ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

September 24, 2009

Mr. John Hickman
Mail Stop: T-8F5
Office of Federal and State Materials
And Environmental Management Programs
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

SUBJECT: DRAFT–REPORT NO. 2: SITE-SPECIFIC DECOMMISSIONING INSPECTION REPORT FOR THE RANCHO SECO NUCLEAR GENERATING STATION, HERALD, CALIFORNIA, DCN 1695-TR-02-DRAFT (DOCKET NO. 50-312; RFTA 06-003)

Dear Mr. Hickman:

Enclosed is the subject report for the final inspection of decommissioning activities completed at the Rancho Seco Nuclear Generating Station (RSNGS) in Herald, California. Oak Ridge Institute for Science and Education (ORISE) personnel toured the Reactor, Turbine, Spent Fuel and Auxiliary Buildings, the Industrial Area and the open land areas (to include the off-site "No Name" Creek) during site visits conducted between June 7, 2006 and March 12, 2009. In addition, ORISE staff observed RSNGS personnel performing decommissioning survey activities on embedded piping internals and Auxiliary Building structural surfaces. ORISE also reviewed multiple decommissioning related documents and discussed procedure implementation with site personnel. An initial report was issued to the U.S. Nuclear Regulatory Commission (NRC) on April 25, 2008. Sacramento Municipal Utility District (SMUD) provided responses to and additional information for observations and recommendations which assisted ORISE's technical inspections. The inspections were conducted in accordance with ORISE confirmatory and inspection plans provided to the NRC.

If you have any questions, please direct them to me at 865.576.0065 or Tim Vitkus at 865.576.5073.

Sincerely,

Wade C. Adams
ORISE Health Physicist/Project Leader
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WCA:bf

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DRAFT–REPORT NO. 2:
SITE-SPECIFIC DECOMMISSIONING INSPECTION REPORT FOR THE RANCHO SECO NUCLEAR GENERATING STATION, HERALD, CALIFORNIA, DCN 1695-TR-02-DRAFT
(DOCKET NO. 50-312; RFTA 06-003)

EXECUTIVE SUMMARY

On April 25, 2008 the Oak Ridge Institute for Science and Education (ORISE) submitted to Mr. John Hickman of the U.S. Nuclear Regulatory Commission (NRC) Report No. 1, *"Site Specific Decommissioning Inspection Report For the Rancho Seco Nuclear Generating Station"*, Herald, California (ORISE 2008a). For this in-process inspection report, ORISE performed site-specific decommissioning inspections of the Rancho Seco Nuclear Generating Station (RSNGS) over the periods of June 7 and 8, 2006, October 15 through 18, 2007 and December 10 through 14, 2007. Report No. 1 documented the observations and recommendations ORISE prepared for the inspections items taken from the Site-Specific Decommissioning Inspection Plan (ORISE 2007a). In several instances, ORISE noted the need for additional information or later review in the Report No. 1 Recommendations.

Sacramento Municipal Utility District (SMUD) personnel provided responses to the ORISE Observations and Recommendations listed in Report No. 1.[1] These responses provided clarification and closure to the topics ORISE addressed in Report No. 1, and provided additional information and/or documentation that ORISE would require to complete the inspections. As these requests for additional information were fulfilled, ORISE provided, in a few instances, "Follow-up" information to supplement the Observations and Recommendations. The SMUD responses are included in this final inspection report (Report No. 2).

For Report No. 2, ORISE concentrated on the inspection items that had not yet been addressed by ORISE in Report No. 1 and also concentrated on SMUD's responses to Report No. 1 Observations and Recommendations. There were no major issues determined during reviews of SMUD's procedures for survey instrumentation and analytical equipment calibrations, DCGL determinations, data collection and reporting, and QA/QC methods. Issues that were addressed included the improper collection of soil samples (from Report No. 1) and the discovery of discrete particles in Class 1 survey units that had received 100% scan coverage during Final Status Survey (FSS) activities (Report No. 2). SMUD personnel addressed these issues by revising appropriate procedures and providing additional training to FSS personnel.

[1] Email from E. Ronningen (SMUD) to J. Hickman (NRC), RE: Response to ORISE Rpt #1. February 26, 2009.

REPORT NO. 2
SITE-SPECIFIC DECOMMISSIONING INSPECTION REPORT
FOR THE RANCHO SECO NUCLEAR GENERATING STATION
HERALD, CALIFORNIA

At the request of the U.S. Nuclear Regulatory Commission's (NRC) Office of Federal and State Materials and Environmental Management Programs (FSME), the Oak Ridge Institute for Science and Education (ORISE) performed a site-specific decommissioning in-process inspection for the Rancho Seco Nuclear Generating Station (RSNGS) in Herald, California. The inspection was performed in accordance with the ORISE Site-Specific Decommissioning Inspection Plan, submitted to the NRC on September 10, 2007 (ORISE 2007a), and the ORISE Survey Procedures and Quality Program Manuals (ORISE 2008b and ORAU 2009a). This report describes the on-site inspection activities performed during the period of June 7, 2006 through March 12, 2009. The inspections evaluated the Sacramento Municipal Utility District (SMUD) final status survey (FSS) activities. As part of the in-process inspection, ORISE performed side-by-side field measurements and performed inter-laboratory comparison analyses with SMUD in order to corroborate SMUD's FSS results.

The following NRC Inspection Procedure was used for guidance, in part, during this inspection:

- Inspection Procedure 83801 - Inspection of Final Surveys at Permanently Shutdown Reactors

ORISE reviewed several RSNGS documents and procedures. These included the License Termination Plan (LTP), several Decommissioning Technical Basis Documents (DTBD) and several Decommissioning Survey Implementation Procedures (DSIP). In addition, ORISE reviewed the licensee's instrument calibration and check-out records and FSS field data documentation forms. Portions of the following documents and computer software applications were used for guidance during this inspection:

- EPA – Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)
- ISO-7503-1: Evaluation of Surface Contamination – Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters
- NUREG-1505: A Proposed Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys
- NUREG-1507: Minimal Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions
- NUREG-1575: Multi-Agency Radiation Survey and Site Investigation Manual [MARSSIM]
- NUREG-1727: NMSS Decommissioning Standard Review Plan
- NUREG-1757: Consolidated NMSS Decommissioning Guidance: Updates to Implement the License Termination Rule Analysis
- SMUD – *Rancho Seco Nuclear Generating Station Historical Site Assessment* (HSA) (2004)
- SMUD – *Rancho Seco Nuclear Generating Station License Termination Plan* (LTP) (2006)
- SMUD – *Rancho Seco Nuclear Generating Station Final Site Survey Handbook* (2008, Rev. 5)
- SMUD – Phased Release of the Rancho Seco Site. Letter from E. Ronningen (SMUD) to J. Hickman (NRC). June 8, 2009.

- SMUD – Email from E. Ronningen (SMUD) to J. Hickman (NRC), RE: Response to ORISE Report #1. February 26, 2009.
- SMUD – *Chemistry Procedure Manual*
  - Chemistry Quality Control Program [CAP-0003, Rev. 12]
  - Gross Alpha/Gross Beta Activity [CHM-3202, Rev. 3]
  - Isotopic Analysis using Gamma Spectroscopy [CHM-3203, Rev. 8]
  - Canberra Gamma Spectrometer and Computer System [CHM-4113, Rev. 1]
  - Tennelec Low Background Alpha and Beta Counter System-Series 5 [CHM-4116, Rev. 1]
  - Canberra Apex Gamma Spectrometer System [CHM-4117, Rev. 1]
- SMUD – *Decommissioning Technical Basis Documents (DTBD) for RSNGS*
  - Radionuclide for Consideration During RSNGS Characterization or Final Status Surveys [DTBD 04-001, Rev. 2]
  - Embedded Piping Scenario and DCGL Determination Basis [DTBD-05-009, Rev. 1]
  - Beta Detection During RSNGS Characterization or FSS [DTBD-05-010, Rev. 1]
  - Eberline SPA-3 and Ludlum 44-10 Detector Sensitivity (MDC) [DTBD-05-012, Rev. 0]
  - Buried Piping Scenario and DCGL Determination Basis [DTBD-05-013, Rev. 1]
  - RSNGS Surface Soil Nuclide Fractions and DCGL [DTBD-05-014, Rev. 1]
  - Structure Nuclide Fraction and DCGLs [DTBD-05-015, Rev. 0]
  - Initial Classification of Survey Areas and Survey Design Sigma Values [DTBD-06-001, Rev. 3]
  - Use of a Survey Unit Size of 319 m^2 for Class One Structure Surveys [DTBD-06-002, Rev. 0]
  - Use of an Alarm Setpoint with the Ludlum Model 2350-1 Data Logger for FSS Survey [DTBD-07-001, Rev. 0]
- SMUD – *Decommissioning Survey Implementing Procedures (DSIP) for RSNGS*
  - FSS Controls [DSIP-0050, Rev. 0]
  - Department Training and Qualification [DSIP-0060, Rev. 1]
  - Final Status Survey Package Design and Preparation [DSIP-0101, Rev. 3]
  - Decommissioning Survey Instruction for Structures, Systems and Soils [DSIP-0110, Rev. 3]
  - FSS Data Processing and Reporting [DSIP-0120, Rev. 3]
  - Remediation Work Package Procedure [DSIP-0160, Rev. 2]
  - Decommissioning Survey Quality Control [DSIP-0200, Rev. 2]
  - Surface Soil, Subsurface Soil, and Other Bulk Media Sampling and Preparation [DSIP-0310, Rev. 2]
  - Operation of the Ludlum 2350-1 Datalogger [DSIP-0510, Rev. 6]
  - Performance of M2350-1 Downloads [DSIP-0520, Rev. 1]
  - Operation of the ISOCS Portable Gamma Spectroscopy System [DSIP-0530, Rev. 1]
  - Operation of the Inspector 1000 NaI Spectrometer [DSIP-0540, Rev. 2]
- SMUD – *Final Status Survey Summary Reports*
  - Waste Gas Decay Tank Room Floor and Lower Walls (Room 018) Survey Unit F8130201
  - Waste Gas Decay Tank Room Upper Walls and Ceiling (Room 018) Survey Unit F8130211

- SMUD – *Potential Deviation from Quality* (PDQ)
  - PDQ-07-020: Discrete Particle in SU F8130201 (December 2007)
  - PDQ-08-021: Particle in Emergency Sump (December 10, 2008)
  - PDQ-08-017: Examination of Error in DCGL Calculations (2008)
- SMUD – *Radiation Control Manual*
  - Routine and Radiation Work Permit Surveys [RP.305.08A, Rev. 7]
- ORISE
  - Confirmatory Survey Results for the Reactor Building Dome Upper Structural Surfaces, Rancho Seco Nuclear Generating Station, Herald, California (Docket No. 50-312, RFTA No. 06-003). Oak Ridge, Tennessee; October 25, 2006.
  - Final Site-Specific Decommissioning Inspection Plan for the Rancho Seco Nuclear Generating Station, Herald, California, Revision 0 (Docket No. 50-312; RFTA 06-003, Revision 1). Oak Ridge, Tennessee; September 10, 2007a.
  - Revised–Confirmatory Survey Report for Portions of the Auxiliary Building Structural Surfaces and Turbine Building Embedded Piping, Rancho Seco Nuclear Generating Station, Herald, California. DCN 1695-SR-01-01. Oak Ridge, Tennessee; December 21, 2007b.
  - Final Confirmatory Survey Plan for the Remaining Structural Surfaces, Embedded Piping, Standing Water and Open Land Area Survey Units. Rancho Seco Nuclear Generating Station, Herald, California [Docket No. 50-312; RFTA No. 06-003]. Oak Ridge, Tennessee; August 10, 2007c.
  - Report No. 1: Site Specific Decommissioning Inspection Report for the Rancho Seco Nuclear Generating Station, Herald, California. DCN 1695-TR-01-0 (Docket No. 50-312; RFTA 06-003). Oak Ridge, Tennessee; April 25, 2008a.
  - Survey Procedures Manual for the Independent Environmental Assessment and Verification Program. Oak Ridge, Tennessee; May 1, 2008b.
  - Interim Letter Report-Confirmatory Survey Results for Activities Performed in December 2007; Rancho Seco Nuclear Generating Station, Herald, California. DCN 1695-SR-02-0 (Docket No. 50-312, RFTA No. 06-003). Oak Ridge, Tennessee; March 12, 2008c.
  - Revised Interim Letter Report – Confirmatory Survey Results for Activities Performed in April and May 2008, Rancho Seco Nuclear Generating Station, Herald, California. DCN 1695-SR-03-01. Oak Ridge, Tennessee; August 29, 2008d.
  - Confirmatory Survey Report for Activities Performed in the Industrial Area of the Rancho Seco Nuclear Generating Station, Herald, California. DCN 1695-SR-06-0. Oak Ridge, Tennessee; July 21, 2009a.
  - Laboratory Procedures Manual for the Independent Environmental Assessment and Verification Program. Oak Ridge, Tennessee; April 30, 2009b.
  - Confirmatory Survey Report for Activities Performed in September and October 2008, Rancho Seco Nuclear Generating Station, Herald, California. DCN 1695-SR-04-0. Oak Ridge, Tennessee; May 7, 2009c.
  - Confirmatory Survey Report for Activities Performed in the Containment Building, Rancho Seco Nuclear Generating Station, Herald, California. DCN 1695-SR-05-0. Oak Ridge, Tennessee; May 6, 2009d.
- ORAU – Quality Program Manual for the Independent Environmental Assessment and Verification Program. Oak Ridge, Tennessee; May 4, 2009.

