

November 15, 2016

Via Electronic Mail and U.S. Mail

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Subject: Response to September 20, 2016 Department of the Navy Request to Use  
EPA Directive 9200.4-40 for the Mesa Lease Clean-up Requirements

Dear Commander Beery:

The U.S. Marine Corps Commandant's letter, signed by J.D. Williams and dated September 20, 2016, which you sent to Mr. Nino Mascolo, concerns the return of the Mesa property, used by Southern California Edison (SCE) pursuant to a lease from the Department of the Navy (DON). The DON letter references my May 19, 2016 letter to Mr. David Bixler transmitting an "Upper Bound Radiation Dose Evaluation for the San Onofre Mesa Facility" technical document that concluded the radiological dose to a hypothetical person that might live on the Mesa property would be no more than 0.8 mrem/year, well below the DON's 12 mrem/year release criteria. The DON letter requests that SCE use the detection limits of the radiological surveys conducted on the Mesa property and apply U.S. Environmental Protection Agency (EPA) Directive 9200.4-40 to determine the EPA risk level and, consequently, if SCE has achieved a radiological release criteria of 12 mrem/year for the Mesa property.

SCE engaged Radiation Safety & Control Services (RSCS) to perform the requested risk analysis. The attached RSCS technical document concludes that the Mesa property and buildings are within the EPA risk range of  $10^{-4}$  to  $10^{-6}$  and meet the 12 mrem/year release criteria.

We would be pleased discuss the RSCS risk analysis with you at your convenience. Should you have any questions, please contact Mr. Nino Mascolo at 626.302.4459.

Very respectfully,



Chris Ahola, CHP  
Radiation Protection Manager


Attachment (1)

cc: Captain William Whitmire, USMC  
Reid Merrill, USMC  
Greg Magnuson, NAVFAC Southwest  
Nino Mascolo, SCE  
Steven Vaughan, SCE

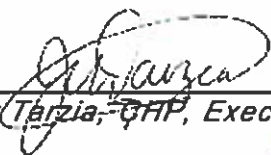
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# Risk Analysis of MESA Land Transfer from SONGS to the Department of the Navy

*Technical Support Document No. 16-078 Rev 00*

Originated by:   
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*October 4, 2016*



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## **1 Scope**

This document has been written to present the calculations, results and conclusions performed by Radiation Safety & Control Services (RSCS) technical staff to address the request presented in the Department of the Navy (DoN) memo, dated September 20, 2016, to San Onofre Nuclear Generating Station (SONGS) as pertains to the MESA land clean-up requirements [Reference 1].

## **2 Background**

To support the operations of the nuclear plants located on the SONGS site, Southern California Edison leased land from the DoN located on the east side of Interstate 5. The parcel of land, known as the MESA, was used to house training facilities, warehouses, and other facilities for plant operational support. The MESA site was not part of the power block and was not included in the Nuclear Regulatory Commission (NRC) licensed footprint.

During the period of 1980 to 2003, eleven events occurred where radioactive material was inadvertently transferred to the MESA. Although the events were surveyed and dispositioned at the time of discovery, a review of these incidents in 2014 [Reference 2] identified 8 locations that were recommended to have follow up surveys conducted. Recent follow up surveys of the MESA, as discussed in Reference 3, resulted in no detectable levels of contamination.

The DoN memo states that the dose evaluation [Reference 3] provides good evidence that the MESA does not exceed 0.8 mrem/year; however, the DoN requests that SONGS use the detection limits of the radiological surveys conducted and apply the EPA's Directive 9200-4.40 [Reference 4] to determine the risk level, and thus determine whether the MESA meets the 12 mrem/year criterion based on EPA methodologies.

## **3 Calculations and Analysis**

### **3.1 NRC Dose to EPA Risk Calculation**

EPA Directive 9200-4.40, "Radiation Risk Assessment at CERCLA Sites: Q & A" (Reference 4) states that the EPA's Federal Guidance Report 13 risk estimates show that 12 mrem/yr corresponds to approximately  $3\text{E-}04$  excess lifetime cancer risk. This risk value is based on Federal Guidance Report (FGR) 13's assumption of a risk of cancer incidence of  $8.46\text{E-}04$  per rem of exposure using the EPA CERCLA standard period of exposure of 30 years for residential land use.

