



DPG 20-027

February 20, 2020

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555-0001

Docket No. 72-11  
Rancho Seco Independent Spent Fuel Storage Installation  
License No. SNM-2510

**ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 2019**

Attention: Scott Morris

In accordance with Rancho Seco Quality Manual, Appendix A, Section 1.5.2.2, SMUD is submitting the Rancho Seco 2019 Annual Radiological Environmental Operating Report for the period of January 1, 2019 through December 31, 2019.

If you or members of your staff have questions requiring additional information or clarification, please contact me at (916) 732-4812 or by email at [Brad.Gacke@smud.org](mailto:Brad.Gacke@smud.org).

Sincerely,

A handwritten signature in black ink that reads "Brad Gacke". The signature is written in a cursive, flowing style.

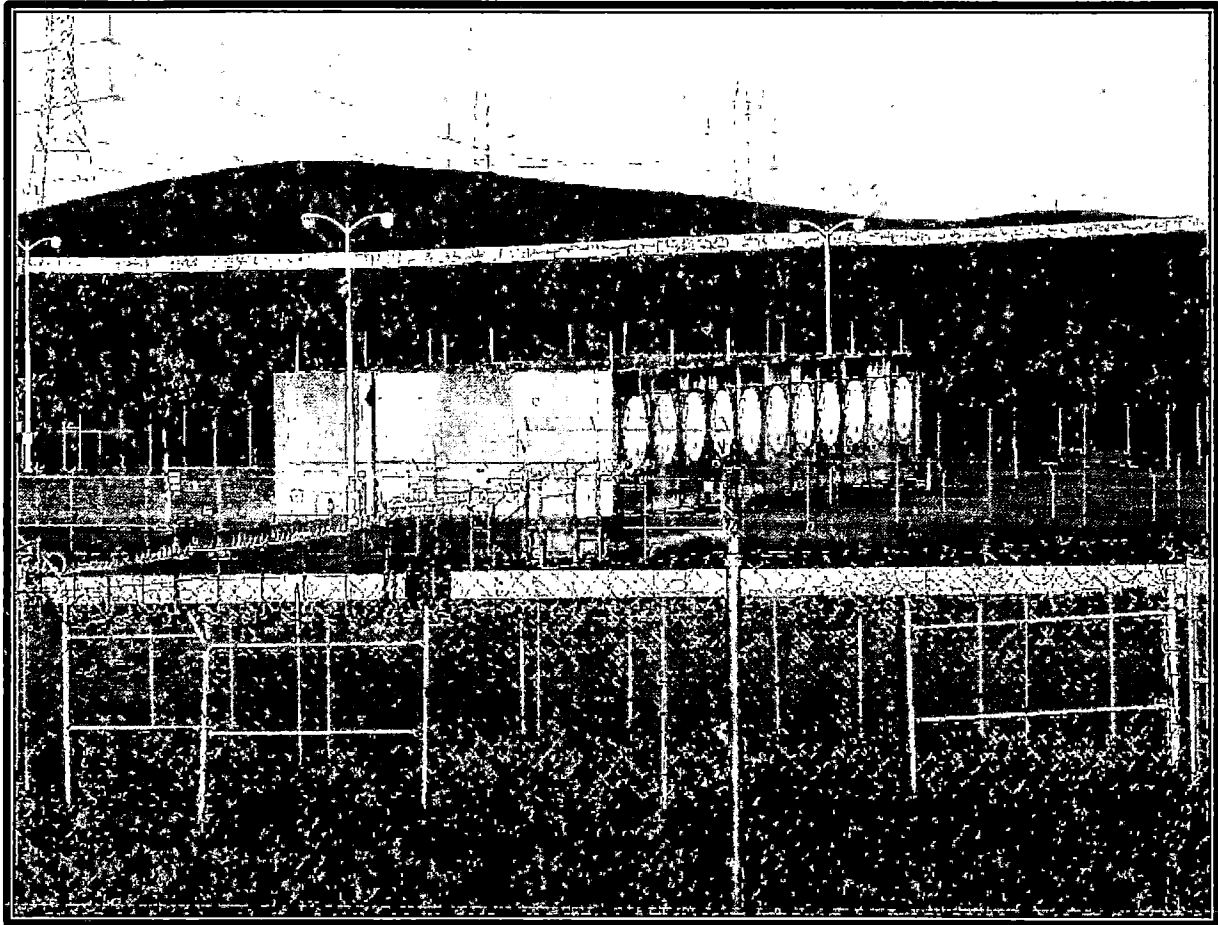
Brad Gacke  
Manager, Rancho Seco Assets

