

## **MEMORANDUM FOR FILE**

July 2, 2014

**SUBJECT:** Results of Confirmatory Radiological Survey at the Mesa

### **REFERENCES:**

1. Assessment of Radiological Events at the Mesa, T. Cooper, dated April 10, 2014
2. Addendum to Memorandum for File – Assessment of Radiological Events at the Mesa, T. Cooper, prepared April 28, 2014
3. Mesa Survey Plan, E. Goldin and T. Cooper, dated April 30, 2014
4. SONGS Annual Radiological Environmental Operating Reports (AREORs), 2009 to 2013
5. Radiation Protection Procedure SO123-VII-20.9.2, Material Release
6. Radiation Protection Procedure SO123-VII-20.9.3, Surveys for Release of Liquids, Sludges, Slurries, and Sand
7. Chemistry Procedure SO123-III-4.5.5, Operation of SONGS Gamma Spectroscopy Systems
8. Environmental Procedure SO123-IX-1.8, Soil Sampling

### **INTRODUCTION**

Reference 1 documents a retrospective assessment of events that resulted in radioactive material being inappropriately transferred from the San Onofre Nuclear Generation Station (SONGS) to the Mesa. The majority of those transfers involved the inadvertent release of tools and equipment with low levels of surface contamination. With few exceptions, the items had fixed, but no accessible removable activity and were discovered in tool or gang boxes providing protection from the weather. The events were remedied at the time of discovery to the then-current standards and the affected areas were found to be free of residual plant-originated radioactive materials. The retrospective assessment included a determination of the adequacy of the previous decontamination efforts to ensure that the surveys met present day standards and that adequate documentation exists.

The assessment concluded that fourteen separate locations (Locations a through n, described below and displayed on attached maps) were affected by those inadvertent transfers. Although residual contamination from licensed radioactive material is unlikely in all of those areas, records of radiological surveys and recovery efforts were incomplete for six of those locations. Consequently, Reference 1 recommended additional survey of those six areas to ensure that the removal of radioactive material was complete before eventual turnover of the property to the Department of the Navy and termination of the appropriate property leases.

Reference 3, Mesa Survey Plan, established the approach and specified the methods and instrumentation used to perform confirmatory radiological surveys of those six locations.

## **PURPOSE**

This memorandum presents the results of the confirmatory radiological surveys conducted at the Mesa. Those six locations are:

- 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 – CI-36 source in Rm 105, Building G-48
- Location l – Source storage vault in Building E-50

## **SUMMARY**

Confirmatory radiological surveys were completed as specified in Reference 3. All measurements were consistent with expected environmental levels. There is no evidence of residual contamination from licensed radioactive material at the Mesa as a result of past inadvertent radioactive material transfers.

## **METHODOLOGY & INSTRUMENTATION**

Each of the six identified locations was surveyed in accordance with the requirements as specified in the Mesa Survey Plan and summarized below. Large outdoor areas were surveyed using a scintillation detector in both static and scan modes as specified for each area. Soil samples were obtained from biased locations and subjected to radiometric analysis. Buildings were surveyed for fixed and removable contamination using field instrumentation (G-M detectors) and scanned with a scintillation detector in accordance with site procedures. All instruments were properly calibrated and performance tested both before and after surveys to preclude instrument errors during the survey process.

### **Large Outdoor Areas**

Scan surveys were performed with an Eberline ASP-1 Ratemeter with a SPA-3, 2" x 2" NaI scintillation detector. The survey plan required use of the audible signal to monitor the count rate during static and scan surveys. Twenty random survey points were selected within each survey unit. Global Positioning System (GPS) coordinates were recorded for all survey points using a Magellan Maestro 4350 GPS Navigator. At the first point, a static reading was obtained. The plan then directed a scan survey of the area from the first 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. That process continued, scanning between each point and obtaining static data at each point until the survey unit was completed.

Soil samples were obtained from biased locations in accordance with Reference 8 and analyzed in accordance with Reference 7. A sample jig was devised to aid in obtaining consistent soil samples. Following the procedural guidance of Reference 8, a one by four foot area was excavated to a depth of three inches. The soil was extracted, separated into

four piles and thoroughly mixed. The four mixed piles were then combined into a single pile and mixed before taking the one liter sample in a Marinelli container.

### **Building Interiors**

Surveys of building interiors required static and scan surveys, and evaluation for removable contamination using approved field instruments.

