April 30, 2014

MESA SURVEY PLAN

REFERENCES:

1. Assessment of Radiological Events at the Mesa, T.L. Cooper, April 10, 2014
2. NUREG-1575, "The Multi-Agency Radiological Site Survey and Investigation Manual (MARSSIM)," Revision 1, August 2000
3. Memorandum for File, E.M. Goldin, December 12, 2013, Sensitivity for Unconditional Release – Foundation for Program Requirements
4. Scanning Sensitivity – Soil/Area Scans of Remediated Areas, SONGS Unit 1 - REVISION 1, E.M. Goldin to J.M. Sills, January 11, 2005
5. RP Procedure SO123-VII-20.9.2, Material Release
6. Final Status Survey Plan for Turbine Building Structures - revised, E.M Goldin, August 19, 2005
7. RP Procedure SO123-VII-20.9.3, Surveys for Release of Liquids, Sludges, Slurries, and Sand

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I. INTRODUCTION AND PROBLEM STATEMENT

Several instances of radiological events occurred at the Mesa property while Southern California Edison site held the lease. The events were remedied at the time of discovery to the then-current day standards and the affected areas were found to be free of residual plant-originated radioactive materials. An assessment and corresponding evaluation was then

performed to determine the adequacy of the previous decontamination efforts to ensure that the surveys meet present day standards and that adequate documentation exists (Reference 1.)

Although residual contamination is unlikely in all areas in which previous events occurred, additional surveys are recommended for a few of the locations to ensure that no additional decontamination is necessary for eventual turnover of the property to the Department of the Navy and termination of the appropriate property leases. This document establishes the approach that will be used to perform those surveys.

II. APPROACH AND DATA QUALITY OBJECTIVES

The methodology to perform the additional confirmatory surveys of the Mesa is based on the Data Quality Objectives (DQO) framework described by the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (Reference 2.)

As explained in Reference 1, the MARSSIM process does not apply. It is used in formulating this survey plan merely as guidance for some specific survey aspects. This document provides a survey plan for the unconditional release of the Mesa property and facilities. It is not a dose-based MARSSIM license termination survey plan. A dose-based standard, as utilized in license termination proceedings, is not appropriate since the area was not described by a license. However, while not applicable, portions of MARSSIM provide a well-structured approach to plan the surveys that demonstrate removal of radioactive materials was complete.

Specifically, the DQO methodology identifies the following steps:

- State the problem
- Identify the decision
- Identify inputs to the decision
- Define study boundaries
- Develop a decision rule
- Specify limits on decision errors

The historical assessment (Reference 1) provided the details for the first four objectives and the last two are addressed with this survey plan.

1. **Problem Statement**
   Did radioactively contaminated items that were discovered in the past at the Mesa leave behind any detectable residual contamination?

2. **Identify the decision.**
   The decision was whether or not the decontamination after each event was adequate and whether or not documentation was sufficient to confirm that. Each event identified in the assessment underwent a review and evaluation, based on interviews and

documentation, such that of the fourteen locations, six require consideration for additional surveys. This determination was made based on the documentation being insufficient to positively support a decision that decontamination was adequate and complete.

3. **Identify inputs to the decision.**
   The assessment included sufficient interviews and documentation to support the decision or to suggest additional survey work. Inputs include surface survey measurements with field instrumentation (such as a Geiger-Muller (G-M) frisker or floor monitor, and scintillation detector such as a SPA-3) and area surveys using a scintillation detector with some limited soil samples to be analyzed by gamma spectrometry.

4. **Define study boundaries.**
   The location for each event was described in the assessment including maps of large area survey units. Those areas will be further identified below as survey units in this survey plan.

5. **Develop a decision rule.**
   The decision rule is “indistinguishable from background.” The Mesa property was not under the Part 50 radioactive materials license for SONGS, therefore, no residual plant-related radioactivity may remain since a dose-based license termination standard does not apply. “Indistinguishable from background” in this context and for this plan is defined as:

   > *no detectable plant-related radioactivity on items or areas being unconditionally released using standard site procedures for the unconditional release of items or materials.*

6. **Specify limits on decision errors.**
   Discussion later in this document will provide the foundation for proper survey instrument selection based on radionuclide distributions, limitations on background, and decision levels.