Enclosure (Rancho Seco Annual Radiological Environmental Operating Report for 2019)

Cc: NRC, Region IV w/ Enclosure  
William C. Allen, NRC w/ Enclosure  
RIC 1F.099 w/ Enclosure

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# **ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT**



**JANUARY - DECEMBER 2019**

**Rancho Seco Nuclear Station**

**Herald, California**

**10 CFR Part 72 License Number SNM-2510**

# 2019 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

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# 2019 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

## I. EXECUTIVE SUMMARY

This report contains results from the Radiological Environmental Monitoring Program (REMP) for the Rancho Seco Nuclear Station (RSNS) compiled for the period January 1, 2019 through December 31, 2019. This program is conducted by Sacramento Municipal Utility District (SMUD) staff in accordance with the REMP Manual. This report is compiled and submitted in accordance with the Rancho Seco Quality Manual, Appendix A, Section 1.5.2.2 [RS01].

The results of the 2019 Radiological Environmental Monitoring Program showed that operations at the Rancho Seco Nuclear Station had no significant radiological impact on the environment.

Phase I radiological dismantlement of the nuclear facility was completed in December 2008 and the release of the Rancho Seco property, except for the area associated with the Interim Onsite Storage Building (IOSB), from NRC license DPR-54 was approved on September 25, 2009. Phase II decommissioning activities, including the performance of Final Site Status Surveys, were performed in 2016 and early 2017. The NRC terminated the Part 50 license on August 31, 2018.

The remaining licensed area at the site consists of the approximately 14-acre Independent Spent Fuel Storage Installation (ISFSI) licensed under 10 CFR Part 72 for the storage of used nuclear fuel.

In accordance with the current site status, the REMP Manual reflects that the only normal remaining pathway to impact a member of the public at the Rancho Seco Nuclear Station is the direct radiation pathway from the ISFSI.

During the reporting period, the environs adjacent to RSNS were monitored using Luxel monitoring badges. Doses resulting from ambient exposure to terrestrial and atmospheric direct radiation sources were measured through the placement and retrieval of Luxel monitoring badges. Direct radiation measurements attributable to Station operations, based on control and indicator locations and review of historical data, ranged from indistinguishable above background levels to slightly elevated levels (approximately 1-2x BKGD).

## II. LAND USE CENSUS

With the completion of Phase I of Radiological Decommissioning in 2008, the requirement to perform a Land Use Census was removed as a required program from the Rancho Seco Quality Manual (RSQM).

## III. RADIOLOGICAL IMPACT EVALUATION

### PREDICTED POTENTIAL RADIOLOGICAL IMPACT

Gaseous Effluent Exposure Pathways

No gaseous effluent releases were conducted in 2019; therefore, no dose calculations were performed.

Liquid Effluent Exposure Pathways

The onsite liquid effluent pathway and any potential source of liquid effluents were removed during the decommissioning process; therefore, there were no liquid effluent releases conducted nor dose calculations performed for 2019.

**FUEL CYCLE DOSE EVALUATION**

REMP Manual section 8.1.4 requires each Annual Radiological Environmental Operating Report (AREOR) to include information related to REMP Manual section 5.0; Fuel Cycle Dose. The Fuel Cycle Dose Specification limits the annual dose or dose commitment to any real member of the public to 25 mrem to the total body or any organ, except the thyroid which is limited to 75 mrem. This specification implements requirements promulgated by the United States Environmental Protection Agency [CFRa].

Consistent with REMP Manual section 5.0, no fuel cycle dose evaluation was required to be performed during 2019 since no REMP measurement exceeded the established reporting levels. Additionally, with no liquid or gaseous effluent releases, effluent dose predictions did not exceed twice the dose guidelines of 10 CFR Part 50, Appendix I [CFRb]. Therefore, Appendix I guidelines for radioactive effluents were not exceeded and determination of an actual dose commitment delivered to a real member of the public was not required.

Analysis of the Luxel measurements taken at the perimeter of the facility (fence boundaries beyond which public access is not normally controlled) indicate that in no case could a real member of the public have received more than 25 mrem during 2019, indicating compliance with 10 CFR 72.104.

## OBSERVED POTENTIAL RADIOLOGICAL IMPACT

### Gaseous Effluent Exposure Pathways

No routine gaseous effluent pathways remain in the current site configuration. No gaseous effluents were released in 2019; therefore, no dose calculations were performed.

