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FEB 2 8 2019

L-2019-038
10 CFR 50.36a

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

Re: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
2018 Annual Radioactive Effluent Release Report

Pursuant to 10 CFR 50.36a(a)(2) and Technical Specification (TS) 6.9.1.7, enclosed is the 2018 Annual Radioactive Effluent Release Report for St. Lucie Units 1 and 2. The report provides information for the 12-month period beginning January 1, 2018 and ending December 31, 2018.

Enclosure 1 includes the Combined Annual Radioactive Effluent Release Report. Enclosure 2 is a copy of C-200, Offsite Dose Calculation Manual (ODCM), Revision 52.

Please contact me at 772-467-7036 with any questions regarding this submittal.

Sincerely,

Michael J. Snyder
Licensing Manager
St. Lucie Plant

MJS/rcs

Enclosures

ENCLOSURE 1

COMBINED ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
(10 PAGES)

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE UNITS 1 AND 2
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
JANUARY 1, 2018 THROUGH DECEMBER 31, 2018

1.0 PROGRAM DESCRIPTION

Regulatory Limits

The Offsite Dose Calculation Manual (ODCM) Radiological Effluent Control limits applicable to the release of radioactive material in liquid and gaseous effluents are described in the following sections.

Fission and Activation Gases (Noble Gases)

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to less than or equal to 500 mrem/yr to the whole body and less than or equal to 3000 mrem/yr to the skin.

The air dose due to noble gases released in gaseous effluents, from each unit, to areas at and beyond the site boundary shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation, and

b. During any calendar year: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

Iodine-131, Iodine-133, Tritium, Carbon-14, and Radioactive Material in Particulate Form

The dose rate due to iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half lives greater than 8 days, released in gaseous effluents from the site to areas at and beyond the site boundary, shall be limited to less than or equal to 1500 mrem/yr to any organ.

The dose to a MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium, carbon-14, and all radionuclides in particulate form with half lives greater than 8 days in gaseous effluents released, from each unit, to areas at and beyond the site boundary, shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrem to any organ, and

b. During any calendar year: Less than or equal to 15 mrem to any organ.

Liquid Effluents

The concentration of radioactive material released in liquid effluents to unrestricted areas shall be limited to 10 times the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2.0E-4 μCi/ml total activity.

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each unit, to unrestricted areas shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mRem to the whole body and to less than or equal to 5 mrem to any organ, and

b. During any calendar year to less than or equal to 3 mRem to the whole body and to less than or equal to 10 mrem to any organ.

Total Dose

The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem.

Effluent Concentration Limits

Gaseous Effluents

For gaseous effluents, effluent concentration limits (ECL) values are not directly used in release rate calculations since the applicable limits are expressed in terms of dose rate at the site boundary.

Liquid Effluents

The values specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 are used as the ECL for liquid radioactive effluents released to unrestricted areas. A value of 2.0E-04 μCi/ml is used as the ECL for dissolved and entrained noble gases in liquid effluents.

Measurements and Approximations of Total Radioactivity

Measurements of total radioactivity in liquid and gaseous radioactive effluents were accomplished in accordance with the sampling and analysis requirements of Tables 4.11-1 and 4.11-2, respectively, of the St. Lucie ODCM. Estimates of errors are in accordance with Methodology Section 4.0.4, of the ODCM.

The estimate of errors associated with values reported are as follows:

	LIQUID		GASEOUS	
Error Topic	Avg. %	Max. %	Avg. %	Max. %
Release Point Mixing	2	5	NA	NA
Sampling	1	5	2	5
Sample Preparation	1	5	1	5
Sample Analysis	3	10	3	10
Release Volume	2	5	4	15
Total %	9	30	10	35

(above values are examples only)

The predictability of error for radioactive releases can only be applied to nuclides that are predominant in sample spectrums. Nuclides that are near background relative to the predominant nuclides in a given sample could easily have errors greater than the above listed maximums.

Liquid Radioactive Effluents

Each batch release was sampled and analyzed for gamma emitting radionuclides using gamma spectroscopy, prior to release. Composite samples were analyzed monthly for tritium and gross alpha radioactivity in the onsite laboratory using liquid scintillation and air ion chamber counting techniques, respectively. Composite samples were analyzed quarterly for Sr-89, Sr-90, Fe-55, Ni-63 and C-14 by a contract laboratory. The results of the composite analyses from the previous month or quarter were used to estimate the quantities of these radionuclides in liquid effluents during the current month or quarter.

The total radioactivity in liquid effluent releases was determined from the measured and estimated concentrations of each radionuclide present and the total volume of the effluent released during periods of discharge.

Gaseous Radioactive Effluents

Each gaseous batch was sampled and analyzed for radioactivity prior to release. For releases from gas decay tanks, noble gas grab samples were analyzed for gamma emitting radionuclides using gamma spectroscopy. For releases from the reactor containment buildings, samples were taken of noble gas and tritium grab samples and analyzed for gamma emitting radionuclides prior to each release. The results of the analyses and the total volume of effluent released were used to determine the total amount of radioactivity released in the batch mode.

For continuous effluent release pathways, noble gas and tritium grab samples were collected and analyzed weekly for gamma emitting radionuclides by gamma spectroscopy and liquid scintillation counting techniques, respectively. Continuous release pathways were continuously sampled using radioiodine adsorbers and particulate filters. The radioiodine adsorbers and particulate filters were analyzed weekly for gamma emitting radionuclides using gamma spectroscopy. Results of the noble gas and tritium grab samples, radioiodine adsorber and particulate filter analyses from the current week and the average effluent flow rate for the previous week were used to determine the total amount of radioactivity released in the continuous mode. The particulate filters were analyzed weekly for gross alpha activity in the onsite laboratory using the air ion chamber counting technique. Quarterly composites of particulate filters were analyzed for Sr-89 and Sr-90 by a contract laboratory.

Meteorological Monitoring Program

In accordance with ODCM Administrative Control 3.11.2.6.b., a summary of hourly meteorological data, collected during 2018, is retained onsite. This data is available for review by the NRC upon request. During 2018, the goal of >90% joint data recovery was met. Actual meteorological data collected during the year was used for the offsite dose calculations in this report.

Carbon-14 Dose Estimation
The estimate of Carbon-14 (C-14) released from the St. Lucie Nuclear Plant was derived from the EPRI document, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents", Report 1021106, issued December 2010.

The site specific source term values used in the St. Lucie calculations were taken from the PWR Section, Page 4-28 of the report, and employed the proxy generation rate values for a Combustion Engineering reactor. The actual 2018 operating data for the units was employed for the calculations to derive the total curies released for each unit.

The total amount of C-14 released in 2018 for Unit 1 was 10.47 Ci, and the total amount of C-14 released in 2018 for Unit 2 was 9.99 Ci.

The highest calculated dose exposure pathway from C-14 is "Bone Dose" to a "Child" from consumption of garden produce. A "Child" consuming vegetables and produce from the garden located at 2.0 miles in the West direction from the plant would have received a total combined "Bone Dose", from C-14, of 1.552E-1 mrem/yr.

Assessment of radiation dose from radioactive effluents to members of the public due to their activities inside the site boundary assumes the visitor to be a lifeguard at Walton Rocks Beach Recreation Area located 1 mile southeast of the site. Dose to the visitor on site for calendar year 2018 is found to be 2.30E-03 mrem/yr, Total Body dose. See Table 3.4, Dose Assessments, for more detail.

This is a fraction of the 1 mrem annual whole body dose received by the average US citizen from natural occurring Carbon-14, primarily generated through cosmogenesis in the terrestrial biosphere. (Reference National Council of Radiation Protection Report 45, Natural Background Radiation in the United States.)

All C-14 dose calculations are based on Regulatory Guide 1.109 values.

2.0 SUPPLEMENTAL INFORMATION

2.1 Abnormal Releases or Abnormal Discharges

2A GDT Unplanned Release - (AR#02268876 / WR#94178803)

- One abnormal (unplanned) gas decay tank discharge from the site occurred on June 15th, 2018. Operations entered 2-AOP-06.04, Uncontrolled Release of Radioactive Gas, due to loss of 21 psig in a 12 hour period from the 2A Gas Decay Tank (GDT).

  The 2A GDT Unplanned Release was accounted for using an Abnormal Gas Decay Release Permit, G-18-215-B. AR #02268876 was generated to document the unplanned GDT release to the auxiliary building which was monitored by an operable plant vent radiation monitor on the plant vent stack. No additional leaks have been identified since its return to service.

  Release Estimates Are As Follows:

Nuclide	μCi/cc concentration	μCi released
Ar-41	3.16E-05	3.129E+02
Kr-88	1.45E-06	1.436E+01
Kr-85m	2.50E-06	2.476E+01
Xe-133	6.71E-04	6.645E+03
Xe-135	8.61E-05	8.526E+02
Xe-133m	1.26E-05	1.248E+02
Co-60	4.11E-06	4.070E+01

  Maximum Infant Dose for NW Site Boundary:

Total Body (mRem)	Skin (mRem)	Gamma Air (mRad)	Beta Air (mRad)
3.31E-07	6.370E-07	3.644E-07	5.265E-07

2.2 Non-Routine Planned Discharges

No non-routine planned discharges were made during the report period.

2.3 Radioactive Waste Treatment System Changes

No changes were made to the radioactive waste treatment system during the report period.

2.4 Annual Land Use Census Changes

One change was made to the Annual Land Use Census from the previous year's report, there is no longer a garden in the WNW sector.

2.5 Effluent Monitoring System Inoperability

Two effluent monitors were out of service for greater than 30 days during the report period.

- On January 18th, 2018 I&C Maintenance was performing the ECCS radiation monitors monthly functional surveillance in accordance with 1-SMI-26.03. At this time it was identified that the 'B' ECCS radiation monitors alarm leads were lifted (i.e. de-termed). The discrepancy was corrected and RSC-26-3 returned to service on January 19th, 2018. During the Past Operability/Functionality Review it was determined that the leads were lifted under WO: 40400949-16, to support installation of the A ECCS radiation monitor. With the B ECCS alarm leads lifted the radiation monitor should have been declared inoperable and St. Lucie could have either restored the radiation monitor within 72 hours or initiated and alternate method of monitoring. St Lucie Unit 1 did not perform the applicable action statement as required by the Offsite Dose Calculation Manual. With the Alarm leads lifted the B ECCS radiation monitor would have performed its required function locally at the ECCS monitor. This means the radiation monitor would have monitored radiation levels using the normal and accident monitors depending on the radiological conditions. In addition, the radiation monitors local display would have indicated and alarmed to alert plant personnel of abnormal radiation conditions or a monitor failure. If a failure of the radiation monitor had occurred it would have not annunciated in the control room, thus not meeting the requirement of ADM-11.16 guidance. During the timeframe that this channel of alarm capability was defeated, the remote monitoring displays of actual values to the control room and other monitoring areas remained functional. Upon review, no effluent releases were performed through this effluent pathway. All gaseous releases during the time frame of December 15th, 2017 and January 18th, 2018, were planned and monitored via approved release pathways. (This was also reported in the 2017 ARERR Report)
- As identified in AR 02291667, on 11/20/18 RM-26-14 Plant Ventilation radiation monitor failed. The failure occurred when the sample pumps would not restart following chemistry performing a weekly grab sample. Initial troubleshooting by I&C Maintenance showed that the sample pumps did not have power and their supply fuse was blown. A replacement pump is scheduled to be installed on 2/19/19 under Work request 94186558. Per ODCM 3.3.3-10, table 3.3-13 the minimum channels functional of 1/RX is still met with RM-26-

13 functional. No compensatory samples were needed, and all releases via the Plant vent were monitored by RM-26-13.

2.6 Offsite Dose Calculation Manual Changes

One revision change was made to the St. Lucie Site ODCM during the report period.

- **Revision 51** - Incorporated PCR 2263650 to replace the word OPERATIONAL with the word FUNCTIONAL and to revise the Environmental sample Locations map (Author: T. Bertolini)

2.7 Process Control Program Changes

There were no changes to the Process Control Program during the report period.

2.8 Corrections to Previous Reports

There were no corrections to previous reports during the report period.

2.9 Other

Three batch releases were made from the South Settling Basin to the Intake Canal during the report period to lower the water level from periods of higher than normal rainfall. All releases were analyzed according to the ODCM and site procedural requirements and were found to have no detectable gamma, tritium, alpha or hard to detect isotopes. The releases are listed below:

Release Start Date	Release Volume
05/14/2018	80,640,000 gallons
05/22/2018	7,970,000 gallons
05/31/2018	6,796,000 gallons

2.10 Groundwater Protection Program

- No limits were exceeded for the analyzed St. Lucie Nuclear Site Groundwater Protection Program for the report period.
- St. Lucie Nuclear Site Groundwater Protection Program results for the report period are contained in the following tables.

2018 St. Lucie Nuclear Plant Groundwater Protection Program Tritium Results (pCi/L)

Well ID	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
MW-3		787				525			556		595	
MW-4		270				<MDC			<MDC		<MDC	
MW-5		<MDC				<MDC			<MDC		<MDC	
MW-6		1140				1140			2680		4520	
MW-7		<MDC				<MDC			<MDC		<MDC	
MW-15		352				293			593		406	
MW-16		322				242			<MDC		223	
MW-17	2280	2580	1680	1680	3920	3840	4170	3750	3540	3620	3800	<2300*
MW-18D	2160	2220	2010	2010	1980	1690	1700	1650	1510	1610	1130	<2300*
MW-19		<MDC				<MDC			<MDC		<MDC	
MW-22D		306				331			447		244	
MW-26		<MDC				<MDC			<MDC		<MDC	
MW-30		666				247			967		369	
MW-31		383				297			350		313	
MW-32		385				451			521		479	
MW-33		577				722			715		665	
RW-2		220				217			<MDC		382	
RW-4		<MDC				<MDC			<MDC		<MDC	
RW-5		<MDC				<MDC			<MDC		<MDC	
S-MW-1		<MDC										
S-MW-4		<MDC										
S-MW-6		251										
S-MW-7A		<MDC										
S-MW-11		<MDC										
S-MW-15D		<MDC										
S-MW-16		<MDC										
S-MW-16i		<MDC										
S-MW-17		<MDC										
S-MW-18		<MDC										
S-MW-19		<MDC										
PSLED-2		<MDC										
NB-MW-1		<MDC										
NB-MW-2		<MDC										
U1 MW-001		347										
U1 MW-002	337	279										
U1 MW-003		<MDC										
U1 MW-004		208										

U1 MW-005		330				429			1860		326	
U2 MW-001		527				<207			679		<MDC	
U2 MW-002		898				454			1890		1290	
U2 MW-003		848				1330			637		726	
U2 MW-004		678				589			589		568	

* Samples counted in house, not from Vendor Lab

3.0 TABLES

3.1 Gaseous Effluents and Liquid Effluents

3.2 Solid Waste Storage and Shipments

3.3 Dose Assessments

3.4 Visitor Dose

TABLE 3.1

GASEOUS EEFFLUENTS AND LIQUID EFFLUENTS
(26 PAGES)

Reg. Guide 1.21, Table 5A and 5B - Liquid and Gas Batch Release Summary

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

A. Liquid Batch Release Totals	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year Totals
1. Number of Batch Releases		26	21	24	10	81
2. Total duration of batch releases	min	1.96E+04	3.75E+04	1.76E+04	7.60E+03	8.23E+04
3. Maximum batch release duration	min	2.06E+03	1.01E+04	8.92E+02	8.77E+02	1.01E+04
4. Average batch release duration	min	7.53E+02	1.78E+03	7.35E+02	7.60E+02	1.02E+03
5. Minimum batch release duration	min	4.85E+02	5.17E+02	5.30E+02	5.95E+02	4.85E+02

B. Gas Batch Release Totals	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year Totals
1. Number of Batch Releases		58	50	68	47	223
2. Total duration of batch releases	min	5.28E+04	2.22E+04	8.15E+04	1.05E+04	1.67E+05
3. Maximum batch release duration	min	1.44E+04	8.64E+03	3.63E+04	5.05E+02	3.63E+04
4. Average batch release duration	min	9.11E+02	4.43E+02	1.20E+03	2.23E+02	7.49E+02
5. Minimum batch release duration	min	1.70E+01	3.20E+01	3.00E+00	1.60E+01	3.00E+00

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Friday, February 15, 2019 10:21:54AM
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St. Lucie Power Plant

Reg. Guide 1.21, Table 6A and 6B - Liquid and Gas Abnormal Release Summary

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

A. Liquid Abnormal Release Totals	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year Totals
1. Number of Abnormal Releases		0	0	0	0	0
2. Total Activity of abnormal releases	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B. Gas Abnormal Release Totals	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year Totals
1. Number of Abnormal Releases		0	1	0	0	1
2. Total Activity of abnormal releases	Ci	0.00E+00	8.01E-03	0.00E+00	0.00E+00	8.01E-03

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Reg. Guide 1.21, Table 1A, Gaseous Effluents - Summation of All Releases

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Total Release	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual	Uncertainty
A. Fission and Activation Gases							
1. Total Release	Ci	1.40E+01	1.78E+00	3.35E+00	3.52E-01	1.95E+01	
2. Average Release Rate for Period	uCi/s	1.80E+00	2.26E-01	4.22E-01	4.42E-02	6.18E-01	
3. Percent of Limit	%						
B. Iodines and Halogens							
1. Total Release	Ci	8.36E-05	3.57E-05	1.88E+05	8.76E-06	1.88E+05	
2. Average Release Rate for Period	uCi/s	1.08E-05	4.54E-06	2.36E+04	1.10E-06	5.95E+03	
3. Percent of Limit	%						
C. Particulates							
1. Total Release	Ci	2.40E-06	2.96E-04	5.19E+05	6.55E-05	5.19E+05	
2. Average Release Rate for Period	uCi/s	3.09E-07	3.76E-05	6.53E+04	8.24E-06	1.65E+04	
3. Percent of Limit	%						
D. Tritium							
1. Total Release	Ci	3.94E+01	2.01E-01	6.42E+00	4.59E-01	4.64E+01	
2. Average Release Rate for Period	uCi/s	5.06E+00	2.55E-02	8.08E-01	5.78E-02	1.47E+00	
3. Percent of Limit	%						
E. Gross Alpha							
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	5.64E-09	5.64E-09	
F. Carbon-14							
1. Total Release	Ci	5.04E+00	5.38E+00	4.59E+00	5.47E+00	2.05E+01	
2. Average Release Rate for Period	uCi/s	6.48E-01	6.84E-01	5.77E-01	6.89E-01	6.49E-01	
3. Percent of Limit	%						

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Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Continuous Mode

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Continuous Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
A. Fission and Activation Gases						
Ar-41	Ci	0.00E+00	1.29E+00	0.00E+00	0.00E+00	1.29E+00
Kr-85m	Ci	0.00E+00	0.00E+00	1.33E-01	0.00E+00	1.33E-01
Kr-87	Ci	9.80E-03	0.00E+00	0.00E+00	0.00E+00	9.80E-03
Xe-131m	Ci	9.12E-02	0.00E+00	0.00E+00	0.00E+00	9.12E-02
Xe-133	Ci	1.29E+00	0.00E+00	0.00E+00	0.00E+00	1.29E+00
Xe-137	Ci	3.80E-01	0.00E+00	0.00E+00	0.00E+00	3.80E-01
Total For Period	**Ci**	**1.77E+00**	**1.29E+00**	**1.33E-01**	**0.00E+00**	**3.20E+00**
B. Iodines and Halogens						
I-131	Ci	1.34E-05	1.71E-06	3.10E-05	0.00E+00	4.60E-05
I-133	Ci	4.19E-05	3.40E-05	5.65E-05	8.76E-06	1.41E-04
Total For Period	**Ci**	**5.52E-05**	**3.57E-05**	**8.75E-05**	**8.76E-06**	**1.87E-04**
C. Particulates						
Co-58	Ci	0.00E+00	0.00E+00	1.68E-07	0.00E+00	1.68E-07
Sr-90	Ci	0.00E+00	0.00E+00	8.43E-04	0.00E+00	8.43E-04
Mo-99	Ci	0.00E+00	0.00E+00	2.53E-06	0.00E+00	2.53E-06
Total For Period	**Ci**	**0.00E+00**	**0.00E+00**	**8.45E-04**	**0.00E+00**	**8.45E-04**
D. Tritium						
H-3	Ci	3.14E+01	0.00E+00	3.30E+00	0.00E+00	3.47E+01

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Continuous Mode

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Continuous Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
E. Gross Alpha						
G-Alpha	Ci	0.00E+00	0.00E+00	0.00E+00	5.64E-09	5.64E-09
F. Carbon-14						
C-14	Ci	5.04E+00	5.38E+00	4.59E+00	5.47E+00	2.05E+01

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Batch Mode

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Batch Mode 1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
A. Fission and Activation Gases						
Ar-41	Ci	3.68E+00	3.95E-01	2.13E+00	3.15E-01	6.52E+00
Kr-85m	Ci	0.00E+00	2.20E-04	6.52E-05	5.45E-05	3.40E-04
Kr-85	Ci	6.78E+00	0.00E+00	0.00E+00	0.00E+00	6.78E+00
Kr-87	Ci	0.00E+00	1.35E-04	1.56E-04	0.00E+00	2.90E-04
Kr-88	Ci	1.42E-04	7.59E-05	1.36E-04	0.00E+00	3.54E-04
Kr-89	Ci	0.00E+00	0.00E+00	0.00E+00	1.56E-02	1.56E-02
Xe-127	Ci	2.55E-03	0.00E+00	7.39E-06	0.00E+00	2.55E-03
Xe-131m	Ci	0.00E+00	4.14E-05	1.44E-03	0.00E+00	1.48E-03
Xe-135	Ci	8.96E-02	8.90E-03	5.31E-03	6.25E-04	1.04E-01
Xe-133m	Ci	0.00E+00	1.16E-03	2.69E-03	0.00E+00	3.85E-03
Xe-133	Ci	1.66E+00	8.37E-02	1.08E+00	2.02E-02	2.85E+00
Xe-135m	Ci	0.00E+00	0.00E+00	1.33E-04	0.00E+00	1.33E-04
Total For Period	**Ci**	**1.22E+01**	**4.90E-01**	**3.22E+00**	**3.52E-01**	**1.63E+01**
B. Iodines and Halogens						
I-131	Ci	1.78E-07	0.00E+00	1.88E+05	0.00E+00	1.88E+05
I-132	Ci	2.82E-05	0.00E+00	0.00E+00	0.00E+00	2.82E-05
Total For Period	**Ci**	**2.84E-05**	**0.00E+00**	**1.88E+05**	**0.00E+00**	**1.88E+05**
C. Particulates						

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Batch Mode

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Batch Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
Co-58	Ci	1.74E-07	1.29E-04	0.00E+00	0.00E+00	1.30E-04
Co-60	Ci	9.25E-07	1.66E-04	4.70E-05	0.00E+00	2.14E-04
Zr-95	Ci	5.14E-07	0.00E+00	0.00E+00	0.00E+00	5.14E-07
Nb-95	Ci	7.91E-07	0.00E+00	6.47E+04	0.00E+00	6.47E+04
Mo-99	Ci	0.00E+00	0.00E+00	3.32E+05	0.00E+00	3.32E+05
Tc-99m	Ci	0.00E+00	0.00E+00	1.23E+05	0.00E+00	1.23E+05
Cs-137	Ci	0.00E+00	0.00E+00	0.00E+00	6.55E-05	6.55E-05
Ce-141	Ci	0.00E+00	0.00E+00	3.23E-05	0.00E+00	3.23E-05
Total For Period	**Ci**	**2.40E-06**	**2.96E-04**	**5.19E+05**	**6.55E-05**	**5.19E+05**
D. Tritium						
H-3	Ci	7.94E+00	2.01E-01	3.13E+00	4.59E-01	1.17E+01
E. Gross Alpha						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F. Carbon-14						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1A, Gaseous Effluents - Summation of All Releases
Unit: PSL1
Starting: 1-Jan-2018 Ending: 31-Dec-2018

Total Release	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual	Uncertainty
A. Fission and Activation Gases							
1. Total Release	Ci	1.31E+01	1.48E+00	4.97E-01	1.54E-01	1.53E+01	
2. Average Release Rate for Period	uCi/s	1.69E+00	1.88E-01	6.25E-02	1.93E-02	4.85E-01	
3. Percent of Limit	%						
B. Iodines and Halogens							
1. Total Release	Ci	8.34E-05	3.57E-05	2.34E-06	8.76E-06	1.30E-04	
2. Average Release Rate for Period	uCi/s	1.07E-05	4.54E-06	2.95E-07	1.10E-06	4.13E-06	
3. Percent of Limit	%						
C. Particulates							
1. Total Release	Ci	2.40E-06	1.71E-04	8.43E-04	6.55E-05	1.08E-03	
2. Average Release Rate for Period	uCi/s	3.09E-07	2.18E-05	1.06E-04	8.24E-06	3.43E-05	
3. Percent of Limit	%						
D. Tritium							
1. Total Release	Ci	7.81E+00	1.03E-01	5.99E-01	3.06E-01	8.82E+00	
2. Average Release Rate for Period	uCi/s	1.00E+00	1.31E-02	7.53E-02	3.85E-02	2.80E-01	
3. Percent of Limit	%						
E. Gross Alpha							
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	5.64E-09	5.64E-09	
F. Carbon-14							
1. Total Release	Ci	2.20E+00	2.51E+00	2.92E+00	2.86E+00	1.05E+01	
2. Average Release Rate for Period	uCi/s	2.83E-01	3.19E-01	3.68E-01	3.59E-01	3.33E-01	
3. Percent of Limit	%						

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Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Continuous Mode

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Continuous Mode				
		1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
A. Fission and Activation Gases						
Ar-41	Ci	0.00E+00	1.29E+00	0.00E+00	0.00E+00	1.29E+00
Kr-85m	Ci	0.00E+00	0.00E+00	1.33E-01	0.00E+00	1.33E-01
Xe-133	Ci	1.18E+00	0.00E+00	0.00E+00	0.00E+00	1.18E+00
Total For Period	**Ci**	**1.18E+00**	**1.29E+00**	**1.33E-01**	**0.00E+00**	**2.60E+00**
B. Iodines and Halogens						
I-131	Ci	1.33E-05	1.71E-06	2.34E-06	0.00E+00	1.74E-05
I-133	Ci	4.17E-05	3.40E-05	0.00E+00	8.76E-06	8.44E-05
Total For Period	**Ci**	**5.50E-05**	**3.57E-05**	**2.34E-06**	**8.76E-06**	**1.02E-04**
C. Particulates						
Sr-90	Ci	0.00E+00	0.00E+00	8.43E-04	0.00E+00	8.43E-04
D. Tritium						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E. Gross Alpha						
G-Alpha	Ci	0.00E+00	0.00E+00	0.00E+00	5.64E-09	5.64E-09
F. Carbon-14						
C-14	Ci	2.20E+00	2.51E+00	2.92E+00	2.86E+00	1.05E+01

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Batch Mode

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Batch Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
A. Fission and Activation Gases						
Ar-41	Ci	3.46E+00	1.44E-01	1.75E-01	1.35E-01	3.91E+00
Kr-85m	Ci	0.00E+00	1.96E-04	6.52E-05	0.00E+00	2.61E-04
Kr-85	Ci	6.78E+00	0.00E+00	0.00E+00	0.00E+00	6.78E+00
Kr-88	Ci	1.42E-04	6.15E-05	1.36E-04	0.00E+00	3.39E-04
Kr-89	Ci	0.00E+00	0.00E+00	0.00E+00	1.56E-02	1.56E-02
Xe-127	Ci	2.55E-03	0.00E+00	7.39E-06	0.00E+00	2.55E-03
Xe-131m	Ci	0.00E+00	0.00E+00	1.44E-03	0.00E+00	1.44E-03
Xe-135	Ci	8.90E-02	7.46E-03	4.90E-03	0.00E+00	1.01E-01
Xe-133m	Ci	0.00E+00	1.04E-03	2.51E-03	0.00E+00	3.55E-03
Xe-133	Ci	1.63E+00	4.03E-02	1.79E-01	3.00E-03	1.86E+00
Xe-135m	Ci	0.00E+00	0.00E+00	1.33E-04	0.00E+00	1.33E-04
Total For Period	**Ci**	**1.20E+01**	**1.93E-01**	**3.64E-01**	**1.54E-01**	**1.27E+01**
B. Iodines and Halogens						
I-131	Ci	1.78E-07	0.00E+00	0.00E+00	0.00E+00	1.78E-07
I-132	Ci	2.82E-05	0.00E+00	0.00E+00	0.00E+00	2.82E-05
Total For Period	**Ci**	**2.84E-05**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**2.84E-05**
C. Particulates						
Co-58	Ci	1.74E-07	1.29E-04	0.00E+00	0.00E+00	1.30E-04
Co-60	Ci	9.25E-07	4.18E-05	0.00E+00	0.00E+00	4.28E-05
Zr-95	Ci	5.14E-07	0.00E+00	0.00E+00	0.00E+00	5.14E-07
Nb-95	Ci	7.91E-07	0.00E+00	0.00E+00	0.00E+00	7.91E-07
Cs-137	Ci	0.00E+00	0.00E+00	0.00E+00	6.55E-05	6.55E-05
Total For Period	**Ci**	**2.40E-06**	**1.71E-04**	**0.00E+00**	**6.55E-05**	**2.39E-04**

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Batch Mode

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Batch Mode 1ST Quarter	Batch Mode 2ND Quarter	Batch Mode 3RD Quarter	Batch Mode 4TH Quarter	Batch Mode Annual
D. Tritium						
H-3	Ci	7.81E+00	1.03E-01	5.99E-01	3.06E-01	8.82E+00
E. Gross Alpha						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F. Carbon-14						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1A, Gaseous Effluents - Summation of All Releases

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Total Release	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual	Uncertainty
A. Fission and Activation Gases							
1. Total Release	Ci	8.46E-01	2.97E-01	2.86E+00	1.98E-01	4.20E+00	
2. Average Release Rate for Period	uCi/s	1.09E-01	3.77E-02	3.60E-01	2.49E-02	1.33E-01	
3. Percent of Limit	%						
B. Iodines and Halogens							
1. Total Release	Ci	2.35E-07	0.00E+00	1.88E+05	0.00E+00	1.88E+05	
2. Average Release Rate for Period	uCi/s	3.02E-08	0.00E+00	2.36E+04	0.00E+00	5.95E+03	
3. Percent of Limit	%						
C. Particulates							
1. Total Release	Ci	0.00E+00	1.25E-04	5.19E+05	0.00E+00	5.19E+05	
2. Average Release Rate for Period	uCi/s	0.00E+00	1.59E-05	6.53E+04	0.00E+00	1.65E+04	
3. Percent of Limit	%						
D. Tritium							
1. Total Release	Ci	3.15E+01	9.74E-02	5.82E+00	1.53E-01	3.76E+01	
2. Average Release Rate for Period	uCi/s	4.06E+00	1.24E-02	7.33E-01	1.92E-02	1.19E+00	
3. Percent of Limit	%						
E. Gross Alpha							
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
F. Carbon-14							
1. Total Release	Ci	2.84E+00	2.87E+00	1.66E+00	2.62E+00	9.99E+00	
2. Average Release Rate for Period	uCi/s	3.65E-01	3.65E-01	2.09E-01	3.29E-01	3.17E-01	
3. Percent of Limit	%						

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Continuous Mode

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Continuous Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
A. Fission and Activation Gases						
Kr-87	Ci	9.80E-03	0.00E+00	0.00E+00	0.00E+00	9.80E-03
Xe-131m	Ci	9.12E-02	0.00E+00	0.00E+00	0.00E+00	9.12E-02
Xe-137	Ci	3.80E-01	0.00E+00	0.00E+00	0.00E+00	3.80E-01
Xe-133	Ci	1.11E-01	0.00E+00	0.00E+00	0.00E+00	1.11E-01
Total For Period	**Ci**	**5.92E-01**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**5.92E-01**
B. Iodines and Halogens						
I-131	Ci	1.24E-08	0.00E+00	2.86E-05	0.00E+00	2.86E-05
I-133	Ci	2.22E-07	0.00E+00	5.65E-05	0.00E+00	5.68E-05
Total For Period	**Ci**	**2.35E-07**	**0.00E+00**	**8.52E-05**	**0.00E+00**	**8.54E-05**
C. Particulates						
Co-58	Ci	0.00E+00	0.00E+00	1.68E-07	0.00E+00	1.68E-07
Mo-99	Ci	0.00E+00	0.00E+00	2.53E-06	0.00E+00	2.53E-06
Total For Period	**Ci**	**0.00E+00**	**0.00E+00**	**2.70E-06**	**0.00E+00**	**2.70E-06**
D. Tritium						
H-3	Ci	3.14E+01	0.00E+00	3.30E+00	0.00E+00	3.47E+01
E. Gross Alpha						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Continuous Mode

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Continuous Mode 1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
F. Carbon-14						
C-14	Ci	2.84E+00	2.87E+00	1.66E+00	2.62E+00	9.99E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Batch Mode

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Batch Mode				
		1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
A. Fission and Activation Gases						
Ar-41	Ci	2.24E-01	2.52E-01	1.95E+00	1.80E-01	2.61E+00
Kr-85m	Ci	0.00E+00	2.48E-05	0.00E+00	5.45E-05	7.93E-05
Kr-87	Ci	0.00E+00	1.35E-04	1.56E-04	0.00E+00	2.90E-04
Kr-88	Ci	0.00E+00	1.44E-05	0.00E+00	0.00E+00	1.44E-05
Xe-131m	Ci	0.00E+00	4.14E-05	0.00E+00	0.00E+00	4.14E-05
Xe-133m	Ci	0.00E+00	1.25E-04	1.76E-04	0.00E+00	3.00E-04
Xe-135	Ci	6.14E-04	1.43E-03	4.08E-04	6.25E-04	3.08E-03
Xe-133	Ci	3.03E-02	4.34E-02	9.02E-01	1.72E-02	9.93E-01
Total For Period	**Ci**	**2.55E-01**	**2.97E-01**	**2.86E+00**	**1.98E-01**	**3.61E+00**
B. Iodines and Halogens						
I-131	Ci	0.00E+00	0.00E+00	1.88E+05	0.00E+00	1.88E+05
C. Particulates						
Co-60	Ci	0.00E+00	1.25E-04	4.70E-05	0.00E+00	1.72E-04
Nb-95	Ci	0.00E+00	0.00E+00	6.47E+04	0.00E+00	6.47E+04
Mo-99	Ci	0.00E+00	0.00E+00	3.32E+05	0.00E+00	3.32E+05
Tc-99m	Ci	0.00E+00	0.00E+00	1.23E+05	0.00E+00	1.23E+05
Ce-141	Ci	0.00E+00	0.00E+00	3.23E-05	0.00E+00	3.23E-05
Total For Period	**Ci**	**0.00E+00**	**1.25E-04**	**5.19E+05**	**0.00E+00**	**5.19E+05**
D. Tritium						
H-3	Ci	1.29E-01	9.74E-02	2.53E+00	1.53E-01	2.91E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 1B, Gaseous Effluents - Ground Level Release - Batch Mode

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Batch Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
E. Gross Alpha						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F. Carbon-14						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 2A, Liquid Effluents - Summation of All Releases
Unit: Site
Starting: 1-Jan-2018 Ending: 31-Dec-2018

Total Release	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual	Uncertainty
A. Fission and Activation Products							
1. Total Release	Ci	1.05E-02	1.64E-02	3.18E-02	5.59E-03	6.43E-02	
2. Average Concentration	uCi/mL	1.61E-10	2.19E-10	5.70E-10	2.24E-10	2.91E-10	
3. Percent of Limit	%						
B. Tritium							
1. Total Release	Ci	4.34E+02	2.18E+02	2.08E+02	5.42E+01	9.14E+02	
2. Average Concentration	uCi/mL	6.63E-06	2.92E-06	3.73E-06	2.17E-06	4.14E-06	
3. Percent of Limit	%						
C. Dissolved and Entrained Gases							
1. Total Release	Ci	9.54E-03	1.21E-04	3.14E-03	1.52E-04	1.29E-02	
2. Average Concentration	uCi/mL	1.46E-10	1.61E-12	5.62E-11	6.09E-12	5.86E-11	
3. Percent of Limit	%						
D. Gross Alpha Activity							
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2. Average Concentration	uCi/mL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
E. Primary Liquid Release Volume							
1. Total Release	Liters	2.40E+06	8.37E+07	2.40E+06	1.05E+06	8.96E+07	
F. Dilution Volume							
1. Total Release	Liters	6.54E+10	7.48E+10	5.58E+10	2.50E+10	2.21E+11	

Reg. Guide 1.21, Table 2A, Liquid Effluents - Summation of All Releases

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Total Release	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual	Uncertainty
A. Fission and Activation Products							
1. Total Release	Ci	5.27E-03	8.19E-03	1.59E-02	2.80E-03	3.21E-02	
2. Average Concentration	uCi/mL	1.61E-10	2.19E-10	5.70E-10	2.24E-10	2.91E-10	
3. Percent of Limit	%						
B. Tritium							
1. Total Release	Ci	2.17E+02	1.09E+02	1.04E+02	2.71E+01	4.57E+02	
2. Average Concentration	uCi/mL	6.63E-06	2.92E-06	3.73E-06	2.17E-06	4.14E-06	
3. Percent of Limit	%						
C. Dissolved and Entrained Gases							
1. Total Release	Ci	4.77E-03	6.03E-05	1.57E-03	7.61E-05	6.47E-03	
2. Average Concentration	uCi/mL	1.46E-10	1.61E-12	5.62E-11	6.09E-12	5.86E-11	
3. Percent of Limit	%						
D. Gross Alpha Activity							
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2. Average Concentration	uCi/mL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
E. Primary Liquid Release Volume							
1. Total Release	Liters	1.20E+06	4.19E+07	1.20E+06	5.27E+05	4.48E+07	
F. Dilution Volume							
1. Total Release	Liters	3.27E+10	3.74E+10	2.79E+10	1.25E+10	1.11E+11	