Locations:
The assessment Conclusions and Recommendations identified the following locations for consideration of additional surveys. See Reference 1 attachments for maps with these identified locations:

- Location f – Edison Warehouse, Building W-50
- Location g – Units 2 and 3 Laydown Area
- Location h – STAR Yard and Ameron Laydown Area
- Location i – Mesa Salvage Yard
- Location k – Cl-36 source in Rm 105, Building G-48
- Location l – Source storage vault in Building E-50

III. RADIONUCLIDE DISTRIBUTION

One key objective for planning an appropriate and defensible survey is to identify the radionuclide distribution most suitable for the contaminated items/equipment and account for hard-to-detect radionuclides, if necessary.

A second key objective is to provide guidance on survey methods that will be adequate to determine if the removal of radioactivity from the building or area was satisfactory to a prescribed level of "indistinguishable from background."

The levels of contamination found on each piece of equipment were low but detectable using standard field instrumentation such as a G-M pancake probe and scaler ("frisker.") This industry standard instrument is sensitive to beta-gamma emitting radionuclides, typically the cesium isotopes and cobalt isotopes associated with fission products and activated corrosion products. Reference 3 provided an evaluation that demonstrated frisker sensitivity to the radionuclide distribution associated with both Unit 1 and Units 2/3 contamination during plant operation and at varying times after permanent unit retirement. The frisker is approximately 10% or more efficient for the detection of these radionuclides, taking into account hard-to-detect radionuclides such as common electron-capture nuclides. Therefore, for all of the events, the industry standard field instruments, frisker and portable scintillation detector will be adequate for surveying. This is true now and was true when the items were discovered at the Mesa as well, when the contaminant mix was "fresh" with short-lived radionuclides present. It should be noted that a detailed analysis of the instrument capability to detect a specified fraction of the Derived Concentration Guideline Level (DCGL) as required by MARSSIM is not necessary because any contamination above instrument background is unacceptable.

The Unit 1 profile evaluated in Reference 3 contained the following relative abundances of radionuclides:
Co-60: 44%, Ni-63: 12%, Fe-55: 31%, and Cs-137: 10% as of year 2000 (Reference 3.)

Items discovered at the Mesa that originated from Unit 1 were released between 1977 and the early to mid-1980's (Reference 1). At that age of greater than 30 years, Reference 3 demonstrated that frisker efficiency is well over 10% and, in fact, close to 20% due to the domination of Cs-137. Co-60 and other short-lived fission and activation products will have decayed to negligible amounts. Hard-to-detect radionuclides were accounted for in that evaluation and frisker efficiency included their contribution to reduced total efficiency. In addition to the analysis in Reference 3, twelve Dry Active Waste profiles were evaluated in a spreadsheet that showed the following distribution:
Co-60: 22%, Ni-63: 11%, Fe-55: 14%, Cs-134: 9%, and Cs-137: 41%. For these data, representing over 97% of the radioactivity, decay over the years leaves Cs-137 as the predominant radionuclide.

It is also noteworthy that the majority of the tools and items discovered at the Mesa originated at Unit 1 where, at the time of discovery, Co-60 dominated the radionuclide distribution making detection by field instruments relatively easy and sensitive.

Hence, for contamination due to radioactivity originating in Unit 1, standard field instruments were adequate during the time of discovery at the Mesa and remain adequate for confirmatory surveys in the present.

For potential contamination derived from Units 2/3, the analysis in Reference 3 contained the following relative abundances of radionuclides:
Cr-51: 33%, Ni-63: 11%, Fe-55: 14%, Co-58: 28%, Cs-137: 3% as of year 2013 (Reference 3.)