### Liquid Effluent Exposure Pathways

All liquid effluent pathways have been decommissioned at Rancho Seco. The REMP Manual was revised to delete all liquid exposure pathway sample locations in reflection of current site conditions, therefore, no dose calculations were completed for 2019.

### Direct Radiation Exposure Pathway

Based on Luxel control and indicator locations, and a review of historical data, the RSNGS did not contribute a significant component to the recorded direct gamma radiation field. The current year's data shows that there is little measurable direct radiation effect on the environment. Since RSNS is in a static materials storage condition and there are minimal direct radiation measurements of the surrounding environment, the conclusion remains that the Station has no significant direct radiation effect on the environment. This is the same conclusion that has been made since the fuel was placed into the ISFSI in 2002.

Luxel badge locations around the ISFSI security fence indicated higher readings, attributed to the fuel stored in the ISFSI, and are within design calculations. This monitoring is outside of the REMP and therefore the results of this monitoring are not included in this report.

## IV. PROGRAM ANALYSIS RESULTS SUMMARY

This section compiles Program data with corresponding evaluations. Each of the following subsections presents information about each of the principal environmental exposure pathways monitored by the Program:

### ⇒ Direct Radiation (Section IV-C)

Table 1 is a comprehensive data summary presented in a format considered acceptable by the US Nuclear Regulatory Commission. Information contained in Table 1 was derived from data presented in Appendix F.

## IV-A. ATMOSPHERIC MONITORING

### DATA EVALUATION

The REMP Manual was revised in January 2010 to delete all sample locations except for the Luxel direct radiation monitoring badges. No atmospheric monitoring data was collected.



## **IV-B. WATER MONITORING**

### **DATA EVALUATION**

The REMP Manual was revised in January 2010 to delete all sample locations except for the Luxel direct radiation monitoring badges. No water monitoring data was collected.

## **IV-C. DIRECT RADIATION MONITORING**

### **DATA EVALUATION**

The revision to the REMP Manual conducted in 2010 eliminated some locations where dose monitoring was performed to reflect the current status of the licensed facility as discussed above. During 2010, and again in 2011, the locations eliminated from the REMP continued to be monitored. Beginning in 2012, only the locations requiring monitoring by the REMP are being monitored. Comparisons of historical data on a year-to-year basis have been provided in previous reports. Because the environmental impact is so low, such comparisons will no longer be reported.

In addition to the Control Locations utilized for comparison purposes, Quality Control Luxels are included throughout the process to account for variables like dose received during shipment.

Luxel data for indicator and control locations during 2019 ranged from 2 to 13 mrem per quarter, with an average of 8.4 mrem. This confirms that there continues to be no significant observable direct radiation component due to Station operations (i.e., storage or utilization of licensed radioactive material within the restricted area).

The summary data for 2019 direct radiation monitoring is presented in Table 1. Comprehensive data tables are given in Appendix F, Table F-1.

TABLE 1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility Rancho Seco Nuclear Station Docket No. SNM-2510

Location of Facility Sacramento, California Reporting Period January - December 2019  
(County, State)

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (f) <sup>a</sup> Range	Location with Highest Annual Mean		Control locations Mean (f) <sup>a</sup> Range	Number of Non-routine Reported Measurements
				Name Distance & Direction	Mean (f) <sup>a</sup> Range		
Direct Radiation (mrem/qtr.)	Luxel 56	1 mrem/qtr	8.9 (48/48) (6-13)	RTL0.5 NP 0.5 miles 281°	10.8 (8/8) (9-13)	5.3 (8/8) (2-7)	0
				RTL0.4 PP 0.4 miles 293°	10.4 (8/8) (9-12)		

<sup>a</sup> Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses. (f)

## V. REFERENCES

- CFRa Code of Federal Regulations, "Environmental Radiation Protection Standards for Nuclear Power Operations," Title 40, Part 190.
- CFRb Code of Federal Regulations, "Domestic Licensing of Production and Utilization Facilities," Title 10, Part 50.
- NRC79a United States Nuclear Regulatory Commission, 1979, "An Acceptable Radiological Environmental Monitoring Program," Branch Technical Position, Revision 1.
- NRC79b United States Nuclear Regulatory Commission, 1979, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment," Regulatory Guide 4.15, Revision 2.
- NUREG79 United States Nuclear Regulatory Commission, 1979, "Radiological Effluent Technical Specifications for PWRs," NUREG-0472, Revision 2.
- NUREG80a United States Nuclear Regulatory Commission, 1980, "Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190)," NUREG-0543.
- RS01 RSLBD-010, Rancho Seco Quality Control Manual, Appendix A

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**VI. APPENDICES**

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## APPENDIX A: LAND USE CENSUS RESULTS

With the revision of the REMP Manual in January 2010, the requirement to complete a Land Use Census has been deleted.