- ORNL – Evaluation of Radioactive Liquid Effluent Releases from the Rancho Seco Nuclear Power Plant (1986)
- RESRAD and RESRAD-BUILD
- MicroShield™

The following applicable checklist items were taken from the ORISE Site-Specific Decommissioning Inspection Plan (ORISE 2007a). Observations and recommendations are noted under each checklist item.

1.0 GENERAL

1.1 Tour plant areas to obtain familiarity with the facility, surrounding areas, and decommissioning work completed. Review the licensee's plans and schedule for completing further decontamination work and surveying of the facility.

Report No. 1 Observations: ORISE staff toured plant areas and observed in-process decommissioning work. Areas toured included the Reactor, Turbine and Auxiliary Buildings and the exterior site grounds. SMUD personnel were performing FSS activities of embedded piping and several interior survey units (SUs) within the Auxiliary Building during the tours. The Fuel Handling Building was looked at but was not toured due to ongoing work.

During the Reactor Building tour in June 2006, decontamination activities consisted of the removal of shielding walls and the reactor monolith; the grinding operation of walls for decontamination; and, the preparation of surfaces for FSS. Concerns and issues included accessing the dome of the structure for FSS using the overhead crane as a platform for conducting surveys. ORISE staff performed confirmatory surveys of the Reactor Dome during the period of June 7 and 8, 2006 and a confirmatory survey letter report was submitted to the NRC on October 25, 2006 (ORISE 2006).

The Auxiliary Building tour provided examples of various stages and activities of the facility decommissioning. The team was shown the methods used for accessing the embedded piping for FSS activities and FSS structural surface scans were observed within several survey units. Numerous rooms containing support systems had been gutted of equipment and were essentially in final status condition.

The Turbine Building consists of five main elevations with residual radioactive material known to be present on each level. The predominant interior classifications were Class 1 and 2 and the exterior was Class 3.

The Site Grounds were indicated as having minimal potential for contamination. One area that had become contaminated was the result of overflow of the "No Name" Creek; this location was remediated and ORISE performed confirmatory survey activities during December 2007. The results of the confirmatory surveys of this area were reported to the NRC in a letter report on March 12, 2008 (ORISE 2008c). Several other areas were noted as either storing, or prepared to store, radioactive material or waste containers.

Report No. 1 Recommendations: None

SMUD Response: None

Report No. 2 Observations: ORISE also toured the Fuel Storage Building, the Pump Alley, the Cooling Towers Buffer Areas, the Tank Farm Area, the RHUT Area, and the Industrial Area. ORISE observed SMUD personnel performing FSS activities of additional surfaces and several exterior survey units.

Report No. 2 Recommendations: None

1.2 Review past records of spills or other releases of radioactive material and documentation of cleanup.

Report No. 1 Observations: Chapter 2 of the *License Termination Plan* (LTP) and the *Historical Site Assessment* (HSA) provided information on known release events that resulted in contamination of various site areas (SMUD 2006 and 2004). These events included those that took place within the power block and are contained within the Radioactive Control Area (RCA) and those that took place outside the RCA and contributed to the impacted classification of substantial portions of the Industrial Area. There were plant radioactive liquid effluent releases resulting in soil contamination due to overflow of "No Name" Creek (this area has been remediated) and multiple spills in the Reactor, Auxiliary and Turbine Buildings (currently undergoing FSS activities). Refer to Section 1.1 where ORISE indicates that confirmatory surveys were performed in the "No Name" Creek overflow area.

Report No. 1 Recommendations: ORISE will review other pertinent documents, such as those documents listed in the LTP Chapter 2, during future site inspections.

SMUD Response: None

Report No. 2 Observations: ORISE personnel reviewed the HSA and NUREG-4286 *"Evaluation of Radioactive Liquid Effluent Releases from the Rancho Seco Nuclear Power Plant"* (SMUD 2004 and ORNL 1986). No further observations noted.

Report No. 2 Recommendations: None

2.0 IDENTIFICATION OF CONTAMINANTS AND DCGLS

2.1 Review previous measurement and analytical results to confirm the nature of the site information and contaminants at the site. In particular, review the data that relate to the licensee's determination of radionuclide ratios, fractional contributions to total activity and variability.

Report No. 1 Observations: Information provided in the LTP was reviewed. The LTP summarizes data that had been compiled from characterization data available at the time of the plan preparation. The summarized data included radionuclide mixtures in site soils, embedded and buried piping, and structural surfaces.

Structures: The data for building structures were further subdivided based on areas of the plant. DTBD-05-015 was reviewed for nuclide fractions data for structural surfaces. SMUD personnel collected concrete core samples from locations of known contamination from the Turbine Building Condenser Pit, the Spent Fuel Pool Wall, the Reactor Building and the Auxiliary Building and then used the highest activity samples from these locations to establish radionuclide ratios and fractional contributions. The nuclide fraction for site structures is based on the averaged results of the individual concrete samples.

Embedded Piping: DTBD-05-009, the procedure for evaluating the radionuclide profiles for embedded piping, was reviewed. After sampling from various systems within individual buildings, SMUD determined that the overall mean radionuclide fractions in the embedded piping were similar to the concrete structure fractions.

Soils: DTBD-05-014 was reviewed for nuclide fractions data for surface soils. Surface soil radionuclide fractions were determined from areas that represented the maximum radionuclide concentrations in regions with the most significant contamination. SMUD personnel used soil samples collected from the Spent Fuel Pool Cooler Area, Turbine-Spent Fuel and Diesel Generator Room gap, the Effluent Stream (Corridor) and the Tank Farm since those areas exhibited elevated soil activity. The collected soil samples were initially analyzed on site with high purity germanium (HPGe) detectors and, based on these results, selected samples were submitted to General Engineering Laboratories, LLC (GEL) for hard-to-detect (HTD) radionuclide analyses. SMUD used the GEL soil sample analyses to establish radionuclide ratios, fractional contributions and to determine if the radionuclide ratios were consistent. Based on cesium-137's (Cs-137) abundance and ease of measurement, SMUD used Cs-137 as the surrogate radionuclide to account for the HTDs. Since the Cs-137 to cobalt-60 (Co-60) ratios in the FSS soil samples may vary, SMUD states in the LTP that they will use the Unity Rule to determine compliance with soil DCGLs. The described methods used to determine the soil surrogate DCGL values are consistent with MARSSIM practices.

Buried Piping: The radionuclide ratios for buried piping are the same as those for embedded piping. SMUD states in the LTP that they will assume that the buried piping will deteriorate and become part of the subsurface soil; therefore, SMUD uses the soil DCGLs for buried piping. DTBD-05-013 describes the buried piping technical basis for determining DCGLs and aptly applies MARSSIM practices.

Overall, the information provided indicates that the licensee is adequately investigating and developing methods to evaluate the radionuclide mixtures and incorporating these mixtures appropriately into survey implementation plans.

Report No. 1 Recommendations: None

SMUD Response: None

Report No. 2 Observations: No additional observations noted.

Report No. 2 Recommendations: None

2.2 Review the derived concentration guideline levels (DCGLs) that the licensee will use for outdoor soil areas, structure surfaces, embedded and buried piping, and/or rubblized structures (bulk material). Verify that the licensee has accounted for all media for which final status surveys will be designed.

Report No. 1 Observations: DCGLs presented in the LTP, DTBD-05-015, and DTBD-05-009 were reviewed. Site-specific DCGL modeling was performed using RESRAD, RESRAD-BUILD and MicroShield™. As such, DCGLs were developed for structures, soils, bulk materials and embedded piping.

Structural Surfaces (Bulk Materials): Information provided during the site characterization identified a suite of 26 site-specific radionuclides on structural surfaces at RSNGS (Table 5-2, LTP). This table lists several HTD radionuclides which could not be detected and/or quantified using field instruments which SMUD calibrates to Cs-137. Therefore, SMUD used the surrogate radionuclide approach to determine site-specific structural DCGLs. The predominant radionuclides on most structural surface SUs were identified as Cs-137 (84%), Co-60 (2%), and Sr-90 (8%). SMUD used the "10 percent rule" as allowed in NUREG-1757, which states that a radionuclide can be removed from consideration if its dose contribution is insignificant (less than 10% of the total dose). Several survey units have Co-60 as the predominant radionuclide and the design DCGL's for those survey units take this into account. With the exception of the Reactor (Containment) Building, the structural surface DCGLs were calculated using the industrial worker scenario in RESRAD-BUILD. SMUD has no plans to renovate or demolish the Reactor Building; however, since the final condition of the building will consist of no electrical lighting or power and no ventilation, SMUD elected to use the renovation/demolition scenario for determining DCGLs for the Reactor Building. SMUD provided summarized data within preliminary FSS data packages for specific SUs for which ORISE performed confirmatory survey activities. SMUD used a similar approach in determining DCGLs for bulk materials.

Embedded (and Buried) Piping: SMUD's embedded piping scenario assumes that the piping will remain in place and that the dose to the industrial worker would be from direct gamma exposure due to residual radioactivity remaining within the pipe (DTBD-05-009). Since the embedded piping is partially shielded and constrained by the encasing concrete structures, the impact of radionuclides that are not gamma emitters was deemed minimal. SMUD derived a DCGL of 100,000 dpm/100 cm^2 which was calculated with MicroShield™ using conservative parameters (i.e., thin concrete coverings and large diameter piping). SMUD also decided to grout embedded piping when residual activity exceeded the NRC screening levels (adjusted for HTD nuclides). A grout action level of 21,000 dpm/100 cm^2 was determined based on the nuclide fractions.

Soils (Buried Piping): Since SMUD has no plans to release the site to the public, the surface and subsurface soil DCGLs were calculated using the industrial worker scenario in RESRAD. SMUD makes an assumption "that buried piping will

disintegrate instantaneously upon license termination." Therefore, it is assumed that the disintegrated pipes will contribute to the soil volume.

Overall, the information provided indicates that the licensee has adequately developed DCGLs based on appropriate radionuclide mixtures.

Report No. 1 Recommendations: None

SMUD Response: None

Report No. 2 Observations: No additional observations noted.

Report No. 2 Recommendations: None

2.3 Evaluate how the DCGLs will be implemented—e.g., use of surrogate measurements and modified DCGLs, gross activity DCGLs, $DCGL_{EMC}$s—to determine how samples/measurements will be compared, implementation of the unity rule, and how radionuclide variability (σ)—specifically modification of σ—will be integrated in DCGL implementation.

Report No. 1 Observations: The current FSSP (LTP Chapter 5) was reviewed for determination of planned DCGL implementation for multiple radionuclides. The FSSP, as currently written, provides a general approach that closely follows the guidance provided in MARSSIM. The licensee has indicated that gross activity and surrogate DCGLs—to account for HTD radionuclides—will be necessary and the appropriate calculational approach for determining a gross activity DCGL and modifying the DCGL based on radionuclide surrogate ratios was provided. A modified Cs-137 DCGL was presented in the calculations and was properly calculated per the specific DTBDs. Additionally, the licensee is required to implement the unity rule as appropriate.

Report No. 1 Recommendations: The actual methods and variables the licensee will use for calculating sample results should be reviewed as initial final status survey work packages are compiled to ensure input parameters account for the multiple radionuclides.

SMUD Response: ORISE representatives have been provided final status work packages relative to final submittals made and confirmatory surveys ORISE has performed. These final survey packages include conditions that demonstrate methods used by SMUD to evaluate radionuclide variability and account for HTD radionuclides. For example, regions where Co-60 and Cs-137 have been identified in the soil were examined using the Cs-137 soil surrogate (to address HTD radionuclides) and the Co-60 single nuclide DCGL values. These values were evaluated by spreadsheet which incorporated the unity rule. Further, the "DQA" spreadsheet for soil was modified to include the methodology. Soil samples where both Co-60 and Cs-137 have been positively identified utilize a "DQA" process where the sample results for Co-60 and Cs-137 are "unitized" and evaluated using

the unity rule. Examples of the "DQA" spreadsheet were provided to both ORISE and NRC representatives.