Items discovered at the Mesa that originated from Units 2/3 were released no later than 1990, greater than 20 years ago (Reference 1). At that age, Reference 3 demonstrated that the frisker efficiency remains about 10%. Again, like Unit 1, Co-60 in these events and other short-lived fission and activation products will have decayed to negligible amounts. In addition, hard-to-detect radionuclides were accounted for in that evaluation and frisker efficiency included their contribution to reduced total efficiency.

In conclusion, the radionuclide distribution from either Unit 1 or Units 2/3 contamination yields sufficient beta-gamma radiation emissions such that standard field instruments are adequately sensitive with appropriate detection efficiency. Note that both of the above conclusions accounted for hard-to-detect radionuclides that form a fraction of each of the distributions. This conclusion applies to historical surveys as well, confirming that surveys completed in the past (such as those conducted in the early 1980's to support recovery of contaminated tools) were adequately sensitive. Also, note that tritium was not present in the radionuclide distributions because it is not present in the dry active waste profiles that form the basis for those analyses. Therefore, no analysis for tritium is required because it was not present on any tools or equipment brought to the Mesa from the plant.

Lastly, one location, "k" in Room 105 of Building G-48, involved a specific exempt quantity source that was compromised. Clorine-36 emits sufficiently high energy betas (709 keV max, 251 keV average, 98% abundance) such that a follow-up survey of that location with standard field instruments will have adequate efficiency and meets the requirements above for sensitivity.

IV. ACCEPTANCE CRITERIA

a. Land Areas

Scan surveys of land areas will be performed using a SPA-3 scintillation detector or equivalent. Reference 4 demonstrated that the scan Minimum Detectable Concentration (MDC) for a SPA-8 (1" x 1" NaI) detector was about 8 pCi/g. The referenced evaluation noted the larger SPA-3 (2" x 2" NaI) detector would have even greater sensitivity. Reference 2, Table 6.7 shows a SPA-3 has a scan MDC of 237 Bq/kg, equivalent to 6.4 pCi/g.

The San Onofre Nuclear Generating Station (SONGS) Annual Radiological Environmental Operating Reports (AREOR) for years have noted low levels of Cs-137 in both indicator and control locations due to the deposition of weapons test fallout (and Chernobyl and Fukushima). Those levels are typically a fraction of 1 pCi/g, for example, in the 2012 AREOR, the control location exhibited 0.25 pCi/g Cs-137.

Therefore, the detection of any radioactivity above background using these scintillation-based field instruments could be indicative of residual plant originated radioactive contamination and require further attention. There is a possibility of finding localized hot spots of elevated radiation levels due to natural radioactivity (Reference 4). Any detection above background will be addressed by the performance of additional and more detailed surveys to determine the need for remediation – see Reclassification Criteria below.

Because field survey scans using a hand-held scintillation detector are not sensitive enough to detect environmental levels of contaminants, each land area surveyed will have supplemental soil samples taken and analyzed by gamma spectrometry in accordance with site procedures (Reference 7). The numbers and locations of those samples are identified in the attached survey summary table.

b. Structural Surfaces

For structural surfaces, such as building surfaces including floors and walls, and outdoor surfaces including sidewalks, paved parking lots, and storm drain basins, the acceptance criterion is “indistinguishable from background” for direct beta and removable beta surface contamination. For the purposes of this survey plan, “indistinguishable from background” means less than the levels specified in NRC IE Circular 81-07 (i.e., less than 5000 dpm/100cm^2 total surface contamination and 1000 dpm/100 cm^2 removable contamination). These are not release criteria but instead are levels that have been determined to be detectable using standard field instruments. For a survey using standard G-M friskers, a scan (no greater than 2 inches per second) requires audible indication and a pause-and-count for any indication of increased count rate. Background will be no greater than 100 cpm, consistent with procedural requirements (Reference 5) for the unconditional release of equipment and items. Scans may also be performed using a floor monitor such as the FLM-3B (with a scan MDC of 500 – 600 dpm/100 cm^2 – see Reference 6). Disc smears for assessing removable contamination also require a frisker in a background no greater than 100 cpm. These conditions provide assurance that the result of “indistinguishable from background” indicates no radioactive contamination greater than 5000 dpm/100 cm^2 total (fixed plus removable) and 1000 dpm/100 cm^2 removable. Scan surveys of surfaces may also be performed using a SPA-8 scintillation detector or equivalent.