The following information is provided for informational purposes only. The information is not intended to be used for regulatory compliance purposes.

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## APPENDIX B: SAMPLE SITE DESCRIPTIONS AND MAPS

This appendix provides descriptive information about the sampling locations and maps of all the locations for the Radiological Environmental Monitoring Program sites.

Table B-1 provides information on sample type, identification codes, and map location references. The sample identification code is an alphanumeric string beginning with the prefix "R" (for Rancho Seco Nuclear Station) followed by two letters to identify the sample media:

TL Direct Gamma Radiation (Luxel)

The numeric designations, which follow the letter designations, indicate the straight-line distance (in miles) from the center of the Reactor Building to the monitoring site.

The next letter designates the sector in which the monitoring location is located. The letters A through R are used for sector designators. The letters I and O are not used to prevent confusion with the numbers one and zero in the ID codes.

Sector Letter	Degrees Azimuth	Compass Point
A	348.75 to 11.25	N
B	11.25 to 33.75	NNE
C	33.75 to 56.25	NE
D	56.25 to 78.75	ENE
E	78.75 to 101.25	E
F	101.25 to 123.75	ESE
G	123.75 to 146.25	SE
H	146.25 to 168.75	SSE
J	168.75 to 191.25	S
K	191.25 to 213.75	SSW
L	213.75 to 236.25	SW
M	236.25 to 258.75	WSW
N	258.75 to 281.25	W
P	281.25 to 303.75	WNW
Q	303.75 to 326.25	NW
R	326.25 to 348.75	NNW

The final letter designation indicates if the location is part of the operational REMP program ("O") or post-operational REMP program ("P").

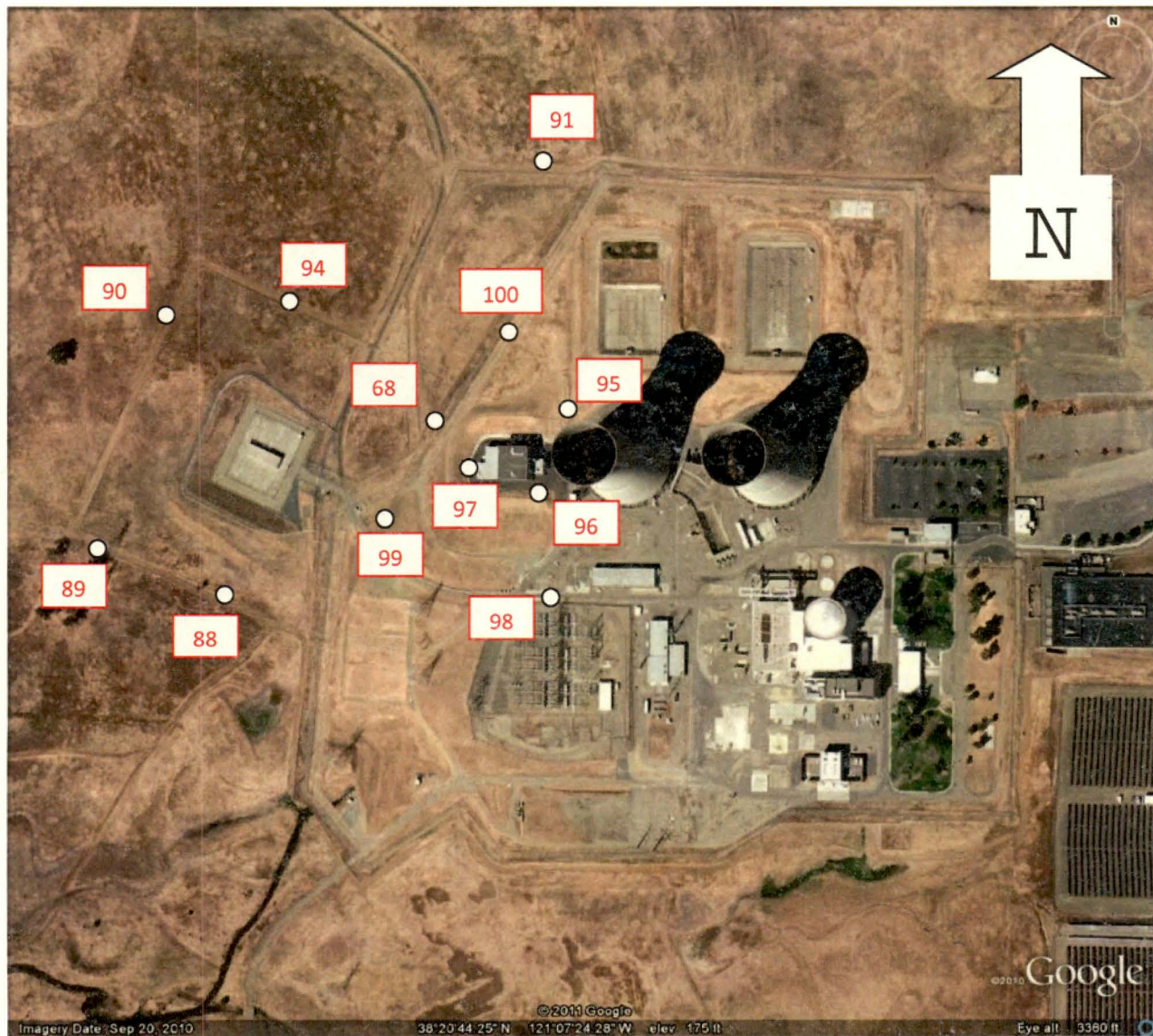
**Table B-1** Lists each location referencing the sample type and the location ID code to the map site number on one of the four Radiological Environmental Monitoring Site Maps included in this Appendix.