Report No. 2 Observations: ORISE reviewed the methods and variables used in calculating sample results; specifically, ORISE evaluated the radionuclide variability and accountability for HTD. The "DQA" spreadsheet and calculations were also reviewed. ORISE concurs with the SMUD response.

Report No. 2 Recommendations: None

3.0 AREA CLASSIFICATION

3.1 Based on plant area tours, site history, reviews of characterization, and other survey results, evaluate the licensee's technical basis for site classification as impacted versus non-impacted areas.

Report No. 1 Observations: The current FSSP (LTP Chapter 5) was reviewed and classification approach discussed during the facility tour. Site areas and respective anticipated classifications have been provided in the FSSP. The initial classification was based on historical process information and site scoping and characterization survey data. Additional information collected during decommissioning activities will be used to re-evaluate the classifications of survey units as appropriate. The FSSP specifies two types of survey unit classification, non-impacted and impacted areas. Non-impacted areas are not required to be surveyed since they have been determined to have "no reasonable potential for residual contamination" due to site operations. Impacted areas are defined as areas that may contain radioactivity from past site operations. Based on the level of contamination, the impacted areas are further divided into Class 1, Class 2 or Class 3 designations. SMUD follows the guidance for classification as per NUREG-1575 and NUREG-1757.

Report No. 1 Recommendations: None

SMUD Response: None

Report No. 2 Observations: No additional observations noted.

Report No. 2 Recommendations: None

3.2 For impacted areas, review the available information and data used for initially classifying the areas as Class 1, 2, or 3.

Report No. 1 Observations: ORISE reviewed the LTP and DTBD-06-01, Rev. 3. The classification for each area included the Area ID #, the Survey Area nomenclature, the operating history for the area, the characterization results for the area and a listing of any HSA events. The initial review of the average and maximum activity levels indicates that survey areas have been appropriately classified relative to the anticipated DCGLs.

Report No. 1 Recommendations: None

SMUD Response: None

Report No. 2 Observations: No additional observations noted.

Report No. 2 Recommendations: None

4.0 FINAL STATUS SURVEY PROCEDURES, INSTRUMENTATION AND DATA

4.1 Land Area Survey Instrumentation

4.1.1 Evaluate the instrument sensitivity for scan surveys of land areas. Review the scan MDC in terms of the soil DCGL(s). Ensure that *a priori* scan MDCs adequately account for modified DCGLs if a surrogate approach or the unity rule is used.

Report No. 1 Observations: Currently, the licensee plans to use 2" × 2" NaI scintillation detectors (Ludlum Model 44-2 and Eberline Model SPA-3) for land area surveys. The primary radionuclides of concern for outdoor soil areas are Cs-137 and Co-60. The licensee calculated the scanning minimum detectable concentrations (MDCs) for these detectors using the MicroShield™ computer application software. Modeling assumed a scan speed of 0.5 meters per second and source area measuring less than 1 square meter. Source to detector distance was less than 10 centimeters. The DCGL's for Cs-137 and Co-60 are 52.8 and 12.6 pCi/g, respectively. Per MARSSIM, the scan MDC for a 2" × 2" NaI scintillation detector is 6.4 pCi/g for Cs-137 and 3.4 pCi/g for Co-60. For soils, SMUD determined the scan MDC using a method described in NUREG-1507 and in MARSSIM; the conversion factor of 0.282 μR/h per pCi/g (footnote j, Table 5-12 of the LTP) was determined using MicroShield™ and the results are presented in DTBD-05-012. The 2" × 2" NaI detector instrument background was determined to be 8,000 to 10,000 counts per minute (cpm) with a typical scan MDC in the range of 5 to 6 pCi/g for a mixture of 95% Cs-137 and 5% Co-60. SMUD's modified scan MDC was reported to be 5.2 pCi/g.

The calculated scan MDC, as reported by SMUD, is therefore considered to be adequate for the primary radionuclides of concern.

Report No. 1 Recommendations: ORISE recommends that the licensee review the unit analysis of the conversion factor in footnote j of LTP Table 5-12. It appears the units may be reversed. ORISE will follow-up on this recommendation and review the calculations with site personnel during a future visit.

Report No. 1 Follow-up: SMUD provided a response to the ORISE comment concerning the conversion factor in an e-mail dated on March 11,

2008.[2] SMUD indicated that the units for the conversion factor were indeed inverted in the footnote in Table 5-12 and will make the appropriate correction.

SMUD Response: SMUD uses both the Ludlum Model 44-10 and Eberline Model SPA-3, 2"x 2" NaI detectors and not a Ludlum Model 44-2. The values found in Table 5-12 of the LTP list "typical" values for instrumentation. The conversion factor, 0.282 μR/h per pCi/g assumes a 3.0 inch distance from source to detector centerline. This conversion factor varies somewhat depending on detector centerline to source distance and the radionuclide mixture. For example, at a distance of 3.0 inches to the detector centerline (2.0 inches from the detector endcap) for a 95% Cs-137 and 5.0% Co-60 soil mixture a conversion factor of 0.307 (DTBD 05-012). This factor results in a 6.0 pCi/g MDC for a background of 12,000 cpm. Following the discovery made by ORISE regarding units being reversed corrections were made to Revision 1 of the LTP and the DTBD was checked for correctness.

Report No. 2 Observations: ORISE reviewed revisions to the LTP and the DTBD and reviewed the calculations with site personnel. ORISE concurs with the SMUD response. SMUD also reported an error in the surrogate nuclide DCGL calculation and submitted a Potential Deviation from Quality (PDQ 08-017) which documented the cause of the error and the correction. ORISE reviewed the PDQ and deems it appropriate.

Report No. 2 Recommendations: None

4.1.2 Review the equipment set up and performance check procedures.

Report No. 1 Observations: The NaI detectors (Ludlum Model 44-2 and Eberline Model SPA-3) are coupled to Ludlum Model M2350-1 data logger instruments. The DCGLs and scan MDCs for the instrumentation, as presented in above in Section 4.1.1, may need to be re-addressed based on the ORISE recommendation in Section 4.1.1. The performance check procedures are appropriate.

Report No. 1 Recommendations: ORISE will review SMUD's response to Section 4.1.1 recommendations during a future site survey and update this section after the review.

SMUD Response: As stated in the SMUD response to Section 4.1.1 the NaI 2"x 2" detectors used are the Ludlum Model 44-10 and Eberline Model SPA-3. The DCGL's and scan MDCs for the instrumentation are correct values. For soil surveys using a 44-10 detector and Ludlum Model 2350-1 instrument in latching mode a series of background measurements are acquired in the survey unit and a three sigma deviation of the averaged

[2] Electronic mail from E. Ronningen (SMUD) to W. Adams (ORISE): RE: DTBD-05-012. March 11, 2008.

background measurement is used to provide an investigation level. The background collection process is documented in DSIP 510 Attachment 8.6. Typically, a measurement above the three sigma background level is examined with a Canberra InSpector 1000 NaI MCA to determine if plant-derived nuclides are present. If plant-derived nuclides are present soil samples are collected and analyzed using HPGe detectors as part of the investigation. If the InSpector 1000 NaI is not available soil samples are taken from the suspect area(s) and analyzed using the facility HPGe detectors. The Ludlum and Eberline NaI detectors are used to identify areas of potentially elevated activity but are not used to quantify the results. The MDC response for the detector and instrument are based on the parameters provided in DTBD 05-012 which provide a given geometry, soil depth, density and distance to the detector centerline.

Performance checks are based on the response of the NaI detector to a known source positioned at a given distance from the detector. The detector performance check is conducted prior and following instrument use. The results are compared to the calculated response for the specific detector and logged on a response check form that is maintained as part of instrument response functions.

Report No. 2 Observations: ORISE reviewed DSIP-0510 and DTBD-05-012 and concurs with the SMUD response. No further observations noted.

Report No. 2 Recommendations: None

4.1.3 Review the survey procedures for performing surface and sub-surface soil sampling and surface scanning. In particular, observe that soil samples are collected at the stated frequency and spacing in accordance with RSNGS procedures.

Report No. 1 Observations: ORISE has not performed a thorough review of soil sampling procedures.

Report No. 1 Recommendations: ORISE will review appropriate soil sampling and scanning procedures during a future site survey and update this section after the review.

SMUD Response: For Survey Units requiring soil sampling the frequency and spacing are depicted by the Survey Design and Instructions. These documents, frequency and spacing instructions are provided in Section 6.0 of DSIP-0101 and determined by the survey area size. The survey package contains maps which provide (as required) the random start location and provide the spacing and locations relative to the survey unit. Gamma scanning requirements are depicted by the Survey Instructions and the requirements provided in DSIP-0110 and DSIP-0310. Attachment 8.6 of DSIP-0510 provides the formula used to determine a 3.0 sigma alarm set point based on acquisition of a series of background measurements.

Training is required for personnel performing MARSSIM surveys and includes modules for soil collection and scanning protocol. The training consists of procedure review, topics applicable to the processes provided in the procedures and observation of the collection and scanning processes by the Trainer(s). There are training module sign off requirements by the Trainer for each individual performing the tasks. Specific training not listed in the Training Modules consists of the training outline and, as required, applicable data, and training form DM-270 with applicable signatures. Training files are maintained for all technicians and a master list is maintained of the modules completed for all technicians and available for confirming that a technician meets the requirements for specific surveys. In addition training information for each technician is maintained in the DEG files on the 5th floor.

Report No. 2 Observations: ORISE did not visually observe SMUD soil sample collection or scanning techniques. The documents listed above and soil samples data and maps provided in FSS data packages were reviewed and ORISE concurs that the written procedures were adequate.

As reported in the ORISE confirmatory survey report submitted to the NRC on July 21, 2009, ORISE identified several discrete particles on the soil surface in the Tank Farm Areas (ORISE 2009a). Additional investigations of these locations indicated three discrete particles within the surface soil in SUs F8100021 (Northwest Tank Farm) and F8100031 (Northeast Tank Farm). SMUD personnel remediated these locations and initiated a Potential Deviation from Quality (PDQ) report concerning the discrete particle findings by ORISE. Based on the discrete particle findings, the confirmatory survey results for two of the evaluated surface soil SUs (F8100021 and F8100031) were not in agreement with the radiological status of these SUs as presented in the licensee's preliminary FSS data packages. Therefore, the NRC tasked the licensee with performing additional evaluations of the significance of the discrete particles found by ORISE and with performing a gamma walkover resurvey of the transport routes and all outdoor Class 1 areas.[3]

SMUD provided a response to the ORISE discrete particle findings in a letter dated on June 8, 2009.[4] In the response, SMUD instituted a protocol that was to "...emulate the ORISE surveys, where the focus was not on a regimented MARSSIM-type survey pattern designed to detect regions of contamination that are large in relation to the detector size, but was instead based upon finding and detecting areas of contamination very small in relation to the size of the detector." Based on SMUD's re-survey activities, 32 additional locations/items of elevated gamma activity were detected on the soil and/or paved surfaces. SMUD remediated these locations, provided size descriptions, gamma count rates and gamma spectroscopy analyses for

[3] E-mail from J. Hickman (NRC) to E. Ronningen (SMUD), RE: Discrete Particle Issue. March 25, 2009.
[4] Letter from E. Ronningen (SMUD) to J. Hickman (NRC). RE: Phased Release of the Rancho Seco Site. June 8, 2009.

the elevated items and a calculated 1 m^2 distributed activity for each item. SMUD stated that their re-survey activities were "...conducted under 'ideal' conditions with essentially zero site activity occurring during the surveys..." and that the "...focus was on finding and locating any activity above background, not the MARSSIM technical basis of detecting a small fraction of a DCGL." The items detected (and listed in Table 3; SMUD 2009) ranged, in respect to physical size, "...sand-grain or smaller particles to rocks and/or concrete aggregate with a mass of several grams." SMUD retrieved each item and analyzed (identified and quantified) them in their on-site laboratory. On page 33 of the SMUD response, SMUD listed seven conclusions and ORISE concurs with Conclusions 1 through 6. Conclusion 7 states that, "While SMUD retrieved (i.e., remediated) the particles discovered during the Post-FSS surveys, it was not ALARA to do so: SMUD has demonstrated in the approved LTP that remediation below the 25-mrem/y limit is not necessary."

