

U. S. NUCLEAR REGULATORY COMMISSION

REGION V

Report Nos. 50-206/86-19, 50-361/86-14, 50-362/86-14

Docket Nos. 50-206, 50-361, 50-362

License Nos. DPR-13, NPF-10, NPF-15

Licensee: Southern California Edison Company  
P. O. Box 800  
2244 Walnut Grove Avenue  
Rosemead, California 91770

Facility Name: San Onofre Units 1, 2, and 3

Inspection at: Camp Pendleton

Inspection Conducted: April 15-24, 1986 and inoffice review of data through  
May 13, 1986

Inspectors: G. H. Hamada 5/29/86  
G. H. Hamada, Radiation Laboratory  
Specialist Date Signed

J. Moore 5/29/86  
J. Moore, Radiation Specialist Date Signed

Approved by: G. P. Yunas 5/29/86  
G. P. Yunas, Chief Date Signed  
Facilities Radiological Protection Section

Summary:

Inspection of April 15-24, 1986 and inoffice review of data through May 13, 1986 (Report Nos. 50-206/86-19, 50-361/86-14, 50-362/86-14)

Areas Inspected: Routine, announced inspection of capability of chemistry and radiochemistry laboratories to adequately perform the required measurements. A review of the Unit 2 secondary water polishing system, as well as the Unit 1 post accident sample system measurement capability, (was) also performed.

Inspection activities conducted are covered by inspection modules 84725 and 79701.

Results: No items of noncompliance were identified in the areas inspected.

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DETAILS

1. Persons Contacted

- A. Abusamra, Engineer II
- D. Bascom, Engineer I
- \*E. Bennett, Quality Assurance Engineer
- \*S. Chick, Engineer, Nuclear chemistry
- \*C. Couser, Compliance Engineer
- \*G. Gibson, Supervisor, Compliance
- J. Heflin, Effluent Foreman
- \*R. Jervey, Quality Assurance Engineer
- R. Lacuata, Nuclear chemistry Technician
- \*J. Mundis, Supervisor, Nuclear Services
- P. Penseyres, Supervisor, Station chemistry
- \*R. Warnock, HP Engineering Supervisor
- \*J. Winter, Engineer
- \*J. Young, Supervising Engineer, chemistry

\*Indicates licensee personnel present at exit interview.

2. Discussion

Measurements were performed for liquids and gases which were split for analysis by Unit 1 Chemistry, Unit 2/3 Chemistry and the NRC Mobile Laboratory. Unit 2/3 Health Physics (HP) was also included in the analysis of particulate filter and charcoal cartridge samples. The results are tabulated below:

Table 1

Unit 1 Liquid Waste

<u>Nuclide</u>	<u>Songs 1</u> <u>uCi/ml</u>	<u>NRC</u> <u>uCi/ml</u>	<u>Ratio</u> <u>Songs/NRC</u>	<u>*Agreement</u> <u>Range</u>
Mn-54	4.17 E-6	4.40 E-6	0.95	0.75-1.33
Co-57	4.10 E-7	1.79 E-7	2.29	0.40-2.50
Co-58	9.99 E-5	1.06 E-4	0.94	0.80-1.25
Co-60	8.83 E-5	1.15 E-4	0.77	0.80-1.25
Cs-134	6.64 E-5	7.08 E-5	0.94	0.80-1.25
Cs-137	2.33 E-4	2.29 E-4	1.02	0.85-1.18

\*See enclosure for explanation.

Table 2

Unit 1 RCS Liquid

<u>Nuclide</u>	<u>Songs 1</u> <u>uCi/ml</u>	<u>NRC</u> <u>uCi/ml</u>	<u>Ratio</u> <u>Songs 1/NRC</u>	<u>Agreement</u> <u>Range</u>
Mn-54	1.21 E-3	1.13 E-3	1.07	0.80-1.25
Co-57	1.95 E-4	1.76 E-4	1.11	0.75-1.33
Co-58	5.10 E-2	4.85 E-2	1.05	0.85-1.18
Co-60	1.69 E-2	1.61 E-2	1.05	0.85-1.18
Cs-134	5.25 E-3	4.52 E-3	1.16	0.80-1.25
Cs-137	8.25 E-3	7.59 E-3	1.09	0.80-1.25

