ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

April 25, 2008

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
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SUBJECT: **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)**

Dear Mr. Hickman:

Enclosed is the subject report for the initial in-process inspection of decommissioning activities underway at the Rancho Seco Nuclear Generating Station (RSNGS) in Herald, California. During site visits, which were conducted during the periods of June 7 and 8, 2006, October 15 through 18, 2007 and December 10 through 14, 2007, Oak Ridge Institute for Science and Education (ORISE) personnel toured the Reactor, Turbine and Auxiliary Buildings and the open land areas (to include the off-site "No Name" Creek. In addition, ORISE staff observed RSNGS personnel performing decommissioning survey activities on embedded piping and on Auxiliary Building structural surfaces. ORISE personnel also reviewed several decommissioning related documents and discussed procedure implementation with site personnel. The inspection was conducted in accordance with ORISE confirmatory and inspection plans provided to the U.S. Nuclear Regulatory Commission (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
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WCA:ar

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REPORT NO. 1
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 2007b and ORAU 2007). This report describes the inspection activities performed on site during the periods of June 7 and 8, 2006, October 15 through 18, 2007 and December 10 through 14, 2007 specifically pertaining to 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 interlaboratory comparison analyses with SMUD in order to corroborate the 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 include the License Termination Plan (LTP), several Decommissioning Technical Basis Documents (DTBD), and several Decommissioning Survey Implementation Procedures (DSIP). In addition, ORISE reviewed the contractor'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:

- NUREG-1575: Multi-Agency Radiation Survey and Site Investigation Manual [MARSSIM]
- NUREG-1507: Minimal Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions
- NUREG-1505: A Proposed Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys
- NUREG-1727: NMSS Decommissioning Standard Review Plan
- SMUD – Rancho Seco Nuclear Generating Station License Termination Plan (LTP) (2006)
- SMUD – Rancho Seco Nuclear Generating Station Historical Site Assessment (HSA) (2004)
- SMUD – Decommissioning Technical Basis Documents (DTBD) for RSNGS
    - Initial Classification of Survey Areas and Survey Design Sigma Values [DTBD-06-001, Rev. 3]
    - Structure Nuclide Fraction and DCGLs [DTBD-05-015, Rev. 0]
    - Embedded Piping Scenario and DCGL Determination Basis [DTBD-05-009, Rev. 1
    - Beta Detection During RSNGS Characterization or FSS [DTBD-05-010, Rev. 1]
    - Use of a Survey Unit Size of 319 m^2 for Class One Structure Surveys [DTBD-06-002, Rev. 0]

- Eberline SPA-3 and Ludlum 44-10 Detector Sensitivity (MDC) [DTBD-05-012, Rev. 0]
  - RSNGS Surface Soil Nuclide Fractions and DCGL [DTBD-05-014]
  - Buried Piping Scenario and DCGL Determination Basis [DTBD-05-013
- SMUD – Decommissioning Survey Implementing Procedures (DSIP) for RSNGS
  - Final Status Survey Package Design and Preparation [DSIP-0101, Rev. 3]
  - Decommissioning Survey Instruction for Structures, Systems and Soils [DSIP-0110]
  - FSS Data Processing and Reporting [DSIP-0120, Rev. 2]
  - FSS Controls [DSIP-0050, Rev. 0]
  - Operation of the Ludlum 2350-1 Datalogger [DSIP-0510, Rev. 6]
  - Surface Soil, Subsurface Soil, and Other Bulk Media Sampling and Preparation [DSIP-0310, Rev. 1]
  - Decommissioning Survey Quality Control [DSIP-0200, Rev. 2]
  - Department Training and Qualification [DSIP-0060, Rev. 1]
- 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
- 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.
  - Survey Procedures Manual for the Independent Environmental Assessment and Verification Program. Oak Ridge, Tennessee; August 3, 2007b.
  - Laboratory Procedures Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, Tennessee; June 15, 2007c.
  - 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, 2007d.
  - 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, 2008.
- ORAU
  - Quality Program Manual for the Independent Environmental Assessment and Verification Program. Oak Ridge, Tennessee; March 1, 2007.
- 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.