Although MARSSIM and LTP dose considerations have been met, ORISE disagrees that ALARA (as low as reasonably achievable) was met. ALARA good housekeeping practices states that "...all licensees should use typical good practice efforts such as...removal of readily removable radioactivity in buildings or in soil areas..." The SMUD Post FSS particle surveys demonstrated that particles, which were easily removable, were still present on the site. Previous ORISE findings led to SMUD investigations and possible recontamination issues and waste transport issues (Refer to PDQ 07-020 and ORISE 2008c). PDQ 07-020 specifically states that the apparent cause of the recontamination was "migration of loose contamination into previously surveyed areas from adjacent areas undergoing remediation." In the case of the RHUT Area recontamination, SMUD states that "The contamination was found adjacent to a roadway used to transport radwaste and not far from the rail spur used to load contaminated concrete from the Reactor Building." SMUD states in this PDQ that it was "...unlikely that the material was present during the FSS survey and missed by the surveyor.... (and that) given the activity of the particles (~0.5 μCi Co-60), it would have been easily detected if it had been present at the time of the FSS survey." It is also stated in PDQ 07-020, that "...an additional particle and two areas of soil contamination were discovered in the area covered by the tent just outside the Reactor Building equipment hatch where radwaste removal occurs." Based on these findings, SMUD developed a protocol to detect particulate contamination (PDQ 07-020).

NRC's request that SMUD perform these additional surveys was based on ORISE findings and to "...assure that other discrete particles have not been missed." ORISE concurs with the NRC assessment that these surveys were "...necessary to ensure sufficient confidence, ours and the public's, in the survey process..." and is a direct ALARA consideration. ORISE also notes that the surveys in March 2009 determined the presence of recontamination in the vicinity of the Reactor Building equipment hatch which should have been surveyed with SMUD's particulate contamination detection protocol.

Regulatory guidance on ALARA is provided in Appendix N of NUREG-1757, Volume 2, Revision 1.

Report No. 2 Recommendations: ORISE recommends that a map identifying the location of the 32 particles found during the Post FSS Particle Surveys be provided. This map would provide clarification of the locations of the particles. Also, SMUD did not address the root cause of why these particles were not discovered during the initial FSS survey activities which should have included using SMUD's particulate contamination detection protocol. ORISE also notes that the recontamination of "clean areas" is not ALARA.

4.1.4 Review the chain-of-custody procedures. Evaluate quantification methods used for gamma spectroscopy. Determine if soil data are verified throughout the data management system and the correct sum-of-fraction calculations are performed for multiple radionuclides.

Report No. 1 Observations: ORISE has not reviewed the chain-of-custody, gamma spectroscopy, or sum-of-fractions verification calculations.

Report No. 1 Recommendations: ORISE will review appropriate procedures during a future site survey and update this section after the review.

SMUD Response: Chain-of-Custody does not apply to the collection of samples that are analyzed on site. DSIP-0310 directs the technicians to maintain custody of the samples as do the package survey instructions. A Chain-of -Custody Form is used for samples being sent to an off-site vendor. In cases when NRC and ORISE require samples to be sent to their facility SMUD has used the NRC or ORISE Chain-of-Custody forms.

Quantification for gamma spectroscopy analysis for final status survey samples includes the following: Each gamma spectroscopy system used on site is calibrated to NIST traceable mixed gamma standards. The samples are counted utilizing the Rancho Seco existing Chemistry procedures. CHM-3203, *"Isotopic Analysis Using Gamma Spectroscopy"* discusses quantitative analysis methods. Following analysis the sample results are entered into the Chemistry log book and the analysis hardcopy results review by the analyst and routed to the responsible FSS Engineer. The electronic analysis results are saved and later transferred into the FSS DQA by the database manager for final status evaluation and entry into the Final Status Survey Summary Report. The Validation and Verification of the FSS DQA for both structure and land surveys were demonstrated to both the NRC and ORISE during past visits. In addition, portions of the summary data for confirmation of selected survey units have been provided to ORISE representatives as part of the evaluation of specific survey units. The DQA database was tested for the sum-of-the-fractions conditions and directly utilizes the sum-of-the-fractions

where the DCGL is equal to 1.0 (LTP Section 5.6.2.1). These conditions exist when both Co-60 and Cs-137 are present in the soil sample results.

Report No. 2 Observations: ORISE reviewed DSIP-0310, CHM-3203 and the sum-of-the-fractions calculations as presented by SMUD and the procedures are adequate. SMUD does not provide a chain-of-custody (COC) for field samples collected and analyzed on-site.

Report No. 2 Recommendations: Chapters 10 and 11 of MARLAP recommend a field and a lab COC. Table 11.1 of MARLAP specifically states that a site should "maintain chain of custody and document sample handling during transfer from the field to the laboratory, then within the laboratory. Also, from the *Chemistry Quality Control Program* (CAP-0003), Section 6.6.2 on Sample Custody, it is stated that "Normally the technician who collects the sample also performs the analyses. If the sample technician does not perform the analyses, the transfer of custody is noted in the logbook." This seems to be inconsistent with SMUD's statement of no COC for samples that are collected and analyzed on site. ORISE recommends following COC procedures for all samples.

4.2 Building Surface Survey Instrumentation

4.2.1 Review the calibration and performance check procedures. Ensure calibrations will account for any environmental or other factors that could potentially impact performance. Evaluate the appropriateness of the calibration source energies in determining instrument efficiencies and any applied weighting factors relative to the radionuclides of concern. Evaluate the licensee's selection of surface efficiency value(s). Review the survey instrumentation operational checkout procedures and acceptance parameters.

Report No. 1 Observations: Instrumentation calibration was observed and was done according to site procedures. Cs-137 sources are used since this is the primary nuclide on site and is appropriate for the submitted nuclide fractions as per the characterization data. Surface efficiency (ε_s) values were determined by SMUD based on site-specific data and are in agreement with those that are recommended by MARSSIM. Operational check procedures, as currently presented in existing procedures, are required at the beginning and end of each data acquisition period and reflect an industry accepted practice of a ± 20 % acceptance criterion.

However, footnote b in Table 5-12 of the LTP states that Tc-99 was the beta calibration source for the Ludlum 43-68. The instrument efficiency (ε_t) was calculated according to footnote g from the analysis of concrete samples as per DTBD-05-010 to be 0.146. DTBD-05-010 states that the Ludlum 43-68s are calibrated with a Cs-137 NIST traceable source (Section 6.1, first paragraph). Table 1 provides the weighted ε_s and ε_t values (assuming that the ε_i values for Co-60 and Cs-137 are the same). **Note:** ORISE calculated ε_i for Cs-137 was 0.48 and for Co-60 is 0.37. For the instrument comparison in

Room 51, SMUD's ε_t was 0.153 for a reported Cs-137 to Co-60 fraction of 0.87 to 0.13. ORISE's calculated ε_t was 0.22 based on the nuclide fraction which is more in agreement with the Table 1 ε_t for that fraction. The SMUD ε_t is more in agreement with a Cs-137 to Co-60 fraction of 0.20 to 0.80 from Table 1.

Report No. 1 Recommendations: ORISE recommends that the licensee re-check the ε_t values that are being used to determine static surface activity measurements and to provide additional information as to how the ε_t is calculated. It is also recommended that other footnotes (e.g. footnote j; which states the detector sensitivities for gamma detectors are in units of cpm per mR/hr instead of μR/hr) should be checked for accuracy and if those discrepancies were carried through in any other calculations.

Report No. 1 Follow-up: SMUD provided a response to ORISE comments on the structural surface calibration efficiency in an e-mail dated on March 6, 2008.[5] Although SMUD did not indicate if corrections to the footnote in Table 5-12 would be made in future revisions to the LTP, the response indicated that the ε_t being used by SMUD (0.153) is more conservative than the ε_t calculated by ORISE (0.22).

SMUD Response: Corrections to the footnotes noted by ORISE were included in Revision 1 of the LTP.

Table 1 of DTBD 05-010 was used only to illustrate the change in ε_s and ε_t as the nuclide fraction of Co-60 and Cs-137 changed based on the values provided in ISO-7503-1. It does not reflect the ε_s values determined for concrete at Rancho Seco.

Report No. 2 Observations: ORISE reviewed *Operation of Ludlum 2350-1 Datalogger* (DSIP-0510) and *Operation of the ISOCS Portable Gamma Spectroscopy System* (DSIP-0530). These procedures are technically adequate and appropriate as used for the FSS activities. ORISE concurs with the SMUD response. No further observations noted.

Report No. 2 Recommendations: None

4.2.2 Review both the scanning and static measurement MDC determinations.

Report No. 1 Observations: ORISE reviewed the LTP Chapter 5 which gives both the static and scan MDC for instrumentation. Excluding the discrepancy listed above in Section 4.2.1, the static and scan MDCs are acceptable based on the approved DCGLs and were calculated appropriately.

[5] Electronic mail from E. Ronningen (SMUD) to W. Adams (ORISE): RE: Nuclide Fractions and Calibration Efficiency. March 6, 2008.

Report No. 1 Recommendation: As per the issue noted in Section 4.2.1, this item may require further evaluation during future in-process inspections.

SMUD Response: See SMUD response to section 4.2.1. Also, the efficiency results provided in the FSS Handbook provide additional information on static and scan MDC's. A copy of the Handbook was provided to ORISE and NRC representatives.

Report No. 2 Observations: ORISE also reviewed the efficiency results within the FSS handbook (SMUD 2008). The handbook incorporates much material and condenses the overall procedures into a smaller document that is used by the FSS radiological technicians. ORISE concurs with the SMUD response.

Report No. 2 Recommendations: None

4.2.3 Review the procedures for field use of instrumentation and evaluate that any *a priori* factors which may impact use in the field have been accounted for, such as scan speed and background variability.

Report No. 1 Observations: The procedure for surveying building areas was reviewed (DSIP-0110). The procedure indicated the required instrument checks (within calibration dates and operational verification), required scan speed, background determination, alarm actions, detector to surface distance, and various environmental conditions that may affect the instrumentation for which the technician must account for during the survey activities.

The contractor is determining the instrument background on a daily basis, and the instrument backgrounds (beta backgrounds are determined using a beta shield) are being determined in areas that are to be surveyed. Currently, SMUD is not subtracting background from structural surface activity measurements (Refer to Section 4.4.3). DSIP-0110 also states the scan speed for the detectors which are similar to the scan speeds listed in Table 5-12 of the LTP.

Report No. 1 Recommendations: ORISE recommends that the technicians use headphones when performing surface scans as noisy decommissioning conditions may affect the technician's ability to determine if the instrument passed over an area of elevated activity during scans.

SMUD Response: Technicians have been encouraged to wear headphone when in high noise areas and have used sound cancelling headphones. In addition, SMUD performed evaluations of the M2350-1 data logger in latching mode. The results are provided in DTBD 07-001, "Use of Alarm Set Point with the Ludlum Model 2350-1 Data Logger for FSS Surveys". This DTBD examined the alarm response of the Ludlum 44-10, Eberline SPA-3 NaI detectors and the Ludlum Model 43-68 gas flow proportional detector. The testing performed for this DTBD showed that the 44-

10/SPA-3 detectors can be used with an alarm set point of the background count rate plus 3 sigma and the 43-68 detector can be used with an alarm set point based on 50% or 100% of the DCGL, or the EMC equivalent count rate. The type 1 and 2 errors were shown to be acceptable under these conditions. This method provides a means to augment NUREG-1507 where audible signal during the performance of scan surveys are recommended. With a proper alarm setting, if the technician did not hear the signal increase (with or without earphones) the instrument registers an alarm that is visible on the instrument face and requires reset to clear the alarm. The downloaded data provides the instrument alarm information and is part of the hardcopy file reviewed by the technician and the FSS Engineer during and after the instrument download process.

Report No. 2 Observations: ORISE concurs with the SMUD response. However, as stated in Section 4.1.3, ORISE identified three discrete particles on surface soils in two separate survey units within the Tank Farm Area. ORISE performed gamma scans with 100% scan coverage using headphones in these Class 1 survey units.

Report No. 2 Recommendations: ORISE recommends the use of headphones during surface scans. Refer to Section 4.1.3 recommendations.

4.3 Embedded Piping Survey Instrumentation

4.3.1 Review the calibration and performance check procedures. Ensure calibrations will account for any environmental or other factors that could potentially impact performance. Evaluate the appropriateness of the calibration source energies in determining instrument efficiencies, surface efficiency value(s), applied weighting factors relative to the radionuclides of concern and determine appropriateness for meeting release criteria. Review the survey instrumentation operational checkout procedures and acceptance parameters.

Report No. 1 Observations: Specific survey elements that were reviewed by ORISE included detector calibration and operational checkout, detector configuration, and the survey methods. ORISE reviewed the licensee's use of sodium iodide (NaI) - and cesium iodide (CsI)-based gamma detectors to assess residual contamination that remains in pipes; ORISE did not review the use of gas proportional detectors for embedded piping surveys. Various detector sizes were used, dependent upon embedded piping internal diameters which range in size from 0.75 to 18 inches.

Refer to Sections 2.1 and 2.2 for the evaluation of radionuclide profiles for embedded piping and the evaluation of the embedded piping scenario used by SMUD.