A detailed review of the radiological impact of the MESA site was conducted and developed an upper bound radiation dose evaluation for the area (Reference 3). The review was based on historical site information as well as current radiological surveys. This dose evaluation concludes that no contamination distinguishable from background was detected on either the soil or building measurements and thoroughly documents the survey methodologies and minimum detectable activities achieved in the survey processes used. The report also states that due to the length of time between the events that occurred at the MESA and the present, Cs-137 is the predominant potential radioactive contaminant at the MESA. The calculations in the report compared the average minimum detectable concentrations (MDCs) of Cs-137 in the soil and building

surface measurements to the NRC 25 mrem/y screening levels presented in NUREG-1757 [Reference 5].

The results of the calculations in Reference 3 show the upper bound dose estimate from the soil is 0.25 mrem/y and from the buildings is 0.54 mrem/y using the NRC methodology.

These dose values have been converted to risk by applying FGR-13 dose-to-risk methodologies as follows:

$$\text{Soil Risk} = 0.25 \text{ mrem/y} \times (3E-4) / (12 \text{ mrem/y}) = 6.3E-6$$

$$\text{Buildings Risk} = 0.54 \text{ mrem/y} \times (3E-4) / (12 \text{ mrem/y}) = 1.3E-5$$

$$\begin{aligned} \text{The total risk from soil and buildings (by NRC screening levels)} \\ = 6.3E-6 + 1.3E-5 = 1.9E-5. \end{aligned}$$

### 3.2 EPA Risk Calculation

An independent evaluation was performed by using the EPA's Preliminary Remediation Goals for Radionuclides (PRG) Calculators to assess the risk from both soil and building surface contamination. The calculators are a set of tools used to assist project managers and technical support personnel involved in risk assessment and decision making at CERCLA sites in developing PRGs.

Default PRGs are available for a variety of exposure conditions such as; resident, indoor and outdoor workers, recreator and farmer. The standardized PRGs are based upon default exposure parameters and food consumption rates. The appropriately conservative exposure scenario for the MESA is the resident scenario, which was used to calculate risk.

The resident spends most of every day and year at home. The resident is assumed to be exposed to contaminants in the following pathways; incidental ingestion of soil, external radiation from contaminants in soil, inhalation of fugitive dust and consumption of home grown produce (25% of fruits and vegetables). This exposure scenario includes an adult as well as a child.

#### 3.2.1 Soil Risk Calculations

An independent assessment was performed using the PRG calculator to assess the resident scenario with soil as the media, which assumed that the bulk of soil at the MESA was contaminated at the minimum detectable concentration (MDC) of the soil measurements performed at the site. The radionuclide selected was Cs-137+D which included the radioactive progeny of the parent nuclide, Ba-137m.

The conservative assumptions used in the calculation were:

1. The Cs-137+D activity concentration used was 0.11 pCi/g; equal to the MDC for the soil measurements,



2. The soil area used was 500,000 m<sup>2</sup>, which is large enough to make the area correction factor equal to 1 (the largest value). This is a conservative value and is equivalent to the default area factor.
3. The cover thickness was set to 0 cm such that no clean soil or cover shielded any radioactive contamination.
4. All other parameters associated with the resident scenario (e.g. exposure durations, soil intake rates, inhalation rates, consumption rates, etc.) were left as their default parameters. These conservative default parameters assume that individuals were exposed 24 hours per day for 350 days per year.

The output of this calculation is presented in Attachment 1. The results of this run show the calculated risk for a Cs-137+D concentration of 0.11 pCi/g is equal to **2.36E-6**.

### 3.2.2 Building Surface Risk Calculations

A second independent evaluation was performed by using the EPA's Preliminary Remediation Goals for Radionuclides in Buildings (BPRG) Calculator. The calculator is a tool used to assist project managers and technical support personnel involved in risk assessment and decision making for buildings contaminated with radionuclides.

The resident is exposed to the radioactive contaminants in dust that settles in the building. Exposure is via two exposure routes. The first exposure route is external exposure. The second exposure route is ingestion. Ingestion of dust occurs when hands contact dust-laden surface and then come in contact with the mouth. Variation is allowed for contact with hard and soft surfaces as the transfer to skin varies on surface type. A review of all the loose surface contamination surveys performed in buildings on the MESA showed no removable activity above the MDC and that contamination events documented at the site were limited to small discrete areas.