Table 3

Unit 1 Suspended Solids

<u>Nuclide</u>	<u>Songs 1</u> <u>uCi/ml</u>	<u>NRC</u> <u>uCi/ml</u>	<u>Ratio</u> <u>Songs 1/NRC</u>	<u>Agreement</u> <u>Range</u>
Cr-51	9.62 E-6	8.23 E-6	1.17	0.75-1.33
Mn-54	5.30 E-6	4.69 E-6	1.13	0.75-1.33
Fe-59	1.26 E-6	8.49 E-7	1.48	0.50-2.00
Co-57	1.78 E-7	2.13 E-7	0.84	0.60-1.66
Co-58	4.95 E-5	4.44 E-5	1.11	0.80-1.25
Co-60	3.88 E-5	3.50 E-5	1.11	0.80-1.25
Cs-134	1.69 E-6	1.97 E-6	0.86	0.75-1.33
Cs-137	3.00 E-6	2.88 E-6	1.04	0.75-1.33

The results in Tables 1, 2, and 3 represent analyses performed by Unit 1 Chemistry on a relatively low activity liquid sample, a relatively high activity liquid sample and a sample simulating a particulate filter geometry, respectively. The results indicate adequate agreement between Unit 1 Chemistry and the NRC.

Table 4

Liquid Waste

<u>Nuclide</u>	<u>Songs 2/3 Chem</u> <u>uCi/ml</u>	<u>NRC</u> <u>uCi/ml</u>	<u>Ratio</u> <u>Songs/NRC</u>	<u>Agreement</u> <u>Range</u>
Cr-51	1.91 E-5	2.10 E-5	0.91	0.60-1.66
Mn-54	2.64 E-6	3.18 E-6	0.83	0.60-1.66
Fe-59	7.82 E-7	9.16 E-7	0.85	0.50-2.00
Co-58	2.45 E-5	2.48 E-5	0.99	0.80-1.25
Co-60	6.70 E-6	7.29 E-6	0.92	0.75-1.33
Zr-95	1.21 E-6	1.96 E-6	0.62	0.60-1.66
Nb-95	2.42 E-6	2.91 E-6	0.83	0.75-1.33
Ag-110M	1.33 E-6	1.16 E-6	1.15	0.60-1.66
I-131	7.34 E-7	8.36 E-7	0.88	0.50-2.00
Cs-134	7.93 E-6	7.42 E-6	1.07	0.75-1.33
Cs-137	1.08 E-5	9.98 E-6	1.08	0.75-1.33

Table 5

Unit 3 Waste Gas

<u>Nuclide</u>	<u>Songs 2/3 Chem</u> <u>uCi/cc</u>	<u>NRC</u> <u>uCi/cc</u>	<u>Ratio</u> <u>Songs/NRC</u>	<u>Agreement</u> <u>Range</u>
Xe-131M	9.90 E-4	7.20 E-4	1.38	0.40-2.5
Xe-133	7.78 E-2	8.12 E-2	0.96	0.85-1.18
Xe-133M	3.01 E-4	2.84 E-4	1.06	0.40-2.5
Xe-135	1.13 E-4	9.13 E-5	1.24	0.60-1.66

Tables 4 and 5 summarize the results obtained by Unit 2/3 Chemistry for a relatively low activity liquid and a waste gas sample. Adequate agreement was obtained for both categories.

