U. S. NUCLEAR REGULATORY COMMISSION

REGION V

Report Nos. 50-206/85-16, 50-361/85-15, 50-362/85-14

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

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

Licensee: Southern California Edison Company
2244 Walnut Grove Avenue
Rosemead, California 91770

Facility Name: San Onofre Units 1, 2, 3

Inspection at: Camp Pendleton

Inspection conducted: April 2-10, 1985

Inspector: G. H. Hamada 6-3-85
G. H. Hamada, Radiation Laboratory Specialist Date Signed

Approved By: G. Yuhas 6/3/85
G. Yuhas, Chief
Facilities Radiological Protection Section Date Signed

Summary:

Inspection of April 2-10, 1985 (Report Nos. 50-206/85-16, 50-361/85-15 50-362/85-14)

Areas Inspected: Routine, announced inspection of capability of laboratories to perform required chemical and radiochemical analyses. The inspection involved the Region V Mobile Laboratory and the onsite inspection hours totaled 61 hours by one inspector.

In addition to the onsite inspection effort, an in-office inspection involving a detailed review of sample data and telephone discussions with cognizant licensee personnel was conducted through May 8, 1985.

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

DETAILS

1. Persons Contacted

*E. Bennett, Quality Assurance Engineer
*D. Brevig, Supervisor, Site Nuclear and Chemistry
*S. Chick, Engineer, Nuclear Chemistry
*P. Croy, Manager, Compliance
*R. Erickson, Senior Engineer
J. Heflin, Effluent Foreman
*K. Helm, Effluent Engineer
*C. Kergis, Compliance Engineer
*P. King, Quality Assurance Supervisor
*T. Mackey, Jr., Compliance Supervisor
*R. McWey, Chemistry, Units 2/3 Supervisor
*D. Schone, Site Quality Assurance Manager
*V. Woodall, Chemistry Unit 1, Foreman
*J. Young, Supervising Engineer, Chemistry

*Indicates personnel present at exit interview.

2. Discussion

The NRC Mobile Laboratory was brought onsite to perform split sample comparisons with the Unit 1 and Units 2/3 laboratories. A review of chemical and radiochemical procedures and practices was also conducted. This review involved discussions with laboratory personnel and observation of specific measurements.

During the period of this inspection, Unit 2 was not in operation. Normally, the Unit 1 laboratory performs chemical and radiochemical measurements for Unit 1 and the Unit 2 laboratory serves the same function for both Units 2 and 3. In addition, Health Physics maintains its own gamma spectroscopy equipment. It is intended that these systems would serve as backup to each other as needed. In view of this situation, split sample comparisons were conducted, where feasible, with all three entities. The results are tabulated below.

Table 1

Unit 1 - Reactor Coolant from Pressurizer

(April 5, 1985 - 9:15 a.m.)

Nuclide	SONGS #1 uCi/ml	NRC uCi/ml	Ratio SONGS/NRC	Agreement* Range
Na-24	7.50 E-4	5.45 E-4	1.38	0.60 - 1.66
I-131	1.60 E-3	1.43 E-3	1.12	0.75 - 1.33
I-132	1.01 E-2	8.87 E-3	1.14	0.80 - 1.25
I-133	9.49 E-3	8.98 E-3	1.06	0.80 - 1.25
I-134	1.04 E-2	1.03 E-2	1.01	0.75 - 1.33
I-135	1.40 E-2	1.46 E-2	0.96	0.75 - 1.33
Cs-134	4.67 E-4	3.03 E-4	1.54	0.50 - 2.00
Cs-137	9.54 E-4	8.39 E-4	1.14	0.75 - 1.33
Cs-138	1.25 E-2	1.21 E-2	1.03	0.75 - 1.33

*See enclosure for explanation.

Table 2

Unit 1 - Stripped Gas - Reactor Coolant from Pressurizer

(April 5, 1985 - 9:15 a.m.)