**Figure B-1** Site Location Map: Shows the locations of the sample locations near the Site.

**Figure B-2** Distant Locations Map: Control locations away from the site are shown on this map.

**Map Key**

- 9A Location that requires monitoring per REMP



**Figure B-1 Radiological Environmental Sampling Locations on and near the Site**





Figure B-2 Radiological Environmental Control Locations

**Table B-1  
Radiological Environmental Monitoring Sites and Map Locations**

Sample Type	ID Code	Class	Map Location No.	Collection Frequency	Description of Location	Miles	Sector
LUXEL	RTL1.7FO	CON	43	Quarterly	Well pump fence @ reservoir	1.7	G
LUXEL	RTL1.8FO	CON	19	Quarterly	Rancho Seco Lake Maintenance Building	1.8	F
LUXEL	RTL0.3PO	IND	68	Quarterly	West Perimeter Fence, West of IOSB	0.3	P
LUXEL	RTL0.3NP	IND	88	Quarterly	South ISFSI 100m Fence	0.3	N
LUXEL	RTL0.4NP	IND	89	Quarterly	Southwest Corner ISFSI 100 m Fence	0.4	N
LUXEL	RTL0.5NP	IND	90	Quarterly	Northwest ISFSI 100 m Fence	0.5	P
LUXEL	RTL0.3QP	IND	91	Quarterly	North Perimeter Fence/Pole UD034403	0.3	Q
LUXEL	RTL0.4PP	IND	94	Quarterly	North ISFSI 100 m Fence	0.4	P
LUXEL	RTL0.2PP	IND	95	Quarterly	Well East of IOSB	0.2	P
LUXEL	RTL0.2NP	IND	96	Quarterly	IOSB Electrical Transformer, SE corner	0.2	P
LUXEL	RTL0.3NP	IND	97	Quarterly	IOSB west roof access ladder	0.3	P
LUXEL	RTL0.2NP	IND	98	Quarterly	Switchyard Fence north side	0.2	N
LUXEL	RTL0.3NP	IND	99	Quarterly	ISFSI 100 meter fence, vehicle access gate	0.3	N
LUXEL	RTL0.3NP	IND	100	Quarterly	West Perimeter Fence, NW of IOSB	0.3	N

Note: Prior to the 2010 Report, the "Map Location No." used here was different than the "Location Number" used in Table F-1. To prevent confusion, the same numbering system is now used throughout the report.

\*The monitoring badge at Map Location No. 91 was moved approximately 30 feet southwest on November 20, 2018 to support removal of unnecessary fencing. The badge was moved from the fence to utility pole UD034403.