Reg. Guide 1.21, Table 2A, Liquid Effluents - Summation of All Releases

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Total Release	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual	Uncertainty
A. Fission and Activation Products							
1. Total Release	Ci	5.27E-03	8.19E-03	1.59E-02	2.80E-03	3.21E-02	
2. Average Concentration	uCi/mL	1.61E-10	2.19E-10	5.70E-10	2.24E-10	2.91E-10	
3. Percent of Limit	%						
B. Tritium							
1. Total Release	Ci	2.17E+02	1.09E+02	1.04E+02	2.71E+01	4.57E+02	
2. Average Concentration	uCi/mL	6.63E-06	2.92E-06	3.73E-06	2.17E-06	4.14E-06	
3. Percent of Limit	%						
C. Dissolved and Entrained Gases							
1. Total Release	Ci	4.77E-03	6.03E-05	1.57E-03	7.61E-05	6.47E-03	
2. Average Concentration	uCi/mL	1.46E-10	1.61E-12	5.62E-11	6.09E-12	5.86E-11	
3. Percent of Limit	%						
D. Gross Alpha Activity							
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2. Average Concentration	uCi/mL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
E. Primary Liquid Release Volume							
1. Total Release	Liters	1.20E+06	4.19E+07	1.20E+06	5.27E+05	4.48E+07	
F. Dilution Volume							
1. Total Release	Liters	3.27E+10	3.74E+10	2.79E+10	1.25E+10	1.11E+11	

Reg. Guide 1.21, Table 2B, Liquid Effluents - Continuous Mode

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Continuous Mode 1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
A. Fission and Activation Products						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C. Dissolved and Entrained Gases						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha Activity						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 2B, Liquid Effluents - Batch Mode

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Batch Mode 1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
A. Fission and Activation Products						
C-14	Ci	0.00E+00	1.73E-03	3.65E-03	7.28E-04	6.10E-03
Na-24	Ci	0.00E+00	4.20E-05	0.00E+00	0.00E+00	4.20E-05
Be-7	Ci	0.00E+00	0.00E+00	0.00E+00	4.75E-05	4.75E-05
Cr-51	Ci	2.34E-04	5.04E-05	2.67E-03	1.18E-03	4.13E-03
Mn-54	Ci	7.22E-05	5.34E-05	6.32E-04	7.18E-05	8.29E-04
Fe-55	Ci	0.00E+00	5.63E-03	3.62E-03	0.00E+00	9.25E-03
Fe-59	Ci	3.48E-05	0.00E+00	1.79E-04	3.18E-05	2.46E-04
Co-57	Ci	0.00E+00	0.00E+00	1.16E-05	2.17E-06	1.38E-05
Co-58	Ci	5.34E-04	6.20E-04	7.48E-03	4.74E-04	9.11E-03
Co-60	Ci	1.95E-03	1.30E-03	6.36E-03	9.38E-04	1.05E-02
Ni-63	Ci	0.00E+00	0.00E+00	2.85E-03	4.52E-04	3.31E-03
Ni-65	Ci	0.00E+00	0.00E+00	2.03E-05	0.00E+00	2.03E-05
Zn-65	Ci	1.90E-05	0.00E+00	1.37E-04	0.00E+00	1.56E-04
Sr-91	Ci	0.00E+00	0.00E+00	8.25E-06	0.00E+00	8.25E-06
Y-92	Ci	0.00E+00	7.46E-05	0.00E+00	0.00E+00	7.46E-05
Zr-95	Ci	9.33E-05	2.91E-05	3.50E-04	2.10E-04	6.82E-04
Nb-95	Ci	1.57E-04	7.88E-05	6.14E-04	3.65E-04	1.21E-03
Nb-97	Ci	3.74E-03	1.31E-03	7.93E-04	4.41E-04	6.28E-03
Tc-99m	Ci	0.00E+00	0.00E+00	0.00E+00	2.85E-06	2.85E-06
Ag-110m	Ci	2.91E-03	9.24E-04	6.94E-04	3.77E-04	4.91E-03
Sn-113	Ci	0.00E+00	0.00E+00	2.71E-05	0.00E+00	2.71E-05
Sn-117m	Ci	0.00E+00	6.61E-06	0.00E+00	0.00E+00	6.61E-06
Sb-124	Ci	4.30E-05	1.83E-03	2.91E-04	1.31E-05	2.18E-03
Sb-125	Ci	4.66E-04	2.09E-03	8.96E-04	8.91E-05	3.54E-03
Te-123m	Ci	4.89E-05	2.19E-04	1.52E-04	1.21E-04	5.41E-04
Te-129m	Ci	0.00E+00	3.70E-04	9.51E-05	0.00E+00	4.65E-04

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 2B, Liquid Effluents - Batch Mode
Unit: Site
Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Batch Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
Te-132	Ci	1.02E-04	0.00E+00	1.78E-05	0.00E+00	1.20E-04
I-132	Ci	8.91E-05	0.00E+00	1.09E-05	0.00E+00	9.99E-05
I-133	Ci	0.00E+00	0.00E+00	9.36E-06	0.00E+00	9.36E-06
I-134	Ci	0.00E+00	0.00E+00	4.14E-06	4.80E-06	8.94E-06
I-135	Ci	1.03E-05	0.00E+00	0.00E+00	0.00E+00	1.03E-05
Cs-136	Ci	0.00E+00	5.38E-06	0.00E+00	0.00E+00	5.38E-06
Cs-137	Ci	2.32E-05	1.45E-05	0.00E+00	3.98E-06	4.17E-05
Ba-140	Ci	0.00E+00	0.00E+00	8.91E-05	0.00E+00	8.91E-05
La-140	Ci	1.35E-05	2.38E-06	1.19E-04	0.00E+00	1.35E-04
Ce-141	Ci	0.00E+00	0.00E+00	0.00E+00	3.71E-06	3.71E-06
W-187	Ci	0.00E+00	0.00E+00	0.00E+00	3.53E-05	3.53E-05
Total For Period	**Ci**	**1.05E-02**	**1.64E-02**	**3.18E-02**	**5.59E-03**	**6.43E-02**
B. Tritium						
H-3	Ci	4.34E+02	2.18E+02	2.08E+02	5.42E+01	9.14E+02
C. Dissolved and Entrained Gases						
Kr-85m	Ci	0.00E+00	3.88E-06	0.00E+00	0.00E+00	3.88E-06
Xe-135	Ci	8.11E-06	0.00E+00	0.00E+00	0.00E+00	8.11E-06
Xe-133m	Ci	8.73E-05	0.00E+00	0.00E+00	0.00E+00	8.73E-05
Xe-133	Ci	9.44E-03	1.17E-04	3.14E-03	1.52E-04	1.28E-02
Total For Period	**Ci**	**9.54E-03**	**1.21E-04**	**3.14E-03**	**1.52E-04**	**1.29E-02**
D. Gross Alpha Activity						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 2B, Liquid Effluents - Batch Mode

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Batch Mode 1ST Quarter	Batch Mode 2ND Quarter	Batch Mode 3RD Quarter	Batch Mode 4TH Quarter	Batch Mode Annual
A. Fission and Activation Products						
C-14	Ci	0.00E+00	8.63E-04	1.82E-03	3.64E-04	3.05E-03
Na-24	Ci	0.00E+00	2.10E-05	0.00E+00	0.00E+00	2.10E-05
Be-7	Ci	0.00E+00	0.00E+00	0.00E+00	2.38E-05	2.38E-05
Cr-51	Ci	1.17E-04	2.52E-05	1.33E-03	5.91E-04	2.07E-03
Mn-54	Ci	3.61E-05	2.67E-05	3.16E-04	3.59E-05	4.15E-04
Fe-55	Ci	0.00E+00	2.82E-03	1.81E-03	0.00E+00	4.63E-03
Fe-59	Ci	1.74E-05	0.00E+00	8.95E-05	1.59E-05	1.23E-04
Co-57	Ci	0.00E+00	0.00E+00	5.81E-06	1.08E-06	6.90E-06
Co-58	Ci	2.67E-04	3.10E-04	3.74E-03	2.37E-04	4.56E-03
Co-60	Ci	9.74E-04	6.49E-04	3.18E-03	4.69E-04	5.27E-03
Ni-63	Ci	0.00E+00	0.00E+00	1.43E-03	2.26E-04	1.65E-03
Ni-65	Ci	0.00E+00	0.00E+00	1.01E-05	0.00E+00	1.01E-05
Zn-65	Ci	9.49E-06	0.00E+00	6.84E-05	0.00E+00	7.79E-05
Sr-91	Ci	0.00E+00	0.00E+00	4.13E-06	0.00E+00	4.13E-06
Y-92	Ci	0.00E+00	3.73E-05	0.00E+00	0.00E+00	3.73E-05
Zr-95	Ci	4.67E-05	1.45E-05	1.75E-04	1.05E-04	3.41E-04
Nb-95	Ci	7.85E-05	3.94E-05	3.07E-04	1.82E-04	6.07E-04
Nb-97	Ci	1.87E-03	6.56E-04	3.97E-04	2.20E-04	3.14E-03
Tc-99m	Ci	0.00E+00	0.00E+00	0.00E+00	1.43E-06	1.43E-06
Ag-110m	Ci	1.46E-03	4.62E-04	3.47E-04	1.88E-04	2.45E-03
Sn-113	Ci	0.00E+00	0.00E+00	1.36E-05	0.00E+00	1.36E-05
Sn-117m	Ci	0.00E+00	3.31E-06	0.00E+00	0.00E+00	3.31E-06
Sb-124	Ci	2.15E-05	9.16E-04	1.45E-04	6.54E-06	1.09E-03
Sb-125	Ci	2.33E-04	1.04E-03	4.48E-04	4.45E-05	1.77E-03
Te-123m	Ci	2.44E-05	1.10E-04	7.59E-05	6.04E-05	2.70E-04
Te-129m	Ci	0.00E+00	1.85E-04	4.76E-05	0.00E+00	2.33E-04

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 2B, Liquid Effluents - Batch Mode

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Batch Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
Te-132	Ci	5.11E-05	0.00E+00	8.90E-06	0.00E+00	6.00E-05
I-132	Ci	4.45E-05	0.00E+00	5.44E-06	0.00E+00	5.00E-05
I-133	Ci	0.00E+00	0.00E+00	4.68E-06	0.00E+00	4.68E-06
I-134	Ci	0.00E+00	0.00E+00	2.07E-06	2.40E-06	4.47E-06
I-135	Ci	5.17E-06	0.00E+00	0.00E+00	0.00E+00	5.17E-06
Cs-136	Ci	0.00E+00	2.69E-06	0.00E+00	0.00E+00	2.69E-06
Cs-137	Ci	1.16E-05	7.26E-06	0.00E+00	1.99E-06	2.08E-05
Ba-140	Ci	0.00E+00	0.00E+00	4.45E-05	0.00E+00	4.45E-05
La-140	Ci	6.75E-06	1.19E-06	5.95E-05	0.00E+00	6.74E-05
Ce-141	Ci	0.00E+00	0.00E+00	0.00E+00	1.86E-06	1.86E-06
W-187	Ci	0.00E+00	0.00E+00	0.00E+00	1.76E-05	1.76E-05
Total For Period	**Ci**	**5.27E-03**	**8.19E-03**	**1.59E-02**	**2.80E-03**	**3.21E-02**
B. Tritium						
H-3	Ci	2.17E+02	1.09E+02	1.04E+02	2.71E+01	4.57E+02
C. Dissolved and Entrained Gases						
Kr-85m	Ci	0.00E+00	1.94E-06	0.00E+00	0.00E+00	1.94E-06
Xe-135	Ci	4.06E-06	0.00E+00	0.00E+00	0.00E+00	4.06E-06
Xe-133m	Ci	4.37E-05	0.00E+00	0.00E+00	0.00E+00	4.37E-05
Xe-133	Ci	4.72E-03	5.84E-05	1.57E-03	7.61E-05	6.42E-03
Total For Period	**Ci**	**4.77E-03**	**6.03E-05**	**1.57E-03**	**7.61E-05**	**6.47E-03**
D. Gross Alpha Activity						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 2B, Liquid Effluents - Batch Mode

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Nuclides Released	Units	Batch Mode 1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
A. Fission and Activation Products						
C-14	Ci	0.00E+00	8.63E-04	1.82E-03	3.64E-04	3.05E-03
Na-24	Ci	0.00E+00	2.10E-05	0.00E+00	0.00E+00	2.10E-05
Be-7	Ci	0.00E+00	0.00E+00	0.00E+00	2.38E-05	2.38E-05
Cr-51	Ci	1.17E-04	2.52E-05	1.33E-03	5.91E-04	2.07E-03
Mn-54	Ci	3.61E-05	2.67E-05	3.16E-04	3.59E-05	4.15E-04
Fe-55	Ci	0.00E+00	2.82E-03	1.81E-03	0.00E+00	4.63E-03
Fe-59	Ci	1.74E-05	0.00E+00	8.95E-05	1.59E-05	1.23E-04
Co-57	Ci	0.00E+00	0.00E+00	5.81E-06	1.08E-06	6.90E-06
Co-58	Ci	2.67E-04	3.10E-04	3.74E-03	2.37E-04	4.56E-03
Co-60	Ci	9.74E-04	6.49E-04	3.18E-03	4.69E-04	5.27E-03
Ni-63	Ci	0.00E+00	0.00E+00	1.43E-03	2.26E-04	1.65E-03
Ni-65	Ci	0.00E+00	0.00E+00	1.01E-05	0.00E+00	1.01E-05
Zn-65	Ci	9.49E-06	0.00E+00	6.84E-05	0.00E+00	7.79E-05
Sr-91	Ci	0.00E+00	0.00E+00	4.13E-06	0.00E+00	4.13E-06
Y-92	Ci	0.00E+00	3.73E-05	0.00E+00	0.00E+00	3.73E-05
Zr-95	Ci	4.67E-05	1.45E-05	1.75E-04	1.05E-04	3.41E-04
Nb-95	Ci	7.85E-05	3.94E-05	3.07E-04	1.82E-04	6.07E-04
Nb-97	Ci	1.87E-03	6.56E-04	3.97E-04	2.20E-04	3.14E-03
Tc-99m	Ci	0.00E+00	0.00E+00	0.00E+00	1.43E-06	1.43E-06
Ag-110m	Ci	1.46E-03	4.62E-04	3.47E-04	1.88E-04	2.45E-03
Sn-113	Ci	0.00E+00	0.00E+00	1.36E-05	0.00E+00	1.36E-05
Sn-117m	Ci	0.00E+00	3.31E-06	0.00E+00	0.00E+00	3.31E-06
Sb-124	Ci	2.15E-05	9.16E-04	1.45E-04	6.54E-06	1.09E-03
Sb-125	Ci	2.33E-04	1.04E-03	4.48E-04	4.45E-05	1.77E-03
Te-123m	Ci	2.44E-05	1.10E-04	7.59E-05	6.04E-05	2.70E-04
Te-129m	Ci	0.00E+00	1.85E-04	4.76E-05	0.00E+00	2.33E-04

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

Reg. Guide 1.21, Table 2B, Liquid Effluents - Batch Mode

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

		Batch Mode				
Nuclides Released	**Units**	**1ST Quarter**	**2ND Quarter**	**3RD Quarter**	**4TH Quarter**	**Annual**
Te-132	Ci	5.11E-05	0.00E+00	8.90E-06	0.00E+00	6.00E-05
I-132	Ci	4.45E-05	0.00E+00	5.44E-06	0.00E+00	5.00E-05
I-133	Ci	0.00E+00	0.00E+00	4.68E-06	0.00E+00	4.68E-06
I-134	Ci	0.00E+00	0.00E+00	2.07E-06	2.40E-06	4.47E-06
I-135	Ci	5.17E-06	0.00E+00	0.00E+00	0.00E+00	5.17E-06
Cs-136	Ci	0.00E+00	2.69E-06	0.00E+00	0.00E+00	2.69E-06
Cs-137	Ci	1.16E-05	7.26E-06	0.00E+00	1.99E-06	2.08E-05
Ba-140	Ci	0.00E+00	0.00E+00	4.45E-05	0.00E+00	4.45E-05
La-140	Ci	6.75E-06	1.19E-06	5.95E-05	0.00E+00	6.74E-05
Ce-141	Ci	0.00E+00	0.00E+00	0.00E+00	1.86E-06	1.86E-06
W-187	Ci	0.00E+00	0.00E+00	0.00E+00	1.76E-05	1.76E-05
Total For Period	**Ci**	**5.27E-03**	**8.19E-03**	**1.59E-02**	**2.80E-03**	**3.21E-02**
B. Tritium						
H-3	Ci	2.17E+02	1.09E+02	1.04E+02	2.71E+01	4.57E+02
C. Dissolved and Entrained Gases						
Kr-85m	Ci	0.00E+00	1.94E-06	0.00E+00	0.00E+00	1.94E-06
Xe-133m	Ci	4.37E-05	0.00E+00	0.00E+00	0.00E+00	4.37E-05
Xe-135	Ci	4.06E-06	0.00E+00	0.00E+00	0.00E+00	4.06E-06
Xe-133	Ci	4.72E-03	5.84E-05	1.57E-03	7.61E-05	6.42E-03
Total For Period	**Ci**	**4.77E-03**	**6.03E-05**	**1.57E-03**	**7.61E-05**	**6.47E-03**
D. Gross Alpha Activity						
No Nuclides Found	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

If Not Detected, Nuclide is Not Reported. Zeroes in this table indicates that no radioactivity was present at detectable levels.

TABLE 3.2

SOLID WASTE STORAGE AND SHIPMENTS
(8 PAGES)

NRC Regulatory Guide 1.21 Report

Solid Waste Shipped Offsite for Disposal and Estimates of Major Nuclides by Waste Class and Stream

During Period From: 01/01/2018 to 12/31/2018

Resins, Filters, And Evaporator Bottoms			
Waste Class	Volume ft³	Volume m³	Curies Shipped
A	1.60E+02	4.53E+00	3.32E+00
B	0.00E+00	0.00E+00	0.00E+00
C	0.00E+00	0.00E+00	0.00E+00
Unclassified	0.00E+00	0.00E+00	0.00E+00
All	1.60E+02	4.53E+00	3.32E+00

Major Nuclides for the Above Table:

H-3, C-14, Mn-54, Fe-55, Co-60, Ni-63, Sr-90, Tc-99, Ag-110m, I-129, Cs-137

Dry Active Waste (DAW)			
Waste Class	Volume ft³	Volume m³	Curies Shipped
A	1.62E+04	4.58E+02	3.42E+00
B	0.00E+00	0.00E+00	0.00E+00
C	0.00E+00	0.00E+00	0.00E+00
Unclassified	0.00E+00	0.00E+00	0.00E+00
All	1.62E+04	4.58E+02	3.42E+00

Major Nuclides for the Above Table:

H-3, C-14, Cr-51, Mn-54, Fe-55, Fe-59, Co-58, Co-60, Ni-59, Ni-63, Sr-90, Zr-95, Nb-94, Nb-95, Tc-99, Ag-110m, Sb-125, I-129, Cs-137, Ce-144, U-234, U-238, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-242, Cm-243

Irradiated Components			
Waste Class	Volume ft³	Volume m³	Curies Shipped
A	2.19E+00	6.20E-02	2.53E-02
B	0.00E+00	0.00E+00	0.00E+00
C	0.00E+00	0.00E+00	0.00E+00
Unclassified	0.00E+00	0.00E+00	0.00E+00
All	2.19E+00	6.20E-02	2.53E-02

Major Nuclides for the Above Table:

H-3, C-14, Fe-55, Co-60, Ni-59, Ni-63, Sr-90, Nb-94, Tc-99, I-129, Cs-137, U-234, U-238, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-242, Cm-243

NRC Regulatory Guide 1.21 Report

Solid Waste Shipped Offsite for Disposal and Estimates of Major Nuclides by Waste Class and Stream

During Period From: 01/01/2018 to 12/31/2018

Other Waste			
Waste Class	Volume ft³	Volume m³	Curies Shipped
A	1.00E+03	2.83E+01	3.78E-03
B	0.00E+00	0.00E+00	0.00E+00
C	0.00E+00	0.00E+00	0.00E+00
Unclassified	0.00E+00	0.00E+00	0.00E+00
All	1.00E+03	2.83E+01	3.78E-03

Major Nuclides for the Above Table:
H-3, C-14, Mn-54, Fe-55, Co-58, Co-60, Ni-63, Nb-95, Tc-99, Ag-110m, Sb-125, I-129, Cs-137, Ce-144, Pu-238,
Pu-239, Am-241, Cm-242, Cm-243

Sum Of All Low-Level Waste Shipped From Site			
Waste Class	Volume ft³	Volume m³	Curies Shipped
A	1.73E+04	4.90E+02	6.77E+00
B	0.00E+00	0.00E+00	0.00E+00
C	0.00E+00	0.00E+00	0.00E+00
Unclassified	0.00E+00	0.00E+00	0.00E+00
All	1.73E+04	4.90E+02	6.77E+00

Major Nuclides for the Above Table:
H-3, C-14, Cr-51, Mn-54, Fe-55, Fe-59, Co-58, Co-60, Ni-59, Ni-63, Sr-90, Zr-95, Nb-94, Nb-95, Tc-99, Ag-110m, Sb-125, I-129, Cs-137, Ce-144, U-234, U-238, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-242, Cm-243

WMG Suite 9.3.0

Reg Guide Activity Report

Report Date: 01/29/2019

NRC Regulatory Guide 1.21 Activity Report

Solid Waste Shipped Offsite for Disposal and Estimates of Major Nuclides by Shipment, Package, and Category

During Period From: 01/01/2018 to 12/31/2018 — Percent Cutoff: 1.0%

Dry Active Waste

Waste Class A

Nuclide Name	Abundance	Activity (Ci)
H-3	3.29%	1.12E-01
Cr-51	1.08%	3.69E-02
Fe-55	59.9%	2.05E+00
Co-60	23.33%	7.97E-01
Ni-63	7.38%	2.52E-01
Sb-125	1%	3.42E-02

Total Combined

Nuclide Name	Abundance	Activity (Ci)
H-3	3.29%	1.12E-01
Cr-51	1.08%	3.69E-02
Fe-55	59.9%	2.05E+00
Co-60	23.33%	7.97E-01
Ni-63	7.38%	2.52E-01
Sb-125	1%	3.42E-02

NRC Regulatory Guide 1.21 Activity Report

Solid Waste Shipped Offsite for Disposal and Estimates of Major Nuclides by Shipment, Package, and Category

During Period From: 01/01/2018 to 12/31/2018 Percent Cutoff: 1.0%

Irradiated Components

Waste Class A

Nuclide Name	Abundance	Activity (Ci)
Fe-55	1.39%	3.52E-04
Co-60	17.5%	4.43E-03
Ni-63	34.29%	8.69E-03
Sr-90	2.14%	5.41E-04
Cs-137	2.25%	5.71E-04
U-234	40.66%	1.03E-02
U-235	1.31%	3.31E-04

Total Combined

Nuclide Name	Abundance	Activity (Ci)
Fe-55	1.39%	3.52E-04
Co-60	17.5%	4.43E-03
Ni-63	34.29%	8.69E-03
Sr-90	2.14%	5.41E-04
Cs-137	2.25%	5.71E-04
U-234	40.66%	1.03E-02
U-235	1.31%	3.31E-04

Other Waste

Waste Class A

Nuclide Name	Abundance	Activity (Ci)
Fe-55	72.55%	2.74E-03
Co-60	15.19%	5.74E-04
Ni-63	5.32%	2.01E-04
Ag-110m	1.53%	5.77E-05

Total Combined

Nuclide Name	Abundance	Activity (Ci)
Fe-55	72.55%	2.74E-03
Co-60	15.19%	5.74E-04
Ni-63	5.32%	2.01E-04
Ag-110m	1.53%	5.77E-05

NRC Regulatory Guide 1.21 Activity Report

Solid Waste Shipped Offsite for Disposal and Estimates of Major Nuclides by Shipment, Package, and Category

During Period From: 01/01/2018 to 12/31/2018 Percent Cutoff: 1.0%

Resins, Filters, and Evap Bottoms

Waste Class A

Nuclide Name	Abundance	Activity (Ci)
H-3	12.62%	4.19E-01
C-14	2.74%	9.09E-02
Mn-54	1.22%	4.03E-02
Fe-55	7.01%	2.33E-01
Co-60	60.71%	2.01E+00
Ni-63	12.35%	4.10E-01
Ag-110m	1.09%	3.61E-02
Cs-137	1.06%	3.52E-02

Total Combined

Nuclide Name	Abundance	Activity (Ci)
H-3	12.62%	4.19E-01
C-14	2.74%	9.09E-02
Mn-54	1.22%	4.03E-02
Fe-55	7.01%	2.33E-01
Co-60	60.71%	2.01E+00
Ni-63	12.35%	4.10E-01
Ag-110m	1.09%	3.61E-02
Cs-137	1.06%	3.52E-02

NRC Regulatory Guide 1.21 Activity Report

Solid Waste Shipped Offsite for Disposal and Estimates of Major Nuclides by Shipment, Package, and Category

During Period From: 01/01/2018 to 12/31/2018 Percent Cutoff: 1.0%

Sum of All 4 Categories

Waste Class A

Nuclide Name	Abundance	Activity (Ci)
H-3	7.85%	5.31E-01
C-14	1.38%	9.33E-02
Fe-55	33.74%	2.28E+00
Co-60	41.64%	2.82E+00
Ni-63	9.92%	6.71E-01

Total Combined

Nuclide Name	Abundance	Activity (Ci)
H-3	7.85%	5.31E-01
C-14	1.38%	9.33E-02
Fe-55	33.74%	2.28E+00
Co-60	41.64%	2.82E+00
Ni-63	9.92%	6.71E-01

WMG Suite 9.3.0

Reg Guide Report

Report Date: 01/29/2019

During Period From: 01/01/2018 to 12/31/2018

Total Shipments by Carrier

Number of Shipments per each carrier

Number of Shipments	Mode of Transportation	Destination
2	Hittman Transport (SC)	Energy Solutions LLC (Bulk) Interstate 80, Exit 49
1	Hittman Transport (TN)	Energy Solutions LLC (Bulk) Interstate 80, Exit 49
5	Hittman Transport (TN)	EnergySolutions Bear Creek 1560 Bear Creek Road
3	Hittman Transport (TN)	EnergySolutions Bear Creek 1560 Bear Creek Road
2	Landstar	EnergySolutions Bear Creek 1560 Bear Creek Road

WMG Suite 9.3.0

Report date:
1/29/2019

NRC Regulatory Guide 1.21 Report
Shipment and Package Summary

Solid Waste Shipped Offsite for Disposal

During Period from: 1/1/2018 to 12/31/2018

Shipment Date	Manifest ID	Destination	Package Name	Category Name	NRC Class	DOT Type
5/9/2018	FPL/PSL18-017	EnergySolutions Bear Creek	ESUU202049 20' Sealand	Other Waste	A	Exempt Quantity
5/11/2018	FPL/PSL 18-055	EnergySolutions Bear Creek	ESUU200529 20' Sealand	Dry Active Waste	A	A LSA-II
			ESUU200731 20' Sealand	Dry Active Waste	A	A LSA-II
8/7/2018	1061-02-0001	Energy Solutions LLC (Bulk)	2885-019 B-25	Other Waste	A	A LSA-II
8/22/2018	FPL/PSL 18-083	EnergySolutions Bear Creek	PO652659-95 14-215 liner	Resins, Filters, and Evap Bottoms	A	A LSA-II
9/19/2018	FPL/PSL 18-097	EnergySolutions Bear Creek	ESUU 200965 20' Sealand	Dry Active Waste	A	A LSA-II
			ESUU 200572 20' Sealand	Dry Active Waste	A	A LSA-II
9/19/2018	FPL/PSL 18-098	EnergySolutions Bear Creek	ESUU 200789 20' Sealand	Dry Active Waste	A	A LSA-II
			ESUU 200288 20' Sealand	Dry Active Waste	A	A LSA-II
9/19/2018	FPL/PSL 18-096	EnergySolutions Bear Creek	ESUU 200718 20' Sealand	Dry Active Waste	A	A LSA-II
			ESUU 200629 20' Sealand	Dry Active Waste	A	A LSA-II
11/7/2018	FPL/PSL18-109	EnergySolutions Bear Creek	ESUU200652 20' Sealand	Dry Active Waste	A	A LSA-II
			ESUU300066 20' Sealand	Dry Active Waste	A	A LSA-II
11/7/2018	FPL/PSL 18-105	EnergySolutions Bear Creek	ESUU200572 20' Sealand	Dry Active Waste	A	A LSA-II
			ESUU200829 20' Sealand	Dry Active Waste	A	A LSA-II
11/21/2018	FPL/PSL18-115	EnergySolutions Bear Creek	ESUU200434 20' Sealand	Dry Active Waste	A	A LSA-II
			ESUU200399 20' Sealand	Dry Active Waste	A	A LSA-II
12/17/2018	1061-01-0002	Energy Solutions LLC (Bulk)	U1 1A1 Impeller Shield	Dry Active Waste	A	A LSA-II
12/17/2018	1061-01-0001	Energy Solutions LLC (Bulk)	U2 2A2 Impeller shield	Dry Active Waste	A	A LSA-II
12/19/2018	FPL/PSL18-122	EnergySolutions Bear Creek	109 20' Sealand	Dry Active Waste	A	Exempt Quantity
			Tan Sealand 1 20' Sealand	Dry Active Waste	A	Exempt Quantity

TABLE 3.3

DOSE ASSESSMENTS
(18 PAGES)

Friday, February 15, 2019 10:37:42AM
Florida Power & Light
St. Lucie Power Plant

OpenEMS Effluent Management Software

Reg. Guide 1.21, App B, Sec Doses due to Radioiodines, Tritium, and Particulates in Gaseous Releases

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Organ Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Bone	mRem	1.29E-03	2.24E-03	2.64E-02	1.56E-03	2.67E-02
Limit	mRem					
Percent of Limit	%					
Liver	mRem	1.93E-03	2.04E-03	1.38E-03	1.36E-03	6.71E-03
Limit	mRem					
Percent of Limit	%					
Total Body	mRem	1.93E-03	2.04E-03	1.96E-03	1.36E-03	7.29E-03
Limit	mRem					
Percent of Limit	%					
Thyroid	mRem	1.95E-03	2.04E-03	1.41E-03	1.36E-03	6.76E-03
Limit	mRem					
Percent of Limit	%					
Kidney	mRem	5.20E-04	1.03E-03	4.42E-04	3.31E-04	2.32E-03
Limit	mRem					
Percent of Limit	%					
Lung	mRem	1.93E-03	2.08E-03	1.24E-02	1.36E-03	1.78E-02
Limit	mRem					
Percent of Limit	%					
GI-Lli	mRem	1.93E-03	2.04E-03	1.48E-03	1.36E-03	6.81E-03
Limit	mRem					
Percent of Limit	%					

Period: Ann, 2018 **Site/Unit/Discharge Point:** Site

Site Boundary NNG Doserate Summary - Note: All Doses in mRem/yr

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
NW Site Boundary - In	Infant	1.603E-02	6.712E-03	7.291E-03	6.764E-03	2.320E-03	1.780E-02	6.811E-03	0.000E+00
WNW Site Boundary - I	Infant	2.823E-04	2.823E-04	2.823E-04	2.823E-04	2.823E-04	2.823E-04	2.823E-04	0.000E+00
Maximum Doserate by Organ:		1.603E-02	6.712E-03	7.291E-03	6.764E-03	2.320E-03	1.780E-02	6.811E-03	0.000E+00

Maximum Organ Doserate (mRem/yr): 1.780E-02

Maximum Total Body Doserate (mRem/yr): 7.291E-03

Site Boundary NG Doserate Summary

Gas Receptor Location	Gamma (mRad/yr)	Beta (mRad/yr)	Total Body (mRem/yr)	Skin (mRem/yr)
NW Site Boundary	3.825E-03	1.811E-03	3.627E-03	5.608E-03
WNW Site Boundary	3.295E-03	1.560E-03	3.124E-03	4.831E-03
Maximum NG Dose Rate:	3.825E-03	1.811E-03	3.627E-03	5.608E-03

Period: Ann, 2018 **Site/Unit/Discharge Point:** Site

Maximum Individual NNG Dose Summary - Note: All Doses in mRem

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
NW - Near Milk - Adult	Adult	5.169E-03	8.973E-05	5.068E-04	1.817E-04	8.326E-05	5.213E-04	1.218E-04	0.000E+00
NW Near Milk - Child	Child	2.272E-03	1.097E-04	4.905E-04	3.794E-04	8.346E-05	7.601E-04	1.153E-04	0.000E+00
NW Near Milk - Infant	Infant	2.814E-03	1.525E-04	6.506E-04	7.943E-04	8.340E-05	7.864E-04	1.070E-04	0.000E+00
NW Near Milk - Teenager	Teenager	1.668E-03	9.697E-05	3.760E-04	2.327E-04	8.438E-05	8.422E-04	1.361E-04	0.000E+00
SE Nearest Res - Adult	Adult	2.675E-02	4.649E-04	2.081E-03	4.821E-04	4.644E-04	3.034E-03	6.568E-04	0.000E+00
SE Nearest Res - Child	Child	4.811E-03	4.651E-04	7.289E-04	4.907E-04	4.642E-04	4.417E-03	5.559E-04	0.000E+00
SE Nearest Res - Infant	Infant	3.962E-03	4.650E-04	6.777E-04	4.886E-04	4.641E-04	4.543E-03	5.010E-04	0.000E+00
SE Nearest Res - Teenager	Teenager	3.591E-03	4.651E-04	6.560E-04	4.862E-04	4.644E-04	4.901E-03	6.571E-04	0.000E+00
SE Visitor - Lifeguard 1.0 mi	Adult	1.242E-02	2.159E-04	9.664E-04	2.234E-04	2.157E-04	1.408E-03	3.050E-04	0.000E+00
W Near Garden - Adult	Adult	1.255E-02	2.180E-04	9.759E-04	2.251E-04	2.178E-04	1.422E-03	3.080E-04	0.000E+00
W Near Garden - Child	Child	2.256E-03	2.181E-04	3.419E-04	2.287E-04	2.177E-04	2.070E-03	2.607E-04	0.000E+00
W Near Garden - Teenager	Teenager	1.684E-03	2.181E-04	3.076E-04	2.268E-04	2.178E-04	2.296E-03	3.081E-04	0.000E+00
Maximum Dose by Organ:		2.675E-02	4.651E-04	2.081E-03	7.943E-04	4.644E-04	4.901E-03	6.571E-04	0.000E+00

Maximum Organ Dose (mRem): 2.675E-02

Maximum Total Body Dose (mRem): 2.081E-03

Maximum Individual NG Dose Summary

Gas Receptor Location	Gamma (mRad)	Beta (mRad)	Total Body (mRem)	Skin (mRem)
NW Near Milk 4.25 mi	3.347E-04	1.585E-04	3.173E-04	4.907E-04
SE Nearest Res 1.52 mi 142 deg	1.703E-03	8.060E-04	1.614E-03	2.496E-03
SE Visitor @ 1 mi	7.372E-04	3.490E-04	6.989E-04	1.081E-03
W Near Gard 2.0 miles	5.857E-04	2.773E-04	5.553E-04	8.588E-04
Maximum NG Dose:	1.703E-03	8.060E-04	1.614E-03	2.496E-03

Friday, February 15, 2019 10:36:50AM
Florida Power & Light
St. Lucie Power Plant

OpenEMS Effluent Management Software

Reg. Guide 1.21, App B, Sec Doses due to Radioiodines, Tritium, and Particulates in Gaseous Releases

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Organ Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Bone	mRem	5.63E-04	8.68E-04	2.63E-02	8.94E-04	2.64E-02
Limit	mRem					
Percent of Limit	%					
Liver	mRem	6.28E-04	7.74E-04	6.50E-04	7.90E-04	2.84E-03
Limit	mRem					
Percent of Limit	%					
Total Body	mRem	6.28E-04	7.74E-04	1.62E-03	7.88E-04	3.42E-03
Limit	mRem					
Percent of Limit	%					
Thyroid	mRem	6.44E-04	7.81E-04	6.51E-04	7.90E-04	2.87E-03
Limit	mRem					
Percent of Limit	%					
Kidney	mRem	1.32E-04	3.02E-04	9.56E-05	2.50E-04	7.80E-04
Limit	mRem					
Percent of Limit	%					
Lung	mRem	6.28E-04	7.88E-04	1.17E-02	7.88E-04	1.39E-02
Limit	mRem					
Percent of Limit	%					
GI-Lli	mRem	6.28E-04	7.74E-04	7.50E-04	7.88E-04	2.94E-03
Limit	mRem					
Percent of Limit	%					

Period: Ann, 2018 **Site/Unit/Discharge Point:** PSL1

Site Boundary NNG Doserate Summary - Note: All Doses in mRem/yr

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
NW Site Boundary - In	Infant	1.259E-02	2.841E-03	3.421E-03	2.866E-03	7.804E-04	1.389E-02	2.940E-03	0.000E+00
WNW Site Boundary - I	Infant	8.552E-05	8.552E-05	8.552E-05	8.552E-05	8.552E-05	8.552E-05	8.552E-05	0.000E+00
Maximum Doserate by Organ:		1.259E-02	2.841E-03	3.421E-03	2.866E-03	7.804E-04	1.389E-02	2.940E-03	0.000E+00

Maximum Organ Doserate (mRem/yr): 1.389E-02

Maximum Total Body Doserate (mRem/yr): 3.421E-03

Site Boundary NG Doserate Summary

Gas Receptor Location	Gamma (mRad/yr)	Beta (mRad/yr)	Total Body (mRem/yr)	Skin (mRem/yr)
NW Site Boundary	2.540E-03	1.062E-03	2.408E-03	3.579E-03
WNW Site Boundary	2.188E-03	9.149E-04	2.075E-03	3.083E-03
Maximum NG Dose Rate:	2.540E-03	1.062E-03	2.408E-03	3.579E-03