Nuclide	SONGS #1 uCi/CC	NRC uCi/CC	Ratio SONGS/NRC	Agreement Range
Kr-85M	1.13 E-3	1.27 E-3	0.89	0.75 - 1.33
Kr-87	4.07 E-4	5.42 E-4	0.75	0.60 - 1.66
Kr-88	1.52 E-3	1.78 E-3	0.85	0.75 - 1.33
Xe-133	6.83 E-2	7.64 E-2	0.89	0.85 - 1.18
Xe-133M	1.47 E-3	1.82 E-3	0.81	0.60 - 1.66
Xe-135	1.32 E-2	1.50 E-2	0.88	0.80 - 1.25

Table 3

Unit 1 - Reactor Coolant from Letdown

(April 5, 1985 - 8:10 a.m.)

Nuclide	SONGS #1 uCi/ml	NRC uCi/ml	Ratio SONGS/NRC	Agreement Range
Na-24	1.50 E-3	1.11 E-3	1.35	0.60 - 1.66
I-131	1.95 E-3	2.16 E-3	0.90	0.75 - 1.33
I-132	2.09 E-2	2.27 E-2	0.92	0.80 - 1.25
I-133	1.30 E-2	1.25 E-2	1.04	0.80 - 1.25
I-134	3.24 E-2	4.19 E-2	0.77	0.75 - 1.33
I-135	2.28 E-2	2.31 E-2	0.99	0.75 - 1.33
Cs-134	5.03 E-4	6.27 E-4	0.80	0.50 - 2.00
Cs-137	1.13 E-3	8.05 E-4	1.40	0.50 - 2.00
Cs-138	4.34 E-2	5.32 E-2	0.82	0.80 - 1.25
Ba-139	8.52 E-3	7.52 E-3	1.13	0.60 - 1.66

The results in Tables 1 and 2 are the Unit 1 primary coolant liquid and stripped fission gas activities, respectively. Currently, reactor coolant samples are being obtained from the pressurizer because of difficulties in obtaining samples from the normal sampling point. For a time, samples were being drawn from the Post-Accident Sampling System (PASS) sampling point, but because of a leaky valve in this line, sampling at this location was discontinued in favor of the pressurizer. The results indicate satisfactory agreement for both categories.

Table 3 summarizes the results for reactor coolant liquid obtained from letdown. (Note the approximately one hour difference in sampling time between the two samples.) Unit 1 chemistry routinely obtains reactor coolant samples from this location in addition to those from the pressurizer for additional information. While the splits (within group) show adequate agreement, between group results (Table 1 vs. Table 3) indicate significant differences. These differences are due in part to differences in sampling time and sampling location. In either case, however, the absolute levels are only a small fraction of regulatory limits (100/Ē and/or Iodine limit).

Table 4

Unit 1 - Suspended Solids in Reactor Coolant

Nuclide	SONGS #2 uCi/ml	SONGS #1 uCi/ml	SONGS-HP uCi/ml	NRC uCi/ml	Agreement Range
Na-24	4.23 E-7	7.02 E-7	5.59 E-7	5.31 E-7	0.50 - 2.00
Cr-51	8.04 E-5	7.81 E-5	8.16 E-5	8.14 E-5	0.80 - 1.25
Mn-54	1.62 E-6	1.62 E-6	1.37 E-6	1.82 E-6	0.75 - 1.33
Mn-56	1.84 E-5	1.90 E-5	1.51 E-5	1.92 E-5	0.75 - 1.33
Fe-59	2.22 E-6	1.91 E-6	2.02 E-6	1.93 E-6	0.60 - 1.66
Co-58	2.20 E-4	2.15 E-4	2.04 E-4	2.20 E-4	0.85 - 1.18
Co-60	1.20 E-5	1.13 E-5	1.09 E-5	1.18 E-5	0.80 - 1.25
Ni-65	3.92 E-5	4.20 E-5	3.23 E-5	4.02 E-5	0.75 - 1.33
Cu-64	2.47 E-4	2.30 E-4	-	2.53 E-4	0.60 - 1.66
As-76	7.18 E-6	6.63 E-6	-	7.76 E-6	0.75 - 1.33
Sr-91	1.94 E-6	1.54 E-6	-	2.47 E-6	0.60 - 1.66
Sr-92	1.42 E-6	4.84 E-6	-	1.68 E-6	0.60 - 1.66
Zr-97	4.88 E-7	3.21 E-7	-	5.47 E-7	0.50 - 2.00
Nb-97	6.71 E-7	-	-	9.66 E-7	0.50 - 2.00
Mo-99	3.88 E-6	3.44 E-6	-	4.49 E-6	0.60 - 1.66
Ru-103	8.62 E-7	7.71 E-7	6.74 E-7	6.90 E-7	0.50 - 2.00
Sb-122	1.54 E-5	1.69 E-5	-	1.67 E-5	0.80 - 1.25
Sb-124	3.68 E-6	3.34 E-6	-	3.16 E-6	0.75 - 1.33
I-132	3.37 E-5	9.80 E-5	5.81 E-5	6.57 E-6	0.75 - 1.33
I-133	1.48 E-6	1.57 E-6	1.77 E-6	1.71 E-6	0.60 - 1.66
I-134	-	-	-	8.35 E-6	0.75 - 1.33
I-135	1.98 E-6	-	1.13 E-6	3.80 E-6	0.60 - 1.66
Cs-137	6.36 E-7	9.18 E-7	1.33 E-6	9.46 E-7	0.60 - 1.66
Cs-138	-	-	-	5.73 E-5	0.75 - 1.33
Ba-139	7.12 E-5	-	-	9.66 E-5	0.80 - 1.25
Ba-140	3.00 E-6	3.06 E-6	3.00 E-6	2.59 E-6	0.50 - 2.00
Ce-143	8.48 E-7	7.83 E-7	-	6.05 E-7	0.40 - 2.50
W-187	4.67 E-6	4.32 E-6	5.13 E-6	6.12 E-6	0.60 - 1.66
Np-239	4.34 E-6	3.88 E-6	3.98 E-6	4.35 E-6	0.75 - 1.33