SMUD uses large-area, flexible Cs-137 and Co-60 calibration sources which represent the primary gamma-emitting radionuclides of concern within

embedded piping at the RSNGS. The sources are wrapped around the interior of the pipe mock-up when determining embedded piping survey instrumentation calibration efficiencies. The calibration is performed separately for each source. The site uses a pipe of each size and type to conduct the calibration and to take into account the difference in pipe diameter and construction. The efficiencies for embedded piping instrumentation vary according to the diameter of the pipe being surveyed.

Additionally, the background and operational response checkout process was also reviewed. For both processes, an acceptable response range was established during an initial checkout and daily checks performed at the beginning and end of each work day that must be within ± 20% of the average respective response value.

Report No. 1 Recommendations: ORISE will review the gas proportional detector calibrations and procedures and check background and response checkouts during a future survey trip.

SMUD Response: Essentially all the embedded piping has been surveyed using NaI and CsI detectors. The use of gas flow proportional detectors (GFPD) for FSS surveys has been limited to penetrations consisting of concrete and steel. Efficiency values for gas flow proportional detectors are noted in the FSS Handbook provided to ORISE and NRC Representatives. These detectors were calibrated using Cs-137 and Co-60 large area (150 cm^2) sources. Two rubber o-rings surround each GFPD detector providing a fixed stand-off distance for the detector from the source or surface of interest. Efficiency determination for the 0.5 inch diameter GFPD is performed by positioning the detector active area over the large area source and acquiring a five minute count. The detector is rotated 180 degrees and a second five minute count is acquired. The average of the two counts is divided by the ratio of the active source area under the detector area (~19.4/150 cm^2). For the 1.0 and 1.5 inch diameter detectors the active area is positioned over the source and a five minute count is performed. The detector is then rotated 90 degrees and subsequent counts and rotations are performed for the entire (360 degree) active area of the detector. The mean of the four counting locations is used to determine the detector efficiency. As for the 0.5 inch diameter detector the area of the 1.0 and 1.5 inch diameter detectors is used to ratio the source activity from the wide area (150 cm^2) source. Applicable ε_s adjustments are made for metal or concrete conditions. Response checks are performed using a 50 mm diameter Tc-99 source. A source jig is used to insure response reproducibility where the source is positioned at the detector midpoint and the detector is aligned in the same position (matched mark) in the jig. Background measurements are also performed with the detector in the jig (source removed).

Report No. 2 Observations: ORISE did not observe the instrumentation during field use. ORISE has reviewed the procedure and concurs with the SMUD response. No further observations noted.

Report No. 2 Recommendations: None

4.3.2 Review both the scanning and static measurement MDC determinations.

Report No. 1 Observations: ORISE reviewed LTP Chapter 5 which provides appropriate static MDCs for embedded piping instrumentation based on the approved DCGLs. Scan MDCs are not required for embedded piping.

Report No. 1 Recommendations: None

SMUD Response: Scan Rates have been used for penetration surveys with GFPD detectors. GFPD Scan MDC values are provided in the FSS Handbook for metal and concrete.

Report No. 2 Observations: ORISE reviewed the FSS Handbook GFPD scan rates and Scan MDC values for metal and concrete penetrations and concurs with the SMUD response. Penetrations were scanned as part of the structural surfaces of the survey unit containing the walls/floor/ceiling. For embedded piping, only static measurements were performed at 6 inch increments. No further observations noted.

Report No. 2 Recommendations: None

4.3.3 Review the procedures for field use of instrumentation and evaluate that any *a priori* factors which may impact use in the field have been accounted for, such as scan speed and background variability.

Report No. 1 Observations: The procedures for surveying embedded piping with NaI and CsI detectors were reviewed. The procedures indicated the required instrument checks (within calibration dates and operational verification), required scan speed, background determination, alarm actions, and interval for taking static measurements.

Report No. 1 Recommendations: ORISE recommends that the technicians use headphones when performing embedded piping scans as noisy decommissioning conditions may affect the technician's ability to determine if the instrument passed over an area of elevated activity during scans.

SMUD Response: SMUD did not perform piping scans for embedded piping. All measurements were direct (static) measurements performed at six inch (15 cm) intervals resulting in direct measurements for 100% of the piping.

Report No. 2 Observations: ORISE concurs with the SMUD response regarding embedded piping. No further observations noted.

Report No. 2 Recommendations: None

4.4 Final Status Survey Procedures

Review final status survey (FSS) procedures and planning documents for the following:

4.4.1 Review survey plans and procedures, quality assurance plans, and field records. Additionally, review completed survey unit data packages for the use of investigation levels and if the licensee performed appropriate protocols and follow-up actions per RSNGS procedures.

Report No. 1 Observations: ORISE reviewed the FSSP, the quality control procedure, several field records, and applicable technical basis documents and survey implementing procedures (Refer to list of reviewed documents). The FSSP follows the guidance in MARSSIM. The quality control procedures (DSIP-0200) are appropriate for the survey activities being performed. ORISE noted that SMUD performs QC Replicate Surveys for random survey units (repeat scans, fixed-point measurements, and sampling) in an effort to perform an independent check on FSS measurement techniques and instrumentation and to validate the original survey data.

ORISE reviewed FSS Summary Reports for Auxiliary Building Room 18 (Waste Gas Decay Tank Room, Survey Units F8130201 and F8130211). SMUD's documentation for these survey units follows the FSSP and applicable procedures and is appropriate for these areas. Based on the original FSS findings, no further investigations were required. However, during the ORISE confirmatory surveys of SU F813201, a Cs-137 discrete particle was found on the floor. SMUD personnel removed the particle and implemented a corrective action process (Deviation from Quality #07-020). SMUD's conclusion was that the particle migrated from an adjacent area during remediation efforts. SMUD performed additional radiological surveys in the SU that consisted of fixed and loose contamination and stated that the resulting data did not indicate a change in the original FSS results. ORISE notes that the confirmatory fixed direct surface activity measurement of this particle was 110,000 dpm/100 cm^2 which is less than the SU $DCGL_{EMC}$ of 137,600 dpm/100 cm^2 thus meeting the release criteria for the SU. Although SMUD's follow-up actions indicated that the approved guidelines were met, their response does not address the issue of how the discrete particle arrived at this location and SMUD did not provide data to indicate that the Class 2 upper surface penetrations were not the point of entry for the discrete particle due to remediation efforts on the other side of the wall.

ORISE reviewed the FSSP, Section 5.3.6 (Investigation Levels and Elevated Areas Test). The investigation levels closely follow the example in MARSSIM Table 5.8. For Class 1, direct measurement and scan investigation count rates in excess of those corresponding to the $DCGL_{EMC}$ will be investigated by marking the area for a specific investigation survey to include performing additional high density scans and direct measurements (or soil samples if appropriate). The licensee's documentation and

discussions following the confirmatory survey discrete particle discovery in Room 18 provided limited specifics of the follow-up investigations.

Report No. 1 Recommendations: ORISE recommends that SMUD re-evaluate the FSS isolation control procedures and provide more information on the re-investigation of Room 18. Since the contamination was a discrete particle, all possible points-of-entry (wall penetrations, doorways, ventilation penetrations) should be reinvestigated. ORISE will review procedures on FSS Controls (LTP Section 5.2.4) and discuss control issues with site personnel during a future site inspection. ORISE further recommends that SMUD focus on recontamination prevention techniques, i.e., the use of positive pressure in FSS released rooms when nearby remediation activities are being performed and the use of plastic sheeting to prevent the possible spread of contamination through adjacent wall penetrations or openings.

SMUD Response: As stated above, following identification of the discrete particle in Room 18 resulted in the revision of the remediation work package procedure, DSIP-0160 to address the possibility of spreading contamination from areas undergoing remediation to those in which FSS is complete. Immediate actions were taken and documented in email (M. Murdock to E. Ronningen, 4/16/08). DSIP-160 revision was final on 6/24/08. DSIP-160 also references DSIP-050, FSS Controls which addresses methods and controls that may be used to mitigate the introduction of contamination into areas where FSS is in progress or has been completed. The routine Radiation Work Permit procedure (RP.305.08A) was revised to better define how to conduct surveys in areas that have undergone FSS. Specifically including verification of room/penetration barriers and add it to the "FSS Surveillance Form" Revised procedure RP.305.08A was effective 3/26/08. Training of FSS personnel was conducted on 3/25/08. The training stressed contamination controls. Areas that were at risk for recontamination were identified and surveys were performed in these area. The surveys were completed on 4/29/08 and no additional issues of recontamination were found.

Report No. 2 Observations: ORISE has reviewed the revisions to DSIP-0160 and the investigation results for SU F8130541 (May 1, 2008) and concurs with the SMUD response. ORISE, along with the NRC site representatives, participated in several meetings regarding discrete particle findings. These meetings focused on the ORISE findings of discrete particles in Auxiliary Building Room 18, the RHUT Area, the Pump Alley and the Tank Farm. The ORISE findings were addressed adequately and SMUD personnel took proper actions in addressing the findings by making appropriate revisions to the procedures listed above. However, discrete particles in "clean" areas were still an issue (Refer to Section 4.1.3).

Report No. 2 Recommendations: Refer to Section 4.1.3 recommendations.

4.4.2 Perform FSS data package reviews to ensure compliance with RSNGS procedures and commitments made to NRC.

Report No. 1 Observations: Refer to Observations in Section 4.4.1.

Report No. 1 Recommendations: ORISE will continue to review future FSS data packages.

SMUD Response: Refer to SMUD response for Section 4.4.1.

Report No. 2 Observations: ORISE continued to review additional preliminary FSS data packages as they were provided after the completion of FSS activities. ORISE submitted seven confirmatory survey reports which documented ORISE's survey results and comparisons with SMUD's preliminary FSS results (ORISE 2006, 2007b, 2008c and d, 2009a, c and d) ORISE confirmatory survey activities were conducted under an NRC-approved confirmatory survey plan (ORISE 2007c).

Report No. 2 Recommendations: None

4.4.3 Verify the adequacy of reference areas selected by the licensee for assessing background contributions to surface activity levels and radionuclides in soils or other volumetric media.

Report No. 1 Observations: SMUD states in Chapter 2 of the LTP that due to the "...relatively large DCGLs, neither background subtraction nor use of background reference areas are expected to be applied during FSS." It is the licensee's intent, in most cases, to not correct surface activity measurement data for the ambient gamma radiation or construction material-specific components of the background. Currently, the licensee's procedure (DSIP-0110) states that background measurements will be performed in each survey area as per specific Survey Instructions. These background measurements determine the ambient backgrounds for each gamma and beta activity detector that will be used in that survey unit. The background measurement is made in contact with the predominant survey unit construction material with a beta shield mounted on the detector. The resultant count rate could then be subtracted from the final status surface activity measurement results. This would be an acceptable practice for data reduction using the Sign test; however, when the survey data analysis requires the use of the Wilcoxon Rank Sum test, *gross* surface activity measurements should be compared between the survey unit and reference area (i.e. no background subtraction is performed).

Suitable background reference areas identified by the licensee, should they be required, will be located in a non-impacted area of the site. A review of available data to verify the appropriateness of any background reference area locations was not performed and should be evaluated during future inspections should background reference areas become necessary.

For the FSS data packages reviewed to date, the licensee has not subtracted a material-specific or ambient background. This is an acceptable, conservative approach when the Sign test is used.

Report No. 1 Recommendations: ORISE will continue to review future FSS data packages and determine if backgrounds reference areas were required.

SMUD Response: SMUD had not used the Wilcoxon Rank Sum test, only the Sign test has been used for FSS Survey Unit evaluations.

Report No. 2 Observations: ORISE reviewed preliminary FSS data packages for each survey unit where confirmatory surveys were performed. ORISE concurs with the SMUD response. No further observations noted.

Report No. 2 Recommendations: None

4.4.4 Review procedures for establishing survey unit boundaries. Review maps showing preliminary survey unit designations.

Report No. 1 Observations: The contractor has defined the survey unit boundaries based on contamination potential and area classification. The licensee's procedures (DSIP-0101 and LTP) describe the methodology for establishing survey unit boundaries. These procedures appear appropriate as they follow the suggested guidance provided in NUREG-1575 (MARSSIM) and NUREG-1757. For Class 1 structural surfaces, SMUD uses a survey unit size of 319 m^2 which exceeds the MARSSIM suggested size of 100 m^2. DTBD-06-002 provides an appropriate technical basis for the use of a larger survey unit size for Class 1 structures and preserves the sample density for a 100 m^2 area.

Report No. 1 Recommendations: Verification that the total survey unit surface area (including both walls and floors) satisfies the maximum recommended survey unit area will be evaluated by ORISE during subsequent inspections.

SMUD Response: The maximum size used for a class 1 survey unit was 319 m^2 for SU F8260010 which is consistent with the LTP and DTBD 06-002. All other class 1 survey unit sizes have been less.

Report No. 2 Observations: ORISE has reviewed additional survey unit FSS data packages and concurs with the SMUD response. No further observations noted.