The survey plan required 100% survey of available floor surfaces using a Bicorn/NE FLM3B Floor Monitor. That instrument incorporates a large area beta scintillation probe. Scan speed was limited such that the detector probe area is over a given point for at least 2 seconds. Smears from random locations on the floor were taken and evaluated with a Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe.

Walls were smeared and subjected to scan surveys using a Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe up to a height of six feet above the floor to provide documentation with respect to contamination above the floor.

## **DESCRIPTION OF SURVEYS & SURVEY RESULTS**

### **Background Reference Areas**

Before conducting the confirmatory surveys of the six target locations, the survey plan required that radiological measurements be taken in an unaffected area with the same material characteristics as the area being surveyed. In practice, two locations were chosen as background reference areas: the Mesa Helipad and the Mesa Security Training Facility.

Direct radiation levels were measured with an Eberline ASP-1 Ratemeter with a SPA-3 scintillation detector at the same elevation above ground (no more than six inches) with the same material surface (e.g. asphalt, soil, concrete, or gravel) as the survey unit. The count rate under those conditions was relatively consistent at 8,000 counts per minute (cpm.)

Soil samples were obtained at both locations in accordance with Reference 8 and analyzed in accordance with Reference 7. The gamma spectrometry parameters are consistent with the environmental levels reported in the SONGS Annual Radiological Environmental Operating Reports (AREORs.)

After discovering the Storm Drain Culvert and including it in the survey (described below in the section on Location g), it became necessary to provide data from a representative reference area with similar characteristics. The two reference areas described above were representative of soil found in large open areas at the Mesa, but not the fine grained sediment sampled in the culvert. That fine sediment in the culvert would be expected to act as a filter of sorts. Consequently, as directed by the plan, another background reference

sample was obtained from an area with similar characteristics located on the bluff opposite the north end of Parking Lot 4.

Table 1 summarizes the background reference areas.

TABLE 1 – Summary of Background Reference Areas

LOCATION	RADIONUCLIDE	pCi/g	%
Helipad	K-40	17.9	85
	Tl-208	0.263	1
	Pb-212	0.616	8
	Bi-214	0.457	2
	Pb-214	0.729	3
	Total	20.0	
Security Training Facility	K-40	14.3	88
	Tl-208	0.193	1
	Pb-212	0.653	4
	Bi-214	0.357	2
	Pb-214	0.538	3
	Ac-228	0.168	1
North Parking Lot #4	Total	16.2	
	K-40	16.1	81
	Tl-208	0.149	1
	Pb-212	0.527	3
	Bi-214	0.616	3
	Pb-214	0.978	5
	Ac-228	1.38	7
	Cs-137	0.209	1
	Total	20.0	

(Note that isotopes of radium and radon, present in all the soil samples, have been omitted.)

The following sections describe the survey efforts and results for each of the identified six locations. The surveys prescribed by the plan were completed for each of the six locations. In several instances additional measurements were made and an increased number of soil samples were obtained. Those additions are described below and summarized in Table 2, attached.

#### **Location f – Edison Warehouse, Building W-50**

Seven inadvertently released contaminated items were found in the Edison Warehouse, Building W-50, during the early-to-mid 1980s. Two of those items contained removable activity. Those items were returned to SONGS upon their discovery and the area was verified free of residual contamination. Although it is unlikely that contamination remains, the building was included in the survey plan.

In accordance with the survey plan, 100% of accessible floor area was surveyed using the Bicon floor monitor and Eberline ASP-1/SPA-3 ratemeter. Background count rate was determined to be 40 counts per second (cps) and 8,000 cpm, respectively for those instruments. No activity above background was detected on the floor surface. Random locations on walls/racks were scanned and smears were obtained from walls and floor and analyzed using the Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe. No activity above a background of 40 to 60 cpm was detected.

Because of the size of the warehouse, it was divided into two survey units, North and South. That change doubled the number of random locations from 10 to 20 in which walls and racks were scanned and evaluated for removable contamination using the Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe. No activity above a background of 40 to 60 cpm was detected.

#### **Location g – Units 2 and 3 Laydown Area**

Sixty-seven inadvertently released contaminated items were recovered from the Units 2 and 3 Laydown Area during the early-to-mid 1980s. With few exceptions, those items contained only fixed contamination. While it is believed that most items were contained in tool and gang boxes, available data do not make that clear. Exposure to the weather may have been a factor there. Those items were promptly returned to SONGS upon discovery and the area verified free of residual contamination. Although it is unlikely that contamination remains, the area was included in the survey plan.