Period: Ann, 2018 **Site/Unit/Discharge Point:** PSL1

Maximum Individual NNG Dose Summary - Note: All Doses in mRem

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
NW - Near Milk - Adult	Adult	5.113E-03	3.447E-05	4.516E-04	6.401E-05	2.792E-05	4.617E-04	6.569E-05	0.000E+00
NW Near Milk - Child	Child	2.217E-03	5.403E-05	4.347E-04	1.408E-04	2.810E-05	6.997E-04	5.953E-05	0.000E+00
NW Near Milk - Infant	Infant	2.758E-03	9.588E-05	5.942E-04	3.012E-04	2.807E-05	7.271E-04	5.128E-05	0.000E+00
NW Near Milk - Teenager	Teenager	1.612E-03	4.156E-05	3.206E-04	8.382E-05	2.894E-05	7.806E-04	7.995E-05	0.000E+00
SE Nearest Res - Adult	Adult	2.643E-02	1.429E-04	1.759E-03	1.506E-04	1.424E-04	2.693E-03	3.339E-04	0.000E+00
SE Nearest Res - Child	Child	4.489E-03	1.431E-04	4.069E-04	1.551E-04	1.422E-04	4.072E-03	2.336E-04	0.000E+00
SE Nearest Res - Infant	Infant	3.640E-03	1.430E-04	3.557E-04	1.541E-04	1.421E-04	4.203E-03	1.789E-04	0.000E+00
SE Nearest Res - Teenager	Teenager	3.269E-03	1.431E-04	3.340E-04	1.527E-04	1.424E-04	4.551E-03	3.343E-04	0.000E+00
SE Visitor - Lifeguard 1.0 mi	Adult	1.227E-02	6.632E-05	8.168E-04	6.971E-05	6.611E-05	1.250E-03	1.550E-04	0.000E+00
W Near Garden - Adult	Adult	1.239E-02	6.696E-05	8.249E-04	7.016E-05	6.676E-05	1.263E-03	1.566E-04	0.000E+00
W Near Garden - Child	Child	2.105E-03	6.705E-05	1.908E-04	7.201E-05	6.669E-05	1.909E-03	1.096E-04	0.000E+00
W Near Garden - Teenager	Teenager	1.533E-03	6.706E-05	1.566E-04	7.102E-05	6.676E-05	2.134E-03	1.568E-04	0.000E+00
Maximum Dose by Organ:		2.643E-02	1.431E-04	1.759E-03	3.012E-04	1.424E-04	4.551E-03	3.343E-04	0.000E+00

Maximum Organ Dose (mRem): 2.643E-02

Maximum Total Body Dose (mRem): 1.759E-03

Maximum Individual NG Dose Summary

Gas Receptor Location	Gamma (mRad)	Beta (mRad)	Total Body (mRem)	Skin (mRem)
NW Near Milk 4.25 mi	2.223E-04	9.293E-05	2.107E-04	3.132E-04
SE Nearest Res 1.52 mi 142 deg	1.131E-03	4.727E-04	1.072E-03	1.593E-03
SE Visitor @ 1 mi	4.896E-04	2.047E-04	4.642E-04	6.898E-04
W Near Gard 2.0 miles	3.890E-04	1.626E-04	3.688E-04	5.480E-04
Maximum NG Dose:	1.131E-03	4.727E-04	1.072E-03	1.593E-03

Reg. Guide 1.21, App B, Sec Doses due to Radioiodines, Tritium, and Particulates in Gaseous Releases

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Organ Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Bone	mRem	7.27E-04	1.37E-03	6.66E-04	6.71E-04	3.43E-03
Limit	mRem					
Percent of Limit	%					
Liver	mRem	1.31E-03	1.26E-03	7.29E-04	5.73E-04	3.87E-03
Limit	mRem					
Percent of Limit	%					
Total Body	mRem	1.31E-03	1.26E-03	7.29E-04	5.73E-04	3.87E-03
Limit	mRem					
Percent of Limit	%					
Thyroid	mRem	1.31E-03	1.26E-03	7.57E-04	5.73E-04	3.90E-03
Limit	mRem					
Percent of Limit	%					
Kidney	mRem	3.88E-04	7.24E-04	3.46E-04	8.10E-05	1.54E-03
Limit	mRem					
Percent of Limit	%					
Lung	mRem	1.31E-03	1.29E-03	7.41E-04	5.73E-04	3.91E-03
Limit	mRem					
Percent of Limit	%					
GI-Lli	mRem	1.31E-03	1.26E-03	7.29E-04	5.73E-04	3.87E-03
Limit	mRem					
Percent of Limit	%					

Period: Ann, 2018 **Site/Unit/Discharge Point:** PSL2

Site Boundary NNG Doserate Summary - Note: All Doses in mRem/yr

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
NW Site Boundary - In	Infant	3.434E-03	3.871E-03	3.871E-03	3.898E-03	1.539E-03	3.911E-03	3.871E-03	0.000E+00
WNW Site Boundary - I	Infant	1.968E-04	1.968E-04	1.968E-04	1.968E-04	1.968E-04	1.968E-04	1.968E-04	0.000E+00
Maximum Doserate by Organ:		3.434E-03	3.871E-03	3.871E-03	3.898E-03	1.539E-03	3.911E-03	3.871E-03	0.000E+00

Maximum Organ Doserate (mRem/yr): 3.911E-03

Maximum Total Body Doserate (mRem/yr): 3.871E-03

Site Boundary NG Doserate Summary

Gas Receptor Location	Gamma (mRad/yr)	Beta (mRad/yr)	Total Body (mRem/yr)	Skin (mRem/yr)
NW Site Boundary	1.285E-03	7.489E-04	1.218E-03	2.029E-03
WNW Site Boundary	1.107E-03	6.451E-04	1.049E-03	1.748E-03
Maximum NG Dose Rate:	1.285E-03	7.489E-04	1.218E-03	2.029E-03

Period: Ann, 2018 **Site/Unit/Discharge Point:** PSL2

Maximum Individual NNG Dose Summary - Note: All Doses in mRem

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
NW - Near Milk - Adult	Adult	5.515E-05	5.526E-05	5.523E-05	1.177E-04	5.535E-05	5.963E-05	5.613E-05	0.000E+00
NW Near Milk - Child	Child	5.557E-05	5.569E-05	5.576E-05	2.385E-04	5.536E-05	6.037E-05	5.578E-05	0.000E+00
NW Near Milk - Infant	Infant	5.616E-05	5.661E-05	5.634E-05	4.931E-04	5.534E-05	5.934E-05	5.569E-05	0.000E+00
NW Near Milk - Teenager	Teenager	5.525E-05	5.542E-05	5.537E-05	1.488E-04	5.544E-05	6.163E-05	5.616E-05	0.000E+00
SE Nearest Res - Adult	Adult	3.220E-04	3.220E-04	3.220E-04	3.315E-04	3.220E-04	3.415E-04	3.230E-04	0.000E+00
SE Nearest Res - Child	Child	3.220E-04	3.220E-04	3.220E-04	3.356E-04	3.220E-04	3.446E-04	3.223E-04	0.000E+00
SE Nearest Res - Infant	Infant	3.220E-04	3.220E-04	3.220E-04	3.345E-04	3.220E-04	3.403E-04	3.221E-04	0.000E+00
SE Nearest Res - Teenager	Teenager	3.220E-04	3.220E-04	3.220E-04	3.335E-04	3.220E-04	3.500E-04	3.228E-04	0.000E+00
SE Visitor - Lifeguard 1.0 mi	Adult	1.495E-04	1.495E-04	1.495E-04	1.537E-04	1.495E-04	1.581E-04	1.500E-04	0.000E+00
W Near Garden - Adult	Adult	1.510E-04	1.510E-04	1.510E-04	1.549E-04	1.510E-04	1.591E-04	1.514E-04	0.000E+00
W Near Garden - Child	Child	1.510E-04	1.510E-04	1.510E-04	1.566E-04	1.510E-04	1.604E-04	1.511E-04	0.000E+00
W Near Garden - Teenager	Teenager	1.510E-04	1.510E-04	1.510E-04	1.558E-04	1.510E-04	1.626E-04	1.513E-04	0.000E+00
Maximum Dose by Organ:		3.220E-04	3.220E-04	3.220E-04	4.931E-04	3.220E-04	3.500E-04	3.230E-04	0.000E+00

Maximum Organ Dose (mRem): 4.931E-04

Maximum Total Body Dose (mRem): 3.220E-04

Maximum Individual NG Dose Summary

Gas Receptor Location	Gamma (mRad)	Beta (mRad)	Total Body (mRem)	Skin (mRem)
NW Near Milk 4.25 mi	1.124E-04	6.553E-05	1.066E-04	1.776E-04
SE Nearest Res 1.52 mi 142 deg	5.718E-04	3.333E-04	5.423E-04	9.032E-04
SE Visitor @ 1 mi	2.476E-04	1.443E-04	2.348E-04	3.911E-04
W Near Gard 2.0 miles	1.967E-04	1.147E-04	1.866E-04	3.107E-04
Maximum NG Dose:	5.718E-04	3.333E-04	5.423E-04	9.032E-04

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Reg. Guide 1.21, App B, Sec Air Doses Due To Gaseous Releases

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

NG Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Gamma Air	mRad	1.83E-03	7.97E-04	1.03E-03	1.63E-04	3.83E-03
Limit	mRad					
Percent of Limit	%					
Beta Air	mRad	1.04E-03	2.86E-04	4.26E-04	6.20E-05	1.81E-03
Limit	mRad					
Percent of Limit	%					
NG Total Body	mRem	1.73E-03	7.58E-04	9.80E-04	1.55E-04	3.63E-03
Limit	mRem					
Percent of Limit	%					
NG Skin	mRem	2.81E-03	1.11E-03	1.46E-03	2.30E-04	5.61E-03
Limit	mRem					
Percent of Limit	%					

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Reg. Guide 1.21, App B, Sec Air Doses Due To Gaseous Releases

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

NG Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Gamma Air	mRad	1.69E-03	6.78E-04	9.49E-05	7.75E-05	2.54E-03
Limit	mRad					
Percent of Limit	%					
Beta Air	mRad	7.36E-04	2.42E-04	5.29E-05	3.10E-05	1.06E-03
Limit	mRad					
Percent of Limit	%					
NG Total Body	mRem	1.60E-03	6.44E-04	8.98E-05	7.38E-05	2.41E-03
Limit	mRem					
Percent of Limit	%					
NG Skin	mRem	2.38E-03	9.42E-04	1.42E-04	1.12E-04	3.58E-03
Limit	mRem					
Percent of Limit	%					

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Reg. Guide 1.21, App B, Sec Air Doses Due To Gaseous Releases

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

NG Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Gamma Air	mRad	1.41E-04	1.20E-04	9.39E-04	8.53E-05	1.28E-03
Limit	mRad					
Percent of Limit	%					
Beta Air	mRad	3.00E-04	4.44E-05	3.74E-04	3.09E-05	7.49E-04
Limit	mRad					
Percent of Limit	%					
NG Total Body	mRem	1.33E-04	1.14E-04	8.90E-04	8.10E-05	1.22E-03
Limit	mRem					
Percent of Limit	%					
NG Skin	mRem	4.30E-04	1.67E-04	1.31E-03	1.19E-04	2.03E-03
Limit	mRem					
Percent of Limit	%					

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Reg. Guide 1.21, App B, Sec Doses to a member of the public due to Liquid Releases

Unit: Site

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Organ Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Bone	mRem	2.48E-04	1.45E-02	1.43E-02	5.23E-04	2.96E-02
Limit	mRem					
Percent of Limit	%					
Liver	mRem	3.55E-03	6.60E-02	4.85E-02	5.49E-04	1.19E-01
Limit	mRem					
Percent of Limit	%					
Total Body	mRem	3.41E-03	1.86E-02	1.56E-02	4.93E-04	3.81E-02
Limit	mRem					
Percent of Limit	%					
Thyroid	mRem	2.97E-03	1.48E-03	1.45E-03	3.21E-04	6.23E-03
Limit	mRem					
Percent of Limit	%					
Kidney	mRem	4.02E-03	1.88E-03	3.18E-03	4.01E-04	9.49E-03
Limit	mRem					
Percent of Limit	%					
Lung	mRem	3.29E-03	7.71E-02	5.18E-02	3.95E-04	1.33E-01
Limit	mRem					
Percent of Limit	%					
GI-Lli	mRem	4.40E-02	4.27E-02	6.18E-02	1.26E-02	1.61E-01
Limit	mRem					
Percent of Limit	%					

Period: Ann, 2018 **Site/Unit/Discharge Point:** Site

Liquid Dose Summary - Note: All Doses in mRem

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
Liquid Receptor - Teenager	Teenager	2.959E-02	1.187E-01	3.810E-02	6.229E-03	9.486E-03	1.326E-01	1.611E-01	0.000E+00
Liquid Recptor - Child	Child	1.353E-02	5.529E-02	2.063E-02	5.435E-03	4.135E-03	6.129E-02	6.935E-02	0.000E+00
Maximum Dose by Organ:		2.959E-02	1.187E-01	3.810E-02	6.229E-03	9.486E-03	1.326E-01	1.611E-01	0.000E+00

Maximum Organ Dose (mRem): 1.611E-01

Maximum Total Body Dose (mRem): 3.810E-02

Reg. Guide 1.21, App B, Sec Doses to a member of the public due to Liquid Releases

Unit: PSL1

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Organ Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Bone	mRem	1.24E-04	7.27E-03	7.14E-03	2.61E-04	1.48E-02
Limit	mRem					
Percent of Limit	%					
Liver	mRem	1.78E-03	3.30E-02	2.43E-02	2.74E-04	5.93E-02
Limit	mRem					
Percent of Limit	%					
Total Body	mRem	1.71E-03	9.32E-03	7.78E-03	2.47E-04	1.91E-02
Limit	mRem					
Percent of Limit	%					
Thyroid	mRem	1.49E-03	7.40E-04	7.27E-04	1.61E-04	3.11E-03
Limit	mRem					
Percent of Limit	%					
Kidney	mRem	2.01E-03	9.40E-04	1.59E-03	2.00E-04	4.74E-03
Limit	mRem					
Percent of Limit	%					
Lung	mRem	1.64E-03	3.86E-02	2.59E-02	1.98E-04	6.63E-02
Limit	mRem					
Percent of Limit	%					
GI-Lli	mRem	2.20E-02	2.13E-02	3.09E-02	6.29E-03	8.05E-02
Limit	mRem					
Percent of Limit	%					

Period: Ann, 2018 **Site/Unit/Discharge Point:** PSL1

Liquid Dose Summary - Note: All Doses in mRem

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
Liquid Receptor - Teenager	Teenager	1.480E-02	5.933E-02	1.905E-02	3.114E-03	4.743E-03	6.632E-02	8.053E-02	0.000E+00
Liquid Recptor - Child	Child	6.763E-03	2.764E-02	1.031E-02	2.718E-03	2.068E-03	3.064E-02	3.468E-02	0.000E+00
Maximum Dose by Organ:		1.480E-02	5.933E-02	1.905E-02	3.114E-03	4.743E-03	6.632E-02	8.053E-02	0.000E+00

Maximum Organ Dose (mRem): 8.053E-02

Maximum Total Body Dose (mRem): 1.905E-02

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Reg. Guide 1.21, App B, Sec Doses to a member of the public due to Liquid Releases

Unit: PSL2

Starting: 1-Jan-2018 Ending: 31-Dec-2018

Organ Dose	Units	1ST Quarter	2ND Quarter	3RD Quarter	4TH Quarter	Annual
Bone	mRem	1.24E-04	7.27E-03	7.14E-03	2.61E-04	1.48E-02
Limit	mRem					
Percent of Limit	%					
Liver	mRem	1.78E-03	3.30E-02	2.43E-02	2.74E-04	5.93E-02
Limit	mRem					
Percent of Limit	%					
Total Body	mRem	1.71E-03	9.32E-03	7.78E-03	2.47E-04	1.91E-02
Limit	mRem					
Percent of Limit	%					
Thyroid	mRem	1.49E-03	7.40E-04	7.27E-04	1.61E-04	3.11E-03
Limit	mRem					
Percent of Limit	%					
Kidney	mRem	2.01E-03	9.40E-04	1.59E-03	2.00E-04	4.74E-03
Limit	mRem					
Percent of Limit	%					
Lung	mRem	1.64E-03	3.86E-02	2.59E-02	1.98E-04	6.63E-02
Limit	mRem					
Percent of Limit	%					
GI-Lli	mRem	2.20E-02	2.13E-02	3.09E-02	6.29E-03	8.05E-02
Limit	mRem					
Percent of Limit	%					

Period: Ann, 2018 **Site/Unit/Discharge Point:** PSL2

Liquid Dose Summary - Note: All Doses in mRem

Receptor	Agegroup	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-Lli	Skin
Liquid Receptor - Teenager	Teenager	1.480E-02	5.933E-02	1.905E-02	3.114E-03	4.743E-03	6.632E-02	8.053E-02	0.000E+00
Liquid Recptor - Child	Child	6.763E-03	2.764E-02	1.031E-02	2.718E-03	2.068E-03	3.064E-02	3.468E-02	0.000E+00
Maximum Dose by Organ:		1.480E-02	5.933E-02	1.905E-02	3.114E-03	4.743E-03	6.632E-02	8.053E-02	0.000E+00

Maximum Organ Dose (mRem): 8.053E-02

Maximum Total Body Dose (mRem): 1.905E-02

TABLE 3.4

VISITOR DOSE
(1 PAGE)

3.4 Visitor Dose

Dose to a Member of the Public from Activities Inside the Site Boundary: Assessment of radiation dose from radioactive effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY assumes the VISITOR to be a lifeguard at the Walton Rocks Beach recreation area. The visitor is assumed to be onsite for 6 hours per day for 312 days per year at a distance of 1 mile in the South East Sector. The VISITOR received exposure from each of the two reactors on the site. Actual Met Data was used to calculate Visitor Dose for Calendar Year 2018.

VISITOR DOSE RESULTS FOR CALENDAR YEAR 2018 were:

Noble Gas Dose	**mrad**
Gamma Air Dose	2.36E-03
Beta Air Dose	1.12E-03

Gas, Particulate, Iodine, Carbon Dose	**mrem**
Bone	1.81E-02
Liver	1.50E-03
Thyroid	1.54E-03
Kidney	1.13E-03
Lung	8.85E-03
GI-LLI	1.57E-03
Total Body	2.30E-03

ENCLOSURE 2

C-200, OFFSITE DOSE CALCULATION MANUAL REVISION 52
(231 PAGES)

FOR INFORMATION ONLY
Before use, verify revision and change documentation (if applicable) with a controlled index or document.
DATE VERIFIED ______ INITIAL ______

FPL	**ST. LUCIE PLANT** **CHEMISTRY OPERATING PROCEDURE** SAFETY RELATED **REFERENCE USE**	Procedure No. **C-200** Current Revision No. **52**

Title:

OFFSITE DOSE CALCULATION MANUAL (ODCM)

Responsible Department: **CHEMISTRY**

REVISION SUMMARY:

NOTE
All changes to this procedure require an Emergency Preparedness Review.

Revision 52 - Incorporated PCR 2278129 to define a tank release to prevent accounting for the same radioactivity multiple times when performing activities such as maintenance, and to remove the requirement for the SGBTF vent monitor to be operable when no releases are being made through that pathway. (Author: C. Crawford)

Revision 51 - Incorporated PCR 2263650 to replace the word OPERATIONAL with the word FUNCTIONAL and to revise the Environmental Sample Locations map. (Author: T. Bertolini)

Revision 50 - Incorporated PCR 2223046 to remove affected process effluent radiation monitors from the Technical Specifications and incorporate them into the Offsite Dose Calculation Manual. (Author: T. Bertolini)

Revision 49 - Incorporated PCR 2137189 per EC 278372 to update values in Methodology Section. (Author: T. Bertolini)

Revision 48 - Incorporated PCR 2184721 to add note to cover page ensuring that changes to the ODCM are reviewed by EP. (Author: N. Davidson)

Revision 47 - Incorporated PCR 2174317 to correct location on map in the AREOR. (Author: N. Davidson)

Revision	Approved By	Approval Date
0	C.M. Wethy	04/27/82
52	B. Beltz	01/11/19

UNIT #	
DATE	
DOCT	PROCEDURE
DOCN	C-200
SYS	
STATUS	COMPLETED
REV	52
# OF PGS	

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METHODOLOGY SECTION

Glossary for Methodology Section (continued)

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METHODOLOGY SECTION

APPENDIXES

INTRODUCTION

The ODCM consists of the Controls Section followed by the Methodology Section.

The Controls Section provides the Control Statements, Limits, ACTION Statements, Surveillance Requirements and BASES for ensuring that Radioactive Liquid and Gaseous Effluents released to UNRESTRICTED AREAS and/or the SITE BOUNDARY will be maintained within the requirements of 10 CFR Part 20, 40 CFR Part 190, 10 CFR Part 72, 10 CFR 50.36.a and 10 CFR Part 50 Appendix-I radioactive release criteria. All Control Statements and most Administrative Control Statements in the ODCM are directly tied to and reference the Plant Technical Specification (TS) Administrative Section. The Administrative Control for Major Changes to Radioactive Liquid, Gaseous and Solid Treatment Systems is as per the guidance of NUREG-1301, April 1991, Supplement No. 1 to NRC Generic Letter 89-01. The numbering sequences of Control Statements also follow the guidance of NUREG-1301 as applicable, to minimize differences. Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, 6.3.1 and 6.3.2, provide the background for the need to maintain Quality Assurance programs for effluent releases and radiological environmental monitoring.

The Methodology Section uses the models suggested by NUREG-0133, November, 1978 and Regulatory Guide 1.109 to provide calculation methods and parameters for determining results in compliance with the Controls Section of the ODCM. Simplifying assumptions have been applied where applicable to provide a more workable document for implementing the Control requirements. Alternate calculation methods may be used from those presented as long as the overall methodology does not change or as long as most up-to-date revisions of the Regulatory Guide 1.109 dose conversion factors and environmental transfer factors are substituted for those currently included and used in this document.

RECORDS AND NOTIFICATIONS

All records of reviews performed for changes to the ODCM shall be maintained in accordance with RM-AA-100-1000, Processing Quality Assurance Records. All ORG approved changes to the ODCM, with required documentation of the changes per TS 6.14, shall be submitted to the NRC in the Annual Effluent Release Report. Procedures that directly implement, administer or supplement the requirements of the ODCM Controls and Surveillances are:

- CY-SL-102-0104, Processing Aerated Liquid Waste
- CY-SL-102-0105, Processing Gaseous Wastes
- 0-CPP-28.20, Met Tower Data Processing
- COP-05.04, Chemistry Department Surveillances and Parameters
- CY-SL-104-0112, Determination of Process Radiation Monitor Setpoints
- The Radiological Environmental Monitoring Program is performed by the State of Florida as per FPL Juno Nuclear Plant Services Corporate Environmental Procedure Number EV-SR-104-1001.
- The licensee also performs environmental monitoring per EV-AA-01, Fleet Groundwater Protection Program, in order to meet the objectives of the Nuclear Energy Institute's Industry Initiative (NEI 07-07).

CONTROLS
AND
SURVEILLANCE REQUIREMENTS

1.0 DEFINITIONS for CONTROLS SECTION OF ODCM

The defined terms of this section appear in capitalized type and are applicable throughout these Controls.

ACTION

1.1 ACTION shall be that part of a Control that prescribes remedial measures required under designated conditions.

CHANNEL CALIBRATION

1.4 CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds with the necessary range and accuracy to known values of the parameter which the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel including the sensor and alarm and/or trip functions and shall include the CHANNEL FUNCTIONAL TEST. The CHANNEL CALIBRATION may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is calibrated.

CHANNEL CHECK

1.5 CHANNEL CHECK shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.

CHANNEL FUNCTIONAL TEST

1.6 A CHANNEL FUNCTIONAL TEST shall be the injection of a simulated signal into the channel as close to the primary sensor as practicable to verify OPERABILITY including alarm and / or trip functions.

DOSE EQUIVALENT I-131

1.10 DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microCurie/gram) which alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134 and I-135 actually present. The thyroid dose conversion factors used for this calculation shall be the thyroid dose conversion factors listed in Federal Guidance Report 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion.

1.0 DEFINITIONS for CONTROLS SECTION OF ODCM (continued)

FREQUENCY NOTATION

1.13 The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the intervals defined in Table 1.1.

INDUSTRY INITIATIVE

1.14 Nuclear Energy Institute Initiative (NEI 07-07) on Managing Situations Involving Inadvertent Radiological Releases into Groundwater (The industry initiative has been adopted through FPL Nuclear Policy EV-AA-01, Fleet Groundwater Protection Program).

MEMBER (S) OF THE PUBLIC

1.17 MEMBER OF THE PUBLIC means an individual in a controlled or unrestricted area. However, an individual is not a member of the public during any period in which the individual receives an occupational dose.

OFFSITE DOSE CALCULATION MANUAL

1.18 The OFFSITE DOSE CALCULATION MANUAL (ODCM) shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints and in the conduct of the Environmental Radiological Monitoring Program. The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by TS section 6.8.4 and (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Annual Radioactive Effluent Release Reports required by TS 6.9.1.7 and 6.9.1.8.

OPERABLE - OPERABILITY

1.19 A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s) and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component or device to perform its function(s) are also capable of performing their related support function(s).

OPERATIONAL MODE - MODE

1.20 An OPERATIONAL MODE (i.e., MODE) shall correspond to any one inclusive combination of core reactivity condition, power level and average reactor coolant temperature specified in Table 1.2 of the St. Lucie Plant TS.

1.0 DEFINITIONS for CONTROLS SECTION OF ODCM (continued)

PURGE - PURGING

1.24 PURGE or PURGING shall be any controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

RATED THERMAL POWER

1.25 RATED THERMAL POWER shall be a total reactor core heat transfer rate to the reactor coolant of 3020 MWt.

REPORTABLE EVENT

1.27 A REPORTABLE EVENT shall be any of those conditions specified in Section 50.73 of 10 CFR Part 50.

SITE BOUNDARY

1.30 SITE BOUNDARY means that line beyond which the land or property is not owned, leased or otherwise controlled by the licensee.

SOURCE CHECK

1.31 A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a radioactive source.

TANK RELEASE

1.32 A tank that has been isolated from any ingress of radioactive materials, sampled, and permitted for release. Once the tank has been permitted and released, it may be purged from a non-radioactive source then re-released under the same permit. A new sample and permit shall be required if any Radioactive Materials have been introduced into the tank or waste stream.

THERMAL POWER

1.33 THERMAL POWER shall be the total reactor core heat transfer rate to the reactor coolant.

1.0 DEFINITIONS for CONTROLS SECTION OF ODCM (continued)

UNPLANNED RELEASE

1.34 **UNPLANNED RELEASE** is the unintended discharge of a volume of liquid or airborne radioactivity to the environment. The following guidance is presented to classify differences between unplanned releases and other releases that are not considered as an **UNPLANNED RELEASE**:

Is an **UNPLANNED RELEASE** if:

1. The wrong waste gas decay tank or liquid radwaste release tank is released off site.

2. Failure of process system to automatically divert a process stream to a radioactive treatment system upon radioactivity being present in the process at the detection level or at a certain level of activity, and the result is a discharge off site occurs.

3. Large losses from unexpected pipe or valve leaks where the resulting loss of radioactive material to off site such that a 10 CFR Part 50.72 or 10 CFR Part 50.73 report is required.

4. For Gas Decay Tank, if a Gas Decay Tank loses greater than 2 psig per 8 hours for 9 consecutive shifts, or 18 psig in 72 hours, AND the losses were determined to be to the Reactor Auxiliary Building Atmosphere, then declare the losses as an UNPLANNED RELEASE (reference CR 00-2039).

Is not an **UNPLANNED RELEASE** if:

1. It cannot be shown that the release went off site, i.e., gas went to another part of the system(s) that contained the loss.

2. Normal losses through the Plant Vent due to valve and pipe leakage and purging activities to make the system safe for maintenance activities.

UNRESTRICTED AREA

1.35 UNRESTRICTED AREA means an area, access to which is neither limited nor controlled by the licensee.

1.0 DEFINITIONS for CONTROLS SECTION OF ODCM (continued)

VENTILATION EXHAUST TREATMENT SYSTEM

1.39 A VENTILATION EXHAUST TREATMENT SYSTEM shall be any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal absorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. Such a system is not considered to have any effect on noble gas effluents. Engineered Safety Features Atmospheric Cleanup Systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

VENTING

1.40 VENTING shall be the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.

WASTE GAS HOLDUP SYSTEM

1.41 A WASTE GAS HOLDUP SYSTEM shall be any system designed and installed to reduce radioactive gaseous effluents by collecting Reactor Coolant System offgases from the Reactor Coolant System and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

TABLE 1.1
FREQUENCY NOTATION
(Page 1 of 1)

NOTATION	FREQUENCY
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days.
4/M*	At least 4 per month at intervals of no greater than 9 days and minimum of 48 per year.
M	At least once per 31 days.
Q	At lease once per 92 days.
SA	At least once per 184 days.
R	At least once per 18 months.
S/U	Prior to each reactor startup.
N.A.	Not Applicable.
P**	Completed prior to each release
1/DSC	Once per Dry Shielded Canister (DSC) loading and unloading operation when DSC is in the Cask Handling Facility (CHF) and DSC is loaded with Spent Fuel.

* For Radioactive Effluent Sampling
** For Radioactive Batch Releases Only

3/4 CONTROLS AND SURVEILLANCE REQUIREMENTS

3/4.0 APPLICABILITY

CONTROLS

3.0.1 Compliance with the Controls contained in the succeeding controls is required during the conditions specified therein; except that upon failure to meet the Control, the associated ACTION requirements shall be met.

3.0.2 Noncompliance with a Control shall exist when the requirements of the Control and associated ACTION requirements are not met within the specified time intervals. If the Control is restored prior to expiration of the specified time intervals, completion of the ACTION requirements is not required.

SURVEILLANCE REQUIREMENTS

4.0.1 Surveillance Requirements shall be met during the conditions specified for individual Controls unless otherwise stated in an individual Surveillance Requirement.

4.0.2 Each Surveillance Requirement shall be performed within the specified time interval with:

a. A maximum allowable extension not to exceed 25% of the surveillance interval.

INSTRUMENTATION

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.3.9 In accordance with St. Lucie Plant TS 6.8.4.f.1), the radioactive liquid effluent monitoring instrumentation channels shown in Table 3.3-12 shall be OPERABLE with their Alarm/Trip Setpoints set to ensure that the limits of Control 3.11.1.1 are not exceeded. The Alarm/Trip Setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY: At all times.

ACTION:

a. With a radioactive liquid effluent monitoring instrumentation channel Alarm/Trip Setpoint less conservative than required by the above control, immediately suspend the release of radioactive liquid effluents monitored by the affected channel or declare the channel inoperable or change the setpoint so it is acceptably conservative.

b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 3.3-12. Restore the inoperable instrumentation to OPERABLE status within 30 days and, if unsuccessful, explain in the next Annual Radioactive Effluent Release Report why this inoperability was not corrected in a timely manner.

c. Report all deviations in the Annual Radioactive Effluent Release Report.

SURVEILLANCE REQUIREMENTS

4.3.3.9 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST at the frequencies shown in Table 4.3-8.

TABLE 3.3-12

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

(Page 1 of 2)

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1. Radioactivity Monitors Providing Alarm and Automatic Termination of Release		
a) Liquid Radwaste Effluent Line	1	35
b) Steam Generator Blowdown Effluent Line	1/SG	36, 37
2. Flow Rate Measurement Devices		
a) Liquid Radwaste Effluent Line	N.A	38
b) Discharge Canal	N.A	38
c) Steam Generator Blowdown Effluent Lines	N.A	38

SG - Denotes Steam Generator

ACTION STATEMENTS

ACTION 35 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may continue provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with the Surveillance Requirement for concentration limit of Control 4.11.1.1.1.

AND

b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge line valving.

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 36 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided grab samples are analyzed for gross radioactivity (beta or gamma) at a limit of detection of at least 2.E-07 micro-Curie/ml:

a. At least once per 8 hours(1) when the specific activity of the secondary coolant is greater than 0.01 micro-Curies/gram DOSE EQUIVALENT I-131

OR

b. At least once per 24 hours(1) when the specific activity of the secondary coolant is less than or equal to 0.01 micro-Curies/gram DOSE EQUIVALENT I-131.

TABLE 3.3-12

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

(Page 2 of 2)

ACTION STATEMENTS (continued)

ACTION 37 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, isotopic grab samples shall be obtained and analyzed at a Lower Limit of Detection for I-131, Co-58, Co-60, Cs-134, and Cs-137 to achieve detection sensitivity capable of detecting a primary-to-secondary leak rate of 5 gallons per day, provided that the Reactor Coolant System has sufficient activity present.

The applicable frequency shall be:

In MODES 1, 2, 3, 4

a. At least once per day(1) for isotopic activity on the affected Steam Generator, provided that the Air Ejector Gas Activity Monitor is OPERABLE,

OR

b. At least every 8 hours(1) for isotopic activity on the affected Steam Generator, if the Air Ejector Gas Activity Monitor is INOPERABLE.

This requirement is intended to meet EPRI PWR Primary-to-Secondary Leak Guidelines (TR-104788-R2) per reference PMAI 00-08-109.

ACTION 38 - Minimum system design flow of required running pumps shall be utilized for ECL calculations for discharge canal flow and maximum system design flow be utilized for ECL calculations for effluent line flow.

TABLE 3.3-12 Notation

(1) - The initial sample shall be completed prior to the frequency interval specified. Subsequent samples (of the same INOPERABLE condition) may be performed per ODCM surveillance requirement 4.0.2 (a maximum allowable extension not to exceed 25% of the surveillance interval).

TABLE 4.3-8
RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS (4)
(Page 1 of 1)

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1. Radioactivity Monitors Providing Alarm and Automatic Termination of Release				
a) Liquid Radwaste Effluent Line	D	P	R (2)	Q (1)
b) Steam Generator Blowdown Effluent Line	D	M	R (2)	Q (1)
2. Flow Rate Measurement Devices				
a) Liquid Radwaste Effluent Line	D (3)	N.A.	R	Q
b) Discharge Canal	D (3)	N.A.	R	Q
c) Steam Generator Blowdown Effluent Line	D (3)	N.A.	R	Q

TABLE NOTATIONS

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate automatic isolation of this pathway and control room alarm annunciation occur if any of the following conditions exist:

1. Instrument indicates measured levels above the alarm/trip setpoint or
2. Circuit failure or
3. Instrument indicates a downscale failure or
4. Instrument controls not set in operate mode.

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards traceable to the National Institute of Standards & Technology (NIST) or using standards that have been calibrated against standards certified by the NIST. These standards should permit calibrating the system over its intended range of energy and rate capabilities that are typical of normal plant operation. For subsequent CHANNEL CALIBRATION, button sources that have been related to the initial calibration may be used.

(3) CHANNEL CHECK shall consist of verifying indication of flow during periods of release. CHANNEL CHECK shall be made at least once per 24 hours on days on which continuous, periodic or batch releases are made.

(4) The requirements to perform the surveillances is not applicable, if Table 3.3-12 list the INSTRUMENT MINIMUM CHANNELS OPERABLE as not applicable (N.A.). (Reference CR 99-0361, PMAI 99-04-106).

INSTRUMENTATION

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.3.10 In accordance with St. Lucie Plant TS 6.8.4.f.1), the radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.3-13 shall be FUNCTIONAL with their Alarm/Trip Setpoints set to ensure that the limits of Control 3.11.2.1.are not exceeded. The Alarm/Trip Setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the ODCM.

APPLICABILITY: As shown in Table 3.3-13

ACTION:

a. With a radioactive gaseous effluent monitoring instrumentation channel Alarm/Trip Setpoint less conservative than required by the above control, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel or declare the channel inoperable or change the setpoint so it is acceptably conservative.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels FUNCTIONAL, take the ACTION shown in Table 3.3-13. Restore the inoperable instrumentation to FUNCTIONAL status within 30 days and, if unsuccessful, explain in the next Annual Radioactive Effluent Release Report why this inoperability was not corrected in a timely manner.

c. Report all deviations in the Annual Radioactive Effluent Release Report.

SURVEILLANCE REQUIREMENTS

4.3.3.10 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated FUNCTIONAL by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST at the frequencies shown in Table 4.3-9.

TABLE 3.3-13
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(Page 1 of 4)

INSTRUMENT	MINIMUM CHANNELS FUNCTIONAL	APPLICABILITY	ACTION	MEASUREMENT RANGE
1. Waste Gas Holdup System				
a) Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	1/ Rx	*	45	
2. Condenser Evacuation System				
a) Noble Gas Activity Monitor	1/ Rx	**	47	
		Modes 1, 2, 3, 4	48	
3. Plant Vent System				
a) Noble Gas Activity Monitor (Low Range)	1/ Rx	***	47	10^{-7} – 10^{5} uCi/cc (Unit 1) 10^{-7} – 10^{-2} uCi/cc (Unit 2)
b) Noble Gas Activity Monitor (High Range)	1/ Rx	***	47	10^{-2} – 10^{5} uCi/cc (Unit 2)
c) Iodine Sampler	1/ Rx	*	51	
d) Particulate Sampler	1/ Rx	*	51	
e) Flow Rate Monitor	N.A. (3)	*	53	
f) Sampler Flow Rate Monitor	1/ Rx	*	46	
4. Fuel Storage Area Ventilation System				
a) Noble Gas Activity Monitor	1/ Rx	*	47,54	10^{-7} – 10^{5} uCi/cc (Unit 1) 10^{-7} – 10^{5} uCi/cc (Unit 2)
b) Iodine Sampler	1/ Rx	*	51	
c) Particulate Sampler	1/ Rx	*	51,54	1-10^{6} cpm
d) Flow Rate Monitor	N.A. (3)	*	53	
e) Sampler Flow Rate Monitor	1/ Rx	*	46	

TABLE 3.3-13
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(Page 2 of 4)

INSTRUMENT	MINIMUM CHANNELS FUNCTIONAL	APPLICABILITY	ACTION	MEASUREMENT RANGE
5. Steam Generator Blowdown Building Vent				
a) Noble Gas Activity Monitor (Low Range)	1	*	47	$10^{-7} – 10^{-2}$ uCi/cc
b) Iodine Sampler	1	*	51	
c) Particulate Sampler	1	*	51	
d) Flow Rate Monitor	N.A. (3)	*	53	
e) Sampler Flow Rate Monitor	1	*	46	
6. Steam Safety Valve Discharge #	1/Steam Header	Modes 1,2,3,4	55	$10^{-1} – 10^{3}$ uCi/cc
7. Atmospheric Steam Dump Valve Discharge #	1/Steam Header	Modes 1,2,3,4	55	$10^{-1} – 10^{3}$ uCi/cc
8. ECCS Exhaust	1/Train	Modes 1,2,3,4	55	$10^{-7} – 10^{5}$ uCi/cc

* - At all times while making releases via this pathway

** - At all times when air ejector exhaust is not directed to plant vent.

*** - At all times while making releases via this pathway or modes 1-4

- On Unit 2, The steam safety valve discharge monitor and the atmospheric steam dump valve discharge monitor are the same monitor.

Rx - Denotes reactor

ACTION STATEMENTS

ACTION 45 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, the contents of the tank(s) may be released to the environment provided that prior to initiating a release:

a. At least two independent samples of the tank's contents are analyzed and

b. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge valve lineup.

Otherwise, suspend release of radioactive effluents via this pathway.

