development.

Post Closure Institutional Control Approaches

Methods, approaches, assumptions, and activities developed and utilized by DOE and non-DOE LLW waste disposal sites were reviewed to meet post closure requirements for the institutional control periods. The activities differ considerably reflecting the different features of the site (e.g. site geology) and different site inventories. The specific institutional control measures have been developed to meet the applicable regulatory standards for the site’s bounding scenarios (in most cases, inadvertent intruder scenarios with drilling, and resident agriculture). Different methodologies, approaches, assumptions, and activities are used by different sites.

1.3 Findings

- The data inventory (LLW disposed wastes) for Area 5 needs reconciliation as discussed above. It is the foundation for all PA safety assessments. Similarly, recent DOE NVO published documents need to be reconciled for both consistency and factual accuracy in site description.
- The use of PA model assumptions for the post closure period will play a significant bearing on meeting compliance goals. Different DOE (and non-DOE) LLW waste management sites have developed alternative approaches, safety assessment methodologies, and assumptions. It will be valuable to compare these for insights in the planning of the Area 5 closure of the 92-acre site.

The Goldsim Area 5 calibrated model, including the fate-transport component, is needed.

2.0 Evaluation of Cap Subsidence due to Waste Package Degradation (PI: Moses Karakouzian, UNLV Department of Civil Engineering)

2.1 Subsidence Modeling Approach: Activities and Status

- The modeling approach report was being written.
- The methodology has been partially applied to an Air Force waste site in California in order to conduct a preliminary check of the new approach.
- The literature review regarding subsidence has been completed.
- This task is almost completed.

2.2 Probabilistic Subsidence Model: Activities and Status

- The GoldSim software is being worked with in order to create a model that will best work with the new approach.
- The GoldSim office will be visited early in August to discuss the model.

3.0 Radionuclide Behavior in Tank Waste (PI: Ken Czerwinski, UNLV Department of Chemistry)

3.1 Activities and Status

This quarter collaborations with Edgar Buck of PNNL on TEM evaluation of tank waste precipitates was initiated. Tank waste samples of bismuth phosphate prepared for TEM analysis were received. Initial training of Dr. Buck and HRC personnel on the TEM was completed. Further studies are planned for August.

4.0 Environmental Behavior of Technetium and Evaluation of Stable Analogs for Actinide Elements in Tracer Experiments (PI: Ken Czerwinski, UNLV Department of Chemistry)

4.1 Activities and Status

The primary result this quarter was the development of a technetium electrode for evaluating fundamental oxidation chemistry shown in Figure 1. The metal from the technetium was prepared by steam reforming technetium sorbed to anion exchange resin. These studies stemmed from research on the synthesis and characterization of Tc-Zr alloy as a waste form. The data will be used to compare with Re redox chemistry and evaluate the fundamental chemistry of Tc. Initial results by linear voltammetry showed the two step oxidation of Tc in 0.1 M sodium trifluoromethanesulfonate (NaTFMS) (see Figure 2). Against a Ag/AgCl electrode the oxidation of the metal to TcO_2 occurs at 0.35 V while the oxidation from the TcO_2 to TcO_4^- is around 0.6 V. Further experiments will be performed.

For radionuclide analysis, a mass spectroscopy unit with laser ablation capabilities is under development.