## APPENDIX C: QUALITY CONTROL SAMPLE ANALYSIS RESULTS

### QUALITY ASSURANCE AND CONTROL

Implementation of the Radiological Environmental Monitoring Program (REMP) consists of a number of discrete steps including:

- ⇒ Sample collection,
- ⇒ Packaging,
- ⇒ Shipment and receipt,
- ⇒ Measurements of radioactivity,
- ⇒ Data evaluation, and
- ⇒ Reporting.

These program elements are performed according to approved, written procedures to assure the validity of REMP results.

Because REMP measurement validity is important for evaluating protection of the health and safety of the public, RSNS has established an Environmental Quality Assurance Program (EQAP) for radiological environmental measurements. The Environmental QA Program implements the guidance provided in Regulatory Guide 4.15, [NRC79b].

### INTERLABORATORY COMPARISON PROGRAM

With the revision of the REMP Manual to delete all sample locations except for Direct Radiation monitoring locations, no discussion of Interlaboratory Comparison or analysis of laboratory Quality Assurance program is necessary.

### RANCHO SECO AUDIT AND SURVEILLANCE RESULTS

The Rancho Seco Quality Program requires periodic audits of REMP activities. Contract laboratory performance is evaluated by an independent Quality Assurance audit company and an "Approved Vendor List" is created from these audits. Audits are either conducted by independent Quality Assurance audit company or by reviewing audits conducted by other facilities (NUPIC audit review). Landauer is currently on the approved supplier list.

**DIRECT RADIATION (Luxel) COMPARISON PROGRAM**

Landauer maintains NVLAP certification with NIST. A review of Landauer's NVLAP certification results indicates that Landauer has satisfactorily completed all the required tests for the types of environmental radiation monitored at RSNS and is certified through December 31, 2020. NVLAP certification is considered to satisfy the interlaboratory comparison requirements for the direct radiation measurement devices.

This comparison program satisfies the requirement of the REMP Manual section 6.0.

## APPENDIX D: SAMPLE COLLECTION AND ANALYSIS METHODS

For each of the sample media collected, the method of collection is documented in Rancho Seco Nuclear Station procedures. A brief description of these collection and analysis methods is included in this Appendix.

<u>Sample Media</u>	<u>Collection/Analysis Method</u>
<b>DIRECT RADIATION</b>	Monitoring badges, (Luxels), are located within a two (2) mile radius of the site. The badges within a one (1) mile radius are considered indicator badges. Two (2) badges are placed at each monitoring location to assure adequate data recovery and to improve measurement statistics. The badge field exposure cycle is approximately ninety (90) days. At the end of the field exposure cycle, the badges are exchanged and returned to the contract laboratory for processing.

## APPENDIX E: ENVIRONMENTAL MONITORING PROGRAM DESIGN

### PROGRAM BASIS

The Sacramento Municipal Utility District conducts a continuous Radiological Environmental Monitoring Program (REMP) at the Rancho Seco Nuclear Station to assess the impact of Station operation on the surrounding environment. The current Post-Operational REMP has been revised to reflect the requirements of the ISFSI Technical Specifications for direct radiation monitoring.

During 2019, the program was directed and executed by the Manager, Rancho Seco Assets, who has primary accountability.

The Program is designed consistent with Title 10, Code of Federal Regulations, Part 50, Appendix I - Section IV, B.2, B.3 and C, and Appendix A, "General Design Criteria for Nuclear Power Plants," Criterion 64. The program also complies with Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation," Section 1302. These federal requirements are cited in the Rancho Seco Quality Manual, Appendix A, and the REMP Manual. REMP requirements are implemented through the review, approval and routine use of several documents, namely the REMP Manual, Surveillance Procedures and Health Physics Implementing Procedures.

The programmatic elements of the REMP are based on regulatory requirements and associated guidelines. The objectives of the Program are to:

1. Provide the technological basis and the instruction for monitoring the environs for radioactivity sources. The radioactive sources, which contribute to detectable radioactivity in the local environs, are comprised of:
  - ⇒ Naturally occurring background,
  - ⇒ Direct radiation from materials storage,
  - ⇒ World-wide weapons testing, and
  - ⇒ Major global nuclear accidents
2. Provide quantitative measurements in the direct radiation exposure pathway.
3. Provide indications of the largest potential radiation exposure for individuals because of radionuclides in the principal exposure pathways.

The Program is developed and conducted using recognized standards and practices NRC79a, NRC79b, NUREG79, and NUREG80a.