TABLE 3.3-13
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(Page 3 of 4)

ACTION STATEMENTS (continued)

ACTION 46 - With the number of channels FUNCTIONAL less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours.

ACTION 47 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL, effluent releases via this pathway may continue provided:

a. If channel inoperability is due to loss of Control Room alarm annunciation ONLY.

- Channel checks are performed once per four hours(1) to verify normal indication and current assigned setpoints are NOT exceeded.

OR

- Grab samples are taken at least once per 8 hours (1) and these samples are analyzed for isotopic activity within 24 hours.

b. If channel inoperability is due to loss of activity indication, Then

- Grab samples are taken at least once per 8 hours(1) and these samples are analyzed for isotopic activity within 24 hours.

OR

- The effluent pathway is continuously monitored using an effluent radiation monitor that meets all the requirements in Table 4.3-9 and Table 4.11-2.
  - If control room alarm annunciation is not available, Then channel checks are performed once per four hours(1) to verify normal indication and current assigned setpoints are NOT exceeded.

ACTION 48 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, noble gas isotopic grab samples shall be obtained and analyzed at a Lower Limit of Detection for Ar-41, Kr-88, Xe-133, Xe-133m, and Xe-135 to achieve detection sensitivity capable of detecting a primary-to-secondary leak rate of 5 gallons per day, provided that the Reactor Coolant System has sufficient activity present.

TABLE 3.3-13
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
(Page 4 of 4)

ACTION STATEMENTS (continued)

ACTION 48 (continued)

The applicable frequency shall be:

a. At least once per 12 hours[(1),(2)] for noble gas isotopic activity on the Air Ejector Exhaust provided that each affected Unit's Steam Generator Blowdown Monitor is FUNCTIONAL,

OR

b. At least once per 8 hours[(1),(2)] for noble gas isotopic activity on the Air Ejector Exhaust if either of the affected Unit's Steam Generator Blowdown Monitors is NONFUNCTIONAL.

This requirement is intended to meet EPRI PWR Primary-to-Secondary Leak Guidelines (TR-104788-R2), therefore grab samples shall be taken regardless of the Alignment of the Air Ejector Exhaust while in Modes 1, 2, 3, 4. (Reference PMAI 00-08-109.)

ACTION 51 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, effluent releases via the affected pathway may continue provided samples are continuously collected with auxiliary sampling equipment as required in Table 4.11-2.

ACTION 53 - Maximum system flows shall be utilized in the determination of the instantaneous release monitor alarm setpoint.

ACTION 54 - With the number of channels FUNCTIONAL less than required by the Minimum Channels FUNCTIONAL requirement, suspend all operations involving movement of recently irradiated fuel within the spent fuel storage pool or crane operations with loads over recently irradiated fuel assemblies in the spent fuel storage pool.

ACTIONS 55 - With the number of channels FUNCTIONAL less than required by the Minimum Channels OPERABLE requirement, either restore the inoperable Channel(s) to FUNCTIONAL status within 72 hours, or initiate the preplanned alternate method of monitoring the appropriate parameter(s).

TABLE 3.13-13 NOTATION

(1) - The initial sample shall be completed prior to the frequency interval specified. Subsequent samples (of the same NONFUNCTIONAL condition) may be performed per ODCM surveillance requirement 4.0.2 (a maximum allowable extension not to exceed 25 percent of the surveillance interval).

(2) - If there is no steam flow to the air ejector nozzles while the Reactor is in Mode 4, Then the sample may be omitted, but the steam flow condition (status) to the air ejector shall be reverified once per 8 hours to initiate grab samples if steam flow to the air ejector nozzles is established.

(3) - The flow rate monitors are not functional. Vent flow is based on design engineering documents and values in the UFSAR. EPIP-14 contains the correct flow values.

TABLE 3.3-14
RADIOACTIVE EFFLUENT MONITOR SETPOINT BASIS
(Page 1 of 4)

ODCM Effluent Gas Channels	CHANNEL ID	BASIS DOCUMENT	ALERT SETPOINT[e]	HIGH SETPOINT[e]
1PV LOW RANGE GAS	RSC26_1L	C-200[a]	5 x Bkg.[q]	Allotted % Of Site Limit[g]
1FHB LOW RANGE GAS	RSC26_4L	C-200[a]	5 x Bkg.[q]	Allotted % Of Site Limit[g]
2A PV PIG LOW RANGE GAS	423	C-200[a]	5 x Bkg.[q]	Allotted % Of Site Limit[g] For Plant Vent #2
2B PV PIG LOW RANGE GAS	433	C-200[a]	5 x Bkg.	
2FHB LOW RANGE GAS	413	C-200[a]	5 x Bkg.	Allotted % Of Site Limit[g]
SGBDB LOW RANGE GAS	45-6	C-200[a]	5 x Bkg.	Allotted % Of Site Limit[g]
1 CONDENSER AIR EJECTOR	35	C-200	2 x Bkg.[b]	3 x Bkg.
2 CONDENSER AIR EJECTOR	403	C-200	2 x Bkg.[b]	3 x Bkg.
1 BATCH GAS EFFLUENT	42	C-200[a]	As Per CY-SL-102-0105	As Per CY-SL-102-0105[a,h]
2 BATCH GAS EFFLUENT	203	C-200[a]	As Per CY-SL-102-0105	As Per CY-SL-102-0105[a,h]
2PV WRGM — Chan: Low Range Gas 621; Mid Range Gas 622; High Range Gas 623	624[P]	C-200[a]	5 x Bkg.[P] uCi/sec	Allotted % Of Site Limit[P] uCi/sec
2A ECCS WRGM — Chan: Low Range Gas 601; Mid Range Gas 602; High Range Gas 603	604[P]	C-200[a]	0.75 x High[P] uCi/sec	Allotted % Of Site Limit[P] uCi/sec
2B ECCS WRGM — Chan: Low Range Gas 611; Mid Range Gas 612; High Range Gas 613	614[P]	C-200[a]	0.75 x High[P] uCi/sec	Allotted % Of Site Limit[P] uCi/sec

ODCM Related Particulate Channels	CHANNEL ID	BASIS DOCUMENT	ALERT SETPOINT[e]	HIGH SETPOINT[e]
1FHB PARTICULATE	RSC26_4P	FUSAR	5000 CPM	10,000 CPM[c]
2A PV PIG PARTICULATE	421	FUSAR	5000 CPM	10,000 CPM[c]
2B PV PIG PARTICULATE	431	FUSAR	5000 CPM	10,000 CPM[c]
2FHB PARTICULATE	411	FUSAR	5000 CPM	10,000 CPM[c]
SGBDB PARTICULATE	45-4	FUSAR	5000 CPM	10,000 CPM[c]

TABLE 3.3-14
RADIOACTIVE EFFLUENT MONITOR SETPOINT BASIS
(Page 2 of 4)

ODCM Related Iodine Channels	CHANNEL ID	BASIS DOCUMENT	ALERT SETPOINT[e]	HIGH SETPOINT[e]
2A PV PIG IODINE	422	FUSAR	5000 CPM	10,000 CPM[c]
2B PV PIG IODINE	432	FUSAR	5000 CPM	10,000 CPM[c]
2FHB IODINE	412	FUSAR	5000 CPM	10,000 CPM[c]
SGBDB IODINE	45-5	FUSAR	5000 CPM	10,000 CPM[c]

ODCM Related Liquid Channels	CHANNEL ID	BASIS DOCUMENT	ALERT SETPOINT[e]	HIGH SETPOINT[e]
1A S/G BLOWDOWN	44	C-200	2 x Bkg.	2.E-04 uCi/ml[f,m]
1B S/G BLOWDOWN	45	C-200	2 x Bkg.	2.E-04 uCi/ml[f,m]
2A S/G BLOWDOWN	121	C-200	2 x Bkg.	2.E-04 uCi/ml[m]
2B S/G BLOWDOWN	122	C-200	2 x Bkg.	2.E-04 uCi/ml[m]
1 BATCH LIQUID EFFLUENT	R6627	C-200	As Per CY-SL-102-0104	As Per CY-SL-102-0104[n]
2 BATCH LIQUID EFFLUENT	301	C-200	As Per CY-SL-102-0104	As Per CY-SL-102-0104[n]

Monitor channels not listed are covered per CY-SL-104-0112, Determination of Process Radiation Monitor Setpoints

TABLE NOTATIONS

a - ODCM Control 3.11.2.1a

b - ODCM Table 4.11-1 Note (7)

c - ODCM Control 3.11.2.1.b

e - Setpoints may be rounded for analog and digital display input limitations.

f - The channel setpoint to be in cpm equivalent to this activity

g - per ODCM Methodology Step 2.2.2

h - Batch Gaseous Release Rate and Maximum activity limits shall be used such that Plant Vent (PV) Release HIGH setpoints should not be exceeded.

i, j, k, and l not used in notation for clarity

TABLE 3.3-14
RADIOACTIVE EFFLUENT MONITOR SETPOINT BASIS
(Page 3 of 4)

TABLE NOTATIONS (continued)

m - Continuous Liquid setpoint methodology per ODCM 1.3.2

n - Batch liquid setpoint methodology per ODCM 1.3.1

o - Note "oscar" is not used in this table notation

p - The individual Channel 621, 622 and 623 (Plant Vent No. 2)

Channel 601, 602 and 603 (ECCS 2A)

and Channel 611, 612 and 613 (ECCS 2B)

Data Base Alert and High Alarm Setpoint Items do not provide activation of a Control Room Alarm. Only the Skid's Effluent Channel Setpoint provides an alarm function. After the first Alert and High Effluent Channel Alarms are received they will stay locked in if the release is increasing to higher activity levels. Transfer of Skid internal control to Effluent Channel input from the Mid or High Range Gas Channels will not reset an alarm, nor provide additional alarms. The Effluent Channel on the respective Skid has to be reset to new Setpoints by I&C. References to "Alert Alarm" and "High Alarm" settings for the Low Mid and High Channels are for display information only. This is why Table 3.3-14 only list Channel 624, 604 and 614 as the Channel ID for Alarm Setpoints. These are the respective Skid's Alarm Channel.

Channel ID number 604 and 614 are the uCi/sec indication and ALERT/HIGH Alarm channels for ECCS 2A and ECCS 2B respectively. The ECCS exhaust pathways each have a single fan. Their Skid's Monitor Item #059 will be set per the measured ft3/minute exhaust rate. Their Skid's Monitor Item #060 (Accident Flow rate) will be set to zero since there is only one flow rate possible for these ECCS pathways. The uCi/sec value indicated on ECCS skids should be valid regardless of Normal or Accident conditions.

The Channel ID number 624 (generically called the Plant Vent 2 Skid's Channel 4) is the uCi/sec and Control Room active ALERT/HIGH Alarm that is Common (shared by) to the Low (621), Mid (622), and High (623) Range Gas Channels. The Plant Vent 2's skid Monitor Item #059 will be set for the maximum ft3/minute flow rate that could occur under all circumstances. The Plant Vent 2 Channel 624's actual uCi/sec is dependent what is set in Monitor Item #059 and Monitor Item #060 as follows:

TABLE 3.3-14
RADIOACTIVE EFFLUENT MONITOR SETPOINT BASIS
(Page 4 of 4)

TABLE NOTATIONS (continued)

p - (continued)

The NORMAL value for the Common Channel 624 uCi/sec indication and ALERT/High Alarms should be based on the equivalent uCi/sec of the 5 x Bkg (use CY-SL-104-0112, Determination of Process Radiation Monitor Setpoints) uCi/cc of the Low Range Channel #621 and RIM 26-90 Monitor Item #059 (the MAXIMUM process ft3/minute flow rate that could occur in the Unit 2 Plant Vent.

The ACCIDENT value for the Common Channel 624's uCi/sec is based on the Skid switching (at a preset activity value) input from the Low Range Channel to calculate / display a uCi/sec value based on receiving activity uCi/cc input from either the Mid Range Channel 622 (OR from the High Range Channel 623) and RIM 26-90 Monitor Item #060 6,600 ft3/minute (use CY-SL-104-0112, Determination of Process Radiation Monitor Setpoints) flow rate that is expected during a LOCA Safety Injection sequence.

During an ACCIDENT you have to access the running status of 2-HVE-6A, 2-HVE-6B, 2-HVE-7A, 2-HVE-7B, 2-HVE-8A, 2-HVE-8B, 2-HVE-10A and 2-HVE-10B to determine actual Plant Vent exhaust flow rate ft3/minute. This is the flow rate that should be inserted into Plant Vent #2 Skid's Monitor Item #060 with new Setpoints for Alert and High Alarms in units of uCi/sec calculated by using the actual Plant Vent exhaust flow during the Accident. If fan operating status changes, the Effluent Channel 624 uCi/sec indication and existing Alert and High Alarm Setpoints will not be valid for a new flow rate. This is the reason that EPIP-14 does not utilize Channel 624 indication for calculating off-site dose.

q - During an outage, the Low Range gas activity ALERT Alarm Setpoint may be set to slightly above outage anticipated activity levels, but shall always be set to a value less than the High Alarm Setpoint. Examples of outage activities are initiating a Containment Main Purge and venting the S/G primary side bowls.

FUSAR - Channel listed FUSAR, but not required by ODCM Control 3.3.10 Table 3.3-13. The setpoints are used to provide alarm well before exceeding ODCM Control 3.11.2.1.b Site Dose Rate Limit. The inoperability of a FUSAR channel above does not involve an ACTION statement unless TS (Technical Specification) is noted.

2 x Bkg., 3 x Bkg., 5 x Bkg. etc., denotes the number of times the normal channel reading is the appropriate Alarm Setting. These type of setpoints should be periodically evaluated to insure alarm sensitivity is maintained as per CY-SL-104-0112, Determination of Process Radiation Monitor Setpoints.

TABLE 4.3-9
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS (4)
(Page 1 of 2)

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	Modes in which surveillance required
1. Waste Gas Holdup System					
a) Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release	P	P	R (3)	Q (1)	*
2. Condenser Evacuation System					
a) Noble Gas Activity Monitor	D	M	R (3)	Q (2)	**
3. Plant Vent System					
a) Noble Gas Activity Monitor	D	M	R (3)	Q (2)	*
b) Iodine Sampler	W	N.A.	N.A.	N.A.	*
c) Particulate Sampler	W	N.A.	N.A.	N.A.	*
e) Sampler Flow Rate	D	N.A.	R	N.A.	*
4. Fuel Storage Area Ventilation System					
a) Noble Gas Activity Monitor	D	M	R (3)	Q (2)	*
b) Iodine Sampler	W	N.A.	N.A.	N.A.	*
c) Particulate Sampler	W	N.A.	N.A.	N.A.	*
e) Sampler Flow Rate Monitor	D	N.A.	R	N.A.	*
5. Steam Generator Blowdown Building Vent					
a) Noble Gas Activity Monitor	D	M	R (3)	Q (2)	*
b) Iodine Sampler	W	N.A.	N.A.	N.A.	*
c) Particulate Sampler	W	N.A.	N.A.	N.A.	*
e) Sampler Flow Rate Monitor	D	N.A.	R	N.A.	*
6. Cask Handling Facility (CHF) Vent					
a) Sampler Flow Rate Monitor	D	N.A.	Annual	N.A	***

TABLE 4.3-9
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS (4)
(Page 2 of 2)

TABLE NOTATIONS

* - At all times when making releases via this pathway.

** - At all times when air ejector exhaust is not directed to plant vent.

*** - At all times when Cask Handling Vent (CHF) is operative.

(1) The CHANNEL FUNCTIONAL TEST shall also demonstrate automatic isolation of this pathway and control room alarm annunciation occurs if any of the following conditions exist:

1. Instrument indicates measured levels above the alarm/trip setpoint or
2. Circuit failure or
3. Instrument indicates a downscale failure or
4. Instrument controls not set in operate mode.

(2) The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exist:

1. Instrument indicates measured levels above the alarm/trip setpoint or
2. Circuit failure or
3. Instrument indicates a downscale failure or
4. Instrument controls not set in operate mode.

(3) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards traceable to the National Institute of Standards & Technology (NIST) or using standards that have been calibrated against standards certified by the NIST. These standards should permit calibrating the system over its intended range of energy and rate capabilities that are typical of normal plant operation. For subsequent CHANNEL CALIBRATION, button sources that have been related to the initial calibration may be used.

(4) The requirements to perform the surveillances is not applicable, if Table 3.3-13 list the INSTRUMENT MINIMUM CHANNELS FUNCTIONAL as not applicable (N.A.). (Reference CR 99-0361, PMAI 99-04-106).

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1 LIQUID EFFLUENTS

CONCENTRATION

CONTROLS

3.11.1.1 In accordance with the St. Lucie Plant TS 6.8.4.f.2) and 3), the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see TS Figure 5.1-1) shall be limited to ten times the concentrations specified in 10 CFR Part 20.1001-20.2401, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2.E-04 micro-Curie/ml total activity.

APPLICABILITY: At all times.

ACTION:

a. With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, immediately restore the concentration to within the above limits.

SURVEILLANCE REQUIREMENTS

4.11.1.1.1 Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 4.11-1.

4.11.1.1.2 The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in the ODCM to assure that the concentrations at the point of release are maintained within the limits of Control 3.11.1.1.

4.11.1.1.3 Post-release analyses of samples composited from batch releases shall be performed in accordance with Table 4.11-1 and results of the previous post-release analyses shall be used with the calculation methods in the ODCM to assure that the concentrations at the point of release were maintained within the limits of Control 3.11.1.1.

TABLE 4.11-1
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
(Page 1 of 4)

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection LLD (1) (μCi/ml)
A. Batch Waste Release Tanks (2)	P Each Batch	Each Batch	P.G.E. (3)	5.E-07
			I-131	1.E-06
	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	1.E-05
	P Each Batch	M Composite (4)	H-3	1.E-05
			Gross Alpha	1.E-07
	P Each Batch	Q Composite (4)	Sr-89, Sr-90	5.E-08
			C-14, Fe-55, Ni-63	1.E-06
B. Continuous Releases (5, 6)	Daily	4/M Composite	P.G.E.(3)	5.E-07
			I-131	1.E-06
	Daily Grab Sample	4/M Composite	Dissolved and Entrained Gases (Gamma Emitters)	1.E-05
	Daily	M Composite	H-3	1.E-05
			Gross Alpha	1.E-07
	Daily	Q Composite	Sr-89, Sr-90	5.E-08
			C-14, Fe-55, Ni-63	1.E-06
C. East/West Settling Basins (7)	W Grab Sample	W	P.G.E. (3)	5.E-07
			I-131	1.E-06
D. Settling Basin as a Batch Release Pathway. (9) (Reference CR 99-1165 PMAI 99-08-084 PMAI-01-04-115 (12) CR 2010-296. (13) AR 01967018	P Each Batch (8)	Each Batch	P.G.E. (3)	5.E-07
			I-131	1.E-06
			Dissolved and Entrained Gases (Gamma Emitters)	1.E-05
	Each Batch	Each Batch	H-3	1.E-05
			Gross Alpha	1.E-07
			Sr-89, Sr-90	5.E-08
			C-14, Fe-55, Ni-63	1.E-06
E. Groundwater Dewatering Batch Releases (10)	W (11)	W (11)	H-3	1E-05
			P.G.E. (3)	5.E-07
	P Each Batch (8)	Each Batch	H-3	1E-05
			P.G.E. (3)	5.E-07
			Gross Alpha	1.E-07
			Sr-89, Sr-90	5.E-08
			C-14, Fe-55, Ni-63	1.E-06

P.G.E. - Denotes Principal Gamma Emitter

TABLE 4.11-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

(Page 2 of 4)

TABLE NOTATIONS

(1) The LLD is defined for purposes of these controls, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a real signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\, S_b}{E \bullet V \bullet 2.22E+06 \bullet Y \bullet \exp(-\lambda \bullet \Delta T)}$$

Where:

LLD = the a priori lower limit of detection (micro-Curie per unit mass or volume),

S_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22E+06 = the number of disintegrations per minute per micro-Curie.,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (sec^{-1}) and

ΔT = the elapsed time between the midpoint of sample collection and the time of counting (sec).

Typical values of E, V, Y and ΔT should be used in the calculation.

It should be recognized that the LLD is defined as an <u>a priori</u> (before the fact) limit representing the capability of a measurement system and not as an <u>a posteriori</u> (after the fact) limit for a particular measurement.

TABLE 4.11-1
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
(Page 3 of 4)

TABLE NOTATIONS
(continued)

(2) A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated and then thoroughly mixed by a method described in the ODCM to assure representative sampling.

(3) The principal gamma emitters for which the LLD control applies include the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137 and Ce-141 and Ce-144. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report pursuant to Control 3.11.2.6 in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

(4) A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen that is representative of the liquids released.

(5) A continuous release is the discharge of liquid wastes of a nondiscrete volume, e.g., from a volume of a system that has an input flow during the continuous release.

(6) If Component Cooling Water activity is > 1.E-5 μCi/ml, perform a weekly gross activity on the Intake Cooling Water System outlet to ensure the activity level is less than or equal to 2.E-07 μCi/ml LLD limit. If ICW is >2.E-07 μCi/ml, perform analysis in accordance with a Plant Continuous Release on this Table.

(7) Grab samples to be taken when there is confirmed primary to secondary system leakage indicated by the air ejector monitor indicating greater than or equal to 2x background.

(8) At least two independent samples are analyzed in accordance with the surveillance requirement for concentration limit of control 4.11.1.1.1 and at least two technically qualified members of the facility staff independently verify the release rate calculations.

(9) The settling basin(s) may receive low level activity per the guidance of CY-SL-102-0104, therefore these samples shall be taken regardless of the absence of a primary-to-secondary leak (note (7) on liquid release type [C] settling basin does not apply to liquid release type [D] settling basin as a batch release pathway). The South Basin (pond) is a permitted outfall (per FDEP Permit FL002208) to the intake canal. An authorized “bypass” is required to pump directly from the East or West Basins.

TABLE 4.11-1
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
(Page 4 of 4)

TABLE NOTATIONS
(continued)

(10) Applies to groundwater dewatering discharges from locations outside the Plant Protected Area where radiological contamination is not expected at significant levels. This expectation may be a judgment based on local and peripheral samples that indicate radiological contaminant levels below the LLD from sources in the dewatering pump's zone of influence. These samples may include dewatering pump well samples (taken by small-volume sample pumps), upgradient groundwater samples, and upgradient samples taken from surface waters (e.g., IWW percolation basins) within the zone of influence. The sampling protocol for these releases shall be precautionary in nature. A conservative value shall be established in the discharge permit for the effluent activity; however, the permit shall be reconciled with actual activity concentrations ascertained from sample analysis of the actual effluent.

(11) Each outfall shall be sampled at some point in the discharge header at the frequency described herein. Any outfall that includes a well (or well point) that has not yet achieved its steady state flow rate (indicating that it has not yet reached its steady state zone of influence) shall be sampled weekly. After the wells of an outfall reaches steady state, the sampling and analysis frequency may be extended to monthly.

(12) CR 2010-296; Radiological Impact Evaluation of Effluent Releases from Catch Basins to the East Settling Pond (Dec. 2009). It was determined that potential tritium releases via evaporation from the East Settling Pond alone (i.e. gaseous releases) represents <1.0% of the total activity released via all gaseous release points and therefore, does not qualify as significant release point.

(13) Under emergency conditions, the Shift Manager and Chemistry Manager may waive the requirement to analyze the gamma spectroscopy, tritium, and alpha samples prior to starting the release. Analyses must be completed within a 24 hour period following the initiation of a discharge. An “emergency” is a condition where plant flooding, personnel injury, or damage to plant equipment are likely based on plant conditions. AR 01967018, Site Evaluation for Expediting South Pond Releases (May 2014), provides site documentation and justification that the effectiveness of the radioactive effluent control program is not reduced by the change.

RADIOACTIVE EFFLUENTS

DOSE

CONTROLS

3.11.1.2 In accordance with St. Lucie Plant TS 6.8.4.f.4) and 6.8.4.f.5), the dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each unit, to UNRESTRICTED AREAS (see TS Figure 5.1-1) shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrems to the whole body and to less than or equal to 5 mrems to any organ and

b. During any calendar year to less than or equal to 3 mrems to the whole body and to less than or equal to 10 mrems to any organ.

APPLICABILITY: At all times.

ACTION:

a. With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Plant TS 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

SURVEILLANCE REQUIREMENTS

4.11.1.2 Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in the ODCM at least once per 31 days.

RADIOACTIVE EFFLUENTS

LIQUID RADWASTE TREATMENT SYSTEM

CONTROLS

3.11.1.3 In accordance with St. Lucie Plant TS 6.8.4.f.6), the Liquid Radwaste Treatment System shall be OPERABLE and appropriate portions of the system shall be used to reduce releases of radioactivity when the projected doses due to the liquid effluent, from each unit, to UNRESTRICTED AREAS (see TS Figure 5.1-1) would exceed 0.06 mrem to the whole body or 0.2 mrem to any organ in a 31-day period.

APPLICABILITY: At all times.

ACTION:

a. With radioactive liquid waste being discharged without treatment and in excess of the above limits and any portion of the Liquid Radwaste Treatment System not in operation, prepare and submit to the Commission within 30 days, pursuant to Plant TS 6.9.2, a Special Report that includes the following information:

1. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems and the reason for the inoperability,

2. Action(s) taken to restore the inoperable equipment to OPERABLE status and

3. Summary description of action(s) taken to prevent a recurrence.

SURVEILLANCE REQUIREMENTS

4.11.1.3.1 Doses due to liquid releases from each unit to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM when Liquid Radwaste Treatment Systems are not being fully utilized.

4.11.1.3.2 The installed Liquid Radwaste Treatment System shall be demonstrated OPERABLE by operating the liquid radwaste treatment system equipment for at least 30 minutes at least once per 92 days unless the liquid radwaste system has been utilized to process radioactive liquid effluents during the previous 92 days.

RADIOACTIVE EFFLUENTS

3/4.11.2 GASEOUS EFFLUENTS

DOSE RATE

CONTROLS

3.11.2.1 In accordance with St. Lucie Plant TS 6.8.4.f.3) and 7), the dose rate resulting from radioactive materials released in gaseous effluents to areas at or beyond the SITE BOUNDARY (see TS Figure 5.1-1) shall be limited to the following:

a. For noble gases: Less than or equal to 500 mrems/yr to the total body and less than or equal to 3000 mrems/yr to the skin and

b. For Iodine-131, for Iodine-133, for tritium and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrems/yr to any organ

APPLICABILITY: At all times.

ACTION:

a. With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the above limit(s).

SURVEILLANCE REQUIREMENTS

4.11.2.1.1 The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM.

4.11.2.1.2 The dose rate due to Iodine-131, Iodine-133, tritium and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 4.11-2.

TABLE 4.11-2

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

(Page 1 of 3)

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection LLD (1) (μCi/ml)
1. Waste Gas Storage Tank	P Each Tank Grab Sample	P Each Tank	Noble Gas P.G.E. (2)	1.E-04
2. Containment Purge (9)	P Each Purge (6) Grab Sample	P Each Purge (6) (7)	Noble Gas P.G.E. (2)	1.E-04
			H-3	1.E-06
3. Vents:(9) a. Plant b. Fuel Bldg (5) c. S/G Blowdown Bldg.	4/M Grab Sample (8)	4/M (7)	Noble Gas P.G.E. (2)	1.E-04
			H-3	1.E-06
4. All Release Types as listed in 3. above (9)	Continuous (3) (8)	4/M Charcoal Sample (4)	I-131	1.E-12
		4/M Particulate Sample (4)	P.G.E.	1.E-11
		4/M Particulate Sample	Gross Alpha	1.E-11
		Q Composite Particulate Sample	Sr-89, Sr-90	1.E-11
		Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1.E-06
5. Cask Handling Facility Vent (8)	W Grab Sample (8)	W	Noble Gas P.G.E. (2)	1. E-04
			H-3	1.E-06
	Continuous (8)	W Charcoal Sample	I-131	1.E-12
		W Particulate Sample	P.G.E.	1.E-11
		W Particulate Sample	Gross Alpha	1.E-11
		Q Composite Particulate Sample	Sr-89, Sr-90	1.E-11

P.G.E. - Denotes Principal Gamma Emitter

TABLE 4.11-2
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM
(Page 2 of 3)

TABLE NOTATIONS

(1) The LLD is defined for purposes of these controls, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a real signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\, S_b}{E \bullet V \bullet 2.22E+06 \bullet Y \bullet \exp(-\lambda \bullet \Delta T)}$$

Where:

LLD = the a priori lower limit of detection (micro-Curie per unit mass or volume),

LLD = the a priori lower limit of detection (micro-Curie per unit mass or volume),

S_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22E+06 = the number of disintegrations per minute per micro-Curie.,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (sec^{-1}) and

ΔT = the elapsed time between the midpoint of sample collection and the time of counting (sec).

Typical values of E, V, Y and ΔT should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

TABLE 4.11-2
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM
(Page 3 of 3)
TABLE NOTATIONS
(continued)

(2) The principal gamma emitters for which the LLD control applies include the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135 and Xe-138 in noble gas releases and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, Ce-141 and Ce-144 in Iodine and particulate releases. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report pursuant to Control 3.11.2.6 in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

(3) The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Controls 3.11.2.1, 3.11.2.2 and 3.11.2.3.

(4) Samples shall be changed at least four times per month and analyses shall be completed within 48 hours after changing or after removal from sampler. Sampling shall also be performed at least once per 24 hours for at least 7 days following each shutdown, startup or THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLDs may be increased by a factor of 10. This requirement does not apply if: (1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the reactor coolant has not increased more than a factor of 3; and (2) the noble gas monitor shows that effluent activity has not increased by more than a factor of 3.

(5) Tritium grab samples shall be taken at least 4/M from the ventilation exhaust from the spent fuel pool area, whenever spent fuel is in the spent fuel pool.

(6) Sampling and analysis shall also be performed following shutdown, startup or a THERMAL POWER change exceeding 15% of RATED THERMAL POWER within 1 hour unless (1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 3; and (2) the noble gas activity monitor shows that effluent activity has not increased by more than a factor of 3.

(7) Tritium analysis may be delayed for up to 14 days if the LLD is still attainable at the new counting time.

(8) Frequencies applicable only when the ventilation system is operating.

(9) During outages, the affected unit's containment equipment hatch is a potential effluent pathway. Monitoring of the open containment equipment hatch is performed as per procedural guidance. Any calculated release quantity will be reported in the annual report. RADIOACTIVE EFFLUENTS

DOSE - NOBLE GASES

CONTROLS

3.11.2.2 In accordance with St. Lucie Plant TS 6.8.4.f.5) and 8), the air dose due to noble gases released in gaseous effluents, from each unit, to areas at and beyond the SITE BOUNDARY (see TS Figure 5.1-1) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrads for gamma radiation and less than or equal to 10 mrads for beta radiation and

b. During any calendar year: Less than or equal to 10 mrads for gamma radiation and less than or equal to 20 mrads for beta radiation.

APPLICABILITY: At all times.

ACTION:

a. With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Plant TS 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to assure that subsequent releases will be in compliance with the above limits.

SURVEILLANCE REQUIREMENTS

4.11.2.2 Cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with the methodology and parameters in the ODCM at least once per 31 days.

RADIOACTIVE EFFLUENTS

DOSE - IODINE-131, IODINE-133, TRITIUM AND RADIOACTIVE MATERIAL IN PARTICULATE FORM

CONTROLS

3.11.2.3 In accordance with St. Lucie Plant TS 6.8.4.f.5) and 9), the dose to a MEMBER OF THE PUBLIC from Iodine-131, Iodine-133, tritium and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released, from each unit, to areas at and beyond the SITE BOUNDARY (see TS Figure 5.1-1) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrems to any organ and,

b. During any calendar year: Less than or equal to 15 mrems to any organ.

APPLICABILITY: At all times.

ACTION:

a. With the calculated dose from the release of Iodine-131, Iodine-133, tritium and radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Plant TS 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to assure that subsequent releases will be in compliance with the above limits.

SURVEILLANCE REQUIREMENTS

4.11.2.3 Cumulative dose contributions for the current calendar quarter and current calendar year for Iodine-131, Iodine-133, tritium and radionuclides in particulate form with half-lives greater than 8 days shall be determined in accordance with the methodology and parameters in the ODCM at least once per 31 days.

RADIOACTIVE EFFLUENTS

GASEOUS RADWASTE TREATMENT SYSTEM

CONTROLS

3.11.2.4 In accordance with St. Lucie Plant TS 6.8.4.f.6), the VENTILATION EXHAUST Treatment System and the WASTE GAS HOLDUP SYSTEM shall be OPERABLE and appropriate portions of the system shall be used to reduce releases of radioactivity when the projected doses in 31 days due to gaseous effluent releases, from each unit, to areas at and beyond the SITE BOUNDARY (see TS Figure 5.1-1) would exceed:

a. 0.2 mrad to air from gamma radiation or

b. 0.4 mrad to air from beta radiation or

c. 0.3 mrem to any organ.

APPLICABILITY: At all times.

ACTION:

a. With radioactive gaseous waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, pursuant to Plant TS 6.9.2, a Special Report that includes the following information:

1. Identification of any inoperable equipment or subsystems and the reason for the inoperability,

2. Action(s) taken to restore the inoperable equipment to OPERABLE status and

3. Summary description of action(s) taken to prevent a recurrence.

RADIOACTIVE EFFLUENTS

GASEOUS RADWASTE TREATMENT SYSTEM (continued)

SURVEILLANCE REQUIREMENTS

4.11.2.4.1 Doses due to gaseous releases from each unit to areas at and beyond the SITE BOUNDARY shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM when Gaseous Radwaste Treatment Systems are not being fully utilized.

4.11.2.4.2 The installed VENTILATION EXHAUST TREATMENT SYSTEM and WASTE GAS HOLDUP SYSTEM* shall be demonstrated OPERABLE by operating the WASTE GAS HOLDUP SYSTEM equipment and VENTILATION EXHAUST TREATMENT SYSTEM equipment for at least 30 minutes, at least once per 92 days unless the appropriate system has been utilized to process radioactive gaseous effluents during the previous 92 days.

* - If the WASTE GAS HOLDUP SYSTEM is not being fully utilized, an Administrative FUNCTIONAL TEST on the WASTE GAS HOLDUP SYSTEM shall also be performed (in addition to the requirements of 4.11.2.4.2's "at least 30 minutes") once per 92 days, by performing the following:

1) Place a Gas Decay Tank (containing less than 30 psi) in service.

2) With a Waste Gas Compressor, charge the Gas Decay Tank to at least 150 psi.

3) Following appropriate holdup decay time, sample and release the Gas Decay Tank with an OPERABLE Waste Gas Holdup System Noble Gas Activity Monitor (per TABLE 3.3-13).

4) If discrepancies exist, repairs shall be made and the WASTE GAS HOLDUP SYSTEM Administrative FUNCTIONAL TEST shall be repeated until completed successfully.

RADIOACTIVE EFFLUENTS

3/4.11.4 TOTAL DOSE

CONTROLS

3.11.4 In accordance with St. Lucie Plant TS 6.8.4.f.10), the annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrems to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

APPLICABILITY: At all times.

ACTION:

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Control 3.11.1.2.a, 3.11.1.2.b, 3.11.2.2.a, 3.11.2.2.b, 3.11.2.3.a or 3.11.2.3.b, calculations shall be made including direct radiation contributions from the units (including outside storage tanks etc.) to determine whether the above limits of Control 3.11.4 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Plant TS 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in Subpart M of 10 CFR Part 20, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentrations of radioactive material involved and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits and if the release condition resulting in violation of 40 Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request and a variance is granted until staff action on the request is complete.

RADIOACTIVE EFFLUENTS

3/4.11.4 TOTAL DOSE (continued)

SURVEILLANCE REQUIREMENTS

4.11.4.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Controls 4.11.1.2, 4.11.2.2 and 4.11.2.3 and in accordance with the methodology and parameters in the ODCM.

4.11.4.2 Cumulative dose contributions from direct radiation from the units (including outside storage tanks etc.) and Independent Spent Fuel Storage Installation (ISFSI) shall be determined in accordance with the methodology and parameters in the ODCM. This requirement is applicable only under conditions set forth in ACTION a. of Control 3.11.4.

RADIOACTIVE EFFLUENTS

3/4.11.5 MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS AND SOLID WASTE TREATMENT SYSTEMS*

ADMINISTRATIVE CONTROLS

3.11.2.5 Licensee initiated major changes to the radioactive waste systems (liquid, gaseous and solid):

1) Shall be reported to the Commission in the Annual Radioactive Effluent Release Report for the period in which the evaluation was reviewed by the On-Site Review Group (ORG). The discussion of each shall contain:

a) A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR 50.59.

b) Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

c) A detailed description of the equipment, components and processes involved and the interfaces with other plant systems;

d) An evaluation of the change which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto;

e) An evaluation of the change which shows the expected maximum exposure to individuals in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

f) A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid waste, to the actual releases for the period when the changes are to be made;

g) An estimate of the exposure to plant operating personnel as a result of the change; and

h) Documentation of the fact that the change was reviewed and found acceptable by the ORG.

2) Shall become effective upon review and acceptance by the ORG.

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* Licensees may choose to submit the information called for in this Administrative Control as part of the annual FUSAR update.

RADIOACTIVE EFFLUENTS

3/4.11.6 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT TO THE COMMISSION*

ADMINISTRATIVE CONTROLS

3.11.2.6 As per Technical Specification 6.9.1.7, a Annual Radioactive Effluent Release Report covering the operation of each unit during the previous 12 months of operation shall be submitted within 60 days after January 1 of each year. The report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from each unit. The material provided shall be (1) consistent with the objectives outlined in by items a) through f) below, using the example report format in the ODCM and (2) be in conformance with 10 CFR 50.36a and Section IV.B.1 of Appendix I to 10 CFR Part 50.

a. The Radioactive Effluent Release Reports shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants, Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof.

b. The Radioactive Effluent Release Report to be submitted within 60 days after January 1 of each year shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability and precipitation (if measured) or in the form of joint frequency distributions of wind speed, wind direction and atmospheric stability.** This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year.

* - A single submittal may be made for a multiple unit station. The submittal should combine those sections that are common to all units at the station; however, for units with separate radwaste systems, the submittal shall specify the releases of radioactive material from each unit.