Table 5

Unit 3 - Suspended Solids in Reactor Coolant

Nuclide	SONGS #1 uCi/ml	SONGS #2 uCi/ml	SONGS - HP uCi/ml	NRC uCi/ml	Agreement Range
Na-24	9.12 E-5	8.93 E-5	7.80 E-5	7.35 E-5	0.75 - 1.33
Cr-51	9.10 E-4	1.02 E-3	1.00 E-3	9.16 E-4	0.75 - 1.33
Mn-56	2.44 E-5	5.77 E-5	-	4.69 E-5	0.40 - 2.50
Fe-59	4.88 E-5	6.28 E-5	3.74 E-5	3.81 E-5	0.60 - 1.66
Co-58	3.66 E-4	4.15 E-4	3.76 E-4	3.88 E-4	0.80 - 1.25
Co-60	5.39 E-5	5.31 E-5	4.93 E-5	5.09 E-5	0.75 - 1.33
Zr-95	2.02 E-4	1.94 E-4	2.01 E-4	1.98 E-4	0.75 - 1.33
Nb-95	2.44 E-4	2.44 E-4	2.46 E-4	2.33 E-4	0.80 - 1.25
Zr-97	2.17 E-4	2.25 E-4	2.30 E-4	2.09 E-4	0.80 - 1.25
Nb-97	2.56 E-4	2.45 E-4	2.55 E-4	2.61 E-4	0.80 - 1.25
Mo-99	1.76 E-3	1.44 E-3	1.73 E-3	1.76 E-3	0.80 - 1.25
Ru-103	6.49 E-5	6.05 E-5	6.56 E-5	7.22 E-5	0.75 - 1.33
I-131	1.32 E-3	1.36 E-3	1.37 E-3	1.31 E-3	0.80 - 1.25
I-132	7.41 E-4	6.92 E-4	8.36 E-4	7.31 E-4	0.80 - 1.25
I-133	2.53 E-3	2.61 E-3	2.59 E-3	2.58 E-3	0.80 - 1.25
I-134	-	-	-	3.46 E-4	0.60 - 1.66
I-135	1.06 E-3	1.13 E-3	1.02 E-3	1.11 E-3	0.80 - 1.25
Cs-134	7.60 E-4	7.91 E-4	7.70 E-4	7.99 E-4	0.80 - 1.25
Cs-136	3.30 E-4	3.23 E-4	3.12 E-4	3.36 E-4	0.80 - 1.25
Cs-137	1.43 E-3	1.47 E-3	1.46 E-3	1.43 E-3	0.80 - 1.25
Ba-140	4.69 E-5	7.06 E-5	4.83 E-5	3.85 E-5	0.40 - 2.50
La-140	1.59 E-5	1.23 E-5	2.09 E-5	1.75 E-5	0.60 - 1.66
Ce-141	-	6.78 E-6	-	1.08 E-5	0.50 - 2.00
Ce-143	-	1.98 E-5	2.19 E-5	2.24 E-5	0.50 - 2.00
W-187	6.87 E-5	7.43 E-5	9.87 E-5	9.81 E-5	0.60 - 1.66
Np-239	6.69 E-4	7.80 E-4	7.88 E-5	7.28 E-4	0.80 - 1.25