Report No. 2 Recommendations: None

4.4.5 Review available radionuclide variability (σ) data that will be used for calculating required sample size. Additionally, determine whether the

analytical methods and instrumentation used for the initial σ calculations are comparable to those that will be used during FSS.

Report No. 1 Observations: Minimal data are available to adequately assess data variability. The licensee uses characterization data to determine the initial sigma (σ) and then calculates the adjusted σ by assuming that the survey units are remediated to the DCGL values (DTBD-06-001). Since the initial characterization data was not available, ORISE could not duplicate the adjusted sigma calculations. However, reviews of the available documents and associated DCGLs indicate that the sigma values being used by SMUD are conservative.

Report No. 1 Recommendations: ORISE will review and discuss characterization data with SMUD personnel concerning the adjusted sigma calculations during a future inspection.

SMUD Response: In many cases the characterization survey data consisted of the entire room or survey unit using, as a general approach, a 1.0 meter grid size. From these measurements room radiological conditions were well identified to classify lower floor and walls from upper walls and ceiling separately (Class 1 and Class 2, respectively). When characterization surveys did not include 100 percent surveys a minimum of thirty measurements were acquired to provide reasonable statistics for SU classification. For these conditions survey locations were judgmentally selected from location identified in the HSA, low spots (in land and asphalt surveys) or other regions having the highest potential for contamination.

Report No. 2 Observations: Instrumentation and analytical methods used during FSS activities were similar to those used during characterization activities; hence, the radionuclide variability (σ) is comparable. ORISE concurs with the SMUD response. No further observations noted.

Report No. 2 Recommendations: None

4.4.6 Review procedures for required scan coverage based on survey unit classification.

Report No. 1 Observations: The required scan coverage specified in the FSSP is consistent with the guidance contained in MARSSIM (refer to Table 2-2 of the MARSSIM and Table 5-6 of the FSSP). The survey area designations are Impacted Class 1, 2 and 3 areas. The licensee will be performing 100% scan coverage of each Class 1 Survey Unit. Class 2 survey units will receive a scan coverage ranging from 10 to 100% with the amount of scan coverage being "... proportional to the potential for finding areas of elevated activity or areas close to the release criterion.". Scan coverage in Class 3 survey units will be performed on a judgmental basis for 1 to 10% of the area. The scan coverage for each classification is appropriate.

Report No. 1 Recommendations: None

SMUD Response: None

Report No. 2 Observations: No further observations noted.

Report No. 2 Recommendations: None

4.4.7 Review methods for determining area factors that will be used for evaluating areas of elevated activity detected during scans.

Report No. 1 Observations: Area factors for soils and structures, calculated using RESRAD and RESRAD-BUILD, are provided in the RSNGS LTP, Chapter 6. The parameters used as inputs for these calculations are appropriate.

Report No. 1 Recommendations: None

SMUD Response: None

Report No. 2 Observations: No further observations noted.

Report No. 2 Recommendations: None

4.4.8 Review proposed investigation levels and adequacy relative to the required and actual scan MDCs.

Report No. 1 Observations: The LTP provides information on investigation levels in Section 5.3.6.2. For investigation levels, the LTP follows the guidance in MARSSIM Table 5-8.

Due to the relatively large DCGLs for structural surfaces, the required and actual scan MDCs are much less than the $DCGL_w$ and $DCGL_{EMC}$ and are appropriate for structural surfaces. **Note:** Refer to Section 4.2.1 for the discussion of the gas proportional total efficiency for structural surfaces.

For soils, SMUD determined the scan MDC using a method described in NUREG-1507 and in MARSSIM; the conversion factor of 0.282 μR/h per pCi/g (footnote j, Table 5-12 of the LTP) was determined using MicroShield™ and the results are presented in DTBD-05-012. The 2" × 2" NaI detector instrument background was determined to be 8,000 to 10,000 counts per minute (cpm) with a typical scan MDC in the range of 5 to 6 pCi/g for a mixture of 95% Cs-137 and 5% Co-60.

Report No. 1 Recommendations: Refer to Recommendation in Section 4.1.1.

SMUD Response: See SMUD response to Section 4.1.1

Report No. 2 Observations: Refer to Section 4.1.1. No further observations noted.

Report No. 2 Recommendations: None

4.4.9 Review selection process for sample locations in survey units.

Report No. 1 Observations: SMUD follows the guidance in MARSSIM for determining sample locations within SUs. Sample location is a function of the classification of the SU, the number of measurements required and the variability of the contaminants within the SU. For Class 1 and Class 2 SUs, SMUD randomly selects a sample start point and then uses the square grid pattern described in MARSSIM. In Class 3 SUs; the sample locations are randomly selected.

Report No. 1 Recommendations: None.

SMUD Response: None

Report No. 2 Observations: No further observations noted.

Report No. 2 Recommendations: None

4.4.10 Review proposed procedures and any associated factors for surveying embedded piping or other difficult to access or inaccessible areas.

Report No. 1 Observations: Refer to Sections 2.2 and 4.3.1 for procedure review.

Report No. 1 Recommendations: None.

SMUD Response: See SMUD response for Section 4.3.1

Report No. 2 Observations: Refer to Section 4.3.1. No further observations noted.

Report No. 2 Recommendations: None

4.4.11 Review sampling and chain-of-custody procedures.

Report No. 1 Observations: This item will be reviewed during a future site inspection.

SMUD Response: The general sampling procedure is DSIP-0310, "Surface Soil, Subsurface Soil and other Bulk Media Sampling and Preparation". DSIP-0110, "Decommissioning Survey Instructions for Structures, Systems and Soils" provides additional guidance. Chain-of-Custody is discussed in the "SMUD Response" to Section 4.1.4.

Report No. 2 Observations: Refer to observations concerning COC in Section 4.1.4.

Report No. 2 Recommendations: Refer to recommendations concerning COC in Section 4.1.4.

5.0 ANALYTICAL PROCEDURES AND COMPARISON ACTIVITIES

5.1 Review the laboratory instrumentation and analytical methods that will be used for sample analysis. Determine appropriateness and sensitivity of the selected equipment for the radionuclides of concern.

Report No. 1 Observations: This item will be reviewed during a future site inspection.

SMUD Response: The results of laboratory instrumentation has been provided to ORISE and NRC representatives throughout the Decommissioning process in the form of NaI, HPGe and alpha and beta smear results using the Tennelec Low Background Alpha and Beta Counter System Series 5 (see Procedure CHM-4116). Other Chemistry procedures relative to analytical methods are: CHM-4117, "Canberra Apex Gamma Spectroscopy System", CHM-4113, "Canberra Gamma Spectroscopy and Computer System", CHM-3203, "Isotopic Analysis Using Gamma Spectroscopy", and CHM-3202, "Gross Alpha/Gross Beta Activity". In addition, procedures DSIP-0530,"Operation of the ISOCS Portable Gamma Spectroscopy System" and DSIP-0 540, "Operation of the Inspector 1000 NaI Spectrometer" provide insight to the field analysis.

Instrument sensitivity is noted in the survey unit Survey Design information and additional information is often provided in the Survey Instructions. Applicable information is also provided in the Final Status Survey Summary Report, Attachment 2,"Instrumentation". In general, analysis of concrete and soil samples for the principle nuclides (Co-60 and Cs-137) is typically below 0.3 pCi/g and soil results < 0.1 pCi/g are considered normal.

Report No. 2 Observations: The radiological instrumentation and analytical methods used on site are sufficient. The on-site laboratory instrumentation, as mentioned above in the SMUD response, was used to support the operational surveys being conducted during remediation and FSS activities. ORISE noted two single HPGe detectors with Nuclear Data multichannel analyzers and shields, a Tennelec Low Background Alpha and Beta Counter, and the ISOCS Portable Gamma Spectroscopy System (when in the field). ORISE also reviewed the procedures specified in the SMUD response.

Report No. 2 Recommendations: None

5.2 Review the licensee's laboratory analytical procedures for radiological analyses. Specifically:

5.2.1 Evaluate the laboratory's sample preparation techniques—geometries used for gamma spectroscopy on soil samples, etc.

Report No. 1 Observations: ORISE has reviewed the sample preparation procedure (DSIP-0310). The procedure is adequate with suggested minor revisions.

Report No. 1 Recommendations: ORISE recommends that the procedure state a minimum drying time for the microwave or conventional ovens and a minimum weight for the soil samples. ORISE also recommends that the procedure state what methods will be used to grind the samples i.e., parallel plate grinder, ball mill, etc.

SMUD Response: Procedure, DSIP-0310, "Surface Soil, Subsurface Soil, and Other Bulk Media Sampling and Preparation" Section 6.8.4 uses the term "dry" sample which is defined is Section 4.1 as: "For the purposes of this instruction the term "dry" is defined as soil that is not visually wet or moist and has a texture that allows the soil to be easily separated." This statement is intended to address drying conditions for many types of soil without prescribing a specific drying time. Microwave ovens were used to dry soil throughout the Decommissioning process. A majority of the soil samples acquired at Rancho Seco consisted primarily of sandy soils with gravel. Some samples did include duripan or clayey soils which required additional processing to reduce residual consolidated material to a finer grain size. In these instances confined impact methods were used to reduce the media to an appropriate sieve size. No parallel plate grinders, ball mills or similar devices were used.

Report No. 2 Observations: ORISE concurs with the SMUD response. On March 11, 2009, ORISE observed a senior Radiological Protection Technician (RPT) prepare collected soil samples for analyses. The samples contained moisture and were dried in a microwave oven. The sample preparation lab had recently been relocated to an indoor dock within a warehouse building. This was apparently the first use of the new setup as witnessed when both of the dual microwaves overloaded the electrical circuit when turned on. Apparently, the new sample preparation lab set up used multiple extension cords piggy-backed onto other extension cords which led to the electrical system being overloaded; hence, blowing of the fuse in one of the microwaves. This safety issue was reported to SMUD personnel. Due to sample size, the sample was split into two parts with each part being dried separately and then rejoined after drying. ORISE observed sample dust in the air and no mechanism (such as a hood or vacuum) being used to keep the dust levels down when transferring "dry" samples to Marinelli containers.

Report No. 2 Recommendations: ORISE recommends that potentially contaminated samples be transferred under controlled conditions such as a hood and that potential airborne radioactive dusts be controlled and

appropriate personal protective equipment (PPE) for work conditions be used.

5.2.2 Review the protocol the laboratory uses to interpret the gamma spectroscopy results, particularly the radionuclide total absorption peaks used to identify various contaminants.

Report No. 1 Observations: This item will be reviewed during a future site inspection.

SMUD Response: All on site gamma spectroscopy units utilized the Canberra Genie 2000 acquisition software. Spectrum results were reviewed by trained Chemistry technicians and all peaks were identified including peaks not identified by the peak search algorithm (The radionuclide library was specific to the site-specific nuclide suite identified in DTBD 04-001). The spectrum results were forwarded to the responsible FSS who reviewed the results a second time. Specific Chemistry procedures are noted in Section 5.1.

Report No. 2 Observations: Section 7.3 on the Manual Calculation of Nuclides in the *Isotopic Analysis Using Gamma Spectroscopy* procedure (CHM-3203), discusses the use of manual calculations for gamma spectroscopy. It is ORISE's understanding that SMUD gamma spectroscopy systems are such that manual calculations should not be required. Also, Attachment 3 indicates several examples of radionuclides that may interfere with each other. Unless the software package used to discriminate photopeaks is very old, the software available today should be capable of performing interference correction calculations.

Report No. 2 Recommendations: ORISE recommends that SMUD provide an explanation as to the need for hand calculating radionuclide concentrations when their gamma spectroscopy software should be adequate.

5.2.3 Review the laboratory QA/QC procedures, including duplicates, blanks, and matrix spikes. Determine the frequency of analysis for each of the QC checks.

Report No. 1 Observations: This item will be reviewed during a future site inspection.

SMUD Response: Based on sample design a minimum of one smear sample (5.0%) is randomly selected and submitted as a QC sample for recount. In addition one or more soil samples (5.0%) for each applicable survey unit is randomly selected and submitted as a Blind Duplicate Split Sample. The samples are reviewed in accordance with DSIP-0200, "Decommissioning Survey Quality Control" and any disparities addressed. Five percent of all survey units (16) were resurveyed (randomly selected) and

the results when compared to the original survey result in the same conclusion as the original survey.

The Rancho Seco analysis laboratory is a DHS-ELAP certified laboratory. The QA/QC procedure is CAP-0003, "Chemistry Quality Control Program".

Report No. 2 Observations: ORISE has reviewed DSIP-0200 and CAP-0003 and concurs with the SMUD response. Refer to Section 7.1 for additional observations regarding QC procedures.