Table 6

Charcoal CartridgeUnit 3 Containment

<u>Nuclide</u>	<u>Songs 2/3 HP</u> <u>uCi/cc</u>	<u>Songs 2/3 Chem</u> <u>uCi/cc</u>	<u>NRC</u> <u>uCi/cc</u>	<u>Ratio</u> <u>Chem/NRC</u>	<u>Agreement</u> <u>Range</u>
Br-82	8.97 E-11	9.86 E-11	1.16 E-10	0.85	0.80-1.25
I-131	3.41 E-9	3.71 E-9	4.16 E-9	0.89	0.85-1.18
I-132	1.05 E-11	1.28 E-11	1.17 E-11	1.09	0.60-1.66
I-133	7.71 E-10	8.53 E-10	9.50 E-10	0.90	0.80-1.25
I-135	1.32 E-10	1.48 E-10	1.58 E-10	0.94	0.75-1.33
Na-24	-	-	2.32 E-12		
Cs-137	-	-	2.55 E-12		

Table 6 shows that while agreement was achieved for the charcoal cartridge geometry, not all of the nuclides identified by the NRC were identified by chemistry or HP. It appears that concentrations of Na-24 and Cs-137 were too low to be detected under the counting conditions used by both HP and chemistry. However, even if the characteristic peaks of these nuclides had been present, they would not have been identified because San Onofre uses a halogen only library for charcoal cartridge measurements. It should not be assumed that non-halogen activity will always be negligible in charcoal cartridge samples. A simple solution is to use a more comprehensive library for quantifying charcoal cartridge activity.

Table 7

## Unit 3 RCS Liquid

<u>Nuclide</u>	<u>Songs 2/3 Chem</u> uCi/ml	<u>NRC</u> uCi/ml	<u>Ratio</u> Songs/NRC	<u>Agreement</u> Range
Na-24	1.66 E-2	1.57 E-2	1.06	0.80-1.25
I-131	7.76 E-3	7.91 E-3	0.98	0.80-1.25
I-132	9.54 E-2	7.72 E-2	1.24	0.80-1.25
I-133	6.36 E-2	6.14 E-2	1.04	0.85-1.18
I-134	1.96 E-1	1.65 E-1	1.19	0.80-1.25
I-135	1.13 E-1	1.19 E-1	0.95	0.80-1.25
Cs-134	1.33 E-3	1.74 E-3	0.76	0.60-1.66
Cs-137	2.95 E-3	2.74 E-3	1.08	0.75-1.33
Cs-138	2.34 E-1	1.99 E-1	1.18	0.80-1.25
Ba-139	1.82 E-2	1.77 E-2	1.03	0.75-1.33
Xe-133	-	2.27 E-2	-	-

Table 8

## Unit 3 Stripped Gas

<u>Nuclide</u>	<u>Songs 2/3 Chem</u> uCi/ml	<u>NRC</u> uCi/ml	<u>Ratio</u> Songs/NRC	<u>Agreement</u> Range
Kr-85M	3.66 E-2	4.44 E-2	0.82	0.75-1.33
Kr-87	5.36 E-2	5.87 E-2	0.91	0.60-1.66
Kr-88	8.02 E-2	8.68 E-2	0.92	0.75-1.33
Xe-133	1.16 E 0	1.33 E 0	0.87	0.85-1.18
Xe-133M	1.64 E-2	2.15 E-2	0.76	0.60-1.66
Xe-135	2.15 E-1	2.48 E-1	0.87	0.80-1.25

Table 7 summarizes the results obtained for a reactor coolant sample from which the gases had been stripped. Table 8 shows the results obtained for the corresponding stripped gas fraction. Both fractions show adequate agreement. The Xe-133 result for the liquid fraction is listed only to show the relative gas stripping efficiency of the stripping procedure. The results indicate good stripping efficiency.

Table 9

## Suspended Solids

(Unit 3)

<u>Nuclide</u>	<u>Songs (HP)</u> uCi/ml	<u>Songs (Chem)</u> uCi/ml	<u>NRC</u> uCi/ml	<u>Ratio</u> Songs (Chem)/ NRC	<u>Agreement</u> Range
Cr-51	3.13 E-4	3.19 E-4	3.15 E-4	1.01	0.80-1.25
Mn-54	5.97 E-6	6.11 E-6	6.23 E-6	0.98	0.75-1.33
Mn-56	1.73 E-4	1.73 E-4	1.66 E-4	1.04	0.75-1.33