## REMP CHANGES

The REMP Manual and sampling program was revised during 2010 to delete all sample locations except for the direct radiation pathway. The requirement for a Land Use Census and conducting an ICP for the radioactivity analysis laboratory was also deleted.

No revisions to the REMP Manual have occurred since that revision.

## EXPOSURE PATHWAYS

The fundamental parameters, which have been defined prior to monitoring the environs, are:

1. Identification of the effluent release pathways
2. Identification of the human exposure pathways

Each of these parameters is discussed below.

### Effluent Release Pathways

The principal pathways which may result in human exposure to radiation and radioactive material originating from Station operation are direct radiation from onsite sources. Gaseous and liquid effluents are not currently being discharged or monitored.

#### Direct Radiation

In the direct radiation pathway, potential radiation exposure may occur from radioactive material storage areas, which are contained within the facility perimeter.

### MONITORING LOCATION SELECTION

The required monitoring sites are listed in the REMP Manual, Table 3. This program is supplemented with additional samples to compensate for changes in the radiological environment surrounding Rancho Seco. Indicator sites are placed in areas which would be most sensitive to the effects of Station operations. If radioactive material is detected above background at any of these indicator sites, observed potential exposure and dose to humans can be estimated to verify the effectiveness of the REMP in monitoring potential exposures or doses.

Control locations provide data that should not be influenced by the operations of Rancho Seco. These locations are selected based upon distance from the Station. Samples obtained from control locations should, upon analysis, reveal information about the presence and distribution of naturally occurring and man-made radioactive materials. Data from these locations are used to aid in the discrimination between the effects of Rancho Seco direct radiation sources and other natural phenomena or accidental releases, which may result in human exposure.

The direct radiation pathway is monitored through a network of monitoring badges at sites distributed in sectors centered on the Station. The badges are located primarily at the site around the ISFSI. This design provides the capability to easily detect Station-induced direct radiation contributions to the observed terrestrial and cosmic direct radiation background.

Some badges have been sited in locations to record direct radiation to provide 10 CFR Part 72 license required data for the Independent Spent Fuel Storage Installation (ISFSI).

Appendix B contains a detailed description and illustration of the REMP sample and monitoring locations.

## SAMPLE MEDIA

Samples are collected from predetermined monitoring sites at a specified frequency. The sample media chosen is a function of the type of monitoring desired and coincides with one of the following exposure pathways:

- o Direct radiation

**Direct radiation monitoring** is achieved by placing monitoring badges at aboveground sites. The monitoring badges respond to, and record the amount of, gamma radiation exposure. The source of this gamma radiation exposure is varied and includes potential Station effluents, naturally occurring terrestrial, and cosmogenic radionuclides. The monitoring badges are also influenced by seasonal and global (fallout) radiation sources.

There are 14 sites that require monitoring per the REMP, which are within a 2-mile radius of the RSNS. The monitoring badges are placed at the Station Industrial Area Boundary, at the ISFSI and IOSB, and at control locations located beyond one mile of the Station.

## SAMPLE ANALYSIS & DATA HANDLING

Data comparisons are made between individual control and indicator sample sites to isolate potential Station influences on the measurement results. Quality Control dosimeters stored in a shielded storage location during the measurement period, but kept with the dosimeters during shipping and storage measure non-environmental doses and this amount is subtracted from the total measurements at the monitoring and control locations.

The summarized results of the 2019 Radiological Environmental Monitoring Program are presented in Table 1:

Individual (raw data) results are presented in Appendix F, Table F-1.



## REGULATORY REPORTING LEVELS

Sample analysis data is reviewed and evaluated by the Staff as the results are received. All sample analysis results are reviewed for correct sensitivity and anomalies.

The activity concentration values listed in Table E-1 are the environmental Fuel Cycle Dose quantities that, if exceeded, require a Special Report to be submitted to the USNRC. In accordance with the REMP Manual (Section 5, Fuel Cycle Dose), the Special Report must include an evaluation of any release conditions, environmental factors or other aspects, which caused the reporting limits to be exceeded.

In addition to the Fuel Cycle Dose reporting requirements, a Special Report is required to be submitted to the USNRC when more than one of the radionuclides in Table E-1 are detected in the sampling medium and the summed ratio of detected activity concentration to the respective Reporting Level concentration is greater than, or equal to, unity (1). When radionuclides other than those listed in Table E-1 are detected which are a result of Station effluents, a Special Report is required to be submitted if the potential annual dose commitment exceeds the 10 CFR 50, Appendix I guidelines.