A particulate filter geometry was simulated by filtering reactor coolant (1000 ml) through a 47 ml membrane filter to collect the suspended solids. This procedure was used as a test for the particulate filter geometry because particulate filter samples with sufficient activity to measure could not be obtained. The listing in Table 4 shows the multitude of fission and activation products detected in the suspended solids fraction. By concentrating the suspended particles through filtration of a one liter sample, many nuclides were identified which otherwise would not have been detected in the normal coolant sample size of 1-5 ml. Poor counting statistics due to a combination of low concentration and decay resulted in certain nuclides not being detected by one or more parties involved in the test.

Table 5 summarizes the results for suspended solids in Unit 3 reactor coolant. As in the previous case, the results indicate satisfactory agreement among participants.

Table 6

Unit 3 - Reactor Coolant Liquid

Nuclide	SONGS #3 uCi/ml	NRC uCi/ml	Ratio SONGS/NRC	Agreement Range
Na-24	1.04 E-1	9.38 E-2	1.11	0.80 - 1.25
Rb-88	1.69 E-0	2.06 E-0	0.82	0.75 - 1.33
I-131	2.59 E-1	2.49 E-1	1.04	0.80 - 1.25
I-132	3.28 E-1	2.85 E-1	1.15	0.80 - 1.25
I-133	7.12 E-1	6.98 E-1	1.02	0.85 - 1.18
I-134	2.38 E-1	2.31 E-1	1.03	0.80 - 1.25
I-135	5.07 E-1	4.83 E-1	1.05	0.80 - 1.25
Cs-134	1.58 E-2	1.44 E-2	1.10	0.60 - 1.66
Cs-137	2.26 E-2	2.52 E-2	0.90	0.75 - 1.33
Cs-138	1.09 E-0	1.03 E-0	1.06	0.80 - 1.25

Table 7

Unit 3 - Stripped Gas

Nuclide	SONGS #3 uCi/ml	NRC uCi/ml	Ratio SONGS/NRC	Agreement Range
Kr-85M	4.38 E-1	4.16 E-1	1.05	0.85 - 1.18
Kr-87	4.59 E-1	4.16 E-1	1.10	0.75 - 1.33
Kr-88	8.13 E-1	7.28 E-1	1.12	0.80 - 1.25
Xe-133	4.74 E-0	4.42 E-0	1.07	0.85 - 1.18
Xe-133M	1.57 E-1	1.34 E-1	1.17	0.75 - 1.33
Xe-135	2.18 E-0	1.97 E-0	1.11	0.85 - 1.18

Tables 6 and 7 are the results for Unit 3 reactor coolant liquid and stripped gases, respectively. Good agreement is indicated for both categories. Based on NRC results, the I-131 dose equivalent activity during this period was 0.492 microcuries per ml.

Table 8

Charcoal Cartridge from Unit 3 Containment

Nuclide	SONGS #1 uCi/CC	SONGS #3 uCi/CC	SONGS - HP uCi/CC	NRC uCi/CC	Agreement Range
Na-24	-	-	-	4.54 E-13	0.50 - 2.00
Br-82	2.56 E-12	2.45 E-12	2.52 E-12	2.54 E-12	0.75 - 1.33
I-131	1.11 E-9	1.09 E-9	1.22 E-9	1.06 E-9	0.85 - 1.18
I-132	-	1.01 E-12	-	1.11 E-12	0.50 - 2.00
I-133	1.20 E-10	1.20 E-10	1.27 E-10	1.18 E-10	0.85 - 1.18
I-135	1.62 E-11	1.59 E-11	1.72 E-11	1.62 E-11	0.75 - 1.33
Cs-134	-	-	-	2.26 E-12	0.75 - 1.33
Cs-136	-	-	-	5.33 E-13	0.50 - 2.00
Cs-137	-	-	-	3.76 E-12	0.75 - 1.33

Table 8 shows the results for a charcoal cartridge sample obtained from Unit 3 containment. While the agreement is good for the nuclides reported, not all identifiable nuclides were identified. Except for Br-82, the only other nuclides identified were the iodine isotopes. The normal procedure at San Onofre is to use a halogen library, consisting mostly of iodine isotopes, to quantify charcoal cartridge measurements. Consequently, other nuclides that may be present are not identified. If the objective is to identify and measure all radioactive species in containment air, then all activities from the particulate filter as well as the charcoal cartridge should be included in the total. This would require a less exclusive library file for both sample categories.