The conservative assumptions used in this calculation were:

1. The input contamination level for the calculation was the MDC of the surface contamination measurements identified in Reference 3 of 600 dpm/100 cm<sup>2</sup>, converted to 2.7 pCi/cm<sup>2</sup>.
2. All building surfaces were contaminated at the MDC and that 1% of all contamination was available for transfer to the skin of individuals present in the building.
3. All other parameters associated with the resident scenario (e.g. exposure durations, soil intake rates, inhalation rates, consumption rates, etc.) were left as their default parameters. These conservative default parameters assume that individuals were exposed 24 hours per day for 350 days per year.

The output of this calculation is presented in Attachment 2. The results of this run show the calculated risk for a Cs-137+D concentration of 2.7 pCi/cm<sup>2</sup> is equal to **3.54E-5**.

#### 4 Conclusions

No radioactivity above background was detected in either the soil or building surface measurements collected in 2014 at the MESA site. In order to calculate risk from potential radioactivity, an assumption was made that soil and building surfaces were uniformly contaminated to their respective minimum detectable concentrations (MDCs) as achieved by the measurement methods and documented in Reference 3.

The prior bounding dose assessment for the MESA site [Reference 3] calculated a conservative bounding dose due to potential residual radioactivity at the MESA site. This bounding dose was converted to risk as part of this assessment using the EPA's Federal Guidance Report 13 which resulted in a residual risk of **1.9E-5**.

As requested by the DoN, additional bounding risk calculations were performed using the EPA risk methodologies and PRG calculators to assess the total risk from potential soil and building surfaces under extremely conservative conditions. The calculations resulted in risks of 2.36E-6 and 3.54E-5 from soil and building surfaces, respectively. The total risk from both pathways under these conservative conditions is **3.78E-5**.

It is important to note that the final risk values from both methods are well within the acceptable EPA risk range of 10<sup>-4</sup> to 10<sup>-6</sup> and both methods produced similar results. This evaluation shows that using the activity concentrations at the instrumentation MDCs as inputs into the calculations under conservative conditions, the total risk from contaminated soils and building surfaces is less than the EPA recommended 12 mrem/y risk of 3E-4.

#### 5 References

- 1.0 Department of the Navy memo to SONGS, "San Onofre Nuclear Generating Station MESA Lease Clean Up Requirements", J.D. Williams, 20 Sep16.
- 2.0 Memorandum for File, Assessment of Radiological Events at the MESA, T Cooper (BHI), April 2014.
- 3.0 Upper Bound Radiation Dose Evaluation, San Onofre Nuclear Generating Station, MESA Facility, San Clemente, CA, Eric Goldin (BHI), 20 Oct 2015.
- 4.0 EPA Directive 9200-4.40, "Radiation Risk Assessment at CERCLA Sites: Q & A", May 2014.
- 5.0 NUREG-1757 Vol.1, Rev.1, Consolidated NMSS Decommissioning Guidance, Decommissioning Process for Materials Licensees.

#### Attachments

1. PRG Calculator Output for Resident Scenario with Cs-137+D in Soil at the MDC
2. BPRG Calculator Output for Resident Scenario with Cs-137+D on Building Surfaces at the MDC