** - In lieu of submission with the Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

RADIOACTIVE EFFLUENTS

3/4.11.6 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT TO THE COMMISSION* (continued)

ADMINISTRATIVE CONTROLS

3.11.2.6 (continued)

b. (continued)

This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY (see TS Figure 5.1-1) during the report period. All assumptions used in making these assessments, i.e., specific activity, exposure time and location, shall be included in these reports. The meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents, as determined by sampling frequency and measurement, shall be used for determining the gaseous pathway doses, or an approximate and conservative method used in lieu of actual meteorological measurements. The assessment of radiation doses shall be performed in accordance with the methodology and parameters in the ODCM.

c. Every 2 years using the previous 6 months release history for isotopes, determine the controlling age group for liquid pathways. Every 2 years using the previous 1 year or longer interval (to include a refueling outage) and historical meteorological data determine the controlling age group for gaseous pathways. If changed from current submit change to ODCM to reflect new tables for these groups and use the new groups in subsequent dose calculations.

d. The Radioactive Effluent Release Report to be submitted 60 days after January 1 of each year shall also include an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases for the previous calendar year. Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109 March 1976.

RADIOACTIVE EFFLUENTS

3/4.11.6 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT TO THE COMMISSION* (continued)

ADMINISTRATIVE CONTROLS

3.11.2.6 (continued)

e. The Radioactive Effluent Release Reports shall include the following information for each class of solid waste (as defined by 10 CFR Part 61) shipped offsite during the report period:

1. Volume
2. Total Curie quantity (specify whether determined by measurement or estimate)
3. Principal radionuclides (specify whether determined by measurement or estimate)
4. Type of waste (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms)
5. Type of container (e.g., LSA, Type A, Type B, Large Quantity) and
6. Solidification agent or absorbent (e.g., cement, urea formaldehyde).

f. The Radioactive Effluent Release Reports shall include a list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

g. The Radioactive Effluent Release Reports shall include any changes made during the reporting period to the PROCESS CONTROL PROGRAM (PCP) and to the OFFSITE DOSE CALCULATION MANUAL (ODCM), as well as a listing of new locations for dose calculations and/or environmental monitoring identified by the Land Use Census of ODCM Control 3.12.2.

h. The format for an Annual Radioactive Effluent Release Report is provided in ODCM Methodology Section 4.0. The information contained in an annual report shall not apply to any ODCM Control Dose Limit(s) since the methodology for the annual report is based on actual meteorological data, instead of historical conditions that the ODCM Controls and Control required calculations are based on.

RADIOACTIVE EFFLUENTS

3/4.11.6 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT TO THE COMMISSION* (continued)

ADMINISTRATIVE CONTROLS

3.11.2.6 (continued)

i. Beginning with the report due within 60 days after January 1, 2007, the Radioactive Effluent Release Report shall include the following information for the previous year:

a. A listing with descriptions of any leaks or spills that have been communicated to State and Local officials in accordance with the Groundwater Protection INITIATIVE (NEI 07-07).

b. Groundwater sample results that have been taken in support of the Groundwater Protection INITIATIVE (NEI 07-07), unless they are from locations that are described in the Radiological Environmental Monitoring Program and will therefore be reported in the Annual Radiological Environmental Operating Report (AREOR).

RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

CONTROLS

3.12.1 In accordance with St. Lucie Plant TS 6.8.4.g.1), the Radiological Environmental Monitoring Program shall be conducted as specified in Table 3.12-1.

APPLICABILITY: At all times.

ACTION:

a. With the Radiological Environmental Monitoring Program not being conducted as specified in Table 3.12-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Control 3.12.4, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the confirmed* level of radioactivity as the result of plant effluents in an environmental sampling medium at a location specified in Appendix B-1 exceeding the reporting levels of Table 3.12-2 when averaged over any calendar quarter, prepare and submit to the Commission within 30 days, pursuant to Plant TS 6.9.2, a Special Report*** that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose** to a MEMBER OF THE PUBLIC is less than the calendar year limit of Controls 3.11.1.2, 3.11.2.2 or 3.11.2.3. When more than one of the radionuclides in Table 3.12-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + > \text{or} = 1.0\ 1$$

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* A confirmatory reanalysis of the original, a duplicate or a new sample may be desirable, as appropriate. The results of the confirmatory analysis shall be completed at the earliest time consistent with the analysis but in any case within 30 days.

** The methodology and parameters used to estimate the potential annual dose to a MEMBER OF THE PUBLIC shall be indicated in this report.

*** A copy of the 30-day Special Report shall be provided to the Radiation Protection Manager (or designee) so that it can be sent to State and Local Officials in TABLE-1 of HPP-101 concurrent with its submittal to the commission.

RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

Controls (continued)

ACTION:

b. (continued)

When radionuclides other than those in Table 3.12-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose, to a MEMBER OF THE PUBLIC from all radionuclides is equal to or greater than the calendar year limits of Control 3.11.1.2, 3.11.2.2 or 3.11.2.3. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report required by Control 3.12.4.

c. With milk or broad leaf vegetation samples unavailable from one or more of the sample locations required by Table 3.12-1, identify specific locations for obtaining replacement samples and add them within 30 days to the Radiological Environmental Monitoring Program given in the ODCM. The specific locations from which samples were unavailable may then be deleted from the monitoring program. Pursuant to Control 3.11.2.6, submit in the next Annual Radioactive Effluent Release Report documentation for a change in the ODCM including a revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples and justifying the selection of the new location(s) for obtaining samples.

SURVEILLANCE REQUIREMENTS

4.12.1 The radiological environmental monitoring samples shall be collected pursuant to Table 3.12-1 from the specific locations given in the table and figure(s) in the ODCM and shall be analyzed pursuant to the requirements of Table 3.12-1 and the detection capabilities required by Table 4.12-1.

TABLE 3.12-1
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM[a)]
(Page 1 of 3)

EXPOSURE PATHWAY and/or SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[b) c)]	SAMPLING AND COLLECTION FREQUENCY[d)]	TYPE AND FREQUENCY[d)] OF ANALYSIS
1. Direct Radiation[e)]	27 Monitoring Locations	Continuous monitoring with sample collection quarterly[f)]	Gamma exposure rate - quarterly
2. Airborne Radioiodine and Particulates	5 Locations	Continuous sampler operation with sample collection weekly or more frequently if required by dust loading	Radioiodine filter: I-131 analysis weekly Particulate Filter: Gross beta radioactivity analysis ≥24 hours following a filter change[g)] Gamma isotopic[h)] analysis of composite[g)] (by location) quarterly
3. Waterborne			
a. Surface[k)]	1 Location[m)]	Weekly	Gamma isotopic[h)] & tritium analyses weekly
	1 Location[n)]	Monthly	Gamma isotopic[h)] & tritium analyses monthly
b. Sediment from shoreline	2 Locations	Semiannually	Gamma isotopic[h)] analyses semiannually
4. Ingestion			
a. Fish and Invertebrates			
1. Crustacea	2 Locations	Semiannually	Gamma isotopic[h)] analyses semiannually
2. Fish	2 Locations	Semiannually	Gamma isotopic[h)] analyses semiannually
b. Food Products			
1. Broad leaf vegetation	3 Locations[p)]	Monthly when available	Gamma isotopic[h)] and I-131 analyses monthly

TABLE 3.12-1
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM[a)]
(Page 2 of 3)

TABLE NOTATIONS

a. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment or other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, corrective action shall be taken prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to Control 3.12.4.

b. Specific parameters of distance and direction sector from the centerline of one reactor and additional description where pertinent, shall be provided for each sample location required by Table 3.12-1, in Appendix-B and applicable figures.

c. At times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program.

d. The following definition of frequencies shall apply to Table 3.12-1 only:

Weekly	-	Not less than once per calendar week. A maximum interval of 11 days is allowed between the collection of any two consecutive samples.
Semi-Monthly	-	Not less than 2 times per calendar month with an interval of not less than 7 days between sample collections. A maximum interval of 24 days is allowed between collection of any two consecutive samples.
Monthly	-	Not less than once per calendar month with an interval of not less than 10 days between sample collections.
Quarterly	-	Not less than once per calendar quarter.
Semiannually	-	One sample each between calendar dates (January 1 - June 30) and (July 1 - December 31). An interval of not less than 30 days will be provided between sample collections.

The frequency of analyses is to be consistent with the sample collection frequency.

TABLE 3.12-1
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM[a)]
(Page 3 of 3)

TABLE NOTATIONS
(continued)

e. One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of or in addition to, integrating dosimeters. For purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters.

f. Refers to normal collection frequency. More frequent sample collection is permitted when conditions warrant.

g. Airborne particulate sample filters are analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. In addition to the requirement for a gamma isotopic on a composite sample a gamma isotopic is also required for each sample having a gross beta radioactivity which is >1.0 pCi per cubic meters and which is also >10 times that of the most recent control sample.

h. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

k. Discharges from the St. Lucie Plant do not influence drinking water or ground water pathways.

m. Atlantic Ocean, in the vicinity of the public beaches along the eastern shore of Hutchinson Island near the St. Lucie Plant (grab sample)

n. Atlantic Ocean, at a location beyond influence from plant effluents (grab sample).

p. Samples of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground level D/Q and one sample of similar broad leaf vegetation at an available location 15-30 kilometers distant in the least prevalent wind direction based upon historical data in the ODCM.

[i, j, l (lower case) and o are not used on notation for clarity reasons]

TABLE 3.12-2
REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES
(Page 1 of 1)

REPORTING LEVELS

ANALYSIS	WATER pCi/l	AIRBORNE PARTICULATE OR GASES pCi/m^3	FISH pCi/kg, wet	MILK pCi/l	FOOD PRODUCTS pCi/kg, wet
H-3	30,000*				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95***	400				
I-131	2**	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140***	200			300	

l - as in pCi/l denotes liter

* - Since no drinking water pathway exists, a value of 30,000 pCi/l is used. For drinking water samples, a value of 20,000 pCi/l is used; this is 40 CFR Part 141 value.

** - Applies to drinking water pathway exists, 2 pCi/l is the limit for drinking water.

*** - An equilibrium mixture of the parent daughter isotopes which corresponds to the reporting value of the parent isotope.

TABLE 4.12-1
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS (1)(2)
(Page 1 of 2)

LOWER LIMIT OF DETECTION (LLD) (3)

ANALYSIS	WATER pCi/l	AIRBORNE PARTICULATE OR GASES pCi/m^3	FISH pCi/kg, wet	MILK pCi/l	FOOD PRODUCTS pCi/kg, wet	SEDIMENT pCi/kg, dry
Gross Beta	4	0.01				
H-3	3000*					
Mn-54	15		130			
Fe-59	30		260			
Co-58, Co-60	15		130			
Zn-65	30		260			
Zr-95, Nb-95(4)	15					
I-131	1**	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140, La-140(4)	15			15		

* No drinking water pathway exists, a value of 2000 pCi/l is for drinking water.

** LLD for drinking water samples. If no drinking water pathway exists, a value of 15 pCi/l may be used.

TABLE NOTATIONS

(1) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to Control 3.12.4.

(2) Required detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

TABLE 4.12-1
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS (1)(2)
(Page 2 of 2)

TABLE NOTATIONS (continued)

(3) The LLD is defined for purposes of these controls, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a real signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\, S_b}{E \bullet V \bullet 2.22 \bullet Y \bullet \exp(-\lambda \bullet \Delta T)}$$

Where:

LLD = the a priori lower limit of detection (pico-Curie per unit mass or volume),

S_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22 = the number of disintegrations per minute per pico-Curie,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (sec^{-1}) and

ΔT = the elapsed time between the midpoint of sample collection and the time of counting (sec).

Typical values of E, V, Y and ΔT should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant to Control 3.12.4.

(4) An equilibrium mixture of the parent and daughter isotopes which corresponds to 15 pCi/Liter of the parent isotope.

RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.2 LAND USE CENSUS

CONTROLS

3.12.2 In accordance with St. Lucie Plant TS 6.8.4.g.2), a Land Use Census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden* of greater than 50 square meters (500 square feet) producing broad leaf vegetation.

APPLICABILITY: At all times.

ACTION:

a. With a Land Use Census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Control 4.11.2.3, pursuant to Control 3.11.2.6, identify the new location(s) in the next Annual Radioactive Effluent Release Report.

b. With a Land Use Census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained in accordance with Control 3.12.1, add the new location(s) within 30 days to the Radiological Environmental Monitoring Program given in the ODCM. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from this monitoring program after October 31 of the year in which this Land Use Census was conducted. Pursuant to TS 6.14, submit in the next Annual Radioactive Effluent Release Report documentation for a change in the ODCM including a revised figure(s) and table(s) for the ODCM reflecting the new location(s) with information supporting the change in sampling locations.

* Broad leaf vegetation sampling may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. Controls for broad leaf vegetation sampling in Table 3.12-1, Part 4.b., shall be followed, including analysis of control samples.

RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.2 LAND USE CENSUS (continued)

SURVEILLANCE REQUIREMENTS

4.12.2 The Land Use Census shall be conducted during the growing season at least once per 12 months using that information that will provide the best results, such as by a door-to-door survey, aerial survey or by consulting local agriculture authorities. The results of the Land Use Census shall be included in the Annual Radiological Environmental Operating Report pursuant to Control 3.12.4.

RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

CONTROLS

3.12.3 In accordance with St. Lucie Plant TS 6.8.4.g.3), analyses shall be performed on all radioactive materials, supplied as part of an Interlaboratory Comparison Program that correspond to samples required by Table 3.12-1.

APPLICABILITY: At all times.

ACTION:

a. With analyses not being performed as required above, report the corrective action taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to Control 3.12.4.

SURVEILLANCE REQUIREMENTS

4.12.3 A summary of the results obtained as part of the above required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report pursuant to Control 3.12.4. If the Interlaboratory Comparison Program is other than the program conducted by the DOE Mixed Analyte Performance Evaluation Program (MAPEP), then the Interlaboratory Comparison Program shall be described in the ODCM.

RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.4 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)*

ADMINISTRATIVE CONTROLS

3.12.4 In accordance with St. Lucie Plant TS 6.9.1.8, an Annual Radiological Environmental Operating Report covering the operation of the unit during the previous calendar year shall be submitted before May 1 of each year. The report shall include summaries, interpretations and information based on trend analysis of the results of the Radiological Environmental Monitoring Program for the reporting period. The material provided in the AREOR shall be consistent with the objectives outlined below and with Sections IV.B.2, IV.B.3 and IV.C of Appendix I to 10 CFR Part 50.

The Annual Radiological Environmental Operating Reports shall include summaries, interpretations and information based on trend analysis of the results of the radiological environmental surveillance activities for the report period, including a comparison, as appropriate, with preoperational studies, with operational controls and with previous environmental surveillance reports and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of land use census required by Control 3.12.2.

The Annual Radiological Environmental Operating Reports shall include the results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in the Table and Figures in the ODCM, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The Annual Radiological Environmental Operating Report shall also include the results of the analyses for all samples that have been added to the Radiological Environmental Monitoring Program in support of the Groundwater Protection INITIATIVE (NEI 07-07) - Appendix B-2.

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* - A single submittal may be made for multiple unit station.

RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.4 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT (AREOR)* (continued)

ADMINISTRATIVE CONTROLS

The reports shall also include the following: a summary description of the radiological environmental monitoring program; at least two legible maps** covering all sampling locations keyed to a table giving distances and directions from the centerline of one reactor; the results of the Interlaboratory Comparison Program, required by Control 3.12.3; discussion of all deviations from the sampling schedule of Table 3.12-1; and discussion of all analyses in which the LLD required by Table 4.12-1 was not achievable.

* - A single submittal may be made for multiple unit station.

** One map shall cover stations near the SITE BOUNDARY; a second shall include the more distant stations.

BASES
FOR THE
CONTROLS
AND
SURVEILLANCE REQUIREMENTS

NOTE

The BASES contained in succeeding pages summarize the reasons for the Controls in Section 3.0 and 4.0, but are not part of these Controls.

3.3.3.9 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluent during actual or potential releases of liquid effluents. The Alarm/Trip Setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

3.3.3.10 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluent during actual or potential releases of gaseous effluents. The Alarm/Trip Setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

3/4.11 RADIOACTIVE EFFLUENTS

BASES

3/4.11.1 LIQUID EFFLUENTS

3/4.11.1.1 CONCENTRATION

This control is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within: (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC and (2) the limits of 10 CFR Part 20. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its ECL in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

This control applies to the release of radioactive materials in liquid effluents from all units at the site.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD and other detection limits can be found in Currie, L.A., Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements, NUREG/CR-4007 (September 1984) and in the HASL Procedures Manual, HASL-300.

3/4.11.1.2 DOSE

This control is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The Control implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to UNRESTRICTED AREAS will be kept as low as is reasonably achievable. Also, for fresh water sites with drinking water supplies that can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR Part 141. The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated.

3/4.11 RADIOACTIVE EFFLUENTS (Continued)

BASES

3/4.11.1 LIQUID EFFLUENTS (Continued)

3/4.11.1.2 DOSE (Continued)

The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1, October 1977 and Regulatory Guide 1.113, Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, April 1977.

This control applies to the release of radioactive materials in liquid effluents from each unit at the site. For units with shared Radwaste Systems, the liquid effluents from the shared system are to be proportioned among the units sharing that system.

3/4.11.1.3 LIQUID RADWASTE TREATMENT SYSTEM

The OPERABILITY of the Liquid Radwaste Treatment System ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept as low as is reasonably achievable. This control implements the requirements of 10 CFR 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the Liquid Radwaste Treatment System were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50 for liquid effluents.

This control applies to the release of radioactive materials in liquid effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the liquid effluents from the shared system are to be proportioned among the units sharing that system.

RADIOACTIVE EFFLUENTS

BASES

3/4.11.2 GASEOUS EFFLUENTS

3/4.11.2.1 DOSE RATE

This control is provided to ensure that the dose at any time at and beyond the SITE BOUNDARY from gaseous effluents from all units on the site will be within the annual dose limits of 10 CFR Part 20 to UNRESTRICTED AREAS. The annual dose limits are the doses associated with the concentration of 10 CFR Part 20, Appendix B, Table 2, Column I. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to an annual average concentration exceeding the limits specified in Appendix B, Table 2 of 10 CFR Part 20 (Subpart D of 10 CFR Part 20). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrems/year to the total body or to less than or equal to 3000 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrems/year.

This control applies to the release of radioactive materials in gaseous effluents from all units at the site.

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD and other detection limits can be found in Currie, L. A., Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements, NUREG/CR-4007 (September 1984) and in the HASL Procedures Manual, HASL-300.

RADIOACTIVE EFFLUENTS

BASES

3/4.11.2.1 DOSE - NOBLE GASES

This control is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The control implements the guides set forth in Section I.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept as low as is reasonably achievable. The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1, October 1977 and Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors, Revision 1, July 1977. The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

This control applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are to be proportioned among the units sharing that system.

3/4.11.2.3 DOSE - IODINE-131, IODINE-133, TRITIUM AND RADIOACTIVE MATERIAL IN PARTICULATE FORM

This control is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Controls are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept as low as is reasonably achievable. The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated.

RADIOACTIVE EFFLUENTS

BASES

3/4.11.2.1 DOSE - NOBLE GASES (Continued)

3/4.11.2.3 DOSE - IODINE-131, IODINE-133, TRITIUM AND RADIOACTIVE MATERIAL IN PARTICULATE FORM (Continued)

The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject material are consistent with the methodology provided in Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1, October 1977 and Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors, Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate controls for Iodine-131, Iodine-133, tritium and radionuclides in particulate form with half-lives greater than 8 days are dependent upon the existing radionuclide pathways to man in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of the calculations were: (1) individual inhalation of airborne radionuclides, (2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, (3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man and (4) deposition on the ground with subsequent exposure of man.

This control applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

RADIOACTIVE EFFLUENTS

BASES

3/4.11.2.4 GASEOUS RADWASTE TREATMENT SYSTEM

The OPERABILITY of the WASTE GAS HOLDUP SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensure that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept as low as is reasonably achievable. This control implements the requirements of 10 CFR 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Section II.B and II.C of Appendix I, 10 CFR Part 50 for gaseous effluents.

This control applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

3/4.11.2.5 NOT USED

3/4.11.2.6 NOT USED

3/4.11.3 NOT USED

3/4.11.4 TOTAL DOSE

This control is provided to meet the dose limitations of 10 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The control requires the preparation and submittal of a Special Report whenever the calculated doses due to releases of radioactivity and to radiation from uranium fuel cycle sources exceed 25 mrems to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems. For sites containing up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the units (including outside storage tanks, etc.) are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits.

RADIOACTIVE EFFLUENTS

BASES

3/4.11.4 TOTAL DOSE (Continued)

For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 8 kilometers must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and Subpart M of 10 CFR Part 20, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190 and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in Controls 3.11.1.1 and 3.11.2.1. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

BASES

3/4.12.1 MONITORING PROGRAM

The Radiological Environmental Monitoring Program required by this control provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposure of MEMBERS OF THE PUBLIC resulting from the plant operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the Radiological Effluent Monitoring Program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 4.12-1 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an <u>a priori</u> (before the fact) limit representing the capability of a measurement system and not as an <u>a posteriori</u> (after the fact) limit for a particular measurement.

Detailed discussion of the LLD and other detection limits can be found in Currie, L. A., Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements, NUREG/CR-4007 (September 1984) and in the HASL Procedures Manual, <u>HASL-300</u>.

3/4.12.2 LAND USE CENSUS

This control is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the Radiological Environmental Monitoring Program given in the ODCM are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey or from consulting with local agricultural authorities shall be used.

3/4.12.2 LAND USE CENSUS (Continued)

This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 square meters provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kilograms/year) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: (1) 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage) and (2) a vegetation yield of 2 kilograms per square meter.

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

This requirement for participation in an approved Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive materials in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

METHODOLOGY SECTION

METHODOLOGY

for the

CONTROLS

AND

SURVEILLANCE REQUIREMENTS

METHODOLOGY SECTION
GLOSSARY OF COMMONLY USED TERMS IN METHODOLOGY SECTION
(Page 1 of 3)

D_B	-	Dose from Beta Radiation
CC or cc	-	Cubic centimeter
Ci	-	Curies - a unit of radioactivity see μCi
C_i	-	Activity or concentration of a nuclide in the release source. Units of μCi, μCi/cc or μCi/ml
CFR	-	Code of Federal Regulations
Control(s)	-	Regulations for operating, controlling, monitoring and reporting radioactive effluent related activity as indicated by the Controls Section of the ODCM.
Dose	-	The exposure, in mrem or mrad, the organ or the individual receives from radioactive effluents
Dose Factor	-	Normally, a factor that converts the effect of ingesting radioactive material into the body, to dose to a specific organ. Body elimination, radioactive decay and organ uptake are some of the factors that determine a dose factor for a given nuclide
Dose Pathway	-	A specific path that radioactive material physically travels through prior to exposing an individual to radiation. The Grass-Cow-Milk-Infant is a dose pathway
Dose Rate	-	The dose received per unit time
(D/Q)	-	A long term D over Q - a factor with units of $1/m^2$ which describes the deposition of particulate matter from a plume at a point downrange from the source. It can be thought of as what part of the cloud is going to fallout and deposit over one square meter of ground. (See Appendix C).
ECL	-	Effluent Concentration Limit
FUSAR	-	Final Updated Safety Analysis Report.
Y	-	A gamma photon - The dose from Gammas in air, etc.

METHODOLOGY SECTION

GLOSSARY OF COMMONLY USED TERMS IN METHODOLOGY SECTION

(Page 2 of 3)

Ground Plane	-	Radioactive material deposited uniformly over the ground emits radiation that produces an exposure pathway when an individual is standing, sitting, etc., in the area. It is assumed that an adult receives the same exposure as an infant, regardless of the physical height differences. Only the whole body is considered for the ODCM.
H-3	-	Hydrogen-3 or Tritium, a weak Beta emitter
I&8DP	-	Radioiodines and particulates with half-lives greater than 8 days
m^3	-	Cubic Meters
m^2	-	Square Meters
nuclide	-	For the purposes of this manual, a radioactive isotope. Nuclide (i) signifies a specific nuclide, the 1st, 2nd, 3rd one under consideration. If nuclide (i) is I-131, then the Mi (dose factor) under consideration should be M_{I-131} for example.
Organ	-	For the ODCM either the bone, liver, thyroid, kidney, lung, GI-LLI or the Whole Body. Whole Body is considered an organ for ease of writing the methodology in the ODCM.
pCi	-	1 pico-Curie = 1.E-12 Curies.
$(Q\ Dot)_i$	-	$(Q\ Dot)_i$ - Denotes a release rate in μCi/sec for nuclide (i).
Q_i	-	Denotes μCi of nuclide (i) released over a specified time interval.
Radioiodines	-	Iodine-131 and Iodine I-133 for gaseous release pathways.
Receptor	-	The individual receiving the exposure in a given location or who ingests food products from an animal for example. A receptor can receive dose from one or more pathways.
Release Source(s)	-	A subsystem, tank or vent where radioactive material can be released independently of other radioactive release points.
TS	-	The St. Lucie Plant Standard Technical Specifications
Total Body	-	Same as Whole Body in Control Statements
μCi	-	micro Curies. 1 μCi = 10^{-6} Curies. The μCi is the standard unit of radioactivity for all dose calculations in the ODCM.

METHODOLOGY SECTION
GLOSSARY OF COMMONLY USED TERMS IN METHODOLOGY SECTION
(Page 3 of 3)

(X/Q) - A long term Chi over Q. It describes the physical dispersion characteristics of a semi-infinite cloud of noble gases as the cloud traverses downrange from the release point. Since Noble Gases are inert, they do not tend to settle out on the ground. (See Appendix C).

$(X/Q)_D$ - A long term Depleted Chi over Q. It describes the physical dispersion characteristics of a semi-infinite cloud of radioactive iodines and particulates as the cloud travels downrange. Since Iodines and particulates tend to settle out (fallout of the cloud) on the ground, the $(X/Q)_D$ represents what physically remains of the cloud and its dispersion qualities at a given location downrange from the release point. (See Appendix C).

dt, Δt or delta t - A specific delta time interval that corresponds with the release interval data etc.

METHODOLOGY SECTION

1.0 LIQUID RELEASES METHODOLOGY

1.1 Radioactive Liquid Effluent Model Assumptions

The FUSAR contains the official description of the site characteristics. The description that follows is a brief summary for dose calculation purposes:

The St. Lucie Plant is located on an island surrounded on two sides by the Atlantic Ocean and the Indian River, an estuary of the Atlantic Ocean. Normally, all radioactive liquid releases enter the Atlantic Ocean where the Circulating Water Discharge Pipe terminates on the ocean floor at a point approximately 1200 feet offshore (Figure 1-1 Point "L"). No credit is taken for subsequent mixing of the discharge flume with the ocean. The diffusion of radioactive material into the ocean is dependent on the conditions of tide, wind and some eddy currents caused by the Gulf Stream. The conditions are sufficiently random enough to distribute the discharges over a wide area and no concentrating effects are assumed.

There are no direct discharge paths for liquid effluents to either of the north or south private property boundary lines. The Big Mud Creek (part of the Indian River) does connect to a normally locked shut dam, that is intended to provide an emergency supply of circulating water to the Intake Cooling Water Canal in the event a Hurricane causes blockage of the Intake Canal. No radioactive water from plant systems could be discharged directly into the Intake Cooling Water Canal because all plant piping is routed to the discharge canal and no back flow can occur. However, dilute secondary sources from such outfalls as the industrial wastewater system and construction dewatering may be pumped to the Intake Canal. These secondary sources would be secured under the extraordinary conditions that would precede opening the dam. Consult the FUSAR for a detailed description of characteristics of the water bodies surrounding the plant site.

Only those nuclides that appear in the Liquid Dose Factor Tables will be considered for dose calculation.

METHODOLOGY SECTION

1.2 Determining the Fraction F of 10 CFR Part 20 ECLs Limits for A Liquid Release Source

Discussion - Control 3.11.1.1 requires that the sampling and analysis results of liquid waste (prior to discharge) be used with calculation methods in the in-plant procedures to assure that the concentration of liquid radioactive material in the unrestricted areas will not exceed ten times the concentrations specified in 10 CFR Part 20, Appendix B, Table 2. CY-SL-102-0104, Processing Aerated Liquid Waste, provides instruction for ensuring batch release tanks will be sampled after adequate mixing. This section presents the calculation method to be used for this determination. This method only addresses the calculation for a specific release source. The in-plant procedures will provide instructions for determining that the summation of each release source's F values do not exceed the site's 10 CFR Part 20 ECL. The values for release rate, dilution rate, etc., will also have to be obtained from in-plant procedures. The basic equation is:

$$F_L = \frac{R}{D} \sum_{i=1}^{n} \frac{C_i}{(ECL)_i}$$

Where:

F_L = the fraction of 10 CFR Part 20 ECL that would result if the release source was discharged under the conditions specified.

R = The undiluted release rate in gpm of the release source.
Liquid Rad Waste = 170 gpm for Waste Monitor Tank
Steam Generator = 125 gpm/Steam Generator
Liquid Rad Waste = 60 gpm for AWST #2
Liquid Rad Waste = 60 gpm for Laundry Drain Pumps 2A/2B

D = The dilution flow in gpm of Intake Cooling Water or Circulating Water Pumps
Intake Cooling flow is 14,500 gpm/pump
Circulating Water flow is 121,000 gpm/pump

C_i = The undiluted concentration of nuclide (i) in μCi/ml from sample assay

$(ECL)_i$ = The Effluent Concentration Limit of nuclide (i) in μCi/ml from Table L-1. For dissolved or entrained noble gases the ECL value is 2×10^{-4} μCi/ml for the sum of all gases.

METHODOLOGY SECTION

1.2 Determining the Fraction F of 10 CFR Part 20 ECLs Limits for A Liquid Release Source (continued)

The fraction of the 10 CFR Part 20 ECL limit may be determined by a nuclide-by-nuclide evaluation or for purposes of simplifying the calculation by a cumulative activity evaluation. If the simplified method is used, the value of 3×10^{-8} µCi/ml (unidentified ECL value) should be substituted for $(ECL)_i$ and the cumulative concentration (sum of all identified radionuclide concentrations) or the gross concentration should be substituted for C_i. As long as the diluted concentration (C_{total} R/D) is less than 3×10^{-8} µCi/ml, the nuclide-by-nuclide calculation is not required to demonstrate compliance with the 10 CFR Part 20 ECL. The following section provides a step-by-step procedure for determining the ECL fraction.

1. Calculation Process for Solids

   A. Obtain from the in-plant procedures, the release rate value (R) in gpm for the release source.

   B. Obtain from the in-plant procedures, the dilution rate (D) in gpm. No credit is taken for any dilution beyond the discharge canal flow.

   C. Obtain (C_i), the undiluted assay value of nuclide (i), in µCi/ml. If the simplified method is used, the cumulative concentration (C_{total}) is used.

   D. From Table L-1, obtain the corresponding (ECL) for nuclide (i) in µCi/ml. The value of 3×10^{-8} µCi/ml should be used for the simplified method.

   E. Divide C_i by $(ECL)_i$ and write down the quotient

   F. If the simplified method is used, proceed to the next step. If determining the ECL fraction by the nuclide-by-nuclide evaluation, repeat steps 1.2.1.C through 1.2.1.E for each nuclide reported in the assay, for H_3 from previous month composite and for SR89/90 and Fe55 from previous quarter composite with known results.

METHODOLOGY SECTION

1.2 Determining the Fraction F of 10 CFR Part 20 ECLs Limits for A Liquid Release Source (continued)

1. Calculation Process for Solids (continued)

G. Add each C_i/(ECL) quotient from step 1.2.1.E and solve for F_L as follows:

$$F_L = \frac{R}{D} \sum_{i=1}^{n} \frac{C_i}{(ECL)\,i}$$

F_L = a unit-less value where:

the value of F_L could be $\leq$ or >1. The purpose of the calculation is to determine what the initial value of F_L is for a given set of release conditions.

H. The F_L value just obtained is for one release pathway. The TS and ODCM control 3.11.1.1 allow for a site limit of F_L less than or equal to 10. Chemistry Procedure CY-SL-102-0104 administratively controls each pathway's allocation. Compare your F_L result with the administrative control for the release pathway in CY-SL-102-0104.

2. Calculation Process for Gases in Liquid

A. Sum the μCi/ml of each noble gas activity reported in the release.

B. The values of R and D from 1.2.1 above shall be used in the calculations below:

$$F_g = \frac{(\text{sum of 1.2.2.A})\ \mu\text{Ci/ml}}{1} \times \frac{R}{D}$$

C. F_g shall be less than 2×10^{-4} μCi/ml for the site for all releases in progress. Each release point will be administratively controlled. Consult CY-SL-102-0104 procedure for instructions.

METHODOLOGY SECTION

1.3 Determining Setpoints for Radioactive Liquid Effluent Monitors

1.3.1 Setpoints for Batch Liquid Release Monitors channel numbers R6627 and 301 on Table 3.3-14, Radioactive Effluent Monitor Setpoint Basis, are the Batch Liquid Effluent Monitors.

Discussion - Control 3.3.3.9 requires that the liquid effluent monitoring instrumentation alarm / trip setpoints be set to initiate an alarm or trip so that the radioactivity concentration in water in the unrestricted area does not exceed the concentration of 10 CFR Part 20, Appendix B, Table 2 as a result of radioactivity in liquid effluents (Control 3.11.1.1).

Gross cpm vs. total liquid activity curves are available for Batch Liquid Effluent Monitors based on a composite of real release data. A direct correlation between gross cpm and the concentrations that would achieve 10 CFR Part 20 ECL levels in the discharge canal can be estimated. The 1978 liquid release data from annual reports was used to determine the average undiluted release concentration. These concentrations were then projected to a diluted concentration in the discharge canal assuming a 1 gpm release rate and a constant dilution flow of 121,000 gpm from 1 circ. water pump. This diluted activity was divided by the nuclide's respective 10 CFR Part 20 ECL value (Table L-1) to obtain the Mi column on the table that follows:

METHODOLOGY SECTION

1.3 Determining Setpoints for Radioactive Liquid Effluent Monitors (continued)

NUCLIDE SYMBOL	1978 UNDILUTED μCi/ml[1]	M_i[2] (no units)
I-131	4.43 E-5	3.66 E-4
I-132	2.23 E-7	1.84 E-8
I-133	3.17 E-6	3.74 E-6
I-135	1.31 E-6	3.61 E-7
Na-24	1.72 E-7	2.84 E-8
Cr-51	2.51 E-5	4.15 E-7
Mn-54	5.64 E-6	1.55 E-6
Mn-56	1.11 E-9	1.31 E-10
Co-57	3.69 E-7	5.08 E-8
Co-58	1.51 E-4	6.24 E-5
Fe-59	2.92 E-6	2.41 E-6
Co-60	3.66 E-5	1.01 E-4
Zn-65	4.55 E-7	7.52 E-7
Ni-65	8.23 E-7	6.8 E-8
Ag-110	1.96 E-6	2.70 E-6
Sn-113	5.75 E-7	1.58 E-7
Sb-122	2.15 E-6	1.78 E-6
Sb-124	8.40 E-6	9.92 E-6
W-187	3.51 E-6	9.67 E-7
Np-239	1.57 E-7	6.49 E-8
Br-82	3.64 E-7	7.52 E-8
Zr-95	2.82 E-5	1.17 E-5
Zr-97	4.05 E-6	3.72 E-6
Mo-99	3.24 E-6	1.34 E-6
Ru-103	3.84 E-8	1.06 E-8
Sb-125	2.26 E-6	6.23 E-7
Cs-134	2.14 E-5	1.97 E-4
Cs-136	7.82 E-7	1.08 E-6
Cs-137	4.85 E-5	4.01 E-4
Ba-140	6.44 E-7	6.65 E-7
Ce-141	3.04 E-8	8.38 E-9
Ce-144	2.37 E-6	6.53 E-6
A_{tot}=	4.01 E-4	
M_{Total}=		1.18 E-3

(1) 1978 Undiluted Release Volume = 7 E 9 ml.

(2) $$M_i = \frac{\text{1978 Undil. Act Nuclide (i)}}{\text{ECL}_i\text{ (from Table L-1)}} \text{ X } \frac{\text{1 gpm (release rate)}}{\text{121000 gpm (dil rate)}}$$

METHODOLOGY SECTION

1.3 Determining Setpoints for Radioactive Liquid Effluent Monitors (continued)

A_{Tot} is the total average µCi/ml concentration of the reference mixture and M_{Tot} is the fraction of the MPC of all nuclides for the release conditions specified. Dividing A_{Tot} by M_{Tot} yields A_{Max}, which is the maximum total activity concentration equivalent to the ECL limit for the nuclide distribution typical of radwaste discharges. The Technical Specifications allow 10 times the ECL limit where the Site Limit is 10 times A_{Max} as follows:

$$A_{Max} = \frac{A_{Tot}}{M_{Tot}} = \frac{4.01\text{E-}4}{1.18\text{E-}3} = 0.34\ \mu\text{Ci/ml} = \text{ECL Limit}$$

Site Limit = 10 x A_{Max} = 10 x 0.34 = 3.4 µCi/ml

To provide conservative administrative control, A_{Max} of 0.34 µCi/ml should be used as follows:

1. If the effluent monitor requires counts per minute units, a (C_{max}) value in cpm should be obtained for the A_{max} (0.34 µCi/ml) from the release sources radioactive liquid effluent monitor curve of cpm vs. µCi/ml.

NOTE

This setpoint is for a specified release of 1 gpm into 121000 gpm dilution flow.

2. For establishing the setpoint prior to liquid radwaste discharges, the A_{max} (or C_{max}) will be adjusted as needed to account for actual release conditions (i.e., actual design maximum discharge flow rate, dilution flow rate and the contribution of dissolved and entrained Nobles Gas Activity to the Monitor Activity Level).

METHODOLOGY SECTION

1.3 Determining Setpoints for Radioactive Liquid Effluent Monitors (continued)

1.3.2 Setpoints for Continuous Liquid Release Monitors

Discussion - The activity mixture described in 1.3.1 for Liquid Batch Release Monitors cannot be used for Continuous Liquid Pathways since the Steam Generator (S/G) Blowdown Secondary Side is subject to what the current Reactor Coolant System (RCS) activity and primary-to-secondary leakage exist at any time. Although S/G blowdown is not normally aligned to the Site Liquid Radwaste Release Point (Figure 1-1), the monitor setpoints will be based on the ODCM maximum design S/G blowdown rate of 125 gpm with 1 Circulating Water Pump (CWP) 121,000 gpm in operation. The ODCM and CY-SL-102-0104, Processing Liquid Waste assume that the fraction of solids entering the Discharge Canal to the site release point are controlled less than or equal to 1.0, with batch release using 80% and the remaining 20% allocated to continuous sources on site. The actual site limit for solids is 10 times the concentration specified in 10 CFR Part 20, therefore a conservation factor of 10 is already included in the administrative site limit.