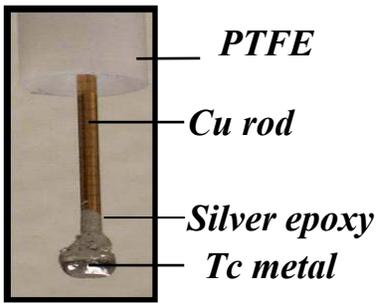


Figure 1. Technetium electrode

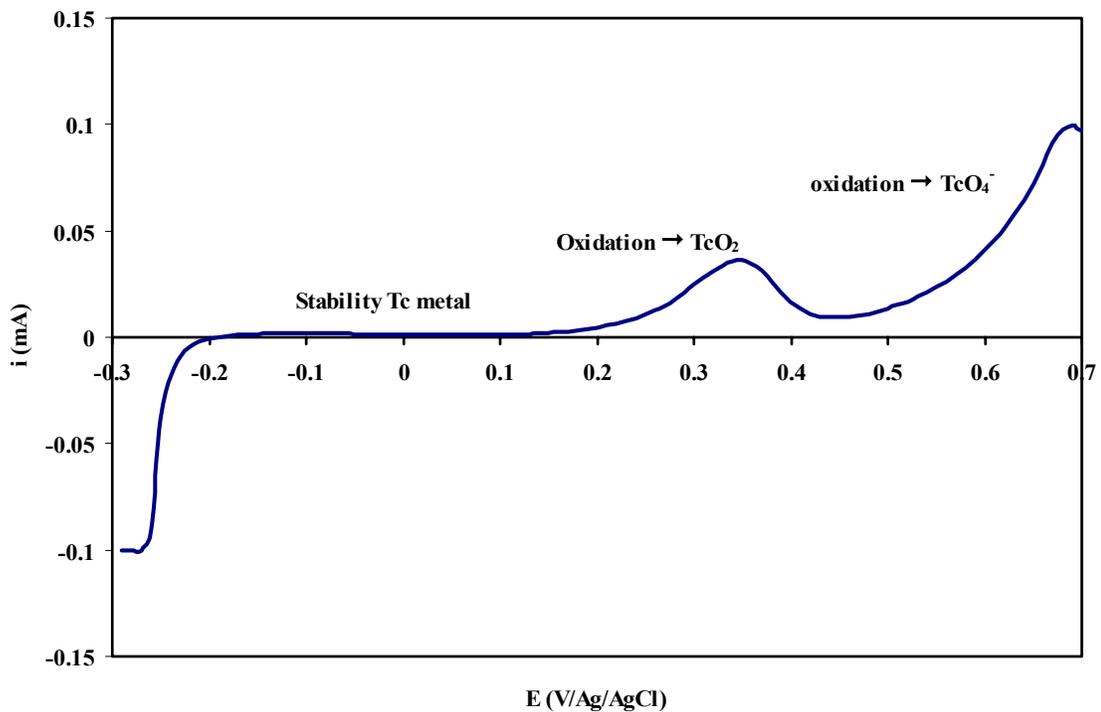


Figure 2. Linear voltammetry (10 mV /s) in H₂O. NaTFMS 0.1M. Tc electrode. Ref=Ag/AgCl.

5.0 Evaluation of Radon Release and Transport from Actinide-Bearing Waste Forms (PI: Gary Cerefice, UNLV Harry Reid Center)

5.1 Highlights

Radon emanation experiments using thorium nitrate [Th(NO₃)₄] were initiated.

5.2 Technical Summary

Initial experimental designs of systems for the equilibrium measurements of radon emanations from test samples have been developed, and evaluated using the RAD-7 radon detector for both a radium check source (for ²²²Rn) and thorium nitrate (for ²²⁰Rn). The efficacy of the thoron

calibration for the detector has been evaluated to determine the impact of sampling times on the detection limit and calibration (due to the short half-life of the ^{220}Rn). Chamber and delivery tube dimensions as were determined in order to evaluate the time of delivery of the emanation to the RAD-7. A small amount (3 grams) of thorium nitrate was ground into a fine powder to identify the amount needed to use in the full scale evaluation of emanation of Rn-220 from the thorium.

Over the next quarter, the experimental design will be modified to ensure that the sampled gas volume is homogeneous prior to sampling. To attempt to reduce the quantities of thorium required for the experiments, work will begin on a reduced volume experimental set-up. As part of this work, the optimum head space for equilibration and sampling stability will be evaluated and incorporated into the experimental design. For the next quarter, the work will primarily focus on ground thorium nitrate, which should have near theoretical radon emanation to validate the designs and establish the baseline for the emanation coefficient.

6.0 Evaluation of Radionuclide Speciation and Release from Vitrified Waste Phases (PI: Tyler Sullens, UNLV Harry Reid Center)

6.1 Highlights

- Literature reviews were conducted to evaluate vitrified waste compositions and dissolution methodologies.
- Materials and equipment for the fabrication and characterization of the vitrified materials were ordered and received.
- A single formulation of the vitrified material was approved by all research team members, and the individual chemicals were ordered for this formulation.
- Lab and hood spaces were prepared for this research, with particular attention focused on the extreme heat conditions and high amount of activity used for this project.

6.2 Technical Summary

A new research team was formed to initiate work for this portion of NRAMP 2. The team has conducted thorough literature investigations into vitrified waste formulations, dissolution test procedures, and characterization methods. An extensive amount of literary references exist for each of these aspects of the vitrified waste project. A single glass formulation was agreed to based on previous work performed by Pacific Northwest National Laboratory (PNNL) personnel on waste from the Hanford site underground storage tank AZ-102. There are a number of dissolution test methods that are performed on vitrified materials, however, it was decided that an MCC-1 inspired method will be conducted, in conjunction with a vapor hydration tests. A third dissolution test will be conducted and dubbed as the hydrothermal method. The hydrothermal method consists of a vapor hydration test modified so that the samples will be submerged prior to heating, unlike the current vapor hydration test where the samples are suspended above the water in the pressure vessel.

Characterization of the dissolved material and aliquots of the solvent have been planned to utilize Laser Ablation Inductively Coupled Plasma Mass Spectroscopy (LA-ICP-MS), ICP-MS,

Scanning Electron Microscopy, Energy Dispersive Analysis by X-ray (EDAX), powder X-ray diffraction (XRD), and single crystal X-ray diffraction. Other characterization methods are available and will be used as necessary.