Nuclide	Songs (HP)	Songs (Chem)	NRC	Ratio	Agreement Range
	uCi/ml	uCi/ml	uCi/ml	Songs (Chem)/ NRC	
Fe-59	6.86 E-4	8.04 E-6	7.56 E-6	1.06	0.75-1.33
Co-58	1.53 E-4	1.59 E-6	1.53 E-4	1.04	0.85-1.18
Co-60	9.33 E-6	9.12 E-6	9.30 E-6	0.98	0.80-1.25
Ni-65	-	9.47 E-5	7.52 E-5	1.26	0.75-1.33
Cu-64	5.86 E-4	5.91 E-4	5.99 E-4	0.99	0.60-1.66
Zr-95	2.88 E-5	3.03 E-5	2.92 E-5	1.04	0.80-1.25
Zr-97	8.88 E-5	9.81 E-5	8.50 E-5	1.15	0.80-1.25
Nb-95	2.16 E-5	2.14 E-5	2.05 E-5	1.04	0.80-1.25
	(9.34 E-5)	(9.95 E-5)			
Nb-97	3.65 E-4	8.39 E-4	9.50 E-5	1.05	0.80-1.25
Mo-99	3.94 E-5	2.68 E-5	3.47 E-5	0.77	0.75-1.33
Tc-99M	2.51 E-5	2.72 E-5	2.70 E-5	1.01	0.80-1.25
Ru-103	7.75 E-6	8.60 E-6	7.06 E-6	1.22	0.75-1.33
		(2.20 E-5)			
Ru-105	-	8.34 E-5	2.24 E-5	0.98	0.60-1.66
		(2.54 E-5)	(2.22 E-5)		
Te-132	-	4.10 E-5	3.89 E-5	1.14	0.75-1.33
	(1.95 E-6)	(2.19 E-6)			
I-131	4.63 E-6	4.50 E-6	2.15 E-6	1.02	0.60-1.66
	(2.16 E-5)	(2.08 E-5)	(2.17 E-5)		
I-132	4.56 E-5	6.67 E-5	1.13 E-4	0.96	0.80-1.25
I-133	1.60 E-5	1.43 E-5	1.68 E-5	0.85	0.80-1.25
I-135	2.76 E-5	2.86 E-5	2.84 E-6	1.01	0.75-1.33
Sb-122	-	3.52 E-6	4.01 E-6	0.88	0.60-1.66
Ba-139	6.66 E-5	6.20 E-5	4.93 E-5	1.26	0.50-2.00
La-140	4.60 E-6	3.29 E-6	3.68 E-6	0.89	0.75-1.33
Ce-141	1.45 E-6	-	1.27 E-6	-	0.60-1.66
W-187	4.46 E-5	4.06 E-5	4.46 E-5	0.91	0.75-1.33
		(1.30 E-4)			
Np-239	1.39 E-4	2.85 E-4	1.41 E-4	0.92	0.85-1.18

A thousand ml of reactor coolant was filtered through a membrane filter to obtain the suspended solids sample. A sample of this type is useful not only as a test for the particulate filter geometry, but because a suspended solids sample often contains a complex mix of radionuclides, also as a test for measurement system parameters such as resolution, sensitivity, peak search algorithm, etc. For this particular sample, three sets of results were obtained from Unit 2/3 Chemistry, Unit 2/3 Health Physics (HP), and the NRC. All three measurement systems are computer based multichannel analyzer systems which depend on the system software to analyze and summarize the raw data. The results in the table are summary data generated by the system software. Results in brackets are calculated values that have been corrected for various effects. For example, the "as obtained" results for I-131 by HP and chemistry do not agree with the NRC. Examination of the peak analysis data revealed that while the NRC showed both a 366 Kev peak and a 364 Kev peak, only a 365 Kev peak was identified by both the chemistry and HP systems. A further examination of the data showed that the resolution of the 365 Kev peak as indicated by the full-width-at-half-maximum (FWHM) was abnormally high (poor) for both the HP and chemistry measurements. This high FWHM was