Since source in-leakage to a S/G cannot be controlled, a High alarm monitor setpoint is calculated based on one S/G releasing to the discharge canal at design blowdown rate while attaining the 20 percent of the site limit (F_L) assuming all the gross solid activity is I-131. The contribution from Dissolved and Entrained Gases is assumed to be zero with all of the gaseous activity going to the Steam Condenser and Air Ejector pathway.

$$F_L \text{ at } 20\% = \frac{0.2}{1} = \frac{\text{Design blowdown rate}}{\text{1 CWP Dilution rate}} \times \frac{\text{I-131 uCi/ml (S/G)}}{\text{I-131 uCi/ml (Table L-1ECL)}}$$

$$F_L \text{ at } 20\% = \frac{0.2}{1} = \frac{\text{125 gal/min}}{\text{121,000 gal/min}} \times \frac{\text{I-131 uCi/ml (S/G)}}{\text{1.E-06 uCi/ml (I-131 Table L-1ECL)}}$$

Solving for the **S/G High Alarm Setpoint I-131 Activity**,

I-131 uCi/ml (S/G) = **~2E-04 uCi/ml I-131** is the maximum S/G activity that could be allowed such that 20 percent of the administrative discharge canal limit would not be exceeded.

This S/G Monitor High Alarm Setpoint activity may be converted to cpm using Liquid Monitor uC/ml to cpm conversion constants.

This Setpoint is conservative given that the actual Liquid Site Limit is a factor of ten times higher than the administrative limit used for calculation purposes, that I-131's ECL is conservative vs other isotope mixtures, and that it is unlikely that more than one S/G would be allowed to operate with a 20 gallon per day primary-to-secondary leak rate.

METHODOLOGY SECTION

1.4 Determining the Dose for Radioactive Liquid Releases

Discussion - Control 3.11.1.2 requires calculations be performed at least once per 31 days to verify that cumulative radioactive liquid effluents do not cause a dose in excess of 1.5 mrem to the whole body and 5 mrem to any organ during any calendar quarter and not in excess of 3 mrem to the whole body and 10 mrem to any organ during any calendar year. This section presents calculational method to be used for this verification.

This method is based on the methodology suggested by sections 4.3 and 4.3.1 of NUREG-0133 Revision 1, November, 1978. The dose factors are a composite of both the fish and shellfish pathways so that the fish-shellfish pathway is the only pathway for which dose will be calculated. The dose for adult, child and teenager can also be calculated by this method provided that their appropriate dose factors are used for the organ of interest. An infant is excluded from Liquid Dose Pathway at St. Lucie since they do not eat fish-shellfish. The effluent supervisor will track which age group is the controlling (most restrictive) age group (see control 3.11.2.6.c). Only those nuclides that appear in the Tables of this manual will be considered.

1. This method provides for a dose calculation to the whole body or any organ for a given age group based on real release conditions during a specified time interval for radioactive liquid release sources. The equation is:

Where:

$$D_{1T} = \frac{A_{iT}\, dt_1\, Q_{i1}}{(DF)_1}$$

D_{1T} = dose commitment in mrem received by organ T of age group (to be specified) during the release time interval dt_1.

A_{iT} = the composite dose factor for the fish-shellfish pathway for nuclide (i) for organ T of age group (to be specified). The A_{iT} values listed in the Tables in this manual are independent of any site specific information and have the units

$$\frac{\text{mrem - ml}}{\mu\text{Ci - hr}}$$

dt_1 = the number of hours that the release occurs.

Q_{il} = The total quantity of nuclide (i) release during dt_1 (μCi)

$(DF)_1$ = The total volume of dilution that occurred during the release time period dt_1 (i.e., the circulating water flow times time)

METHODOLOGY SECTION

1.4 Determining the Dose for Radioactive Liquid Releases (continued)

1. (continued)

The doses associated with each release may then be summed to provide the cumulative dose over a desired time period (e.g., sum all doses for release during a 31 day period, calendar quarter or a year).

$$D_{total_T} = \Sigma D_{1T}$$

Where:

D_{T_T} = the total dose commitment to organ $_T$ due to all releases during the desired time interval (mrem)

> **NOTE**
> Table 1.4 may be used for compiling the dose accounting.

A. Determine the time interval dt_l in hours that the release took place. For once per 31 day dose calculations dt_l would be for the entire month's hours.

For quarterly dose calculations dt_l would be the hours in the quarter, and for annual dose calculations dt_l would be the hours in the year. If required, dt_l may be hours of duration of a single release to evaluate a batch release.

B. Obtain $(DF)_l$ for the time period dt_l from Liquid Waste Management Records for the release source(s) of interest.

C. Obtain Q_i for nuclide (i) for the time period dt_1 from the Liquid Waste Management Records

D. Obtain A_{iT} from the appropriate Liquid Dose Factor Table

Age Group	Dose Factor Table
Infant	N/A
Child	L-4
Teen	L-3
Adult	L-2

METHODOLOGY SECTION

1.4 Determining the Dose for Radioactive Liquid Releases (continued)

1. (continued)

TABLE 1.4
FISH AND SHELLFISH PATHWAY

TIME/DATE START:____:____ ___/___/___ TIME/DATE STOP:____:____ ___/___/___HOURS

TOTAL DILUTION VOLUME:____________mls
AGE GROUP:__________ ORGAN:___________________ DOSE FACTOR TABLE #:________

NUCLIDE (i)	C_i (μCi)	A_{iT}	DOSE (i) mrem
		TOTAL DOSE $_T$ =	mrem

E. Solve for Dose (i)

$$\text{Dose (i)} = \frac{Q_{i1}\, dt_1\, A_{iT}}{(DF)_1}$$

F. For the age group(s) of interest, repeat steps 1.4.1.C through 1.4.1.E for each nuclide reported and each organ required.

G. For the age group(s) of interest, sum the Dose (i) values to obtain the total dose to organ T from the fish-shellfish pathway.

METHODOLOGY SECTION

1.5 Projecting Dose for Radioactive Liquid Effluents

Discussion - Control 3.11.1.3 requires that appropriate subsystems of the liquid radwaste treatment system be used to reduce radioactive material in liquid effluents when the projected doses due to the liquid effluent, from each unit, to UNRESTRICTED AREAS (see TS Figure 5.1-1) would exceed 0.06 mrem to the whole body or 0.2 mrem to any organ in a 31 day period. The following calculation method is provided for performing this dose projection. The method is based on dose as calculated in section 1.4 with the adult as the bases for projecting.

1. For the controlling age group obtain the latest result of the monthly calculation of the whole body dose and the highest organ dose. These doses can be obtained from the in-plant records.

2. Divide each dose by the number of days the reactor plant was operational during the month.

3. Multiply the quotient of each dose by the number of days the reactor plant is projected to be operational during the next month. The products are the projected dose for the next month. These values should be adjusted as needed to account for any changes in failed fuel or other identifiable operating conditions that could significantly alter the actual releases.

4. If the projected dose is greater than 0.06 mrem to the whole body or greater than 0.2 mrem to the adults highest exposed organ, the liquid radwaste system shall be used.

METHODOLOGY SECTION

2.0 GASEOUS RELEASES METHODOLOGY

2.1 Gaseous Effluent Model Assumptions

Description of Site - (The FUSAR contains the official description of the site characteristics. The description that follows is a brief summary for dose calculation purposes only). The St. Lucie Plant is located on an island surrounded on two sides by the Atlantic Ocean and the Indian River, an estuary of the Atlantic Ocean. Private property adjoins the plant site in the north and south directions. A meteorological tower is located north of the plant near the site property line. There are 16 sectors, for dose calculation purposes, divided into 22.5° each. The MET tower is calibrated such that a zero degree bearing coincides with TRUE NORTH. A bearing of zero degrees dissects the north sector such that bearings of 348.75° and 11.25° define the boundaries of the north sector. The nearest distance to private property occurs in the north sector at approximately 0.97 miles. For ease of calculation, this 0.97 mile radius is assumed in all directions, although the real Unrestricted Area Boundary is defined in Figure 5.1-1 of the TS. Doses calculated over water areas do not apply to Controls or the annual report and may be listed as O.W. (over water) in lieu of performing calculations. The 0.97 mile range in the NW sector is O.W., but it was chosen as the worst sector for conservative dose calculations using the historical MET data.

Historical MET Data - MET data, between September 1, 1976 and August 31, 1978, from the St. Lucie MET Tower was analyzed by Dames & Moore of Washington, D.C. The methodology used by Dames & Moore was consistent with methods suggested by Regulatory Guide 1.111, Revision 1. Recirculation correction factors were also calculated for the St. Lucie Site and are incorporated into the historical MET tables (Tables M5, M6 and M7) in Appendix A of this manual. It was determined that these two years are representative data for this locale.

Dose Calculations - Dose calculations for Control dose limits are normally calculated using historical MET data and receptor location(s) which yield calculated doses no lower than the real location(s) experiencing the most exposure. Actual MET data factors are calculated and are normally used in dose calculations for the annual reports. Approximate and conservative methods may be used in lieu of actual meteorological measurements.

Live MET data and hour-by-hour dose calculations are beyond the scope of this manual. Historical information and conservative receptor locations, etc., are only used for ease of Control dose limit calculations. Dose calculations for Control dose limits may be performed using actual MET data and real receptor locations. Any dose calculations performed with actual data should note the source of the data in the annual report. Actual MET data reduction should be performed in accordance with Regulatory Guide 1.111, Revision 1 and should incorporate Recirculation Correction Factors from Table M-4 of this manual.

METHODOLOGY SECTION

2.1 Gaseous Effluent Model Assumptions (continued)

Dose Calculations - (continued)

The St. Lucie site uses the long term ground release model for all gaseous effluents. Only those radionuclides that appear in the gaseous effluent dose factor tables will be considered in any dose calculations. Radioiodines are defined as Iodine-131 and I-133 for application to Controls. Other nuclides of Iodine may be included in dose calculations for ease of performing calculations, but their dose contribution does not have to be included in the Control requirements. Land Census information will apply to the calendar year following the year that the census was taken in to avoid splitting quarters, etc.

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors

Discussion - Control 3.11.2.1 limits the dose rate from noble gases in airborne releases to <500 mrem/yr - total body and <3000 mrem/yr - skin. Control 3.3.3.11 requires that the gaseous radioactive effluent monitoring instrumentation be operable with alarm/trip setpoints set to ensure that these dose rate limits are not exceeded. The results of the sampling and analysis program of Control Table 4.11-2 are used to demonstrate compliance with these limits.

The following calculation method is provided for determining the dose rates to the total body and skin from noble gases in airborne releases. The alarm/trip setpoints are based on the dose rate calculations. The Controls apply to all airborne releases on the site but all releases may be treated as if discharged from a single release point. Only those noble gases appearing in Table G-2 will be considered. The calculation methods are based on Sections 5.1 and 5.2 of NUREG-0133, November 1978. The equations are:

For TOTAL BODY Dose Rate:

$$DR_{TB} = \sum_{i}^{n} K_i \, (X/Q) \, (Q\,DOT)_i$$

For TOTAL SKIN Dose Rate:

$$DR_{skin} = \sum_{i}^{n} [L_i + 1.1 M_i] \, (X/Q) \, (Q\,DOT)_i$$

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

Where:

DR_{TB} = total body dose rate from noble gases in airborne releases (mrem/yr)

DR_{skin} = skin dose rate from noble gases in airborne releases (mrem/yr)

${}^{n}_{i}\Sigma$ = a mathematical symbol to signify the operations to the right of the symbol are to be performed for each noble gas nuclide (i) through (n) and the individual nuclide doses are summed to arrive at the total dose rate for the release source.

K_i = the total body dose factor due to gamma emissions for each noble gas nuclide reported in the release source. (mrem-m^3/μCi-yr)

L_i = the skin dose factor due to beta emissions for each noble gas nuclide (i) reported in the assay of the release source. (mrem-m^3/μCi-yr)

M_i = the air dose factor due to gamma emissions for each noble gas nuclide (i) reported in the assay of the release source. The constant 1.1 converts mrad to mrem since the units of M_i are in (mrad-m^3/μCi-yr)

(X/Q) = for ground level, the highest calculated annual long term historic relative concentration for any of the 16 sectors, at or beyond the exclusion area boundary (sec/m^3)

$(Q\ DOT)_i$ = The release rate of noble gas nuclide (i) in μCi/sec from the release source of interest

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. Setpoint Determination

A. To comply with Control 3.3.3.10, the alarm/trip setpoints are established to ensure that all noble gas releases in progress do not exceed the ODCM Control 3.11.2.1 noble gas release rate limit for the site. Using pre-ODCM Revision 0 data, the total body dose was determined to be more limiting than the calculated skin dose, therefore the site release rate limit of total body dose rate of 500 mrem/yr has been determined to be equivalent to 3.5E+05 uCi/sec being released from the site. Using 3.5E+05 uCi/sec as the equivalent of 100 percent of the site limit, each release point on site may be allotted a portion of the 100 percent, such that the sum of all release point portions allotted shall be less than or equal to 100 percent. The release point's actual monitor setpoint shall take into account the physical release characteristics of maximum expected volume release rate and its percent allotment for a single release point since uCi/sec is proportional to volume rate. The ODCM actual release points and an example of percent allotments is provided:

Site Limit in Percent = 100%

Site Limit in uCi/sec = 3.5E+05 uCi/sec

(Example)

ODCM Release Point		Percent Allotment
Unit 1 Plant Vent		40
Unit 1 Fuel Bldg. Vent		5
ECCS 1A		1
ECCS 1B		1
Unit 2 Plant Vent		40
Unit 2 Fuel Bldg. Vent		5
ECCS 2A		1
ECCS 2B		1
Blowdown Bldg. Vent	+	5
Total Percent Allocated =		99 or 1 percent below the Site Limit

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

A. (continued)

More or less percentage may be used for a release point, but the sum of the total percent allocated to the above Release Points shall never be allowed to exceed 100 percent. The ECCS Reactor Auxiliary Building Exhaust are not ODCM required monitored release points, but a small percentage should be allotted to each to cover short periodic fan surveillance runs. This allocation is controlled per Chemistry Procedure CY-SL-104-0112, Determination of Process Radiation Monitor Setpoints where Chemistry Supervisor approval is required. CY-SL-104-0112, Determination of Process Radiation Monitor Setpoints provides calculation steps to calculate a Noble Gas Release Rate Setpoint based on the methodology steps described below. A release point's percent allotment will be converted into the release point's indicating engineering unit of uCi/cc that will be equivalent to the allocated portion of the site limit.

1. Obtain the release point's maximum expected process flow release rate **(V)** in Cubic Feet per Minute (cfm) from the Effluent Supervisor.

2. Obtain the release point's percent of site limit allotment **(PA)** from the Chemistry Supervisor.

3. Substitute the release point's **V** and **PA** values into the below equation(s) to obtain the Release Point's Setpoint (SP) in the desired engineering unit (uCi/cc or uCi/sec).

$$SP\ (\text{uCi/cc}) = \frac{3.5E{+}05\ \text{uCi}}{\text{sec}} \times \frac{60\ \text{sec}}{\text{min}} \times \frac{\text{min}}{\mathbf{V}\ \text{ft3}} \times \frac{\text{ft3}}{28317\ \text{cc}} \times \frac{\mathbf{PA}}{100\%}$$

SP = ___________uCi/cc which is the TABLE 3.3-14 HIGH SETPOINT for ODCM Effluent Gas Channels that have a "Allotted % of Site Limit" declared as their HIGH SETPOINT.
uCi/cc

$$SP\ (\text{uCi/cc}) = \frac{3.5E{+}05\ \text{uCi}}{\text{sec}} \times \frac{\mathbf{PA}}{100\%}$$

SP = ___________uCi/cc
uCi/cc

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

A. (continued)

In the case of Unit 2 Plant Vent there are 3 ODCM Effluent Gas Channels Monitoring the Plant Vent. The wide range channel 624 HIGH SETPOINT in uCi/sec is equivalent to 2A PV PIG LOW RANGE GAS and 2B PIG LOW RANGE GAS channel 624 uses the equivalent uCi/sec based on the uCi/cc at the maximum expected process flow rate. Since they are monitoring the same release point (i.e., each of these channels does not receive their own allotted % of the Site Limit).

4. The significance of an ODCM Effluent Gas Channel that has a "Allotted % of Site Limit" HIGH Setpoint requires further discussion (Mid and High Noble Gas Accident Channels are not part of this discussion):

a. For Plant Vent Release Points on each reactor unit, the "Allotted % of Site Limit" needs to be high enough to allow for Batch Releases from Gas Decay Tank and Containment Venting Operations, and at the same time CY-SL-102-0105, Processing Gaseous Waste shall provide instruction for administratively controlling Batch Releases such that the radioactive concentration and release rate will not be allowed to exceed the site limit at any time.

b. The receipt of a valid HIGH Alarm on a release point where the ODCM Low Range Gas Channel's radioactivity is approximately equal to the HIGH Alarm setpoint does not mean the site limit has been exceeded, rather it is at a concentration that is equivalent to the "Allotted % of Site Limit".

setpoint in uCi/cc V or Vmax ft3/minute vent flow

$$SP = \_\_\_\_\_\_ \frac{uCi}{cc} \times \frac{28317\ cc}{ft3} \times \frac{Vmax\ ft3}{minute} \times \frac{minute}{60\ second}$$

uCi/sec (equivalent)

$$SP = \_\_\_\_\_\_ \frac{uCi}{sec}$$

(uCi/sec)

equivalent to a channel indicating a uCi/cc concentration assuming a volume release rate of V or Vmax.

$$SP = \_\_\_\_\_\_ \frac{uCi}{sec} \times \frac{100}{350{,}000\ uCi/sec} = \_\_\_\_\_\_ \%$$

(% of Site Limit) (above) of Site Limit

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

A. (continued)

4. (continued)

c. The receipt of a valid HIGH Alarm on a release point where the ODCM Low Range Gas Channel's radioactivity is greater than the HIGH Alarm setpoint may quickly be estimated based on:

F_{SL} = RP_{SL} + (Sum of all other Release Point's RP_{SL} on site)

RP_{SL} = Rel Pt's Channel's uCi/cc x Rel Pt's Release Rate (V) x volume conv. const. x time conv. const. x 1/(site limit)

$$RP_{SL} = \frac{uCi}{cc} \times \frac{V\ ft^3}{min} \times \frac{28317\ cc}{ft_3} \times \frac{min}{60\ sec} \times \frac{sec}{3.5E{+}05\ uCi}$$

Where:

F_{SL} = Fraction of the Site Limit

RP_{SL} = Fraction of a Release Point's contribution to the site limit (Sum of all other Release Point's RP_{SL} on site) is norm ally less than 0.10 under normal operating conditions.

V = in ft^3/min, the Release Point's actual process Volume flow release rate

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

A. (continued)

4. (continued)

c. (continued)

A value of RP_{SL} >1.0 or a F_{SL} >1.0 would be exceeding the Site Limit Based on the above estimate. Off Normal Procedure allow 1 hour to obtain a grab sample of the Release Point so that the actual site limit situation may be evaluated. This method is discussed in the following step.

5. To quantify the Release Point's actual Noble Gas Dose Rate, the following would need to be performed:

a. A Noble Gas Activity Grab Sample would be obtained and analyzed to determine each Noble Gas Isotopic concentration.

b. The results would be used to perform calculations per ODCM Step 2.2.2 for Noble Gas Total Body Dose Rate and Skin Dose Rate.

c. If the Release Point's HIGH Alarms were received on the Table 3.3-14 ODCM Related Particulate and/or Iodine Channel, then ODCM Step 2.3 calculations should be performed as soon as possible after the continuous collection medium(s) and a Tritium Sample can be pulled and analyzed to evaluate compliance with ODCM Control 3.11.2.1.b.

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

B. No Particulate or Iodine Radioactivity Channels are required by the ODCM. Table 3.3-13 requires Iodine and Particulate Samplers only. The ODCM requires a Fuel Building Vent Particulate Channel (the bases for the setpoint on the Fuel Building Vent Particulate Channel is described in 2.2.1.C). The Unit 2 FUSAR does describe Particulate and Iodine Radioactivity Channels. These Channels are listed in ODCM Table 3.3-14 and ALERT and HIGH Setpoints are provided. The intent of providing these setpoints is to provide early warning that the effluent pathway conditions have increased such that a grab sample should be obtained if a HIGH Alarm Setpoint is reached or exceeded. The Particulate and Iodine HIGH Alarm Setpoint bases is that the collection mediums are fixed filter where continuing deposition of radioactivity would cause a increase in the channel count rate up to the setpoint level(s), the resulting dose rate can be shown to be less than 1 percent of the site limit for ODCM Control 3.11.2.1.b for Iodine-131, Iodine-133, and all radionuclides in particulate from with half-lives greater than 8 days, is that these channel detectors are gross activity monitors of the scintillation type where the count rate is not dependent (above threshold) on the energy of the isotope entrained on the collection medium, and that these channels are qualitative trend indicators since the channel count rate cannot be corrected for the accrued sample collection volume. Plant historical trends have shown that Noble Gas Activity may contribute to the count rate of the Reactor Auxiliary Building (Plant) Vent Particulate and Iodine Channel(s). In this event the Noble Gas contribution may be added to the Table 3.3-14 Alert and High Setpoints for Unit 2 Plant Vents only.

The sampling mediums associated with the Particulate and Iodine Channels in Table 3.3-14 are also controlled by the requirements of ODCM Table 4.11-2 which requires 4/M Minimum Analysis Frequency of the sampling mediums. These analysis are used to confirm and quantify the isotopic composition of the radioactivity being monitored by these channels. The presence of Noble Gas on collection medium would be confirmed by these analysis.

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

B. (continued)

If an alarm occurs, Channel Check(s) should be performed on these channel(s), an ALERT Alarm should be investigated and a HIGH Alarm shall require isotopic analysis of particulate and/or iodine channel medium of the affected channel(s). The Isotopic analysis of the medium shall be used to evaluate particulate and/or iodine dose rate levels per the methodology of ODCM 2.3.

C. To comply with the ODCM, Alarm/Trip Setpoints determined and set in accordance with the requirements of the Offsite Dose Calculation Manual, the following is the BASES for Fuel Building Particulate Channel High Alarm Setpoints for Unit 1 and Unit 2:

Unit 1 Fuel Building:

The 10,000 cpm High Setpoint is based on an Infant's Maximum Exposed Organ Dose Rate (Liver) from Inhalation of Cs-137 at the Site Boundary. The value of 10,000 cpm is very conservative relative to the site dose rate limit of 1500 mrem/yr. The methodology is based on measured particulate channel count rates when the detector was calibrated with a known source activity of Cs-137, and on default assumptions as follows:

1. The particulate channel read 32,385 ccpm when exposed to a 7.67 uCi source of Cs-137.

2. Assuming that 7.67 uCi of Cs-137 were collected during 1 hour of skid sample collection (fixed filter), the typical sample volume would yield ~3.3E+06 cc's. Greater than 99% sample filter efficiency is assumed.

3. The maximum building process flow exhaust is ~24,576 cfm.

4. Q(dot) for Cs-137 uCi/sec release rate is approximately 27 uCi/sec as follows:

$$\frac{7.67\ \text{uCi}}{\text{hour}} \times \frac{\text{hour}}{3.3\text{E+06cc.s}} \times \frac{28317\ \text{cc's}}{\text{ft3}} \times \frac{24576\ \text{ft3}}{\text{min}} \times \frac{\text{min}}{60\ \text{sec}} = \frac{27\ \text{uCi}}{\text{sec}}$$

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

C. (continued)

5. The default historical (X/Q)d for the worst sector (NW) at the site boundary is 1.3E-06 meters/sec.

6. The dose rate (equivalent to 10,000 cpm) is calculated per ODCM Section 2.3 Inhalation Dose Rate to an Infant. The resulting dose rates yield.

Bone mrem/yr	Liver mrem/yr	Thyroid mrem/yr	Kidney mrem/yr	Lung mrem/yr	GI-LLI mrem/yr	W.Body mrem/yr
7.4E+00	7.9E+00	0.0E+00	4.2E-01	1.0E+00	1.5E-02	4.8E-01

7. The ODCM 3.11.2.1.b dose rate limit to any organ is 1500 mrem/yr. From the preceding calculation the Infant's Liver is the maximum exposed organ at 0.52 percent of the site dose rate limit.

8. A particulate channel setpoint of 10,000 cpm provides a conservative setpoint given that this channel analyzes gross activity on a fixed filter, Cs-137 is a typical long-lived fission product present at all times with spent fuel in the pool, and that sample collection intervals shorter than 1 hour would provide adequate warning response if significant particulate activity were being released, i.e., the above assumptions assume a Cs-137 activity of ~2.3E-06 uCi/cc.

9. The setpoint of 10,000 cpm was administratively chosen to provide early detection/alarm of a problem. The above dose rate calculations are provided to document that the particulate channel is capable of detection sensitivities to insure compliance with the ODCM site limit. Grab samples should be performed to accurately calculate actual releases associated with real high alarm events as per the ODCM methodology for performing dose rate calculations. (End of Unit 1 Fuel Building evaluation)

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

C. (continued)

Unit 2 Fuel Building:

The 10,000 cpm High Setpoint is based on an Infant's Maximum Exposed Organ Dose Rate (Liver) from Inhalation of Cs-137 at the Site Boundary. The value of 10,000 cpm is very conservative relative to the site dose rate limit of 1500 mrem/yr. The methodology is based on measured particulate channel count rates when the detector was calibrated with a known source activity of Cs-137, and on default assumptions as follows:

1. The particulate channel read 39,782 ccpm when exposed to a 7.59 uCi source of Cs-137 (decayed to June 19, 1996 data).

2. Assuming that 7.59 uCi of Cs-137 were collected during 1 hour of skid sample collection (fixed filter), the typical sample volume would yield 4.08E+06 cc's. Greater than 99% sample filter efficiency is assumed.

3. The maximum building process flow exhaust is ~31,584 cfm.

4. Q(dot) for Cs-137 uCi/sec release rate is approximately 21 uCi/sec as follows:

$$\frac{7.59\ \text{uCi}}{\text{hour}} \times \frac{\text{hour}}{4.08\text{E+06cc.s}} \times \frac{28317\ \text{cc's}}{\text{ft3}} \times \frac{31584\ \text{ft3}}{\text{min}} \times \frac{\text{min}}{60\ \text{sec}} = \frac{27.72\ \text{uCi}}{\text{sec}}$$

5. The default historical (X/Q)d for the worst sector (NW) at the site boundary is 1.3E-06 meters/sec.

6. The dose rate (equivalent to 10,000 cpm) is calculated per ODCM Section 2.3 Inhalation Dose Rate to an Infant. The resulting dose rates yield.

Bone mrem/yr	Liver mrem/yr	Thyroid mrem/yr	Kidney mrem/yr	Lung mrem/yr	GI-LLI mrem/yr	W.Body mrem/yr
6.21E+00	6.62E+00	0E+00	3.52E+00	8.56E+00	1.2E+00	3.99E+00

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

1. (continued)

C. (continued)

7. The ODCM 3.11.2.1.b dose rate limit to any organ is 1500 mrem/yr. From the preceding calculation the Infant's Liver is the maximum exposed organ at 0.34 percent of the site dose rate limit.

8. A particulate channel setpoint of 10,000 cpm provides a conservative setpoint given that this channel analyzes gross activity on a fixed filter, Cs-137 is a typical long-lived fission product present at all times with spent fuel in the pool, and that sample collection intervals shorter than 1 hour would provide adequate warning response if significant particulate activity were being released, i.e., the above assumptions assume a Cs-137 activity of ~1.4E-06 uCi/cc.

9. The setpoint of 10,000 cpm was administratively chosen to provide early detection/alarm of a problem. The above dose rate calculations are provided to document that the particulate channel is capable of detection sensitivities to insure compliance with the ODCM site limit. Grab samples should be performed to accurately calculate actual releases associated with real high alarm events as per the ODCM methodology for performing dose rate calculations.

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

2. Total Body and Skin Nuclide Specific Dose Rate Calculations

The following outline provides a step-by-step explanation of how the total body dose rate is calculated on a nuclide-by-nuclide basis to evaluate compliance with Control 3.11.2.1. This method is only used if the actual releases exceed the value of 3.5×10^5 μCi/sec.

A. The (X/Q) value =__________sec/m^3 and__________is the most limiting sector at the exclusion area. (See Table M-1 for value and sector.)

B. Enter the release rate in ft^3/min of the release source and convert it to:

$$= \frac{(\quad)\,ft^3}{min} \times \frac{2.8317 \times 10^4\,cc}{ft^3} \times \frac{min}{60\,sec}$$

= cc/sec volume release rate

C. Solve for(Q DOT)$_i$ for nuclide (i) by obtaining the μCi/cc assay value of the release source and multiplying it by the product of 2.2.2.B above.

(Q DOT)$_i$ = (nuclide [i])

$$\frac{(assay)\quad \mu Ci}{cc} \times \frac{(2.2.2.B\ value)\,cc}{sec}$$

(Q DOT)$_i$ = μCi/sec for nuclide (i)

D. To evaluate the total body dose rate obtain the K_i value for nuclide (i) from Table G-2.

E. Solve for DR_{TBi}

$$DR_{TBi} = K_i\,(X/Q)\,(Q\,DOT)_i = \frac{mrem - m^3}{\mu Ci - yr} \times \frac{sec}{m^3} \times \frac{\mu Ci}{sec}$$

$DR_{TBi} = \frac{mrem}{yr}$ total body dose from nuclide (i) for the specified release source

METHODOLOGY SECTION

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases And Establishing Setpoints for Effluent Monitors (continued)

2. (continued)

F. To evaluate the skin dose rate, obtain the L_i and M_i values from Table G-2 for nuclide (i).

G. Solve for $DR_{skin\ i}$

$$DR_{skin\ i} = [L_i + 1.1\ M_i]\ (X/Q)(Q\ DOT)_i$$

$DR_{skin\ i} = \frac{mrem}{yr}$ skin dose from nuclide (i) for the specified release source

H. Repeat steps 2.2.2.D through 2.2.2.G for each noble gas nuclide (i) reported in the assay of the release source.

I. The Dose Rate to the Total Body from radioactive noble gas gamma radiation from the specified release source is:

$$DR_{TB} = \sum_{i}^{n} DR_{TBi}$$

J. The Dose Rate to the skin from noble gas radiation from the specified release source is:

$$DR_{skin} = \sum_{i}^{n} DR_{skin\ i}$$

The dose rate contribution of this release source shall be added to all other gaseous release sources that are in progress at the time of interest. Refer to in-plant procedures and logs to determine the Total Dose Rate to the Total Body and Skin from noble gas effluents.

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases

Discussion - Control 3.11.2.1 limits the dose rate from I-131, I-133, tritium and all radionuclides in particulate form with half lives >eight days to ≤1500 mrem/yr to any organ. The following calculation method is provided for determining the dose rate from radioiodines (see 2.1) and particulates and is based on Section 5.2.1 and 5.2.1.1 through 5.2.1.3 in NUREG-0133, November 1978. The Infant is the controlling age group in the inhalation, ground plane and cow/goat milk pathways, which are the only pathways considered for releases. The long term $(X/Q)_D$ (depleted) and (D/Q) values are based on historical MET data prior to implementing Appendix I. Only those nuclides that appear on their respective table will be considered. The equations are:

For Inhalation Pathway (excluding H-3):

$$DR_{I\&8DP_T} = \sum_{i}^{n} R^{*}_{i_T} \, (X/Q)_D \, (Q\,DOT)_i$$

For Ground Plane:

$$DR_{I\&8DP_T} = \sum_{i}^{n} P_{i_T} \, (D/Q)(Q\,DOT)_i$$

For Grass-Cow/Goat-Milk:

$$DR_{I\&8DP_T} = \sum_{i}^{n} R^{*}_{i_T} \, (D/Q)(Q\,DOT)_i$$

For Tritium Releases (Inhalation & Grass-Cow/Goat-Milk):

$$DR_{H3_T} = R^{*}_{H-3_T} \, (X/Q)_D \, (Q\,DOT)_{H-3}$$

* Normally should be Pi_T, but Ri_T values are the same, thus use Ri_T tables in Appendix A.

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

For Total Dose Rate from I & 8DP and H-3 To An Infant Organ T:

$$DR_T = \sum_{Z} [DR_{I\&8DP_T} + DR_{H\text{-}3_T}]$$

Where:

T	=	The organ of interest for the infant age group
z	=	The applicable pathways
$DR_{I\&8DP_T}$	=	Dose Rate in mrem/yr to the organ T from iodines and 8 day particulates
$DR_{H\text{-}3_T}$	=	Dose Rate in mrem/yr to organ T from Tritium
DR_T	=	Total Dose Rate in mrem/yr to organ T from all pathways under consideration
$\sum_{i}^{n}$	=	A mathematical symbol to signify the operations to the right of the symbol are to be performed for each nuclide (i) through (n) and the individual nuclide dose rates are summed to arrive at the total dose rate from the pathway.
$\sum_{Z}$	=	A mathematical symbol to indicate that the total dose rate D_T to organ T is the sum of each of the pathways dose rates
R_i	=	The dose factor for nuclide (i) for organ T for the pathway specified (units vary by pathway)
P_i	=	The dose factor for instantaneous ground plane pathway in units of $\frac{\text{mrem-m}^2\text{ sec}}{\mu\text{Ci-yr}}$

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

From an evaluation of the radioactive releases and environmental pathways, the grass-cow/goat-milk pathway has been identified as the most limiting pathway with the infant's thyroid being the critical organ. This pathway typically contributes >90% of the total dose received by the infant's thyroid and the radioiodine contribute essentially all of this dose. Therefore, it is possible to demonstrate compliance with the release rate limit of Control 3.11.2.1 for radioiodines and particulates by only evaluating the infant's thyroid dose for the release of radioiodines via the grass-cow/goat-milk pathway. The calculation method of Section 2.3.3 is used for this determination. If this limited analysis approach is used, the dose calculations for other radioactive particulate matter and other pathways need not be performed. Only the calculations of Section 2.3.3 for the radioiodines need be performed to demonstrate compliance with the Control dose rate limit.

The calculations of Sections 2.3.1, 2.3.2, 2.3.4 and 2.3.5 may be omitted. The dose rate calculations as specified in these sections are included for completeness and are to be used only for evaluating unusual circumstances where releases of particulate materials other than radioiodines in airborne releases are abnormally high. The calculations of Sections 2.3.1, 2.3.2, 2.3.4 and 2.3.5 will typically be used to demonstrate compliance with the dose rate limit of Control 3.11.2.1 for radioiodines and particulates when the measured releases of particulate material (other than radioiodines and with half lives >8 days) are >10 times the measured releases of radioiodines.

1. The Inhalation Dose Rate Method:

> **NOTE**
> The H-3 dose is calculated as per 2.3.4.

A. The controlling location is assumed to be an Infant located in the ________________ sector at the ________________ mile range. The $X/Q)_D$ for this location is ________________ sec/m^3. This value is common to all nuclides. (See Table M-2 for value, sector and range.)

B. Enter the release rate in ft^3/min of the release source and convert to cc/sec.

$$= \frac{\underline{\qquad} ft^3}{min} \times \frac{2.8317 \times 10^4\ cc}{ft^3} \times \frac{min}{60\ sec.} = \underline{\qquad} cc/sec$$

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

1. (continued)

C. Solve for $(Q\ DOT)_i$ for nuclide (i) by obtaining the µCi/cc assay value of the release source activity and multiplying it by the product of 2.3.1.B above.

$$(Q\,DOT)_i = \frac{(\text{nuclide}[i]\,\text{assay})\ \mu Ci}{cc} \times \frac{(\text{Value}\ 2.3.1.B)\,cc}{sec}$$

$(Q\ DOT)_i$ = µCi/sec for nuclide (i)

D. Obtain the R_i value from Table G-5 for the organ T.

E. Solve for DR_i

$$DR_{iT} = R_{iT}\,(X/Q)_D\,(Q\,DOT)_i = \frac{mrem - m^3}{\mu Ci - yr} \times \frac{sec}{m^3} \times \frac{\mu Ci}{sec}$$

$DR_{iT} = \frac{mrem}{yr}$ The Dose Rate to organ T from nuclide (i)

F. Repeat steps 2.3.1.C through 2.3.1.E for each nuclide (i) reported in the assay of the release source.

G. The Dose Rate to the Infants organ T from the Inhalation Pathway is:

$$DR_{Inhalation\,T} = DR_1 + DR_2 + \_\_\_\_ + DR_n$$

for all nuclides except H-3. This dose rate shall be added to the other pathways as per 2.3.5 - Total Organ Dose.

> **NOTE**
> Steps 2.3.1.C through 2.3.1.G need to be completed for each organ T of the Infant.

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

2. The Ground Plane Dose Rate Method:

> **NOTE**
> Tritium dose via the ground plane is zero.

A. The controlling location is assumed to be an Infant located in the __________ sector at the __________ mile range. The (D/Q) for this location is __________ $1/m^2$. This value is common to all nuclides. (See Table M-2 for sector, range and value.)

B. Enter the release rate in ft^3/min of the release source and convert to cc/sec.

$$= \frac{ft^3}{min} \text{ X } \frac{2.8317 \text{ X } 10^4 \text{ cc}}{ft^3} \text{ X } \frac{min}{60 \text{ sec.}} = \text{cc/sec}$$

C. Solve for $(Q\ DOT)_i$ for nuclide (i) by obtaining the μCi/cc assay value from the release source activity and multiplying it by the product of 2.3.2.B above.

$$(Q\,DOT)_i = \frac{(\text{nuclide[i] assay})\mu Ci}{cc} \text{ X } \frac{(\text{Value } 2.3.2.B)cc}{sec}$$

$(Q\ DOT)_i$ = μCi/sec for nuclide (i)

D. Obtain the P_i value from Table G-3

E. Solve for DR_i

$$DR_i = P_{iT}\,(D/Q)\,(Q\,DOT)_i = \frac{mrem - m^2 - sec}{\mu Ci - yr} \text{ X } \frac{1}{m^2} \text{ X } \frac{\mu Ci}{sec}$$

$DR_i = \frac{mrem}{yr}$ The Dose Rate to organ T from nuclide (i)

F. Repeat steps 2.3.2.C through 2.3.2.E for each nuclide (i) reported in the assay of the release source.

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

2. (continued)

G. The Dose Rate to the Infant's Whole Body from the Ground Plane Pathway is:

$DR_{Gr\ Pl} = DR_1 + DR_2 + \_\_\_\_\_\_\_\_ + DR_n$

for all nuclides. This dose rate shall be added to the other pathways as per 2.3.5.