Table 9

Unit 3 - Liquid Waste Tank (T-076)

Nuclide	SONGS #3 uCi/ml	NRC uCi/ml	Ratio SONGS/NRC	Agreement Range
Cr-51	2.45 E-5	1.77 E-5	1.38	0.60 - 1.66
Mn-54	7.79 E-6	5.30 E-6	1.47	0.75 - 1.33
Fe-59	1.61 E-6	1.48 E-6	1.09	0.50 - 2.00
Co-58	3.17 E-5	2.15 E-5	1.47	0.80 - 1.25
Co-60	2.02 E-5	1.37 E-5	1.47	0.75 - 1.33
Zr-95	1.01 E-5	4.05 E-6	2.50	0.60 - 1.66
Nb-95	1.64 E-5	7.66 E-6	2.14	0.75 - 1.33
Sb-124	3.56 E-6	3.25 E-6	1.10	0.60 - 1.66
Sb-125	1.21 E-5	1.16 E-5	1.04	0.60 - 1.66
I-131	7.45 E-6	7.24 E-6	1.03	0.75 - 1.33
Cs-134	1.60 E-4	1.52 E-4	1.05	0.80 - 1.25
Cs-136	3.21 E-6	2.88 E-6	1.11	0.60 - 1.66
Cs-137	3.37 E-4	3.09 E-4	1.09	0.85 - 1.18
Xe-133	9.36 E-4	9.98 E-4	0.94	0.85 - 1.18
Xe-133M	1.57 E-5	1.68 E-5	0.93	0.60 - 1.66
Xe-135	1.89 E-5	2.03 E-5	0.93	0.75 - 1.33

Table 9 summarizes the results for a liquid waste sample from Unit 3. Except perhaps for Cesium, the concentrations of the various nuclides identified are more or less typical of activities routinely found in Unit 3 liquid waste, including the fission gases. Cesium 137 and Cesium 134 appear to be a little higher than "normal". More typically, they are found in the E-5 microcuries per ml range. On the other hand, the corrosion products occasionally have been detected in the E-4 microcuries per ml range. While the agreement is good for the fission products (Cesiums and Iodine), the "agreement" appears to be poor for the corrosion products. (It is thought that most, if not all, of the zirconium is activation product zirconium rather than fission product zirconium). The apparent disagreement is not caused by measurement errors but by nonuniform corrosion product content in the split fractions. Corrosion products tend to be associated with suspensoids and consequently are subject to nonproportional splitting unlike true solutions. There is ample evidence that calibration is not the problem. In Table 9, the energy mix (including secondary photons) of those nuclides that show good agreement more or less span the entire energy spectrum of the efficiency curve, and calculations based on secondary photons also show good agreement. Recognizing that a sampling problem exists for this category of waste, the licensee routinely obtains two samples for analysis separated by a minimum time interval of 10 minutes. Using criteria similar to those of the NRC, an "agreement range" has been established to determine whether the results agree. Should the ratio fall outside the range, a third sample is obtained. In either case, the highest result is reported.

A one liter sample of condensed steam from generator "C" in Unit 1 was obtained for analysis. Unit 1 laboratory was not able to detect measurable activity in this sample. With the knowledge that this sample contained little or no activity, the NRC performed a long overnight count. Both Ag-110M, and Cs-137 were positively identified in the sample at 6.6 E-8 microcuries per ml and 9.3 E-9 microcuries per ml, respectively. Six of the more abundant Ag-110M peaks were detected leaving little doubt about its identity. Neither Ag-110M, nor Cs-137 could be detected in several overnight background measurements. It is not known why only these two nuclides (especially Ag-110M) showed up in the secondary system. For example, no measurable silver was detected in the primary system (see Table 1). While this observation has little regulatory significance it is recorded here as a point of interest and for future reference. Perhaps an explanation will be forthcoming with more experience and additional data.