V. SPECIFIC SURVEY REQUIREMENTS

Each of the identified locations will be surveyed using the requirements as specified below. Large outdoor areas will be surveyed using a scintillation detector in both static and scan modes as specified for each area. Buildings will be surveyed for fixed and removable contamination using field instrumentation (G-M friskers) and scanned with a scintillation detector in accordance with site procedures. All instruments will be properly calibrated and performance tested both before and after surveys to preclude instrument errors during the survey process.

a. Background Reference Areas

Before conducting the survey, readings will be taken in an unaffected area with the same material characteristics as the area being surveyed and ambient background levels that do not exceed procedural requirements (for example, no greater than 100 cpm for a frisker). For a scintillation detector, background readings will be taken at the same elevation above ground with the same material surface (e.g. asphalt, soil, concrete, or gravel) as the survey unit. For supplemental soil samples, the gamma spectrometry results will be compared to the environmental levels reported in AREORs.

b. Large Outdoor Areas

The majority of the contaminated tools and equipment discovered at the Mesa were found in buildings or containers that protected them from the weather. Typically items had hundreds to a few thousands of counts per minute of fixed activity measured with the industry standard frisker. However, even if a fraction of the contamination were weathered off an unprotected item onto the surrounding surface, the levels would be below the detection threshold. For example, a tool with 2,000 cpm might, at most, lose 10% (assumed 10% removal efficiency similar to NRC IE Notice 85-46) or 200 cpm. That level, if present, would be detected using a frisker. Since each event detailed in Reference 1 did not identify any residual contamination after the item was removed, this scenario is highly unlikely.

To determine if weathered radioactivity could produce a detectable result, the following example is provided. The scenario involves a tool with 2,000 cpm, equivalent to 20,000 dpm (assuming 10% frisker efficiency.) That equals at most 2,000 dpm removed and potentially transferred to the soil. 2,000 dpm equals less than 1 nCi. Distributed in a liter of soil, the end result is less than 1 pCi/g. Accounting for radioactive decay of the majority of the contaminants yields levels at or below the environmental levels required for analysis (Reference 7). Therefore, it is highly unlikely that any weathered contamination would result in soil contamination at detectable levels.

MARSSIM (Reference 2, page 4-15) notes that areas with little likelihood of contamination above the acceptance criterion have no limitation on size. Therefore, the three Mesa Locations identified in Reference 1 as open areas (Locations g, h, and i) can each be surveyed using the standard approach below.

- Location g – Units 2 and 3 Laydown Area

As a large area estimated at about 15,000 square meters, a single survey unit will be adequate.

- Location h – STAR Yard and Ameron Laydown Area
  As a large area estimated at about 35,000 – 50,000 square meters, a single survey will be adequate. For convenience, this area can be split into three survey units with the road Construction Way and the cul-de-sac providing a dividing line. Map #2 in Reference 1 shows an area with cross-hatching that was the site of most of the contamination events for this area. This smaller area will be surveyed as an individual unit with specific requirements defined below.
- Location i – Mesa Salvage Yard
  As a large area estimated at about 6,000 square meters, a single survey unit will be adequate.