## **Attachment 1**

### **PRG Calculator Output for Resident Scenario with Cs-137+D in Soil at the MDC**



## Site-Specific

### Resident Equation Inputs for Soil

RSCS TSD 16-078

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Variable	Value
TR (target cancer risk) unitless	1.0E-6
t <sub>res</sub> (time - resident) yr	26
ED <sub>res</sub> (exposure duration - resident) yr	26
ET <sub>res</sub> (exposure time - resident) hr/day	24
ET <sub>res-c</sub> (exposure time - resident child) hr/day	24
ET <sub>res-a</sub> (exposure time - resident adult) hr/day	24
ET <sub>res-i</sub> (exposure time - indoor resident) hr/day	16.416
ET <sub>res-o</sub> (exposure time - outdoor resident) hr/day	1.752
ED <sub>res-c</sub> (exposure duration - resident child) yr	6
ED <sub>res-a</sub> (exposure duration - resident adult) yr	20
EF <sub>res</sub> (exposure frequency - resident) day/yr	350
EF <sub>res-c</sub> (exposure frequency - resident child) day/yr	350
EF <sub>res-a</sub> (exposure frequency - resident adult) day/yr	350
IRS <sub>res-a</sub> (soil intake rate - resident adult) mg/day	100
IRS <sub>res-c</sub> (soil intake rate - resident child) mg/day	200
IRA <sub>res-a</sub> (inhalation rate - resident adult) m <sup>3</sup> /day	20
IRA <sub>res-c</sub> (inhalation rate - resident child) m <sup>3</sup> /day	10
IFS <sub>res-a</sub> (age-adjusted soil ingestion factor - resident) mg	1120000
IFA <sub>res-aq</sub> (age-adjusted soil inhalation factor - resident) m <sup>3</sup>	161000
GSF (gamma shielding factor - indoor) unitless	0.4
MLF (produce plant mass loading factor) unitless	0.26
Slab size for ACF (area correction factor) m <sup>2</sup>	500014
Cover thickness for GSF (gamma shielding factor) cm	0
IRV <sub>res-a</sub> (vegetable consumption rate - resident adult) g/day	128.9
IRV <sub>res-c</sub> (vegetable consumption rate - resident child) g/day	41.7
IFV <sub>res-a</sub> (age-adjusted vegetable ingestion factor - resident) g	989870
IFF <sub>res-a</sub> (age-adjusted fruit ingestion factor - resident) g	1462510
IRF <sub>res-a</sub> (fruit consumption rate - resident adult) g/day	188.5
IRF <sub>res-c</sub> (fruit consumption rate - resident child) g/day	68.1
CF <sub>res-contam</sub> (contaminated plant fraction) unitless	0.25
TR (target cancer risk) unitless	1.0E-6
ED <sub>res-c</sub> (exposure duration - resident child) yr	6
ED <sub>res-a</sub> (exposure duration - resident adult) yr	20
EF <sub>res-c</sub> (exposure frequency - resident child) day/yr	350

## Site-Specific Resident Equation Inputs for Soil

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Variable	Value
EF <sub>res</sub> (exposure frequency - resident adult) day/yr	350
City (Climate Zone)	0
A <sub>i</sub> (acres)	.5
Q/C <sub>soil</sub> (g/m <sup>2</sup> -s per kg/m <sup>3</sup> )	93.77
PEF (particulate emission factor) m <sup>-3</sup> /kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
U <sub>a</sub> (mean annual wind speed) m/s	4.69
U <sub>t</sub> (equivalent threshold value)	11.32
F(x) (function dependant on U <sub>a</sub> /U <sub>t</sub> ) unitless	0.194

# Site-Specific

Resident PRGs for Soil

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Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Particulate Emission Factor (m <sup>3</sup> /kg)	Lambda (1/yr)	Half-life (yr)	500014 m <sup>2</sup> Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Wet Soil-to-plant transfer factor (pCi/g-fresh plant per pCi/g-wet soil)
Cs-137+D	S	1.12E-10	2.53E-06	3.74E-11	4.26E-11	1.36E+09	2.30E-02	3.02E+01	1.00E+00	1.00E+00	2.52E-02

Isotope	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Consumption PRG (pCi/g)	Total PRG (pCi/g)	Total PRG (mg/kg)
Cs-137+D	2.79E+01	9.97E+04	6.07E-02	2.03E-01	4.66E-02	5.40E-10

**Site-Specific**  
Resident Risk for Soil

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Isotope	ICRP Lung Absorption Type	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Concentration (pCi/g)	Particulate Emission Factor (m <sup>3</sup> /kg)	Lambda (1/yr)	Half-life (yr)
Cs-137+D	S	S	1.12E-10	2.53E-06	3.74E-11	4.26E-11	1.10E-01	1.36E+09	2.30E-02	3.02E+01