apparently caused when the 364 Kev and 366 Kev peaks were combined into a single peak. On the expectation that a complex spectrum such as this (e.g., 113 peaks were identified by the peak analysis program) could produce anomalies, it was requested that SONGS provide not only the full report but also the channel by channel counts for this spectrum. A review of the channel by channel count data indicated that two peaks, 364 Kev and 366 Kev, appeared to be present in the HP measurement, but only one relatively broad peak was indicated in the chemistry measurement. In the HP case, the hardware (detector) was able to separate the two peaks, but the software (peak algorithm) was unable to resolve the peaks. For the chemistry measurement, the detector apparently was not good enough to resolve the two energies involved. This is not surprising when the FWHM for the Co-60 1333 Kev line is examined. For the HP detector, the FWHM for the 1333 Kev energy is 1.97 Kev, while the FWHM for the 1333 Kev line is 2.86 Kev for the chemistry detector. The key energy for I-131 is the 364 Kev line. The 366 Kev interference originates from two sources. When significant amounts of Mo-99 are present, the 366.43 Kev line, while only 1.37% abundant, becomes observable. The 366.27 Kev line (4.61% abundant) from Ni-65 is the other source. In this case, the biggest contribution came from Ni-65. When the contribution from the 366 Kev line to the I-131 peak (364 Kev) was manually subtracted out, the results agreed.

The reason why HP failed to report certain radionuclides like Ni-65, Ru-105, etc., is because these nuclides apparently are not included in the HP library file.

Large discrepancies for Nb-97 were also observed. Examination of the data revealed that the disagreement was caused by improper correction for half life. The half life for Nb-97 is 72 minutes and this is the value recorded in the nuclide library file for both the HP and chemistry systems. However, when Nb-97 is in equilibrium (transient) with its parent, Zr-97, it decays with a half life of 16.90 hours; the half life of Zr-97. The corrected values (in brackets) agree quite well indicating that this indeed was the case for this sample.

The discrepancy observed for Ru-105 was caused by interference from Zr-95. This interference resulted because of a poor choice of the "key line" for Ru-105. The key line is the energy selected by the user to quantify the activity of the nuclide. Although the energy, 724.20 Kev, selected by chemistry is the most abundant (49%), it also coincides with the 724.18 Kev line (43.7% abundant) of Zr-95. Because Ru-105 has other lines with sufficient abundance to give reasonable counting statistics, a line less subject to interference, such as the 469 Kev line, should be used as the key line.

The only photon (larger than 50 Kev) of abundance greater than 2% emitted by Te-132 is the 88.5% abundant 228.16 Kev line. A 228.19 Kev line (10.72% abundant) which cannot be resolved from the Te-132 line is also present in Np-239 decay. In a sample such as this, where significant Np-239 activity is present, all of the six listed Np-239 lines are observed. By determining the Np-239 activity based on the other lines, the contribution of Np-239 to the 228 Kev line can be calculated. The

net activity due to Te-132 can thus be obtained. It should be pointed out that Te-132 (or any other Te radioisotope) is usually not observed. Often, Te-132 appears in the report because of contributions entirely from Np-239 and/or Cs-138. (The 227.76 Kev peak from Cs-138 cannot be resolved from the 228 Kev line.) In this case, however, Te-132 activity appears to be real. First, there is an excess of activity in the 228 Kev peak beyond that due to Np-239, and no Cs-138 was detected in this sample. The second reason, which is more compelling, has to do with the disagreement in the I-132 results. As the table indicates, the I-132 results do not agree. A review of the raw data indicated that significant I-132 decay (I-132 half life is 2.30 hours) had taken place since separation of the sample. For example, the HP measurement was made 2½ hours after sampling, chemistry 4 hours, and the NRC 5½ hours. If, however, the Te-132 half life (3.25 days) is used to correct for decay on the assumption that I-132 is in equilibrium (transient) with its parent, Te-132, then good agreement is achieved.

The result for Np-239 obtained by chemistry does not agree with the values obtained by HP or NRC. Examination of the peak data revealed that the 103 Kev and 106 Kev lines had been combined and reported as a single peak at 105 Kev because the detector-software combination was not able to resolve these peaks. (The reported FWHM for the 105 Kev peak was 4.72 Kev.) The HP system readily resolved these peaks and obtained results in good agreement with the NRC. It can be seen from the above discussion that much can be learned about system capability by performing a detailed review of data from complex spectra such as those obtained for suspended solids.