Report No. 2 Recommendations: None

5.3 Obtain at least ten RSNGS FSS soil samples and several samples of media such as building debris and water for analytical comparison with RSNGS's laboratory results. Evaluate analytical data for agreement within the expected statistical deviation of the procedure.

Report No. 1 Observations: ORISE reviewed RSNGS characterization soil sample data and selected seven soil samples, collected and analyzed by SMUD, for interlaboratory comparison analyses. These samples were shipped by SMUD personnel and received by ORISE laboratory personnel on July 10, 2006. Radioassays were performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2009b). Soil samples were analyzed by gamma spectroscopy for the primary radionuclides-of-concern [ROC (i.e., Co-60 and Cs-137)]. However, spectra were also reviewed for additional gamma-emitting fission and activation products associated with the RSNGS and other identifiable total absorption peaks. Soil sample results were reported in units of picocuries per gram (pCi/g). The interlaboratory comparison results provided in Table 1 indicated that, with the exception of Sample 1695S0001, the quality of the SMUD laboratory data were consistent and in agreement with ORISE's analytical results. Although more conservative than ORISE's reported value, SMUD's reported Cs-137 concentration was approximately twice the ORISE reported concentration for Cs-137.

Report No. 1 Recommendations: ORISE will collect additional soil samples and other media samples for further interlaboratory evaluations during future site inspections.

SMUD Response: SMUD is maintaining samples collected for Submittal 5 (the last submittal) Survey Units in the event the NRC or ORISE wish to examine any of these samples. ORISE has stated that they are returning the samples listed in Table 1 of this report. When these samples arrive SMUD will recount sample 1695S0001. Samples collected in the area where 1695S0001 was collected have contained chips of concrete with elevated activity on the concrete chips. It is possible that when ORISE prepared the sample from the original larger sample that a particulate chip of elevated activity may not have been included in the sample that they analyzed.

Report No. 2 Observations: SMUD evaluated the discrepancy in the interlaboratory comparison analyses for sample 1695S0001 (See Table 1). In an email dated July 6, 2006[6], SMUD stated that "Because sample 7 (Tank Farm XB8100030DS01A) comprised only 640 grams approximately 214 grams of diatomaceous earth was blended into the sample in order to provide a full Marinelli and meet the geometry requirements we utilize for analysis of soil samples. To do this we first counted a full Marinelli of diatomaceous earth and after assuring that the samples contained no significant radiological contaminants we then transferred and blended a sufficient amount of the media (214 g) to fill the Tank Farm sample within an inch from the top. Examination of the added material final results showed good correlation to the original sample results." ORISE's initial review overlooked the final analysis of the sample (which was 44.0 pCi/g and in agreement with ORISE's 46.6 pCi/g result); therefore, ORISE incorrectly reported the initial value. ORISE concurs with the SMUD response for Sample 1695S0001.

ORISE reviewed additional RSNGS FSS soil sample data and selected ten FSS soil samples from the Industrial Area, collected and analyzed by SMUD, for interlaboratory comparison analyses. These samples were provided to ORISE personnel and shipped to the ORISE laboratory on March 12, 2009. Radioassays were performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2009b). Soil samples were analyzed by gamma spectroscopy for the primary radionuclides-of-concern [ROC (i.e., Co-60 and Cs-137)]. However, spectra were also reviewed for additional gamma-emitting fission and activation products associated with the RSNGS and other identifiable total absorption peaks. Soil sample results were reported in units of picocuries per gram (pCi/g). The interlaboratory comparison results provided in Table 2 indicated that the quality of the SMUD laboratory data were consistent and in agreement with ORISE's analytical results.

Report No. 2 Recommendations: None

6.0 IN-PROCESS AUDIT OF RADIOLOGICAL SURVEY TECHNICIANS

Review the licensee's radiological survey technician's implementation of the FSS. Specifically:

6.1 Review training records of personnel who will operate survey instrumentation; evaluate new personnel training and instrumentation skills.

Report No. 1 Observations: This item will be reviewed during a future site inspection.

SMUD Response: SMUD maintains training files on all their technicians. Technicians performing MARSSIM surveys receive specialized training that is maintained in a training spreadsheet that is available for FSS engineers and the Technician Coordinator to review in order to insure the personnel are qualified to

[6] E-mail from B. Decker (SMUD) to W. Adams (ORISE), RE: Soil Samples for comparative analysis by HPGE; July 6, 2006.

perform the MARSSIM tasks required for Final Status Surveys. Copies of training records are also maintained in the DEG office.

Report No. 2 Observations: ORISE did not review training records. ORISE did review procedures that were revised based on ORISE observations. The revisions to the procedures were supplemented with additional training for the FSS personnel subject to those procedures.

6.2 Evaluate technician understanding of the concepts of the LTP and FSS plans and associated documents and procedures.

Report No. 1 Observations: On October 18, 2007, ORISE and NRC personnel collected a soil sample from an area adjacent to the Mixing Box. The soil consisted of compacted clay. The NRC questioned the SMUD Health Physics Technician (HPT) concerning the procedures for handling clay soil samples. The HPT stated that if the clay soil sample would not fit through the mesh screen that he would not collect the clay sample but would collect a loose soil sample from an adjacent location. This was noted as a discrepancy from the soil sample procedure and was addressed with SMUD staff during the closeout meeting.

Report No. 1 Recommendations: ORISE will continue to evaluate technicians understanding of procedures during future site inspections.

SMUD Response: SMUD responded to the above findings by completing a PDQ and following up that PDQ with a review of suspect areas that could contain clayey soils. In addition, additional instructions were provided for collection of soils where clay may be present. Training was provided to the FSS Engineers and Technicians regarding the collection of samples where duripan or caleche may exist. The soil sampling procedure was also revised to address conditions for clayey soils.

Report No. 2 Observations: ORISE reviewed the revised soil sampling procedure and concurs with the SMUD response. Also, based on the discrete particle finding in Auxiliary Building Room 18, revisions were made to the several procedures as documented in SMUD's response in Section 4.4.1 (DSIP-0160, DSIP-0150, and RP.305.08A). SMUD provided additional training to FSS personnel stressing contamination control (specifically re-contamination control).

Report No. 2 Recommendations: None

6.3 Review technician performance of surface scans using the audible output—in particular, that the radiological survey technician passing the detector over the surface being measured is the individual listening to the audible output.

Report No. 1 Observations: Section 6.10 of DSIP-0110 states that structural surface scans are to be performed "...with the instrument response set to Fastfixed (1 second) ... with the speaker activated, and detector(s) specified in the Survey Instructions. The technician shall be observant of any audible or visual increase in count rate." ORISE observed upper wall FSS activities within the Auxiliary Building. Two technicians worked as a team in performing 1 m^2 surface scans of upper wall

surfaces. While one technician used the Ludlum 43-68 gas proportional detector to scan, the other technician observed the count rate and audible output on the external speaker of the Ludlum 2350 instrument.

Report No. 1 Recommendations: ORISE recommends the use of headphones at all times when performing surface scans as noisy conditions (remediation activities in adjacent areas) may affect the technician's ability to audibly interpret increases in surface activity. This may be more important when performing soil scans due to increased difficulties in determining if surface soil scans meet the soil DCGLs.

SMUD Response: See SMUD Response for Section 4.2.3.

Report No. 2 Observations: During the ORISE confirmatory surveys in March 2009, ORISE determined that discrete particles remained on the soil surface at three locations within the Tank Farm Area. The issues of using headphones and the discrete particle findings are addressed in Sections 4.1.3 and 4.2.3.

Report No. 2 Recommendations: Refer to Section 4.1.3 Recommendations.

6.4 Performance observations: Conduct side-by-side measurements and/or sampling with radiological survey technicians.

Report No. 1 Observations: ORISE performed survey instrument surface activity data comparisons at eight locations within Auxiliary Building Room 51; the results indicated that SMUD's radiological survey activity data were generally higher than ORISE's surface activity levels measured at the same locations. ORISE used a multi-point and weighted average calibration total efficiency (ε_t) based on the reported nuclide ratios. SMUD used an empirically derived ε_t based on the nuclide fractions in actual concrete samples. SMUD's reported ε_t is conservative compared to ORISE's calculated ε_t and is appropriate for surface activity measurements.

For the instrument comparison, the ORISE surface activity level data set ranged from 2,200 to 190,000 dpm/100 cm^2 and the SMUD surface activity level data set ranged from 3,000 to 260,000 dpm/100 cm^2. The surface activity data comparison results are presented in Table 3.

Report No. 1 Recommendations: Refer to Observations and Recommendations in Section 4.2.1.

SMUD Response: See SMUD Response for Section 4.2.1.

Report No. 2 Observations: A comparison of ORISE and SMUD gamma scan results for the Acid Waste System Drain Line indicated elevated gamma radiation levels at approximately the same length/depth and levels as reported by SMUD in the preliminary FSS data packages (ORISE 2008c and ORISE 2008d). The confirmatory results agreed with the SMUD FSS results for embedded piping.

Report No. 2 Recommendations: None

7.0 QA/QC AND DATA MANAGEMENT PROCEDURES

7.1 Review the licensee's QA/QC procedures as they relate to FSS personnel training requirements and FSS data acceptance criteria.

Report No. 1 Observations: This item will be reviewed during a future site inspection.

SMUD Response: The QA/QC Concerns fall under the existing QA/QC program. Specific quality controls relating to FSS data acceptance and confirmation are provided in DSIP-200 and Chapter 5.0 of the LTP.

Report No. 2 Observations: DSIP-0200 states that a minimum of 5% of the survey units receive QC replicate surveys and that "The purpose of the QC Replicate Survey is to verify the validity of the original survey data and the conclusions of the original Final Status Survey." The QC Replicate Survey Units are "...randomly selected from the known population of survey units." ORISE reviewed several QC Replicate Survey data packages and the results and conclusions were in agreement with the original FSS data packages.

A review of Chapter 5 of the LTP indicates that SMUD's QA/QC procedures are appropriate and entail many in depth checks and balances to ensure QC oversight (Refer to SMUD response in Sections 5.2.3 and 7.2). Reviews of several preliminary FSS data packages indicated that procedures are followed as presented. No further observations noted.

Report No. 2 Recommendations: None

7.2 Review the licensee's data management system that will be used to track field and analytical results.

Report No. 1 Observations: This item will be reviewed during a future site inspection.

SMUD Response: The data management system used to track field and analytical results is multifaceted. Survey instrumentation results are downloaded daily, reviewed and hardcopy files created for review. Following data acceptance, the data are transferred to the database which is backed up daily. Gamma spectroscopy and Tennelec results are also included on the System server and are backed up daily.

The download for instrumentation process has been demonstrated to NRC and ORISE representatives as has the Data Quality Assessment (DQA) database. The DQA for structures and land are separate applications based on Excel spreadsheet design and the features were demonstrated (along with the validation and verification of the applications) to both the NRC and ORISE representatives. Copies of the applications were provided to both parties. Once a survey unit is completed and the survey data reviewed and accepted by the FSS Engineer, the instrument data are uploaded (by the engineer) for entry into the DQA by the Database Manager. The FSS Engineer provides the Database Manager the information required to transfer

applicable HPGE, NaI and Tennelec results to the DQA for the specific survey unit. Once transferred, the FSS Engineer completed the DQA information and the application automatically. The Evaluation Summary is illustrated below (in Figure 1.0 DQA Example). The tabs on the application spreadsheet depict additional information and regions of the spreadsheet used for review and containing data. Once complete and accepted the information is saved. The FSS Engineer may then (using the Report Builder application) transfer the finalized Survey Unit data to the FSS Summary Report that will later be provided to the NRC. Prior to submittal, the information is reviewed by the FSS Engineer, the Lead FSS Engineer and the Dismantlement Superintendent, Radiological.

The Database information, FSS results, DQA evaluation, maps and other data relative to each survey unit is maintained on the survey and access to the data is limited and controlled. Hardcopy files are also maintained and access is limited. The hard copy files may also contain additional survey information for the Survey Unit that was not required for the FSS Report.

Report No. 2 Observations: As stated above, SMUD personnel demonstrated the instrumentation and DQA database (See Figure 1) to ORISE and NRC representatives. As per the LTP, Chapter 5, SMUD instituted a rigorous validation process and the system has appropriate administrative controls for maintaining data integrity. There were many check points for reviewing the data along the path to becoming completed FSS data; the check points consisted of technical reviews, graphical interpretations and statistical analyses. ORISE concurs with the SMUD response.