No reports of the types described above were required to be submitted during 2019.

## SENSITIVITY OF THE REMP MEASUREMENT PROCESS

All Program measurements must be performed at a sensitivity, which meets USNRC requirements. This sensitivity is determined "before the fact" (*a priori*) for each radionuclide of interest and sample analysis type. Typical controllable sensitivity parameters include:

- ⇒ Sample volume or mass
- ⇒ Sampling efficiency
- ⇒ Time from sample collection to measurement
- ⇒ Instrument detection efficiency for the nuclides (energies) of interest
- ⇒ Background radiation levels
- ⇒ Chemical recovery factors

By adjusting and controlling each of these parameters to maximize measurement process efficiency, a maximum sensitivity level (activity concentration) can be specified for each nuclide of interest and analysis type while maintaining an economic measurement process. The maximum sensitivities in the REMP are specified by the USNRC in the REMP Manual approved for Rancho Seco. These sensitivities are referred to as "LLD's", an acronym for "Lower Limit of Detection". LLD's are specified on an "*a priori*" basis and apply to routine measurement process capabilities when no other interfering radioactivity is present. The word "routine" is emphasized since occasional circumstances, such as limited sample mass, elevated levels of background radiation and interfering nuclides can contribute to sensitivity degradation.

Such occurrences are normally noted and reported during the conduct of REMP activities.

Meeting the LLD requirements is a quality control function shared by both REMP and the analytical laboratory personnel. Once the laboratory establishes values for the controllable parameters for each analysis type, sample chain of custody controls ensure that these parameters are upheld. If all parameters are upheld, then compliance with the LLD requirements has been demonstrated. No specific LLD values for Program measurements are included in this report as no applicable monitoring was performed.

Since most of the samples analyzed result in the detection decision "activity not identified", a Minimum Detectable Activity (MDA) concentration value is calculated and reported. This value can be thought of as the LLD-at-the-time-of-counting since it is calculated using an equation which is similar to the one used to establish LLD parameters. The biggest difference is that actual (not "a priori") parameters are used, including interference from natural radioactive material in the sample. It is important to note that MDA's are reported only for those measurements where the "activity not identified" decision has already been made.

MDA values are used primarily to identify changes in the measurement process and to convey more information about the measurement itself. Without the use of the MDA concept, most Program measurements would be reported simply as "<LLD". With MDA used, Program measurements are reported as "< xxx " where "xxx" is the calculated MDA concentration.

With the revision of the REMP Manual to delete all exposure pathways except for direct radiation, these sensitivities are no longer applicable to the current monitoring program.

**APPENDIX F: 2019 SAMPLE ANALYSIS RAW DATA TABLES**

**TABLE F-1**

**2019 Luxel Badge Summary (Direct Radiation)**  
 Quarterly  
 (mrem)

Location Number	ID	Description	Type	2019-1	2019-2	2019-3	201-4
19	RTL1.8FO	RS Lake Maintenance Building	C	4	5	5	5
43	RTL1.7FO	RS Lake Well Enclosure	C	6	5	7	7
68	RTL0.3PO	Site fence west by IOSB	I	8	7	9	9
88	RTL0.3NP	ISFSI south fence	I	9	7	10	10
89	RTL0.4NP	ISFSI south fence	I	7	7	8	10
90	RTL0.5NP	ISFSI west fence	I	10	10	12	12
91	RTL0.3QP	Site fence NW corner	I	8	7	8	9
94	RTL0.4PP	ISFSI fence north	I	11	9	11	11
95	RTL0.2PP	IOSB Well	I	11	9	11	11
96	RTL0.2NP	IOSB Electrical Transformer	I	9	9	10	10
97	RTL0.3NP	IOSB Roof Access Ladder	I	9	9	9	10
98	RTL0.2NP	Switchyard Fence	I	7	8	9	9
99	RTL0.3NP	100 Meter Fence	I	10	8	10	10
100	RTL0.3NP	Access Road NW of IOSB	I	9	8	9	10

Minimal Reporting Dose is 1 mrem.

I = Indicator Location / C = Control Location

M = Missing Data, see Appendix G

**APPENDIX G: 2019 MISSED SAMPLE REPORT**

In accordance with the requirements REMP Manual section 3.1, the following samples are being reported as not being collected for the reasons indicated. Corrective action as required by the REMP Manual is as indicated.

**Direct Monitoring Pathway (Luxel Badge)**

No Luxel badges were missing from their locations in 2019.