Observations: ORISE staff toured plant areas and observed in-process decommissioning work. Areas toured by ORISE staff 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 are Class 1 and 2 and the exterior is 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 2008). Several other areas were noted as either storing, or prepared to store, radioactive material or waste containers.

ORISE staff will continue to review SMUD's schedules for ongoing work activities to include further decontamination and future FSS activities. SMUD updates the work schedules weekly.

Recommendations: None.

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

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. 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 liquid radioactive 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.

Recommendations: ORISE will review other pertinent documents, such as those documents listed in the LTP Chapter 2, during a future site inspection.

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.

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 the significantly 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. However, 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.

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.

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 is adequately developing DCGLs based on appropriate radionuclide mixtures.

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 variabilities (σ)—specifically modification of σ—will be integrated in DCGL implementation.

Observations: The current FSSP 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.

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.

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.

Observations: The current FSSP (Chapter 5, LTP) 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.

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.

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.

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.

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.

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.

Follow-up: SMUD provided a response to the ORISE comment concerning the conversion factor in an e-mail dated on March 11, 2008.[1] 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.

4.1.2 Review the equipment set up and performance check procedures.

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.

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.

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

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.

Observations: ORISE has not performed a thorough review of soil sampling procedures.

Recommendations: ORISE will review appropriate soil sampling and scanning procedures during a future site survey and update this section after the review.

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.

Observations: ORISE has not reviewed the chain-of-custody, gamma spectroscopy, or sum-of-fractions verification calculations.

Recommendations: ORISE will review appropriate procedures during a future site survey and update this section after the review.

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.

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_i) 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 is more in agreement with a Cs-137 to Co-60 fraction of 0.20 to 0.80 from Table 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.

Follow-up: SMUD provided a response to ORISE comments on the structural surface calibration efficiency in an e-mail dated on March 6, 2008.[2] 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).

4.2.2 Review both the scanning and static measurement MDC determinations.

Observations: 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.

Recommendation: As per the issue noted in Section 4.2.1, this item may require further evaluation during future in-process inspections.

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.

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.

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

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.

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.

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.

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.

Recommendations: ORISE will review the gas proportional detector calibrations and procedures and check background and response checkouts during a future survey trip.

4.3.2 Review both the scanning and static measurement MDC determinations.

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.

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.

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.

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.

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.

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 doesn't 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.

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.

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

Observations: Refer to Observations in Section 4.4.1.

Recommendations: ORISE will continue to review future FSS data packages.

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.

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.

Recommendations: ORISE will continue to review future FSS data packages and determine if backgrounds reference areas were required.

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

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.

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.

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.

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.

Recommendations: ORISE will review and discuss characterization data with SMUD personnel concerning the adjusted sigma calculations during a future inspection.

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

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.

Recommendations: None.

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

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.

Recommendations: None.

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

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.

Recommendations: Refer to Recommendation in Section 4.1.1.

4.4.9 Review selection process for sample locations in survey units.

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.

Recommendations: None.

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

Observations: Refer to Sections 2.2 and 4.3.1 for procedure review.

Recommendations: None.

4.4.11 Review sampling and chain-of-custody procedures.

Observations: This item will be reviewed during a future site inspection.

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.

Observations: This item will be reviewed during a future site inspection.

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.

Observations: ORISE has reviewed the sample preparation procedure (DSIP-0310). The procedure is adequate with suggested minor revisions.

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.

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.

Observations: This item will be reviewed during a future site inspection.

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.

Observations: This item will be reviewed during a future site inspection.

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.

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 2007c). 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.

Recommendations: ORISE will collect additional soil samples and other media samples for further interlaboratory evaluations during future site inspections.

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.

Observations: This item will be reviewed during a future site inspection.

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

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.

Recommendations: ORISE will continue to evaluate technicians understanding of procedures during future site inspections.

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.

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.

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.

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

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 2.

Recommendations: Refer to Observations and Recommendations in Section 4.2.1.

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.

Observations: This item will be reviewed during a future site inspection.

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

Observations: This item will be reviewed during a future site inspection.

8.0 ADDITIONAL NRC/FSME REQUESTS

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

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.

Recommendations: ORISE recommends that a quality review be performed to check reference titles of documents.

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
		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.

TABLE 2

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.