Report No. 2 Recommendations: None

Figure 1.0 DQA Example

Evaluation Input Values		Comments
Survey Area:	F813	The Walls and Ceiling of the Ventilation Room 211 and the Duct Room 208
Survey Unit:	1372	Structure Surface
Class:	2	LTP Table 5-4
SU Area (m²):	811	
Evaluator:	Michael Stein	
DCGL (dpm/100cm²):	43000	Gross Activity DCGL
Area Factor:	N/A	Class 2
Design DCGLemc (dpm/100cm²):	N/A	Class 2
LBGR (dpm/100cm²):	21500	Default = 50% DCGL
Design Sigma (dpm/100cm²):	5461	DTBD-06-001, Table 5-C
Type I error:	0.05	
Type II error:	0.05	
Predominant Nuclide:	Cs-137	
Material Type:	N/A	Background Subtract Not Applied
Sample Area (m²):	57.9	Class 2
Total Area Scanned (m²):	215.0	
Scan Coverage (%):	27%	Class 2
Calculated Values		**Comments**
$Z_{1-\alpha}$:	1.645	
$Z_{1-\beta}$:	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	3.9	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift is >3
N-Value:	11	
N-Value+20%:	14	NUREG-1575 Table 5-5
Design Min Number Samples N:	14	Class 2
Grid Spacing L (m):	7.6	Class 2
Background Values		**Check to use background values.**
Material (dpm/100cm²):	N/A	☐ Use Material BKG
Ambient (dpm/100cm²):	0	☐ Use Ambient BKG
Survey Data Results Net of Background		**Comments**
Actual Direct Measurements N:	14	
Median (dpm/100cm²):	1,637	
Mean (dpm/100cm²):	1,603	
Direct Msmts St. Dev. (dpm/100cm²):	184	
Total Standard Deviation (dpm/100cm²):	184	Based on samples and backgrounds.
Maximum (dpm/100cm²):	1,852	
Sign Test Results		**Comments**
Final N Value:	14	
S+ Value:	14	
Critical Value:	10	
Criteria Satisfaction		**Comments**
Sufficient samples collected:	Yes	
Maximum value <DCGL:	Yes	
Median value <DCGL:	Yes	
Mean value <DCGL:	Yes	
Maximum value <DCGLemc:	N/A	Class 2
Total Standard Deviation <=Sigma:	Yes	
Pass the Sign Test?	Yes	
Reject the Null Hypothesis?	Yes	
Final Status		**Comments**
The survey unit passes all conditions:	Yes	

Append Data from New Worksheets

8.0 ADDITIONAL NRC/FSME REQUESTS

Independently review specific reports, documents and/or procedures as requested by NRC/FSME Project Manager.

Report No. 1 Observations: ORISE noted during the reviews that the titles for procedures and/or technical basis documents did not always agree with how they were listed in other documents. For example, in DSIP-0200, page 2, Reference 3.13, DSIP-0101 is titled "Final Survey Design" while the actual DSIP-0101 is titled "Final Status Survey Package Design and Preparation." In other instances, the reference bared no resemblance to the actual title of the document.

Report No. 1 Recommendations: ORISE recommends that a quality review be performed to check reference titles of documents.

SMUD Response: A review of all DSIP procedures was performed and the following anomalies were noted:

DSIP-0020, "Characterization Survey Assessment" references DSIP-300 which was retired and the pertinent information from DSIP-300 was incorporated into DSIP-0110, "Decommissioning Survey Instructions for Structures, Systems and Soils" and DSIP-310, "Surface Soils, Subsurface Soils, And Other Bulk Media Sampling and Preparation". DSIP-0020 should instead reference DSIP-0110 and DSIP-310.

DSIP-0100, "Characterization Survey Design" references DSIP-0110 "Survey Performance". DSIP-0110 was revised and its title was changed to, "Decommissioning Survey Instructions for Structures, Systems and Soil". The reference in DSIP-0100 should be changed to reflect the correct title.

DSIP-0101, "Final Status Survey Package Design and Preparation" references DSIP-0120, "Final Status Survey Analysis". DSIP-0120 was revised and the title was changed to, "FSS Data Processing and Reporting". The reference in DSIP-0101 should be changed to reflect the correct title.

DSIP-0200, Decommissioning Survey Quality Controls" references DSIP-0101 as stated in "Observations" above. The reference should be changed to reflect the correct Title for DSIP-0101, "Final Status Survey Package Design and Preparation". The last reference (3.14) references DSIP-300 which as previously stated was retired and incorporated into DSIP-0110 and DSIP-0310. DSIP-0200 should reference these latter two procedures and the reference to DSIP-300 deleted.

Report No. 2 Observations: ORISE concurs with the SMUD response. No further observations noted.

Report No. 2 Recommendations: None

TABLE 1: RADIONUCLIDE CONCENTRATIONS INTERLABORATORY COMPARISON SOIL SAMPLES RANCHO SECO NUCLEAR GENERATING STATION HERALD, CALIFORNIA						
Sample Identification		Radionuclide	Radionuclide Concentration (pCi/g)			
ORISE	SMUD		ORISE			SMUD[a]
1695S0001	XB8100030DS01A	Mn-54	-0.15	±	0.15[b]	--[c]
		Co-60	1.45	±	0.14	2.52
		Cs-134	0.05	±	0.07	--
		Cs-137	46.6	±	1.6	86.4/44.0[d]
		Eu-152	0.03	±	0.20	--
		Eu-154	0.06	±	0.16	--
1695S0002	SA8100000DS01A	Mn-54	1.2	±	2.5	--
		Co-60	2.86	±	0.16	3.19
		Cs-134	0.13	±	0.08	--
		Cs-137	113.1	±	3.7	122
		Eu-152	0.15	±	0.24	--
		Eu-154	0.08	±	0.16	--
1695S0003	SA837001DS01	Mn-54	-0.02	±	0.05	--
		Co-60	2.75	±	0.12	2.83
		Cs-134	0.01	±	0.02	--
		Cs-137	24.30	±	0.76	20.4
		Eu-152	0.04	±	0.09	--
		Eu-154	0.04	±	0.08	--
1695S0004	SB837001DS12	Mn-54	0.13	±	0.16	--
		Co-60	0.06	±	0.07	0.06
		Cs-134	0.12	±	0.09	--
		Cs-137	48.1	±	1.6	33.5
		Eu-152	-0.15	±	0.18	--
		Eu-154	-0.03	±	0.12	--
1695S0005	CC8430020S001SS	Mn-54	0.00	±	0.01	--
		Co-60	0.37	±	0.05	0.34
		Cs-134	0.01	±	0.02	--
		Cs-137	4.46	±	0.18	4.11
		Eu-152	0.02	±	0.06	--
		Eu-154	-0.03	±	0.09	--

TABLE 1 (continued): RADIONUCLIDE CONCENTRATIONS INTERLABORATORY COMPARISON SOIL SAMPLES RANCHO SECO NUCLEAR GENERATING STATION HERALD, CALIFORNIA						
Sample Identification		Radionuclide	Radionuclide Concentration (pCi/g)			
ORISE	SMUD		ORISE			SMUD[a]
1695S0006	CC8430020S005SS	Mn-54	-0.11	±	0.19	--
		Co-60	0.04	±	0.03	0.06
		Cs-134	0.04	±	0.03	--
		Cs-137	1.95	±	0.10	2.03
		Eu-152	0.00	±	0.06	--
		Eu-154	0.02	±	0.09	--
1695S0007	8100010SFPCP	Mn-54	0.05	±	0.07	--
		Co-60	0.07	±	0.02	0.05
		Cs-134	0.02	±	0.03	--
		Cs-137	2.09	±	0.09	1.6
		Eu-152	0.01	±	0.03	--
		Eu-154	-0.03	±	0.05	--

[a]Co-60 and Cs-137 concentrations provided by SMUD personnel.
[b]Uncertainties represent the 95% confidence level based on total propagated uncertainties.
[c]Radionuclide concentrations were not provided.
[d]ORISE incorrectly reported the initial SMUD results and not the final SMUD result. An explanation of the corrected result is provided in Section 5.3 of this report.

TABLE 2: RADIONUCLIDE CONCENTRATIONS INTERLABORATORY COMPARISON SOIL SAMPLES RANCHO SECO NUCLEAR GENERATING STATION HERALD, CALIFORNIA						
Sample Identification		Radionuclide	Radionuclide Concentration (pCi/g)			
ORISE	SMUD		ORISE			SMUD[a]
1695S0027	F8100012S0202SS	Mn-54	-0.01	±	0.04[b]	--[c]
		Co-60	0.01	±	0.05	<0.05
		Cs-134	0.00	±	0.05	--
		Cs-137	0.01	±	0.04	<0.06
		Eu-152	-0.38	±	0.13	--
		Eu-154	-0.13	±	0.15	--
1695S0028	F8100012S0081SS	Mn-54	-0.01	±	0.03	--
		Co-60	0.00	±	0.03	<0.13
		Cs-134	0.02	±	0.03	--
		Cs-137	0.75	±	0.07	1.08
		Eu-152	-0.01	±	0.05	--
		Eu-154	-0.01	±	0.08	--
1695S0029	F8100022S0091SS	Mn-54	0.01	±	0.01	--
		Co-60	-0.01	±	0.03	<0.07
		Cs-134	0.02	±	0.03	--
		Cs-137	0.59	±	0.07	0.71
		Eu-152	0.02	±	0.05	--
		Eu-154	-0.12	±	0.13	--
1695S0030	F8100022S0141SS	Mn-54	0.00	±	0.03	--
		Co-60	0.43	±	0.05	0.37
		Cs-134	0.02	±	0.04	--
		Cs-137	39.4	±	3.8	36.20
		Eu-152	-0.35	±	0.26	--
		Eu-154	-0.18	±	0.12	--
1695S0031	F8100031S0002SS	Mn-54	-0.01	±	0.03	--
		Co-60	0.04	±	0.02	<0.08
		Cs-134	-0.01	±	0.04	--
		Cs-137	1.05	±	0.09	1.11
		Eu-152	0.03	±	0.08	--
		Eu-154	-0.17	±	0.12	--

TABLE 2 (Continued): RADIONUCLIDE CONCENTRATIONS INTERLABORATORY COMPARISON SOIL SAMPLES RANCHO SECO NUCLEAR GENERATING STATION HERALD, CALIFORNIA							
Sample Identification		Radionuclide	Radionuclide Concentration (pCi/g)				
ORISE	SMUD		ORISE				SMUD[a]
1695S0032	F8100031S0006SS	Mn-54	0.02	±	0.03		--
		Co-60	0.00	±	0.00		<0.06
		Cs-134	-0.02	±	0.04		--
		Cs-137	1.49	±	0.14		1.74
		Eu-152	-0.24	±	0.11		--
		Eu-154	-0.09	±	0.13		--
1695S0033	F8100032S0071SS	Mn-54	-0.03	±	0.04		--
		Co-60	0.04	±	0.03		<0.06
		Cs-134	0.00	±	0.04		--
		Cs-137	0.05	±	0.02		0.06
		Eu-152	0.01	±	0.07		--
		Eu-154	-0.12	±	0.13		--
1695S0034	F8100053S0008SS	Mn-54	-0.02	±	0.03		--
		Co-60	0.05	±	0.04		<0.04
		Cs-134	0.00	±	0.04		--
		Cs-137	0.08	±	0.02		0.07
		Eu-152	-0.17	±	0.09		--
		Eu-154	-0.07	±	0.12		--
1695S0035	F8100011SS0001SS	Mn-54	-0.01	±	0.03		--
		Co-60	0.04	±	0.01		<0.01
		Cs-134	0.01	±	0.03		--
		Cs-137	1.21	±	0.12		1.67
		Eu-152	-0.04	±	0.07		--
		Eu-154	-0.09	±	0.10		--
1695S0036	F8100011S0005SS	Mn-54	0.01	±	0.03		--
		Co-60	0.18	±	0.03		0.15
		Cs-134	0.05	±	0.03		--
		Cs-137	1.55	±	0.15		1.52
		Eu-152	-0.01	±	0.06		--
		Eu-154	-0.18	±	0.16		--

[a]Co-60 and Cs-137 concentrations provided by SMUD personnel.
[b]Uncertainties represent the 95% confidence level based on total propagated uncertainties.
[c]Radionuclide concentrations were not provided.

TABLE 3: SURFACE ACTIVITY INSTRUMENT COMPARISON AUXILIARY BUILDING ROOM 51 RANCHO SECO NUCLEAR GENERATING STATION HERALD, CALIFORNIA			
Location[a]		Total Beta Activity (dpm/100 cm^2)	
ORISE	SMUD	ORISE	SMUD[b]
1	51-1	4,000	4,500
2	51-2	7,300	8,400
3	51-3	11,000	13,000
4	51-4	2,200	3,000
5	51-5	19,000	23,000
6	51-6	12,000	17,000
7	51-7	190,000	260,000
8	51-8	82,000	100,000

[a]These elevated beta activity measurement locations were determined by SMUD personnel during remediation survey activities for the purpose of performing direct instrument surface activity measurement comparisons.
[b]SMUD Total Beta Activity results were provided by SMUD. ORISE and SMUD Total Beta Activity results were rounded to two significant digits.