As a large open area, the Units 2 and 3 Laydown Area was evaluated by scan survey using the Eberline ASP-1/SPA-3 ratemeter and soil sampling. The plan required static direct radiation readings at 20 locations and three soil samples. Because of the size of the laydown area, it was divided into two survey units, North and South. That designation doubled the number of survey points from 20 to 40. All readings showed no increase above a background of 8,000 cpm.

Rather than the three samples specified by the plan, at management's request 20 soil samples were obtained and analyzed. All samples showed only naturally occurring activity.

The survey plan required identification of any yard/storm drains that may need additional attention. During the survey of Locations g and i, the existence of a storm drainage culvert was discovered. The concrete culvert parallels El Camino Real on its east side between the warehouse deliveries turnoff and Construction Way. It receives rain runoff from the Salvage Yard and the Units 2 and 3 Laydown Area and contained a small amount of sediment along its length. The entire length of the culvert was scanned with the Eberline ASP-1/SPA-3 ratemeter and static readings were taken at 12 random points showing no indications above a background of 8,000 cpm.

Six soil samples were taken from the culvert and analyzed. Those samples showed the expected mix of naturally occurring radionuclides. Although below the *a priori* minimum detectable activity (MDA), Cs-137 was detected in an amount of 0.109 pCi/g in one of the samples (Culvert Sample #12.) That concentration is consistent with Cs-137 levels found in soil due to above ground weapons testing and more recently from Chernobyl and Fukushima fallout:

Culvert Sample #12 Cs-137-- 0.109 pCi/g

*a priori* MDA for Cs-137 -- 0.180 pCi/g

Parking Lot 4

Reference Sample Cs-137 -- 0.209 pCi/g

SONGS AREOR for Years 2009 - 2013

Control Location Cs-137

(Oceanside, CA): Mean -- 0.195 pCi/g

Range -- 0.053 – 0.267 pCi/g

### **Location h – STAR Yard**

The STAR Yard is a large open area that also contains three buildings that required survey. More than 140 inadvertently released contaminated items were recovered there during the 1980s. While the majority of those items had no removable contamination and were found in gang boxes, buildings, or cargo containers, many items were found exposed to the weather. For many of the discovered items the data are incomplete. Although those items were promptly returned to SONGS upon discovery and the area verified free of residual contamination, the area was included in the survey plan.

The southeast portion of the yard experienced the largest number of contaminated item discoveries in the 1980s and was considered an area of concern. (That area is shown in cross-hatch on the attached Mesa Map.) Consequently, the survey plan specified that it be treated as a single survey unit subjected to 100% scan with the Eberline ASP-1/SPA-3 ratemeter, 20 static survey points, and a soil sample obtained from each of those 20 points.

Because of the size of the remainder of the yard, the plan divided it into two survey units, North and South with Construction Way as the dividing line. Each unit was scanned with the Eberline ASP-1/SPA-3 ratemeter including a total of 40 static readings. Twelve soil samples were taken and analyzed from the two survey units.

All readings were consistent with background except for a small area north of Building G-20. During the scan survey of that area, the surveyor noted an increase in countrate from 8,000 cpm to 14,000 – 16,000 cpm in a small area measuring 4 feet by 20 feet bordering the asphalt. Three additional soil samples were obtained within the increased countrate area and showed the same mix of naturally occurring radionuclides but at roughly double the concentration.

The soil in the increased countrate area was noticeably lighter in color and much less densely packed than the existing dirt surface. It appears that the fill had been brought in to serve as a ramp between the asphalt and the existing Mesa soil surface. While the source of that fill is unknown, it contained twice the concentration of naturally occurring radionuclides and that increase is completely consistent with the observed increased direct countrate. Table 3 presents a sampling of the STAR Yard results.

TABLE 3 – STAR Yard Soil Sample Comparison

SAMPLE DESCRIPTION	RADIONUCLIDE	pCi/g	% of Total
STAR Yard Composite Sample			
	K-40	11.7	86
	Tl-208	0.278	2
	Pb-212	0.650	5
	Bi-214	0.513	4
	Pb-214	0.543	4
	Total	13.7	
Increased Countrate Area Sample #1			
	K-40	25.2	79
	Tl-208	0.310	1
	Pb-212	1.77	6
	Bi-214	1.06	3
	Pb-214	1.38	4
	Ac-228	2.01	6
	Total	31.7	
Increased Countrate Area Sample #2			
	K-40	23.3	76
	Tl-208	0.299	1
	Bi-212	1.98	6
	Pb-212	1.58	5
	Bi-214	0.828	3
	Pb-214	1.03	3
	Ac-228	1.50	5
	Total	30.5	
Increased Countrate Area Sample #3			
	K-40	20.4	75
	Tl-208	0.531	2
	Bi-212	2.74	10
	Pb-212	1.43	5
	Bi-214	1.12	4
	Pb-214	0.832	3
	Ac-228	0.295	1
	Total	27.3	

(Note that isotopes of radium and radon, present in all the soil samples, have been omitted.)