3. The Grass-Cow/Goat-Milk Dose Rate Method:

> **NOTE**
> H-3 dose is calculated as per 2.3.4.

A. The controlling animal was established as a __________ located in the __________ sector at __________ miles. The (D/Q) for this location is __________ $1/m^2$. This value is common to all nuclides. (See Table M-3 for sector, range and value.)

B. Enter the anticipated release rate in ft^3/min of the release source and convert to cc/sec.

$$= \frac{\_\_\_\_\ ft^3}{min} \text{ X } \frac{2.8317 \text{ X } 10^4 \text{ cc}}{ft_3} \text{ X } \frac{min}{60 \text{ sec.}} = \text{cc/sec}$$

C. Solve for $(Q\ DOT)_i$ for nuclide (i) by obtaining the µCi/cc assay value of the release source activity and multiplying it by the product of 2.3.3.B above.

$$(Q\,DOT)_i = \frac{(\text{nuclide}[i]\ \text{assay})\ \mu Ci}{cc} \text{ X } \frac{(\text{value } 2.3.3.B)\ cc}{sec}$$

$(Q\ DOT)_i = \mu Ci/sec$ for nuclide (i)

D. Obtain the R_i value from Table G-6(7) (whichever is the controlling animal, cow/goat, for infant).

If the limited analysis approach is being used, limit the calculation to the infant thyroid.

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

3. (continued)

E. Solve for DR_{iT}

$$DR_{iT} = R_{iT}\,(D/Q)\,(Q\,DOT\,)_i = \frac{mrem - m^2 - sec}{\mu Ci - yr} \; X \; \frac{1}{m^2} \; X \; \frac{\mu Ci}{sec}$$

DR_{iT} = $\frac{mrem}{yr}$ the Dose Rate to organ T from nuclide (i)

F. Repeat steps 2.3.3.C through 2.3.3.E for each nuclide (i) reported in the assay of the release source.

Only the radioiodines need to be included if the limited analysis approach is being used.

G. The Dose Rate to the Infant's organ T from Grass-__________-Milk pathway is:

DR_{grass}-______-$Milk_T$ = $DR_1 + DR_2 +$ _____ $+ DR_n$

for all nuclides. This dose rate shall be added to the other pathways as per 2.3.5 - Total Organ Dose.

> **NOTE**
> Steps 2.3.3.C through 2.3.3.G need to be completed for each organ of the Infant. Limit the calculation to the infant thyroid if the limited analysis approach is being used.

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

4. The H-3 Dose Rate Method:

A. The controlling locations and their $(X/Q)_D$ values for each pathway are:

Inhalation - Infant at __________ range in the __________ sector.

$(X/Q)_D$ = sec/m^3 (See Table M-2 for range, sector and value)

Ground Plane - Does not apply to H-3

Grass-Cow/Goat-Milk-__________ located in the __________ sector at _____miles with an Infant at the exclusion area in the __________ sector drinking the milk. The $(X/Q)_D$ for the __________ location is $(X/Q)_D$ = __________ sec/m^3. (From Table M-6 at the range and sector corresponding to the location of the Milk Animal above.)

B. Enter the anticipated release rate in ft^3/min of the release source and convert it to cc/sec.

$$= \frac{\_\_\_\_ \text{ ft}^3}{\text{min}} \text{ X } \frac{2.8317 \text{ X } 10^4 \text{ cc}}{\text{ft}^3} \text{ X } \frac{\text{min}}{60 \text{ sec.}}$$

= cc/sec volume release rate

C. Solve for $(Q\ DOT)_{H\text{-}3}$ for Tritium, by obtaining the µCi/cc assay value of the release source and multiplying it by the product of 2.3.4.B above.

$$(Q\,DOT)_{H\text{-}3} = \frac{(H\text{-}3)\ \mu Ci}{cc} \text{ X } \frac{(2.3.4.B\ value)\, cc}{sec}$$

$(Q\ DOT)_{H\text{-}3}$ = µCi/sec activity release rate

D. Obtain the Tritium dose factor (R_i) for Infant organ T from:

PATH	TABLE #
Inhalation	G-5
Grass-Cow/Goat-Milk	G-6(7)

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

4. (continued)

E. Solve for D_{H-3} (Inhalation) using the $(X/Q)_D$ for inhalation from 2.3.4.A and R_{H-3} (Inhalation) from 2.3.4.D.

$$DR_{H\text{-}3_{Inh\,T}} = R_{H\text{-}3}\,(X/Q\,)_D\,(Q\,DOT\,)_{H\text{-}3}$$

$$DR_{H\text{-}3_{Inh\,T}} = \text{mrem/yr from H-3 Infant Inhalation for organ T}$$

F. Solve for D_{H-3} (Grass-__________-Milk) using the $(X/Q)_D$ for Grass-__________-Milk from 2.3.4.A and R_{H-3} (Grass-__________-Milk) from 2.3.4.D

$$DR_{H\text{-}3_{G\text{-}\ \text{-}M\,T}} = R_{H\text{-}3_{G\text{-}\ \text{-}M\,T}}\,(X/Q\,)_D\,(Q\,DOT\,)_{H\text{-}3}$$

$$DR_{H\text{-}3_{G\text{-}\ \text{-}M\,T}} = \text{mrem/yr from H-3 Infant}$$

G. Repeat steps 2.3.4.D through 2.3.4.F for each Infant organ T of interest.

H. The individual organ dose rates from H-3 shall be added to the other organ pathway dose rates as per 2.3.5.

METHODOLOGY SECTION

2.3 Determining the Radioiodine & Particulate Dose Rate to Any Organ From Gaseous Releases (continued)

5. Determining the Total Organ Dose Rate from Iodines, 8D-Particulates, and H-3 from Release Source(s)

A. The following table describes all the pathways that must be summed to arrive at the total dose rate to an organ T:

PATHWAY	DOSE RATE	STEP # REF.
Inhalation (I&8DP)		2.3.1.G
Ground Plane (I&8DP)	(Whole Body only)	2.3.2.G
Gr-________Milk (I&8DP)		2.3.3.G
Inhalation (H-3)		2.3.4.E
Gr-________-Milk (H-3)		2.3.4.F
DR_T =	(sum of above)	

B. Repeat the above summation for each Infant organ T.

C. The DR_T above shall be added to all other release sources on the site that will be in progress at any instant. Refer to in-plant procedures and logs to determine the Total DR_T to each organ.

2.4 Determining the Gamma Air Dose for Radioactive Noble Gas Release Source(s)

Discussion - Control 3.11.2.2 limits the air dose due to noble gases in gaseous effluents for gamma radiation to <5 mrads for the quarter and to <10 mrads in any calendar year. The following calculation method is provided for determining the noble gas gamma air dose and is based on section 5.3.1 of NUREG-0133, November 1978. The dose calculation is independent of any age group. The equation may be used for Control dose calculation, the dose calculation for the annual report or for projecting dose, provided that the appropriate value of (X/Q) is used as outlined in the detailed explanation that follows. The equation for gamma air dose is:

$$D_{Y}\text{-air} = \sum_{i}^{n} 3.17 \times 10^{-8} M_i (X/Q) Q_i$$

METHODOLOGY SECTION

2.4 Determining the Gamma Air Dose for Radioactive Noble Gas Release Source(s) (continued)

Where:

D_{γ}-air = gamma air dose in mrad from radioactive noble gases.

Σ = A mathematical symbol to signify the operations to the right side of the symbol are to be performed for each nuclide (i) through (n) and summed to arrive at the total dose, from all nuclides reported during the interval. No units apply.

3.17×10^{-8} = the inverse of the number of seconds per year with units of year/sec.

M_i = the gamma air dose factor for radioactive noble gas nuclide (i) in units of $\frac{\text{mrad-m}^3}{\mu\text{Ci-yr}}$

(X/Q) = the long term atmospheric dispersion factor for ground level releases in units of sec/m^3. The value of (X/Q) is the same for all nuclides (i) in the dose calculation, but the value of (X/Q) does vary depending on the Limiting Sector the Control is based on, etc.

Q_i = the number of micro-curies of nuclide (i) released (or projected) during the dose calculation exposure period. (e.g., month, quarter or year)

METHODOLOGY SECTION

2.4 Determining the Gamma Air Dose for Radioactive Noble Gas Release Source(s) (continued)

The following steps provide a detailed explanation of how the radionuclide specific dose is calculated.

1. To determine the applicable (X/Q) refer to Table M-1 to obtain the value for the type of dose calculation being performed. (i.e., Quarterly Control or Dose Projection for examples). This value of (X/Q) applies to each nuclide (i).

2. Determine (M_i) the gamma air dose factor for nuclide (i) from Table G-2.

3. Obtain the micro-Curies of nuclide (i) from the in-plant radioactive gaseous waste management logs for the sources under consideration during the time interval.

4. Solve for D_i as follows:

$$D_i = \frac{3.17 \text{ X } 10^{-8} \text{ yr}}{\text{sec}} \text{ X } \frac{M_i \text{ mrad - m}^3}{\mu\text{Ci - yr}} \text{ X } \frac{(X/Q) \text{ sec}}{\text{m}^3} \text{ X } \frac{Q_i \ \mu\text{Ci}}{1}$$

D_i = mrad = the dose from nuclide (i)

5. Perform steps 2.4.2 through 2.4.4 for each nuclide (i) reported during the time interval in the source.

6. The total gamma air dose for the pathway is determined by summing the D_i dose of each nuclide (i) to obtain D_Y-air dose.

$D_{Y\text{-air}} = D_1 + D_2 +$ _____ $+ D_n$ = mrad

7. Refer to in-plant procedures for comparing the calculated dose to any applicable limits that might apply.

METHODOLOGY SECTION

2.5 Determining the Beta Air Dose for Radioactive Noble Gas Releases

Discussion - Control 3.11.2.2 limits the quarterly air dose due to beta radiation from noble gases in gaseous effluents to <10 mrads in any calendar quarter and <20 mrads in any calendar year. The following calculation method is provided for determining the beta air dose and is based on Section 5.3.1 of NUREG-0133, November 1978. The dose calculation is independent of any age group. The equation may be used for Control dose calculation, dose calculation for annual reports or for projecting dose, provided that the appropriate value of (X/Q) is used as outlined in the detailed explanation that follows.

The equation for beta air dose is:

$$D_{B\text{-}air} \sum_{i}^{n} = 3.17 \text{ X } 10^{-8} N_i (X/Q) Q_i$$

Where:

$D_{B\text{-}air}$ = beta air dose in mrad from radioactive noble gases.

$\sum_i^n$ = a mathematical symbol to signify the operations to the right side of the symbol are to be performed for each nuclide (i) through (n) and summed to arrive at the total dose, from all nuclides reported during the interval. No units apply.

$3.17 \text{ X } 10^{-8}$ = the inverse of the number of seconds per year with units of year/sec.

N_i = the beta air dose factor for radioactive noble gas nuclide (i) in units of $\frac{\text{mrad-m}^3}{\mu\text{Ci-yr}}$

(X/Q) = the long term atmospheric dispersion factor for ground level releases in units of sec/m^3. The value of (X/Q) is the same for all nuclides (i) in the dose calculation, but the value of (X/Q) does vary depending on the Limiting Sector the Control is based on, etc.

Q_i = the number of micro-Curies of nuclide (i) released (or projected) during the dose calculation exposure period

METHODOLOGY SECTION

2.5 Determining the Beta Air Dose for Radioactive Noble Gas Releases (continued)

The following steps provide a detailed explanation of how the dose is calculated.

1. To determine the applicable (X/Q) refer to Table M-1 to obtain the value for the type of dose calculation being performed (i.e., quarterly Control or Dose projection for examples). This value of (X/Q) applies to each nuclide (i).

2. Determine (N_i) the beta air dose factor for nuclide (i) from Table G-2.

3. Obtain the micro-curies of nuclide (i) from the in-plant radioactive gaseous waste management logs for the source under consideration during the time interval.

4. Solve for D_i as follows:

$$D_i = \frac{3.17 \text{ X } 10^{-8} \text{ yr}}{\text{sec}} \text{ X } \frac{N_i \text{ mrad} - \text{m}^3}{\mu\text{Ci} - \text{yr}} \text{ X } \frac{(X/Q) \text{ sec}}{M^3} \text{ X } \frac{Q_i \text{ } \mu\text{Ci}}{1}$$

   D_i = mrad = the dose from nuclide (i)

5. Perform steps 2.5.2 through 2.5.4 for each nuclide (i) reported during the time interval in the release source.

6. The total beta air dose for the pathway is determined by summing the D_i dose of each nuclide (i) to obtain $D_{B\text{-}air}$ dose.

   $D_{B\text{-}air} = D_1 + D_2$ ________ $+ D_n$ = mrad

7. Refer to in-plant procedures for comparing the calculated dose to any applicable limits that might apply.

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases

Discussion - Control 3.11.2.3 limits the dose to the whole body or any organ resulting from the release of I-131, I-133, tritium and particulates with half-lives >8 days to ≤7.5 mrem during any calendar quarter and ≤15 mrem during any calendar year. The following calculation method is provided for determining the critical organ dose due to releases of radioiodines and particulates and is based on Section 5.3.1 of NUREG-0133, November 1978. The equations can be used for any age group provided that the appropriate dose factors are used and the total dose reflects only those pathways that are applicable to the age group. The Effluent Supervisor will track which age group is the controlling (most restrictive) age group (see control 3.11.2.6.c). The $(X/Q)_D$ symbol represents a DEPLETED-(X/Q) which is different from the Noble Gas (X/Q) in that $(X/Q)_D$ takes into account the loss of I&8DP and H-3 from the plume as the semi-infinite cloud travels over a given distance. The (D/Q) dispersion factor represents the rate of fallout from the cloud that affects a square meter of ground at various distances from the site. The I&8DP and H-3 notations refer to I-131, I-133 Particulates having half-lives >8 days and Tritium. For ease of calculations, dose from other Iodine nuclides may be included (see 2.1). Tritium calculations are always based on $(X/Q)_D$. The first step is to calculate the I&8DP and H-3 dose for each pathway that applies to a given age group. The total dose to an organ can then be determined by summing the pathways that apply to the receptor in the sector. The infant age group does not apply to Grass-Cow-Meat or Vegetation pathway dose since they are assumed to eat only milk.

The equations are:

For Inhalation Pathway (excluding H-3):

$$D_{I\&8DP_T} = \sum_{i}^{n} 3.17 \times 10^{-8} R_i (X/Q)_D Q_i$$

For Ground Plane, Grass-Cow/Goat-Milk, Grass-Cow/Goat-Milk, or Vegetation

$$D_{I\&8DP_T} = \sum_{i}^{n} 3.17 \times 10^{-8} R_i (D/Q) Q_i$$

For each pathway above (excluding Ground Plane) For Tritium:

$$D_{H\text{-}3_T} = 3.17 \times 10^{-8} R_{H\text{-}3T} (X/Q)_D Q_i$$

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

For Total Dose from Particulate Gaseous effluent to organ T of a specified age group:

$$D_T = \sum_{Z} [D_{I\&8DP} + D_{H\text{-}3}]$$

Where:

T	=	the organ of interest of a specified age group
z	=	the applicable pathways for the age group of interest
$D_{I\&8DP}$	=	Dose in mrem to the organ T of a specified age group from radioiodines and 8D Particulates
$D_{H\text{-}3}$	=	Dose in mrem to the organ T of a specified age group from Tritium
D_T	=	Total Dose in mrem to the organ T of a specified age group from Gaseous particulate Effluents
$\sum_i^n$	=	A mathematical symbol to signify the operations to the right of the symbol are to be performed for each nuclide (i) through (n) and the individual nuclide doses are summed to arrive at the total dose from the pathway of interest to organ T.
$\sum_Z$	=	A mathematical symbol to indicate that the total dose D_T to organ T is the sum of each of the pathway doses of I&8DP and H-3 from gaseous particulate effluents.
3.17×10^{-8}	=	The inverse of the number of seconds per year with units of year/sec.
R_i	=	The dose factor for nuclide (i) (or H-3) for pathway Z to organ T of the specified age group. The units are either

$$\frac{\text{mrem} - \text{m}^3}{\text{yr} - \mu\text{Ci}} \text{ for pathways using } (X/Q)_D \quad \text{OR} \quad \frac{\text{mrem} - \text{m}^2 - \text{sec}}{\text{yr} - \mu\text{Ci}} \text{ for pathways using } (D/Q)$$

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

$(X/Q)_D$ = The depleted-(X/Q) value for a specific location where the receptor is located (see discussion). The units are sec/m^3

(D/Q) = the deposition value for a specific location where the receptor is located (see discussion). The units are 1/m^2 where m=meters.

Q_i = The number of micro-Curies of nuclide (i) released (or projected) during the dose calculation exposure period.

Q_{H-3} = the number of micro-Curies of H-3 released (or projected) during the dose calculation exposure period.

1. The Inhalation Dose Pathway Method:

NOTE
The H-3 dose should be calculated as per 2.6.4.

A. Determine the applicable $(X/Q)_D$ from Table M-2 for the location where the receptor is located. This value is common to each nuclide (i)

B. For the age group(s) of interest, determine the R_i factor of nuclide (i) for the organ T and age group from the appropriate table number.

Age Group	Inhalation Dose Factor Table Number
Infant	G-5
Child	G-8
Teen	G-13
Adult	G-18

C. Obtain the micro-Curies (Q_i) of nuclide (i) from the radioactive gas waste management logs for the release source(s) under consideration during the time interval.

D. Solve for D_I

$D_i = 3.17 \times 10^{-8} Ri(X/Q)_D Q_I$

D_i = mrem from nuclide (i)

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

1. (continued)

   E. Perform steps 2.6.1.B through 2.6.1.D for each nuclide (i) reported during the time interval for each organ.

   F. The Inhalation dose to organ T of the specified age group is determined by summing the D_i Dose of each nuclide (i)

$$\underset{\text{(Age Group)}}{D_{\text{Inhalation}}} = D_1 + D_2 + \_\_\_\_ + D_n = \qquad \text{mrem}$$

   Refer to 2.6.5 to determine the total dose to organ T from radioiodines & 8D Particulates

2. The Ground Plane Dose Pathway Method:

> **NOTE**
> Tritium dose via the ground plane is zero. The Whole Body is the only organ considered for the Ground Plane pathway dose.

   A. Determine the applicable (D/Q) from Table M-2 for the location where the receptor is located. This (D/Q) value is common to each nuclide (i)

   B. Determine the Ri factor of nuclide (i) for the whole body from Table G-4. The ground plane pathway dose is the same for all age groups.

   C. Obtain the micro-Curies (Q_i) of nuclide (i) from the radioactive gas waste management logs for the source under consideration.

   D. Solve for D_I

$$D_i = 3.17 \, X \, 10^{-8} R_i \, (D/Q) Q_i$$

   D_i = mrem for nuclide (i)

   E. Perform steps 2.6.2.B through 2.6.2.D for each nuclide (i) reported during the time interval.

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

2. (continued)

F. The Ground Plane dose to the whole body is determined by summing the Di Dose of each nuclide (i)

$D_{Gr.Pl.\text{-}WBody} = D_1 + D_2 + \_\_\_\_\_ + D_n =$ mrem

Refer to step 2.6.5 to calculate total dose to the Whole Body.

3. The Grass-Cow/Goat-Milk Dose Pathway Method:

NOTE
Tritium dose is calculated as per 2.6.4.

A. A cow or a goat, will be the controlling animal; (i.e., dose will not be the sum of each animal), as the human receptor is assumed to drink milk from only the most restrictive animal. Refer to Table M-3 to determine which animal is controlling based on its (D/Q).

B. For the age group(s) of interest, determine the dose factor R_i for nuclide (i), for organ T, from the appropriate table number for the applicable milk animal.

Age Group	Cow Milk Dose Factor Table Number	Goat Milk Dose Factor Table Number
Infant	G-6	G-7
Child	G-9	G-10
Teen	G-14	G-15
Adult	G-19	G-20

C. Obtain the micro-Curies (Q_i) of nuclide (i) from the radioactive gas waste management logs for the release source under consideration during the time interval.

D. Solve for D_i

$D_i = 3.17 \text{ X } 10^{-8} R_i (D/Q) Q_i$

D_i = mrem from nuclide (i)

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

3. (continued)

E. Perform steps 2.6.3.B through 2.6.3.D for each nuclide (i) reported during the time interval. Only the radioiodines need to be included if the limited analysis approach is used.

F. The Grass-Cow-Milk (or Grass-Goat-Milk) pathway dose to organ T is determined by summing the Di dose of each nuclide(i).

$D_{G\text{-}C\text{-}M}$ (or $D_{G\text{-}G\text{-}M}$) = $D_1 + D_2 +$ _____ $+ D_n =$ mrem

The dose to each organ should be calculated in the same manner with steps 2.6.3.B through 2.6.3.F. Refer to step 2.6.5 to determine the total dose to organ T from radioiodines &8D Particulates. If the limited analysis approach is being used the infant thyroid dose via the grass-cow(goat)-milk pathway is the only dose that needs to be determined. Section 2.6.5 can be omitted.

4. The Grass-Cow/Goat-Meat Dose Pathway method:

> **NOTE**
> Tritium dose is calculated as per 2.6.6.

A. Determine the controlling herd location by:

1. For dose calculations (other than the annual report) the historical herd was determined to be located in Sector ______ at _________ miles. This herd shall be used for all ODCM Control required dose calculations.

2. For annual report dose calculations the herd from the Land Use Census having the highest (D/Q) at its location will be the reporting herd. The Land Use Census for 1978 (for example) shall apply to the calendar year 1979 (for example) and will locate the nearest herd in each sector over land. The real (D/Q) will be determined from actual met data that occurred during the reporting period.

B. Determine the applicable (D/Q) from Table M-3 for the location(s) of the herd as determined in 2.6.4.A above.

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

4. (continued)

C. Determine the dose factor Ri for nuclide (i) for organ tau from the Table specified below:

Age	Meat Dose Factor Table No.
Infant	N/A *
Child	G-11
Teen	G-16
Adult	G-21

* The infant does not eat meat and therefore dose does not apply to this pathway.

D. Obtain the micro-Curies (Qi) of nuclide (i) from the radioactive gas waste management logs (for projected doses - the micro-Curies of nuclide (i) to be projected) for the release source(s) under consideration during the time interval. The dose can be calculated from a single release source, but the total dose for ODCM Control Limits or annual reports shall be from all gaseous release sources.

E. Solve for Di

Di = 3.17 X 10 Ri (D/Q) Qi

Di = ________________ mrem from nuclide (i)

F. Perform Steps 2.6.4.C through 2.8.4.E for each nuclide (i) reported during the time interval.

G. The Grass-Cow-Meat pathway dose to organ tau is determined by summing the Di dose of each nuclide (i).

Dose = D1 + D2 + D3 + ... + Dn = ___________mrem

Grass-Cow-Meat
Excluding Tritium
(Child, Teen, or Adult)

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

5. The Vegetation (Garden) Dose Pathway method:

A. Determine the controlling garden location by:

1. For dose calculations (other than annual reports) the historical garden was determined to be located in Sector ______ at __________miles. This garden shall be used for all ODCM Control dose calculations.

2. For annual report dose calculations the Land Census Garden having the highest real (D/Q) at its location will be the reporting garden. The Land Use Census for 1978 (for example) shall apply to the calendar year 1979 (for example) and will locate the nearest garden in each sector. The real (D/Q) will be determined from actual met data that occurred during the reporting period.

B. Determine the applicable (D/Q) from Table M-3 for the location(s) of the garden(s) as determined above.

C. Determine the dose factor Ri for nuclide (i) for organ tau from the Table specified below:

Age	Vegetation Dose Factor Table No.
Infant	N/A *
Child	G-12
Teen	G-17
Adult	G-22

* denotes the infant does not eat vegetation and therefore does not apply to this pathway.

D. Obtain the micro-Curies (Qi) of nuclide (i) from the radioactive gas waste management logs (for projected doses - the micro-Curies of nuclide (i) to be projected) for the release source(s) under consideration during the time interval. The dose can be calculated from a single release source, but the total dose for ODCM Control Limits or annual reports shall be from all gaseous release sources.

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

5. (continued)

E. Solve for Di

$Di = 3.17 \times 10^{-8} Ri (D/Q) Qi$

Di = ________________ mrem from nuclide (i)

F. Perform Steps 2.6.5.C through 2.6.5.E for each nuclide (i) reported during the time interval.

G. The Vegetation pathway dose to organ tau is determined by summing the Di dose of each nuclide (i).

Dose = D1 + D2 + D3 + ... + Dn = ___________mrem

Vegetation
(Excluding Tritium)
(Child, Teen, or Adult)

6. The Gaseous Tritium Dose (Each Pathway) Method:

A. The controlling locations for the pathway(s) has already been determined by:

Inhalation	-	as per 2.6.1.A
Ground Plane	-	not applicable for H-3
Grass-Cow/Goat-Milk	-	as per 2.6.3.A
Grass-Cow/Goat-Milk	-	as per 2.6.4.A
Vegetation (Garden)	-	as per 2.6.5.A

B. Tritium dose calculations use the depleted $(X/Q)_D$ instead of (D/Q). Table M-2 describes where the $(X/Q)_D$ value should be obtained from.

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

6. (continued)

C. For the age group(s) of interest, determine the Pathway Tritium dose factor (R_{H-3}) for the organ T of interest from the Table specified below:

AGE	INHALATION	MILK	
		COW	GOAT
Infant	G-5	G-6	G-7
Child	G-8	G-9	G-10
Teen	G-13	G-14	G-15
Adult	G-18	G-19	G-20

D. Obtain the micro-Curies (Q) of Tritium from the radioactive gas waste management logs (for projected doses - the micro-Curies of nuclide (i) to be projected) for the release source(s) under consideration during the time interval. The dose can be calculated from a single release source, but the total dose for Control limits or quarterly reports shall be from all gaseous release sources.

E. Solve for D_{H-3}

$$D_{H-3} = 3.17 \times 10^{-8} R_{H-3}(X/Q)_D Q$$

D_{H-3} = mrem from Tritium in the specified pathway for organ T of the specified age group

METHODOLOGY SECTION

2.6 Determining the Radioiodine and Particulate Dose To Any Age Group's Organ From Cumulative Releases (continued)

7. Determining the Total Organ Dose From Iodines, 8D-Particulates and H-3 From Cumulative Gaseous Releases

NOTE
Control dose limits for I&8DP shall consider dose from all release sources from the reactor unit of interest.

A. The following pathways shall be summed to arrive at the total dose to organ T from a release source or if applicable to Control, from all release sources:

Age Group: INFANT CHILD TEEN ADULT
Organ: BONE LIVER THYROID KIDNEY LUNG GI-LLI WHOLE BODY

PATHWAY	DOSE	Reference to STEP No.	Remark
Inhalation (I&8DP)		2.6.1.F	
Inhalation (Tritium)		2.6.6.E	
Ground Plane (I&8DP)		2.6.2.F	
Grass-________-Milk (I&8DP)		2.6.3.F	
Grass-________-Milk (Tritium)		2.6.6.E	
Grass-________-Meat (I&8DP)		2.6.4.G	N/A for INFANT
Grass-________-Meat (Tritium)		2.6.6.E	N/A for INFANT
Vegetable Garden (I&8DP)		2.6.5.G	N/A for INFANT
Vegetable Garden (Tritium)		2.6.6.E	N/A for INFANT
$Dose_T$ =	(sum of above)		

B. The dose to each of the applicable age group's ORGANS shall be calculated:

BONE, LIVER, THYROID, KIDNEY, LUNG, WHOLE BODY, & GI-LLI

The age group organ receiving the highest exposure relative to its Control Limit is the most critical organ for that age group resulting from the radioiodine & 8D Particulates gaseous effluents.

METHODOLOGY SECTION

2.7 Projecting Dose for Radioactive Gaseous Effluents

Discussion - Control 3.11.2.4 requires that the waste gas holdup system be used to reduce releases of radioactivity when the projected doses in 31 days due to gaseous effluent releases, from each unit, to areas at and beyond the SITE BOUNDARY (see TS Figure 5-1-1) would exceed 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation. The following calculation method is provided for determining the projected doses. This method is based on using the results of the calculations performed in Sections 2.4 and 2.5.

1. Obtain the latest results of the monthly calculations of the gamma air dose (Section 2.4) and the beta air dose if performed (Section 2.5). These doses can be obtained from the in-plant records.

2. Divide these doses by the number of days the plant was operational during the month.

3. Multiply the quotient by the number of days the plant is projected to be operational during the next month. The product is the projected dose for the next month. The value should be adjusted as needed to account for any changes in failed-fuel or other identifiable operating conditions that could significantly alter the actual releases.

4. If the projected doses are >0.2 mrads gamma air dose or > 0.4 mrads beta air dose, the appropriate subsystems of the waste gas holdup system shall be used.

3.0 40 CFR 190 Dose Evaluation

Discussion - Dose or dose commitment to a real individual from all uranium fuel cycle sources be limited to $\leq$25 mrem to the whole body or any organ (except thyroid, which is limited to $\leq$75 mrem) over a period of 12 consecutive months. The following approach should be used to demonstrate compliance with these dose limits. This approach is based on NUREG-0133, Section 3.8.

3.1 Evaluation Bases

Dose evaluations to demonstrate compliance with the above dose limits need only be performed if the quarterly doses calculated in Sections 1.4, 2.4 and 2.6 exceed twice the dose limits of Controls 3.11.1.2.a, 3.11.1.2.b, 3.11.2.2a, 3.1.2.2b, 3.11.2.3a and 3.11.2.3b respectively; i.e., quarterly doses exceeding 3 mrem to the whole body (liquid releases), 10 mrem to any organ (liquid releases), 10 mrads gamma air dose, 20 mrads beta air dose or 15 mrem to the thyroid or any organ from radioiodines and particulates (atmospheric releases). Otherwise, no evaluations are required and the remainder of this section can be omitted.

METHODOLOGY SECTION

3.2 Doses From Liquid Releases

For the evaluation of doses to real individuals from liquid releases, the same calculation method as employed in Section 1.4 will be used. However, more realistic assumptions will be made concerning the dilution and ingestion of fish and shellfish by individuals who live and fish in the area. Also, the results of the Radiological Environmental Monitoring program will be included in determining more realistic dose to these real people by providing data on actual measured levels of plant related radionuclides in the environment.

3.3 Doses From Atmospheric Releases

For the evaluation of doses to real individuals from the atmospheric releases, the same calculation methods as employed in Section 2.4 and 2.6 will be used. In Section 2.4, the total body dose factor (K_i) should be substituted for the gamma air dose factor (M_i) to determine the total body dose. Otherwise the same calculation sequence applies. However, more realistic assumptions will be made concerning the actual location of real individuals, the meteorological conditions and the consumption of food (e.g., milk). Data obtained from the latest land use census (Control 3.12.2) should be used to determine locations for evaluating doses. Also, the results of the Radiological Environmental Monitoring program will be included in determining more realistic doses to these real people by providing data on actual measured levels of radioactivity and radiation at locations of interest.

METHODOLOGY SECTION

4.0 Annual Radioactive Effluent Report

Discussion - The information contained in a annual report shall not apply to any Control. The reported values are based on actual release conditions instead of historical conditions that the Control dose calculations are based on. The Control dose limits are therefore included in item 1 of the report, for information only. The ECLs in item 2 of the report shall be those listed in Tables L-1 and G-1 of this manual. The average energy in item 3 of the report is not applicable to the St. Lucie Plant. The format, order of nuclides and any values shown as an example in Tables 3.3 through 3.8 are samples only. Other formats are acceptable if they contain equivalent information. A table of contents should also accompany the report. The following format should be used:

RADIOACTIVE EFFLUENTS - SUPPLEMENTAL INFORMATION

1. Regulatory Limits:

1.1 For Radioactive liquid waste effluents:

a. The concentration of radioactive material released from the site (see TS Figure 5.1-1) shall be limited to ten times the concentrations specified in 10 CFR Part 20.1001-20.2401, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} μCi/ml total activity.

b. The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released from each reactor unit to unrestricted areas (See TS Fig. 5.1-1) shall be limited during any calendar quarter to ≤1.5 mrem to the whole body and to ≤5 mrem to any organ and ≤3 mrem to the whole body and ≤10 mrem to any organ during any calendar year.

1.2 For Radioactive Gaseous Waste Effluents:

a. The dose rate resulting from radioactive materials released in gaseous effluents to areas at or beyond the SITE BOUNDARY (See TS Figure 5.1-1) shall be limited to the following values:

The dose rate limit for noble gases shall be ≤500 mrem/yr to the total body and ≤3000 mrem/yr to the skin and

The dose rate limit from I-131, I-133, Tritium and particulates with half-lives >8 days shall be ≤1500 mrem/yr to any organ.

METHODOLOGY SECTION

4.0 Annual Radioactive Effluent Report (continued)

1. (continued)

1.2 (continued)

b. The air dose (see TS Figure 5.1-1) due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the SITE BOUNDARY shall be limited to the following:

During any calendar quarter, to $\leq$5 mrad for gamma radiation and $\leq$10 mrad for beta radiation and during any calendar year to $\leq$10 mrad for gamma radiation and $\leq$20 mrad for beta radiation

c. The dose to a MEMBER OF THE PUBLIC from I-131, I-133, Tritium and all radionuclide in particulate form, with half-lives >8 days in gaseous effluents released from each reactor unit to areas at and beyond the SITE BOUNDARY (see Figure 5.1-1 in the TS-A) shall be limited to the following:

During any calendar quarter to $\leq$7.5 mrem to any organ and during any calendar year to $\leq$15 mrem to any organ.

2. Effluent Limiting Concentrations:

Air - as per attached Table G-1

Water - as per attached Table L-1

3. Average energy of fission and activation gases in gaseous effluents is not applicable to the St. Lucie Plant.

METHODOLOGY SECTION

4.0 Annual Radioactive Effluent Report (continued)

4. Measurements and Approximations of Total Radioactivity:

A summary of liquid effluent accounting methods is described in Table 3.1.

A summary of gaseous effluent accounting methods is described in Table 3.2.

Estimate of Errors:

		LIQUID		GASEOUS	
Error Topic		Avg. %	Max. %	Avg. %	Max. %
Release Point Mixing		2	5	NA	NA
Sampling		1	5	2	5
Sample Preparation		1	5	1	5
Sample Analysis		3	10	3	10
Release Volume		2	5	4	15
	Total %	9	30	10	35

(above values are examples only)

The predictability of error for radioactive releases can only be applied to nuclides that are predominant in sample spectrums. Nuclides that are near background relative to the predominant nuclides in a given sample could easily have errors greater than the above listed maximums.

METHODOLOGY SECTION

4.0 Annual Radioactive Effluent Report (continued)

4. (continued)

TABLE 3.1
RADIOACTIVE LIQUID EFFLUENT SAMPLING AND ANALYSIS

LIQUID SOURCE	SAMPLING FREQUENCY	TYPE OF ANALYSIS	METHOD OF ANALYSIS
MONITOR TANK RELEASES	EACH BATCH	PRINCIPAL GAMMA EMITTERS	p.h.a.
		TRITIUM	L.S.
	MONTHLY COMPOSITE	GROSS ALPHA	A.I.C.
	QUARTERLY COMPOSITE	Sr-89, Sr-90, Fe-55	C.S.
STEAM GENERATOR BLOWDOWN RELEASES	FOUR PER MONTH	PRINCIPAL GAMMA EMITTERS AND DISSOLVED GASES	p.h.a.
		TRITIUM	L.S.
	MONTHLY COMPOSITE	GROSS ALPHA	A.I.C.
	QUARTERLY COMPOSITE	Sr-89, Sr-90, Fe-55	C.S.

TABLE NOTATION:

p.h.a. - gamma spectrum pulse height analysis using High Purity Germanium (HPGE) detectors. All peaks are identified and quantified.

L.S. - Liquid Scintillation counting

C.S. - Chemical Separation

A.I.C. - Air Ion Chamber

METHODOLOGY SECTION

4.0 Annual Radioactive Effluent Report (continued)

4. (continued)

TABLE 3.2
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS

GASEOUS SOURCE	SAMPLING FREQUENCY	TYPE OF ANALYSIS	METHOD OF ANALYSIS
Waste Gas Decay Tank Releases	Each Tank	Principal Gamma Emitters	G, p.h.a.
Containment Purge Releases	Each Purge	Principal Gamma Emitters	G, p.h.a.
		H-3	L.S.
Plant Vent	Four per Month	Principal Gamma Emitters	(G, C, P) - p.h.a.
		H-3	L.S.
	Monthly Composite (Particulates)	Gross Alpha	P - A.I.C.
	Quarterly Composite (Particulates)	Sr-90 Sr-89	C.S.
Cask Handling Facility Vent (1)	Weekly	Principal Gamma Emitters	(G, C, P) - p.h.a.
		H-3	L.S.
	Monthly Composite (Particulate)	Gross Alpha	P - A.I.C.
	Quarterly Composite (Particulate)	Sr-90 Sr-89	C.S.

TABLE NOTATION:

G - Gaseous Grab Sample

C - Charcoal Filter Sample

P - Particulate Filter Sample

L.S. - Liquid Scintillation Counting

C.S. - Chemical Separation

p.h.a. - Gamma spectrum pulse height analysis using High Purity Germanium(HPGE)detectors. All peaks are identified and quantified.

A.I.C. - Air Ion Chamber

(1)—Only required when operating.

METHODOLOGY SECTION

4.0 Annual Radioactive Effluent Report (continued)

5. Batch Releases

A. Liquid

1. Number of batch releases: ______
2. Total time period of batch releases: ______minutes
3. Maximum time period for a batch release: ______minutes
4. Average time period for a batch release: ______minutes
5. Minimum time period for a batch release: ______minutes
6. Average dilution stream flow during the period (see Note 1 on Table 3.3): ______GPM

All liquid releases are summarized in tables

B. Gaseous

1. Number of batch releases: ______
2. Total time period for batch releases: ______minutes
3. Maximum time period for a batch release: ______minutes
4. Average time period for batch releases: ______minutes
5. Minimum time period for a batch release: ______minutes

All gaseous waste releases are summarized in tables

METHODOLOGY SECTION

4.0 Annual Radioactive Effluent Report (continued)

6. Unplanned Releases

   A. Liquid

      1. Number of releases: ______

      2. Total activity releases: ______Curies

   B. Gaseous

      1. Number of releases: ______

      2. Total activity released: ______Curies

   C. See attachments (if applicable) for:

      1. A description of the event and equipment involved.

      2. Cause(s) for the unplanned release.

      3. Actions taken to prevent a recurrence

      4. Consequences of the unplanned release

7. Description of dose assessment of radiation dose from radioactive effluents to the general public due to their activities inside the site are reported on the January annual report.