*\*Total Risk*

500014 m <sup>2</sup> Soil Volume Area	0 cm Soil Volume Gamma Shielding Factor	Wet Soil-to-plant transfer factor (pCi/g-fresh plant per pCi/g-wet soil)	Ingestion Risk	Inhalation Risk	External Exposure Risk	Produce Consumption Risk	Total Risk
1.00E+00	1.00E+00	2.52E-02	3.95E-09	1.10E-12	1.81E-06	5.41E-07	2.36E-06
-	-	-	3.95E-09	1.10E-12	1.81E-06	5.41E-07	2.36E-06



## **Attachment 2**

### **BPRG Calculator Output for Resident Scenario with Cs-137+D on Building Surfaces at the MDC**

# Site-specific

## Resident Equation Inputs for Dust

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Variable	Value
TR (target cancer risk) unitless	1.0E-6
$t_{res}$ (time - resident) yr	26
ED <sub>res</sub> (exposure duration - resident) yr	26
F <sub>in</sub> (fraction time spent indoors) unitless	1
k (dissipation rate constant) yr <sup>-1</sup>	0.0
EF <sub>res</sub> (exposure frequency - resident) day/yr	350
EF <sub>res,c</sub> (exposure frequency - resident child) day/yr	350
EF <sub>res,a</sub> (exposure frequency - resident adult) day/yr	350
F <sub>am</sub> (area and material factor) unitless	1
ET <sub>res</sub> (exposure time) hr/day	24
F <sub>offset</sub> (off-set factor) unitless	1
F <sub>c</sub> (fraction of time spent in compartment) unitless	1
IFD <sub>res-adq</sub> (age-adjusted dust ingestion rate - resident) cm <sup>3</sup>	112014
FTSS <sub>h</sub> (fraction transferred surface to skin - hard surface) unitless	0.01
FTSS <sub>s</sub> (fraction transferred surface to skin - soft surface) unitless	0.01
SE (saliva extraction factor) unitless	0.5
SA <sub>res-c</sub> (surface area of fingers - resident child) cm <sup>2</sup>	16
SA <sub>res-a</sub> (surface area of fingers - resident adult) cm <sup>2</sup>	49
ED <sub>res,c</sub> (exposure duration - resident child) yr	6
ED <sub>res,a</sub> (exposure duration - resident adult) yr	20
ET <sub>res,c,h</sub> (exposure time - resident child hard surface) hr/day	4
ET <sub>res,a,h</sub> (exposure time - resident adult hard surface) hr/day	4
ET <sub>res,c,s</sub> (exposure time - resident child soft surface) hr/day	10
ET <sub>res,a,s</sub> (exposure time - resident adult soft surface) hr/day	10
FQ <sub>c</sub> (frequency of hand to mouth - child) event/hr	17
FQ <sub>a</sub> (frequency of hand to mouth - adult) event/hr	3



# Site-specific

Resident Building PRGs for Dust

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Radionuclide	Soil Ingestion Slope Factor (risk/pCi)	External Exposure Slope Factor (Ground Plane) (risk/yr per pCi/cm <sup>2</sup> )	Lambda (1/yr)	Half-life (yr)	Dissipation	Decay	Ingestion BPRG (pCi/cm <sup>2</sup> )	External Exposure BPRG (pCi/cm <sup>2</sup> )	Dust BPRG (pCi/cm <sup>2</sup> )	Dust BPRG (mg/cm <sup>2</sup> )
Cs-137+D	4.26E-11	5.07E-07	2.30E-02	3.02E+01	1.00E+00	4.50E-01	2.79E-01	1.05E-01	7.63E-02	8.83E-13

# Site-specific

Resident Risk for Dust

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Radionuclide	Soil Ingestion Slope Factor	External Exposure Slope Factor	Lambda (1/yr)	Halflife (yr)	Dissipation	Decay	Concentration (pCi/cm <sup>3</sup> )	Ingestion Risk	External Exposure Risk	Total Risk
	(risk/pCi)	(Ground Plane) (risk/yr per pCi/cm <sup>2</sup> )								
Cs-137+D	4.26E-11	5.07E-07	2.30E-02	3.02E+01	1.00E+00	4.50E-01	2.70E+00	9.69E-06	2.57E-05	3.54E-05
<i>*Total Risk</i>	-	-	-	-	-	-	-	9.69E-06	2.57E-05	3.54E-05