The survey requirements for these large areas are:

- Utilize a scintillation detector (such as SPA-3), noting the appropriate background count from a prior reading.
- Use the audible signal from the instrument to monitor the count rate during static and scan surveys.
- Select 20 random survey points within the survey area.
- At the first point, take a static reading of at least 5 seconds, adequate to detect the levels described in Reference 4. Note again that Reference 2, Table 6.7 indicated a scan MDC for a SPA-3 of about 6 pCi/g.
- Scan survey the area from the first point to the second point in a serpentine path, moving at a speed no faster than 20 inches per second, holding the detector no more than 6 inches above the surface.
- Continue scanning between each point and obtaining static data at each point until the survey unit is completed.
- In each survey unit, take 2 or more smears of the inside surface of representative yard/storm drains that could have accumulated any weathered radioactive contamination. If no yard/storm drains are present in the survey unit, document that on the survey map.
- With the advice of knowledgeable staff to determine locations (defined as biased sampling), take 3 soil samples from each survey unit for gamma spectrometric analysis. Analyze according to requirements in Reference 7. In a Class 3 survey unit, MARSSIM recommends (section 5.2.3) that professional judgment be used in this type of directed survey. As noted in Reference 1, the AREORs for the past many years have documented low levels of Cs-137 in surface soil due to weapons fallout. The levels expected are low but easily detectable when analyzed to environmental levels required by Reference 7.
    - Specifically for the STAR Yard/Ameron Laydown area: The cross-hatched area in Map #2 for the STAR Yard/Ameron Laydown area had the majority of the tool discoveries. Therefore, this limited area will be treated as the most suspect. Survey the area as above with scan and static surveys. Supplement those

surveys with a 1 liter soil/sand sample at each accessible survey point. Analyze those samples according to Reference 7.

- Document all static data readings and results of scan data and smear results (such as no significant count rate above the material background data collected in Section V.a. above) on survey maps indicating location (with GPS locations if possible). Indicate location of biased samples on the survey maps as well.

c. Building Interiors

Surveys of building interiors require static and scan surveys using field instruments. Since the three building locations identified in Reference 1 are restricted to individual rooms, the four locations below will be surveyed as follows.

- Location f – Edison Warehouse, Building W-50, scan all accessible floor surfaces in the warehouse storage area (offices and other rooms do not require scanning)
- Location k – Cl-36 source in Rm 105, Building G-48, scan all accessible floor surfaces in the room
- Location l – Source storage vault in Building E-50, scan all accessible floor surfaces in the room
- Location h – There are three buildings in the footprint of the STAR Yard/Ameron Laydown area: G-20, G-21, and G-22 (see Map #2, Reference 1). Scan the interior accessible floor surfaces of those buildings as indicated below for building surveys.

The survey requirements for these rooms are:

1. Utilize a floor monitor (such as the FLM-3B or Electra+/BP-19). Reference 4 described the sensitivity of these monitors and the operating parameters that included:
   a. Background of 40 cps for the FLM and 8 cps for the Electra (note that material background data are collected first according to Section V.a. above)
   b. Scan speed will be such that the detector probe area is over a given point for at least 2 seconds
   c. If a floor monitor is unavailable, use a frisker and scan the appropriate floor surface.
   d. Perform some random wall surveys at no more than 6' above the floor to provide documentation with respect to contamination above the floor.
2. Take 10 smears in G-48 Room 105 and 6 smears in and around the source storage vault in E-50. Take 20 smears of the floor surface in the W-50 warehouse area. Take 10 smears in each of the G-buildings situated in the STAR/Ameron Laydown area.
3. Document all data and results of scan data (such as no significant count rate above the appropriate material background) on survey maps indicating location.
4. Note that these surface surveys are essentially identical to surveys for unconditional release according to Reference 5.

d. Survey Summary Table

Table 1, attached, summarizes the detailed survey requirements for each location.

VI. RECLASSIFICATION CRITERIA

If any plant-related radioactive contamination is confirmed above background levels, contact supervision to determine corrective actions and further activities. Elevated radiation levels in land areas could be due to natural radioactivity as demonstrated in Reference 4. Therefore, an elevated reading at a point in a given land area does not necessarily indicate failure of the survey unit. Supervision will determine corrective actions and subsequent data analysis if required. Any confirmation of plant produced radiation/radioactivity levels above the "no detectable" acceptance criterion requires decontamination (removal of the radioactivity) and subsequent surveys with more rigor, depending on the level detected.

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Attachment: Table 1 – Mesa Survey Plan Summary