On the basis of the above findings, the licensee agreed to make some of the more obvious changes in system parameters, e.g., key line changes, half life changes, etc. In addition, the licensee will be reevaluating whether or not the poor resolution detector is acceptable for routine use. It should be pointed out that this particular detector is only one of three detectors routinely used by Unit 2/3 Chemistry. The newest and best detector has a resolution (FWHM) of approximately 1.9 Kev for the 1333 Kev energy.

Both units 2 and 3 recently installed state of the art secondary polishing systems which can control ionic contaminants down to the parts per trillion level. The main purpose of this system was to create sufficient cleanup capacity to handle various condenser leak scenarios. Currently, however, neither system is in operation because of sulfate contamination problems. Significant quantities of sulfate appeared to be coming from the polishing system, and it was suspected that the new small uniform sphere ion exchange resin (cation) was the source. Tests run by the supplier (Dow Chemical) confirmed that the source of the sulfate was the new cation exchange resin. The systems are being switched over to another type of resin of proven stability and procedures are being developed for operation of the polishers with this resin. Different procedures are needed for different resins because differences in particle size, density, etc., require different flow parameters and different regeneration parameters. When fully operational, these polishers are expected to provide secondary water of high quality and



also provide sufficient reserve cleanup capacity to handle significant condenser leak problems.

Because the Unit 1 PASS system had undergone changes and was being prepared for cold run tests, it appeared to be an appropriate time to conduct a review of the PASS measurement system. Intrinsic germanium detectors with good resolution (1.90 Kev or better at 1333 Kev) have been installed and calibration for the "low" geometry has been completed. Two measurement systems are in place. One of the detectors is set up to monitor containment atmosphere, and the other to monitor reactor coolant. Each detector has three geometries for measuring the sample. For the reactor coolant system, three collimators consisting of tungsten tubes with internal diameters (ID) of 0.080, 0.437 and 1.50 inches were inserted through twelve inches of lead through which the coolant could be measured. For the containment atmosphere measurement system, a similar arrangement but with collimator IDs of 0.25, 0.742 and 1.50 inches were used. The collimator with the largest opening (1.50 inches) is labeled "low" geometry. The other openings are "high" geometry and "high high" for the smallest opening. A National Bureau of Standards (NBS) standard encased in stainless steel similar in shape and size to the stainless steel tube through which the reactor coolant is measured was used for the calibration. The isotope mix for this standard included Ba-133, Cs-134, Cs-137, and Co-60. While this source was adequate for calibrating the "low" geometry, it appears that it is not strong enough to give the desired data points in the lower energy region of the calibration curve for the "high high" geometry. In the next few months when the new gamma spectrometer system has been installed, a recalibration of the "high high" geometry will be made by using long counts (24 hours or longer as needed) on the NBS standard. The adequacy of the calibration for the "low" geometry was demonstrated by taking a reactor coolant grab sample for analysis in the chemistry laboratory and comparing these results with the on-line measurement results obtained by the PASS system. Good agreement was obtained for the nuclides identified.

### 3. Exit Interview

Inspection findings were discussed with licensee personnel indicated in paragraph 1. Licensee management was informed of the overall agreement obtained for the various sample categories tested. It was also pointed out that when quantifying charcoal cartridge activity, contribution from all species present be included.

Enclosure

Criteria for Accepting the Licensee's Measurements

<u>Resolution</u>	<u>Ratio</u>
<4	0.4 - 2.5
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
200	0.85 - 1.18

Comparison

1. Divide each NRC result by its associated uncertainty to obtain the resolution. (Note: For purposes of this procedure, the uncertainty is defined as the relative standard deviation, one sigma, of the NRC result as calculated from counting statistics.)
2. Divide each licensee result by the corresponding NRC result to obtain the ratio (licensee result/NRC).
3. The licensee's measurement is in agreement if the value of the ratio falls within the limits shown in the preceding table for the corresponding resolution.