At San Onofre, routine effluent analysis for gross alpha, Sr-89, Sr-90, and Fe-55 are contracted out for analysis. San Onofre recently changed its contractor laboratory from EAL in Richmond, California to Isotopes, Inc. in Westwood, New Jersey. As an extension of the Mobile Laboratory split sample quality assurance program, the NRC also occasionally provides spiked samples to the licensee or its contractor laboratory for analysis. Through NRC's reference laboratory (Radiological and Environmental Sciences Laboratory of the Department of Energy) a spiked sample is being sent to San Onofre for submittal to its contractor laboratory (Item No. 85-15-01). When the results become available, a supplemental report will be issued.

The in-office inspection phase primarily involved review and evaluation of sample data obtained during the onsite inspection. Because of interference from various sources nuclides not present are frequently identified as being present. Less frequently, nuclides that may be present in the sample are not reported. The latter situation usually arises because of "energy tolerance" and/or "abundance ratio" deficiencies. [Energy tolerance is a user set range (photon energy ± 1.25 Kev in our case) within which all photon energies in the library file are matched against and identified as being present. Abundance ratio is a user set value, in percent, which sets a limit (50% in our case) on the percent of total photons from a given nuclide that must be present for the nuclide to be identified.] The following example illustrates these points.

In the software summary report for the liquid waste sample (Table 9), Sb-124 was not identified as being present. A review of the nuclide by nuclide analysis section of the report indicated that for Sb-124, the 50.0% abundant 1691 Kev and 11.8% abundant 723 Kev peaks were identified but not the 98.1% abundant 602.71 Kev peak. Antimony 124 was thus rejected because it did not meet the abundance ratio limit of 50%. But because the 1691 Kev line is relatively specific for Sb-124, at least within the population of the more common fission and activation products, there was reason to believe that Sb-124 could be present. If so, why was not the 602.71 Kev identified? A review of the raw peak data indicated that a significant peak was present at 601.16 Kev. This peak, however, was greater than 1.25 Kev removed from the assigned energy of 602.71 Kev for Sb-124 and thus was rejected as belonging to Sb-124 because it did not satisfy the energy tolerance criterion. Small gain shifts (energy shifts) are not uncommon in gamma spectroscopy systems, and this is certainly true of the NRC system. This is an area that requires frequent monitoring. In this particular case, however, the energy calibration was excellent as evidenced by the fact that the 661.62 Kev Cs-137 peak was reported at 661.67 Kev and the 604.66 Kev Cs-134 peak at 604.78 Kev. It, therefore, appeared that the "problem" was in the software and not the hardware (amplifiers). An early clue that something unusual was happening in this energy region came when the "full-width-at-half-maximum" (FWHM) value was examined. (The FWHM is a measure of resolution. A high value indicates poor resolution.) The FWHM at 601.16 Kev gave a value of 2.61 Kev as opposed to a FWHM of 1.46 Kev for the 569.37 Kev line and a FWHM of 1.42 Kev for the 604.78 Kev line. The FWHM for the 601.16 Kev line, therefore, was almost twice what it should be for this energy region. This degradation was most likely due to interference but it did not appear to be interference from energy lines from other nuclides in this energy region. An examination of the peak raw data revealed a large peak at 795.76 Kev from Cs-134. Calculation of the Compton edge resulting from this peak showed that it falls at 602.36 Kev, an energy less than 0.5 Kev from the 602.71 Kev line of Sb-124. It appeared that although the peak algorithm was able to pull out the peak from the compton edge interference, it shifted the centroid channel and thus the energy down to 601.16 Kev. On the basis of the above review and evaluation, it was concluded that Sb-124 was present in the sample. Other similar evaluations were performed for all other samples. The above example is documented here to show that careful evaluation of measurement data is necessary if reliable information is to be obtained.

3. Exit Interview

Inspection findings were discussed with licensee personnel indicated in paragraph 1. Licensee management was apprised of the generally satisfactory outcome of the split sample tests.

Enclosure

Criteria for Accepting the Licensee's Measurements

Resolution	Ratio
<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.