The three buildings located in the STAR Yard, G-20, G-21, and G-22, were all subjected to a 100% scan using the Bicon floor monitor. No activity above a background of 40 cps was detected on the floor surfaces.

Ten random locations on interior walls in each building were scanned and smears were obtained from walls and floor and analyzed using the Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe. No activity above a background of 40 to 60 cpm was detected.

#### **Location i – Salvage Yard**

The Salvage Yard is another large open area. It was later included as the western end of Camp Mesa. Only three items with fixed, but no removable contamination were found in the Salvage Yard and returned to SONGS in the early 1990s.

The Salvage Yard was evaluated by scan survey using the Eberline ASP-1/SPA-3 ratemeter and soil sampling. The plan required static direct radiation readings at 20 locations and three soil samples. No activity above a background of 8,000 cpm was found. The number of soil samples was increased from three to ten at management's request. All ten soil samples showed only naturally occurring activity.

#### **Location k – Classroom 105, Building G-48**

HP Classroom 105 experienced a damaged exempt quantity CI-36 button source that spread activity requiring remediation within the room. No records are available related to the event but interviews with involved personnel placed it in the 1993-1994 time frame.

As a preliminary step, the existing carpet was removed to prevent shielding beta radiation from any potential residual CI-36 in the concrete. (Incidentally, the carpet had been replaced several times since the event.) The entire floor of the classroom was then scanned using the Bicon floor monitor. No activity was detected above a background of 40 cps. Ten random smears were taken of the floor and showed no activity above a background of 40 to 60 cpm using the the Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe.

Six random locations on the walls scanned using the Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe showed no activity above a background of 40 to 60 cpm. Smears of those six wall locations also showed no evidence of residual CI-36.

#### **Location l – Source Storage Vault, Building E-50**

Classroom 21 in Building E-50 served as the Health Physics Lab before the lab was moved to Building G-48. An adjoining office contained a floor safe that was used as a radioactive source storage vault. While there is no record of any spread of radioactive material there, confirmatory survey of the vault and surrounding area was considered prudent.

As a preliminary step, a locksmith was employed to open the safe since the combination had been lost. Once opened, the vault was found to be empty except for two small lead rings. The interior of the vault was smeared and direct frisked and showed no evidence of activity above background. The entire floor of the office containing the safe was then scanned using the Bicon floor monitor. No activity was detected above a background of 40 cps. Ten random smears were taken of the floor and showed no activity above a background of 40 to 60 cpm using the the Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe.



Six random wall locations were scanned and smears from those locations evaluated with a Ludlum Model 2-1 140 Ratemeter and HP-210 G-M Probe. No activity above a background of 40 to 60 cpm was detected.

Though not required by the plan, the adjoining HP classroom was subjected to the same radiological surveys. Similarly, all measurements showed no evidence of residual licensed radioactive contamination.

While there were no records or personal recollections that radioactive materials had ever been present, the initiative was taken to survey Classroom 22 that served as the Chemistry Lab. The entire floor of the lab was scanned using the Bicron floor monitor. No activity was detected above a background of 40 cps. Smears and direct frisks of the floor and walls showed no activity above a background of 40 to 60 cpm using a Ludlum Model 2-1 Ratemeter and HP-210 G-M Probe.

## CONCLUSION

Confirmatory radiological surveys were completed as specified in Reference 3. All measurements were consistent with expected environmental levels. These radiological survey results in combination with the conclusions of References 1 and 2 provide the necessary assurance that there is no evidence or indication of residual contamination from licensed radioactive material at the Mesa.

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## **ATTACHMENTS**

1. Table 2 – Mesa Survey Plan vs: Actual Summary
2. Maps:
  - SONGS Mesa
  - Edison Warehouse, Building W-50
  - Building G-20
  - Building G-21
  - Building G-22
  - HP Classroom Room 105, Building G-48
  - Source Storage Vault, Building E-50
  - Chemistry Lab, Building E-50
3. Radiological Survey Data
4. Gamma Spectrographic Data
5. Pictures

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