8. Offsite dose calculation manual revisions initiated during this reporting period. See Control 3.11.2.6 for required attachments to the Annual Report.

9. Solid waste and irradiated fuel shipments as per requirements of Control 3.11.2.6.

10. Process Control Program (PCP) revisions as per requirements of TS 6.13.

11. Major changes to Radioactive Liquid, Gaseous and Solid Waste Treatment Systems as per requirements of Control 3.11.2.5.

12. Results of water samples taken in support of the Groundwater Protection INITIATIVE (NEI 07-07) during the previous calendar year that have not been incorporated into the Radiological Environmental Monitoring Program.

METHODOLOGY SECTION

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE UNIT #_____

ANNUAL REPORT - ____/____/____ THROUGH ____/____/____

TABLE 3.3: LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

	UNIT	QUARTER #	QUARTER #
A. Fission and Activation Products			
1. Total Release - (Not including Tritium, Gases, Alpha)	Ci	______E	______E
2. Average Diluted Concentration During Period	μCi/ml	______E	______E
B. Tritium			
1. Total Release	Ci	______E	______E
2. Average Diluted Concentration During Period	μCi/ml	______E	______E
C. Dissolved and Entrained Gases			
1. Total Release	Ci	______E	______E
2. Average Diluted Concentration During Period	μCi/ml	______E	______E
D. Gross Alpha Radioactivity			
1. Total Release	Ci	______E	______E
E. Volume of Waste Released (Prior to Dilution)	LITERS	______E	______E
F. Volume of Dilution Water Used During Period[1]	LITERS	______E	______E

1 - The volume reported should be for the entire interval of the reporting period, not just during release intervals. This volume should also be used to calculate average dilution stream flow during the period.

METHODOLOGY SECTION

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE UNIT #_____

ANNUAL REPORT - ____/____/____ THROUGH ____/____/____

TABLE 3.4: LIQUID EFFLUENTS (EXAMPLE FORMAT)

NUCLIDES RELEASED*	UNIT	CONTINUOUS MODE		BATCH MODE	
		QUARTER #	QUARTER #	QUARTER #	QUARTER #
I-131	CI	E	E	E	E
I-133	CI	E	E	E	E
I-135	CI	E	E	E	E
NA-24	CI	E	E	E	E
CR-51	CI	E	E	E	E
MN-54	CI	E	E	E	E
CO-57	CI	E	E	E	E
CO-58	CI	E	E	E	E
FE-59	CI	E	E	E	E
CO-60	CI	E	E	E	E
ZN-65	CI	E	E	E	E
NI-65	CI	E	E	E	E
AG-110	CI	E	E	E	E
SN-113	CI	E	E	E	E
SB-122	CI	E	E	E	E
SB-124	CI	E	E	E	E
W-187	CI	E	E	E	E
NP-239	CI	E	E	E	E
ZR-95	CI	E	E	E	E
MO-99	CI	E	E	E	E
RU-103	CI	E	E	E	E
CS-134	CI	E	E	E	E
CS-136	CI	E	E	E	E
CS-137	CI	E	E	E	E
BA-140	CI	E	E	E	E
CE-141	CI	E	E	E	E
BR-82	CI	E	E	E	E
ZR-97	CI	E	E	E	E
SB-125	CI	E	E	E	E

* All nuclides that were detected should be added to the partial list of the example format.

METHODOLOGY SECTION

TABLE 3.4: LIQUID EFFLUENTS (EXAMPLE FORMAT)
(continued)

NUCLIDES RELEASED	UNIT	CONTINUOUS MODE		BATCH MODE	
		QUARTER #	QUARTER #	QUARTER #	QUARTER #
CE-144	CI	E	E	E	E
SR-89	CI	E	E	E	E
SR-90	CI	E	E	E	E
UNIDENTIFIED	CI	E	E	E	E
TOTAL FOR PERIOD (ABOVE)	CI	E	E	E	E

NUCLIDES RELEASED	UNIT	CONTINUOUS MODE		BATCH MODE	
		QUARTER #	QUARTER #	QUARTER #	QUARTER #
AR-41	CI	E	E	E	E
KR-85	CI	E	E	E	E
XE-131M	CI	E	E	E	E
XE-133	CI	E	E	E	E
XE-133M	CI	E	E	E	E
XE-135	CI	E	E	E	E

METHODOLOGY SECTION

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE UNIT #_____

TABLE 3.5: LIQUID EFFLUENTS - DOSE SUMMATION

Age Group: ___________ Location: ________________

Exposure Interval: From________________ Through________________

Fish & Shellfish Pathway to Organ	CALENDAR YEAR DOSE (mrem)
BONE	
LIVER	
THYROID	
KIDNEY	
LUNG	
GI-LLI	
WHOLE BODY	

METHODOLOGY SECTION

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE UNIT #_____

ANNUAL REPORT - ____/____/____ THROUGH ____/____/____

TABLE 3.6: GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

		UNIT	QUARTER #	QUARTER #
A.	Fission and Activation Gases			
	1. Total Release	Ci	______E	______E
	2. Average Release Rate For Period	µCi/SEC	______E	______E
B.	Iodines			
	1. Total Iodine-131	Ci	______E	______E
	2. Average Release Rate for Period	µCi/SEC	______E	______E
C.	Particulates			
	1. Particulates T-1/2 > 8 Days	Ci	______E	______E
	2. Average Release Rate for Period	µCi/SEC	______E	______E
	3. Gross Alpha Radioactivity	Ci	______E	______E
D.	Tritium			
	1. Total Release	Ci	______E	______E
	2. Average Release Rate for Period	µCi/SEC	______E	______E

METHODOLOGY SECTION

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE UNIT #_____

ANNUAL REPORT - ____/____/____ THROUGH ____/____/____

TABLE 3.7: GASEOUS EFFLUENTS - GROUND LEVEL RELEASES
(EXAMPLE FORMAT)

NUCLIDES RELEASED*	UNIT	CONTINUOUS MODE		BATCH MODE	
		QUARTER #	QUARTER #	QUARTER #	QUARTER #
1. Fission Gases					
AR-41	CI	E	E	E	E
KR-85	CI	E	E	E	E
KR-85M	CI	E	E	E	E
KR-87	CI	E	E	E	E
KR-88	CI	E	E	E	E
XE-131M	CI	E	E	E	E
XE-133	CI	E	E	E	E
XE-133M	CI	E	E	E	E
XE-135	CI	E	E	E	E
XE-135M	CI	E	E	E	E
XE-138	CI	E	E	E	E
UNIDENTIFIED	CI	E	E	E	E
TOTAL FOR PERIOD (ABOVE)	CI	E	E	E	E
2. Iodines					
I-131	CI	E	E	E	E
I-133	CI	E	E	E	E
I-135	CI	E	E	E	E
TOTAL FOR PERIOD (ABOVE)	CI	E	E	E	E
3. Particulates					
CO-58	CI	E	E	E	E
SR-89	CI	E	E	E	E
SR-90	CI	E	E	E	E

* All nuclides that were detected should be added to the partial list of the example format.

METHODOLOGY SECTION

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE UNIT #_____

TABLE 3.8: GASEOUS EFFLUENTS - DOSE SUMMATION - CALENDAR YEAR

AGE GROUP:__INFANT__ EXPOSURE INTERVAL: FROM__________ THROUGH__________

PATHWAY		BONE (mrem)	LIVER (mrem)	THYROID (mrem)	KIDNEY (mrem)	LUNG (mrem)	GI-LLI (mrem)	WHOLE BODY (mrem)
Ground Plane	(A)							
Grass- -Milk	(B)							
Inhalation	(A)							
TOTAL								

A)	SECTOR:	RANGE: miles

(B)	COW / GOAT	SECTOR:	RANGE: miles

NOBLE GASES	CALENDAR YEAR (mrad)
Gamma Air Dose	
Beta Air Dose	
Sector:	Range: 0.97 miles

NOTE

The dose values above were calculated using actual meteorological data during the specified time interval with MET data reduced as per Reg. Guide 1.111, March 1976.

APPENDIX A
ECL, DOSE FACTOR
AND
HISTORICAL METEOROLOGICAL TABLES

TABLE L-1
EFFLUENT CONCENTRATION LIMITS IN WATER IN UNRESTRICTED AREAS

NOTE
If a nuclide is not listed below, refer to 10 CFR Part 20, Appendix B, Table 2 Effluent Concentrations Column 2 and use the most conservative ECL listed for the nuclide.

Nuclide	ECL (μCi/ml)	Nuclide	ECL (μCi/ml)	Nuclide	ECL (μCi/ml)
H-3	1 E-3	Sr-92	4 E-5	Te-129	4 E-4
C-14	3 E-5	Y-90	7 E-6	Te-131m	8 E-6
Na-24	5 E-5	Y-91m	2 E-3	Te-131	8 E-5
P-32	9 E-6	Y-91	8 E-6	Te-132	9 E-6
Cr-51	5 E-4	Y-92	4 E-5	I-130	2 E-5
Mn-54	3 E-5	Y-93	2 E-5	I-131	1 E-6
Mn-56	7 E-5	Zr-95	2 E-5	I-132	1 E-4
Fe-55	1 E-4	Zr-97	9 E-6	I-133	7 E-6
Fe-59	1 E-5	Nb-95	3 E-5	I-134	4 E-4
Co-57	6 E-5	Nb-97	3 E-4	I-135	3 E-5
Co-58	2 E-5	Mo-99	2 E-5	Cs-134	9 E-7
Co-60	3 E-6	Tc-99m	1 E-3	Cs-136	6 E-6
Ni-63	1 E-4	Tc-101	2 E-3	Cs-137	1 E-6
Ni-65	1 E-4	Ru-103	3 E-5	Cs-138	4 E-4
Cu-64	2 E-4	Ru-105	7 E-5	Ba-139	2 E-4
Zn-65	5 E-6	Ru-106	3 E-6	Ba-140	8 E-6
Zn-69	8 E-4	Ag-110	6 E-6	Ba-141	3 E-4
Br-82	4 E-5	Sn-113	3 E-5	Ba-142	7 E-4
Br-83	9 E-4	In-113m	7 E-4	La-140	9 E-6
Br-84	4 E-4	Sb-122	1 E-5	La-142	1 E-4
Rb-86	7 E-6	Sb-124	7 E-6	Ce-141	3 E-5
Rb-88	4 E-4	Sb-125	3 E-5	Ce-143	2 E-5
Rb-89	9 E-4	Te-125m	2 E-5	Ce-144	3 E-6
Sr-89	8 E-6	Te-127m	9 E-6	Pr-144	6 E-4
Sr-90	5 E-7	Te-127	1 E-4	W-187	3 E-5
Sr-91	2 E-5	Te-129m	7 E-6	Np-239	2 E-5

TABLE L-2

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - ADULT

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H-3	0.	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01	3.60E-01
C-14	1.45E+04	2.91E+03	2.91E+03	2.91E+03	2.91E+03	2.91E+03	2.91E+03
NA-24	6.08E-01	6.08E-01	6.08E-01	6.08E-01	6.08E-01	6.08E-01	6.08E-01
P-32	1.67E+07	1.05E+06	0.	0.	0.	1.88E+06	6.47E+05
CR-51	0.	0.	3.34E+00	1.23E+00	7.42E+00	1.41E+03	5.59E+00
MN-54	0.	7.07E+03	0.	2.10E+03	0.	2.17E+04	1.35E+03
MN-56	0.	1.78E+02	0.	2.26E+02	0.	5.68E+03	3.17E+01
FE-55	1.15E+05	5.19E+05	0.	0.	6.01E+05	2.03E+05	1.36E+05
FE-59	8.08E+04	1.92E+05	0.	0.	5.32E+04	6.33E+05	7.29E+04
CO-57	0.	1.42E+02	0.	0.	0.	3.60E+03	2.36E+02
CO-58	0.	6.05E+02	0.	0.	0.	1.22E+04	1.35E+03
CO-60	0.	1.74E+03	0.	0.	0.	3.26E+04	3.83E+03
Ni-63	4.97E+04	3.45E+03	0.	0.	0.	7.19E+02	1.67E+03
NI-65	2.02E+02	2.63E+01	0.	0.	0.	6.65E+02	1.20E+01
CU-64	0.	2.15E+02	0.	5.41E+02	0.	1.83E+04	1.01E+02
ZN-65	1.62E+05	5.13E+05	0.	3.43E+05	0.	3.23E+05	2.32E+05
ZN-69	3.43E+02	6.60E+02	0.	4.27E+02	0.	9.87E+01	4.57E+01

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-2

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - ADULT

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
BR-82	0.	0.	0.	0.	0.	4.68E+00	4.08E+00
BR-83	0.	0.	0.	0.	0.	1.05E-01	7.26E-02
BR-84	0.	0.	0.	0.	0.	7.38E-07	9.42E-02
BR-85	0.	0.	0.	0.	0.	0.	3.86E-03
RB-86	0.	6.25E+02	0.	0.	0.	1.23E+02	2.91E+02
RB-88	0.	1.79E+00	0.	0.	0.	0.	9.50E-01
RB-89	0.	1.19E+00	0.	0.	0.	0.	8.38E-01
SR-89	5.01E+03	0.	0.	0.	0.	8.01E+02	1.44E+02
SR-90	1.23E+05	0.	0.	0.	0.	1.65E+03	3.02E+04
SR-91	9.43E+01	0.	0.	0.	0.	4.75E+02	4.15E+00
SR-92	3.50E+01	0.	0.	0.	0.	6.91E+02	1.51E+00
Y-90	6.07E+00	0.	0.	0.	0.	6.43E+04	1.63E-01
Y-91M	5.74E-02	0.	0.	0.	0.	1.68E-01	2.23E-03
Y-91	8.89E+01	0.	0.	0.	0.	4.89E+04	2.38E+00
Y-92	5.34E-01	0.	0.	0.	0.	9.33E+03	1.56E-02

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-2

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - ADULT

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
Y-93	1.69E+00	0.	0.	0.	0.	5.36E+04	4.67E-02
ZR-95	1.60E+01	5.13E+00	0.	8.09E+00	0.	1.59E+04	3.47E+00
ZR-97	8.82E-01	1.78E-01	0.	2.69E-01	0.	5.51E+04	8.19E-02
NB-95	4.48E+02	2.49E+02	0.	2.47E+02	0.	1.51E+06	9.79E+01
NB-97	3.76E+00	9.50E-01	0.	1.11E+00	0.	3.51E+03	3.47E-01
MO-99	0.	1.28E+02	0.	2.90E+02	0.	2.97E+02	2.43E+01
TC-99M	1.30E-02	3.67E-02	0.	5.57E-01	1.80E-02	2.17E+01	4.67E-01
TC-101	1.33E-02	1.93E-02	0.	3.47E-01	9.82E-03	0.	1.89E-01
RU-103	1.07E+02	0.	0.	4.09E+02	0.	1.25E+04	4.61E+01
RU-105	8.90E+00	0.	0.	1.15E+02	0.	5.44E+03	3.51E+00
RU-106	1.59E+03	0.	0.	3.08E+03	0.	1.03E+05	2.01E+02
AG-110	1.57E+03	1.45E+03	0.	2.85E+03	0.	5.92E+05	8.62E+02
SB-124	2.78E+02	5.23E+00	6.71E-01	0.	2.15E+02	7.85E+03	1.10E+02
SB-125	2.20E+02	2.37E+00	1.96E-01	0.	2.30E+04	1.95E+03	4.42E+01
TE-125M	2.17E+02	7.89E+01	6.54E+01	8.83E+02	0.	8.67E+02	2.91E+01

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-2

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - ADULT

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
TE-127M	5.50E+02	1.92E+02	1.40E+02	2.23E+03	0.	1.84E+03	6.70E+01
TE-127	8.92E+00	3.20E+00	6.61E+00	3.63E+01	0.	7.04E+02	1.93E+00
TE-129M	9.32E+02	3.49E+02	3.20E+02	3.89E+03	0.	4.69E+03	1.48E+02
TE-129	2.55E+00	9.65E-01	1.95E+00	1.07E+01	0.	1.92E+00	6.21E-01
TE-131M	1.41E+02	6.87E+01	1.09E+02	6.95E+02	0.	6.81E+03	5.72E+01
TE-131	1.60E+00	6.68E-01	1.31E+00	7.00E+00	0.	2.39E-01	5.04E-01
TE-132	2.05E+03	1.33E+02	1.46E+02	1.28E+03	0.	6.25E+03	1.24E+02
I-130	3.98E+01	1.18E+02	1.50E+04	1.83E+02	0.	1.01E+02	4.63E+01
I-131	2.18E+02	3.13E+02	1.02E+05	5.36E+02	0.	8.24E+01	1.79E+02
I-132	1.07E+01	2.85E+01	3.76E+03	4.55E+01	0.	5.36E+00	1.01E+01
I-133	7.51E+01	1.30E+02	2.51E+04	2.27E+02	0.	1.15E+02	3.98E+01
I-134	5.57E+00	1.51E+01	1.96E+03	2.41E+01	0.	1.32E-02	5.41E+00
I-135	2.33E+01	6.14E+01	8.03E+03	9.77E+01	0.	6.88E+01	2.25E+01
CS-134	6.85E+03	1.63E+04	0.	5.29E+03	1.75E+03	2.85E+02	1.33E+04
CS-136	7.17E+02	2.83E+03	0.	1.58E+03	2.16E+02	3.22E+02	2.04E+03

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-2

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - ADULT

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
CS-137	8.79E+03	1.20E+04	0.	4.09E+03	1.36E+03	2.31E+02	7.88E+03
CS-138	6.08E+00	1.20E+01	0.	8.84E+00	8.73E-01	5.12E-05	5.96E+00
BA-139	7.87E+00	5.61E-03	0.	5.24E-03	3.18E-03	1.39E+01	2.30E-01
BA-140	1.65E+03	2.07E+00	0.	7.04E-01	1.18E+00	3.39E+03	1.09E+02
BA-141	0.	2.89E-03	0.	2.68E-03	1.64E-03	1.80E-09	1.29E-01
BA-142	1.73E+00	1.78E-03	0.	1.50E-03	1.01E-03	0.	1.09E-01
LA-140	1.58E+00	7.95E-01	0.	0.	0.	5.83E+04	2.11E-01
LA-142	8.07E-02	3.67E-02	0.	0.	0.	2.68E+02	9.15E-03
CE-141	3.43E+00	2.32E+00	0.	1.08E+00	0.	8.87E+03	2.63E-01
CE-143	6.05E-01	4.47E+02	0.	1.97E-01	0.	1.67E+04	4.95E-02
CE-144	1.79E+02	7.48E+01	0.	4.43E+01	0.	6.05E+04	9.60E+00
PR-144	1.91E-02	7.88E-03	0.	4.45E-03	0.	2.73E-09	9.65E-04
W-187	9.17E+00	7.68E+00	0.	0.	0.	2.51E+03	2.69E+00
NP-239	3.56E-02	3.50E-03	0.	1.08E-02	0.	7.12E+02	1.92E-03

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-3

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	2.17E-01	2.17E-01	2.74E-01	2.17E-01	2.17E-01	2.17E-01
C-14	2.94E+03	2.94E+03	2.94E+03	2.22E+03	2.94E+03	2.94E+03	2.94E+03
NA--24	4.63E-01	4.63E-01	4.63E-01	4.63E-01	4.63E-01	4.63E-01	4.63E-01
P---32	1.27E+07	7.98E+05	0.	0.	0.	1.43E+06	4.93E+05
CR--51	0.	0.	2.54E+00	9.38E-01	5.64E+00	1.07E+03	4.25E+00
MN--54	0.	5.38E+03	0.	1.60E+03	0.	1.65E+04	1.03E+03
MN--56	0.	1.36E+02	0.	1.72E+02	0.	4.32E+03	2.42E+01
FE--55	8.78E+04	3.95E+05	0.	0.	4.57E+05	1.54E+05	1.04E+05
FE--59	6.14E+04	1.46E+05	0.	0.	4.05E+04	4.81E+05	5.55E+04
CO--57	0.	1.08E+02	0.	0.	0.	2.74E+03	1.79E+02
CO--58	0.	6.12E+02	0.	0.	0.	8.26E+03	1.39E+03
CO--60	0.	1.70E+03	0.	0.	0.	2.04E+04	3.88E+03
Ni-63	3.78E+04	2.63E+03	0.	0.	0.	5.47E+02	1.27E+03
NI--65	1.54E+02	2.00E+01	0.	0.	0.	5.07E+02	9.11E+00
CU--64	0.	1.64E+02	0.	4.12E+02	0.	1.39E+04	7.69E+01
ZN--65	1.23E+05	3.90E+05	0.	2.61E+05	0.	2.46E+05	1.77E+05
ZN--69	2.61E+02	5.02E+02	0.	3.24E+02	0.	7.50E+01	3.47E+01
BR--82	0.	0.	0.	0.	0.	3.55E+00	3.10E+00
BR--83	0.	0.	0.	0.	0.	7.95E-02	5.52E-02
BR--84	0.	0.	0.	0.	0.	5.61E-07	7.16E-02
BR--85	0.	0.	0.	0.	0.	0.	2.94E-03

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-3

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (MREM/HR PER µCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
RB--86	0.	4.76E+02	0.	0.	0.	9.37E+01	2.22E+02
RB--88	0.	1.37E+00	0.	0.	0.	0.	7.23E-01
RB--89	0.	9.04E-01	0.	0.	0.	0.	6.38E-01
SR--89	5.67E+03	0.	0.	0.	0.	6.15E+02	1.63E+02
SR--90	1.28E+05	0.	0.	0.	0.	2.71E+03	3.17E+04
SR--91	7.18E+01	0.	0.	0.	0.	3.61E+02	3.16E+00
SR--92	2.66E+01	0.	0.	0.	0.	5.25E+02	1.15E+00
Y---90	1.58E+01	0.	0.	0.	1.80E+04	5.23E+04	4.25E-01
Y--91M	4.36E-02	0.	0.	0.	0.	1.28E-01	1.69E-03
Y---91	9.40E+01	0.	0.	0.	0.	3.61E+04	2.51E+00
Y---92	4.06E-01	0.	0.	0.	0.	7.10E+03	1.18E-02
Y---93	1.29E+00	0.	0.	0.	0.	4.08E+04	3.55E-02
ZR--95	1.49E+01	4.96E+00	0.	6.16E+00	0.	1.07E+04	3.46E+00
ZR--97	6.72E-01	1.36E-01	0.	2.05E-01	0.	4.20E+04	6.24E-02
NB--95	3.97E+02	2.39E+02	0.	1.88E+02	0.	9.76E+05	1.35E+02
NB--97	2.87E+00	7.24E-01	0.	8.45E-01	0.	2.67E+03	2.64E-01
MO--99	0.	9.74E+01	0.	2.21E+02	0.	2.26E+02	1.85+01
TC-99M	9.87E-03	2.79E-02	0.	4.24E-01	1.37E-02	1.65E+01	3.56E-01
TC-101	1.02E-02	1.47E-02	0.	2.64E-01	7.47E-03	0.	1.44E-01

Based on 1 µCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-3

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
RU-103	1.04E+02	0.	0.	3.11E+02	0.	8.13E+03	4.66E+01
RU-105	6.77E+00	0.	0.	8.74E+01	0.	4.14E+03	2.67E+00
RU-106	1.76E+03	0.	0.	2.34E+03	0.	7.95E+04	2.21E+02
AG110	1.19E+03	1.10E+03	0.	2.17E+03	0.	4.51E+05	6.56E+02
SB-124	2.11E+02	3.99E+00	5.11E-01	0.	1.64E+02	5.98E+03	8.35E+01
SB-125	1.68E+02	1.81E+00	1.49E-01	0.	1.75E+04	1.48E+03	3.37E+01
TE 125M	2.36E+02	8.45E+01	6.66E+01	6.72E+02	0.	6.60E+02	3.13E+01
TE 127M	4.18E+02	1.46E+02	1.07E+02	1.70E+03	0.	1.40E+03	5.09E+01
TE-127	9.31E+00	3.28E+00	6.35E+00	2.76E+01	0.	7.52E+02	1.99E+00
TE 129M	1.02E+03	3.79E+02	3.27E+02	2.96E+03	0.	3.58E+03	1.61E+02
TE-129	1.94E+00	7.34E-01	1.49E+00	8.14E+00	0.	1.46E+00	4.72E-01
TE 131M	1.07E+02	5.22E+01	8.26E+01	5.29E+02	0.	5.18E+03	4.35E+01
TE-131	1.21E+00	5.08E-01	9.99E-01	5.33E+00	0.	1.82E-01	3.83E-01
TE-132	2.19E+02	1.37E+02	1.46E+02	9.74E+02	0.	4.93E+03	1.30E+02
I--130	3.03E+01	8.95E+01	1.14E+04	1.39E+02	0.	7.67E+01	3.52E+01
I--131	2.23E+02	3.14E+02	9.07E+04	4.08E+02	0.	5.95E+01	1.87E+02
I--132	8.11E+00	2.17E+01	2.86E+03	3.46E+01	0.	4.08E+00	7.71E+00
I--133	8.11E+01	1.37E+02	2.50E+04	1.73E+02	0.	9.99E+01	4.24E+01
I--134	4.24E+00	1.15E+01	1.49E+03	1.83E+01	0.	1.00E-02	4.12E+00

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-3

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
I--135	1.77E+01	4.68E+01	6.11E+03	7.43E+01	0.	5.23E+01	1.71E+01
CS-134	6.75E+03	1.63E+04	0.	4.03E+03	1.97E+03	1.88E+02	7.60E+03
CS-136	5.46E+02	2.16E+03	0.	1.20E+03	1.65E+02	2.45E+02	1.55E+03
CS-137	8.98E+03	1.21E+04	0.	3.11E+03	1.60E+03	1.61E+02	4.24E+03
CS-138	4.63E+00	9.15E+00	0.	6.73E+00	6.65E-01	3.90E-05	4.54E+00
BA-139	5.99E+00	4.27E-03	0.	3.99E-03	2.42E-03	1.06E+01	1.75E-01
BA-140	1.75E+03	2.15E+00	0.	5.35E-01	1.44E+00	2.55E+02	1.12E+02
BA-141	0.	2.20E-03	0.	2.04E-03	1.25E-03	1.37E-09	9.80E-02
BA-142	1.31E+00	1.35E-03	0.	1.14E-03	7.64E-04	0.	8.26E-02
LA-140	1.67E+00	8.25E-01	0.	0.	0.	4.55E+04	2.18E-01
LA-142	6.14E-02	2.79E-02	0.	0.	0.	2.04E+02	6.95E-03
CE-141	3.51E+00	2.36E+00	0.	8.19E-01	0.	6.38E+03	2.70E-01
CE-143	4.60E-01	3.40E+02	0.	1.50E-01	0.	1.27E+04	3.76E-02
CE-144	2.01E+02	8.25E+01	0.	3.37E+01	0.	4.74E+04	1.07E+01
PR-144	1.45E-02	5.99E-03	0.	3.39E-03	0.	2.08E-09	7.34E-04
W--187	6.98E+00	5.85E+00	0.	0.	0.	1.91E+03	2.05E+00
NP-239	2.71E-02	2.67E-03	0.	8.25E-03	0.	5.43E+02	1.46E-03

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - CHILD

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	1.81E-01	1.81E-01	1.19E-01	1.81E-01	1.81E-01	1.81E-01
C-14	3.82E+03	3.82E+03	3.82E+03	9.61E+02	3.82E+03	3.82E+03	3.82E+03
NA--24	2.03E-01	2.03E-01	2.03E-01	2.03E-01	2.03E-01	2.03E-01	2.03E-01
P---32	5.53E+06	3.47E+05	0.	0.	0.	6.22E+05	2.14E+05
CR--51	0.	0.	1.12E+00	4.13E-01	2.48E+00	4.70E+02	1.87E+00
MN--54	0.	2.34E+03	0.	6.95E+02	0.	7.15E+03	4.46E+02
MN--56	0.	5.88E+01	0.	7.46E+01	0.	1.88E+03	1.05E+01
FE--55	3.87E+04	1.74E+05	0.	0.	2.02E+05	6.81E+04	4.58E+04
FE--59	2.71E+04	6.43E+04	0.	0.	1.79E+04	2.12E+05	2.45E+04
CO--57	0.	4.78E+01	0.	0.	0.	1.21E+03	7.94E+01
CO--58	0.	5.05E+02	0.	0.	0.	3.00E+03	1.52E+03
CO--60	0.	1.41E+03	0.	0.	0.	7.80E+03	4.23E+03
Ni-63	1.66E+04	1.15E+03	0.	0.	0.	2.39E+02	5.55E+02
NI--65	6.73E+01	8.74E+00	0.	0.	0.	2.22E+02	3.98E+00
CU--64	0.	7.15E+01	0.	1.80E+02	0.	6.09E+03	3.36E+01
ZN--65	5.47E+04	1.74E+05	0.	1.16E+05	0.	1.09E+05	7.86E+04
ZN--69	1.16E+02	2.23E+02	0.	1.44E+02	0.	3.34E+01	1.55E+01
BR--82	0.	0.	0.	0.	0.	1.59E+00	1.39E+00
BR--83	0.	0.	0.	0.	0.	3.55E-02	2.47E-02
BR--84	0.	0.	0.	0.	0.	2.51E-07	3.20E-02
BR--85	0.	0.	0.	0.	0.	0.	1.31E-03

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - CHILD

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
RB--86	0.	2.08E+02	0.	0.	0.	4.09E+01	9.68E+01
RB--88	0.	5.96E-01	0.	0.	0.	0.	3.16E-01
RB--89	0.	3.95E-01	0.	0.	0.	0.	2.78E-01
SR--89	7.53E+03	0.	0.	0.	0.	2.81E+02	2.16E+02
SR--90	9.39E+04	0.	0.	0.	0.	1.25E+03	2.38E+04
SR--91	3.18E+01	0.	0.	0.	0.	1.60E+02	1.40E+00
SR--92	1.18E+01	0.	0.	0.	0.	2.33E+02	5.08E-01
Y---90	9.00E+00	0.	0.	0.	0.	2.57E+04	2.42E-01
Y--91M	1.95E-02	0.	0.	0.	0.	5.71E-02	7.55E-04
Y---91	1.25E+02	0.	0.	0.	0.	1.66E+04	3.34E+00
Y---92	1.81E-01	0.	0.	0.	0.	3.16E+03	5.28E-03
Y---93	5.73E-01	0.	0.	0.	0.	1.82E+04	1.58E-02
ZR--95	1.80E+01	4.19E+00	0.	2.67E+00	0.	4.33E+03	3.81E+00
ZR--97	2.91E-01	5.87E-02	0.	8.86E-02	0.	1.82E+04	2.70E-02
NB--95	4.61E+02	1.97E+02	0.	8.11E+01	0.	3.41E+05	1.45E+02
NB--97	1.24E+00	3.12E-01	0.	3.64E-01	0.	1.15E+03	1.14E-01
MO--99	0.	4.23E+01	0.	9.59E+01	0.	9.81E+01	8.05E+00
TC-99M	4.34E-03	1.23E-02	0.	1.86E-01	6.01E-03	7.26E+00	1.57E-01
TC-101	4.47E-03	6.45E-03	0.	1.16E-01	3.29E-03	0.	6.33E-02

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - CHILD

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
RU-103	1.33E+02	0.	0.	1.39E+02	0.	3.50E+03	5.38E+01
RU-105	3.03E+00	0.	0.	3.91E+01	0.	1.85E+03	1.19E+00
RU-106	2.34E+03	0.	0.	1.05E+03	0.	3.63E+04	2.91E+02
AG110	5.18E+02	4.80E+02	0.	9.43E+02	0.	1.96E+05	2.85E+02
SB-124	9.13E+01	1.72E+00	2.21E-01	0.	7.08E+01	2.58E+03	3.61E+01
SB-125	7.24E+01	7.80E-01	6.43E-02	0.	7.57E+03	6.40E+02	1.46E+01
TE 125M	3.11E+02	8.43E+01	8.73E+01	2.97E+02	0.	3.00E+02	4.15E+01
TE 127M	1.85E+02	6.47E+01	4.72E+01	7.50E+02	0.	6.19E+02	2.25E+01
TE-127	1.23E+01	3.27E+00	8.46E+00	1.22E+01	0.	5.24E+02	2.63E+00
TE129M	1.35E+03	3.77E+02	4.31E+02	1.31E+03	0.	1.63E+03	2.09E+02
TE-129	8.59E-01	3.25E-01	6.58E-01	3.60E+00	0.	6.47E-01	2.09E-01
TE131M	4.75E+01	2.31E+01	3.66E+01	2.34E+02	0.	2.29E+03	1.93E+01
TE-131	5.38E-01	2.25E-01	4.42E-01	2.36E+00	0.	8.05E-02	1.70E-01
TE-132	2.78E+02	1.23E+02	1.81E+02	4.31E+02	0.	2.15E+03	1.48E+02
I--130	1.33E+01	3.94E+01	5.01E+03	6.12E+01	0.	3.38E+01	1.55E+01
I--131	2.87E+02	2.94E+02	9.55E+04	1.79E+02	0.	2.51E+01	2.22E+02
I--132	3.57E+00	9.55E+00	1.26E+03	1.52E+01	0.	1.79E+00	3.39E+00
I--133	1.05E+02	1.30E+02	3.13E+04	7.61E+01	0.	5.26E+01	5.10E+01
I--134	1.86E+00	5.06E+00	6.58E+02	8.07E+00	0.	4.41E-03	1.81E+00

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE L-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - SALT WATER FISH AND SHELLFISH AGE GROUP - CHILD

ORGAN DOSE FACTOR (MREM/HR PER μCi/ML)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
I--135	7.79E+00	2.06E+01	2.69E+03	3.27E+01	0.	2.30E+01	7.54E+00
CS-134	8.14E+03	1.37E+04	0.	1.75E+03	1.52E+03	7.42E+01	2.92E+03
CS-136	2.37E+02	9.34E+02	0.	5.20E+02	7.13E+01	1.06E+02	6.73E+02
CS-137	1.13E+04	1.10E+04	0.	1.35E+03	1.29E+03	6.69E+01	1.64E+03
CS-138	2.01E+00	3.96E+00	0.	2.92E+00	2.88E-01	1.69E-05	1.97E+00
BA-139	2.65E+00	1.89E-03	0.	1.77E-03	1.07E-03	4.69E+00	7.75E-02
BA-140	2.25E+03	1.98E+00	0.	2.37E-01	1.18E+00	1.15E+02	1.32E+02
BA-141	0.	9.71E-04	0.	9.03E-04	5.51E-04	6.06E-10	4.34E-02
BA-142	5.81E-01	5.98E-04	0.	5.05E-04	3.38E-04	0.	3.66E-02
LA-140	2.16E+00	7.52E-01	0.	0.	0.	2.14E+04	2.54E-01
LA-142	2.74E-02	1.24E-02	0.	0.	0.	9.09E+01	3.10E-03
CE-141	4.67E+00	2.34E+00	0.	3.66E-01	0.	2.93E+03	3.48E-01
CE-143	2.05E-01	1.52E+02	0.	6.69E-02	0.	5.67E+03	1.68E-02
CE-144	2.66E+02	8.33E+01	0.	1.50E+01	0.	2.16E+04	1.42E+01
PR-144	6.46E-03	2.67E-03	0.	1.51E-03	0.	9.26E-10	3.27E-04
W--187	3.03E+00	2.54E+00	0.	0.	0.	8.31E+02	8.90E-01
NP-239	1.18E-02	1.16E-03	0.	3.58E-03	0.	2.36E+02	6.34E-04

Based on 1 μCi/sec release rate of each isotope in discharge flow of 1 cc/sec with no additional dilution

TABLE G-1
EFFLUENT CONCENTRATION LIMITS IN AIR IN UNRESTRICTED AREAS

NOTE
If a nuclide is not listed below, refer to 10 CFR Part 20, Appendix B, Table 2 Effluent Concentrations Column 1 and use the most conservative ECL listed for the nuclide.

Nuclide	ECL (μCi/ml)	Nuclide	ECL (μCi/ml)	Nuclide	ECL (μCi/ml)
Ar-41	1 E-8	Co-57	9 E-10	Sb-124	3 E-10
Kr-83m	5 E-5	Co-58	1 E-9	Sb-125	7 E-10
Kr-85m	1 E-7	Fe-59	5 E-10	Te-125m	1 E-9
Kr-85	7 E-7	Co-60	5 E-11	Te-127m	4 E-10
Kr-87	2 E-8	Zn-65	4 E-10	Te-129m	3 E-10
Kr-88	9 E-9	Rb-86	1 E-9	I-130	3 E-9
Kr-89	None	Rb-88	9 E-8	I-131	2 E-10
Kr-90	None	Sr-89	2 E-10	I-132	2 E-8
Xe-131m	2 E-6	Sr-90	6 E-12	I-133	1 E-9
Xe-133m	6 E-7	Y-91	2 E-10	I-134	6 E-8
Xe-133	5 E-7	Zr-95	4 E-10	I-135	6 E-9
Xe-135m	4 E-8	Nb-95	2 E-9	Cs-134	2 E-10
Xe-135	7 E-8	Ru-103	9 E-10	Cs-136	9 E-10
Xe-137	None	Ru-106	2 E-11	Cs-137	2 E-10
Xe-138	2 E-8	Ag-110	1 E-10	Ba-140	2 E-9
H-3	1 E-7	Sn-113	8 E-10	La-140	2 E-9
P-32	1 E-9	In-113m	2 E-7	Ce-141	8 E-10
Cr-51	3 E-8	Sn-123	2 E-10	Ce-144	2 E-11
Mn-54	1 E-9	Sn-126	8 E-11		

TABLE G-2
DOSE FACTORS FOR NOBLE GASES*

RADIONUCLIDE	TOTAL BODY DOSE FACTOR K_i (mrem/yr per μCi/m^3)	SKIN DOSE FACTOR L_i (mrem/yr per μCi/m^3)	GAMMA AIR DOSE FACTOR M_i (mrad/yr per μCi/m^3)	BETA AIR DOSE FACTOR N_i (mrad/yr per μCi/m^3)
Kr-83m	7.56E-02**	--------	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

* The listed dose factors are for radionuclides that may be detected in gaseous effluents.

** 7.56E-02 = 7.56×10^{-2}

TABLE G-3

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P (I) FOR GASEOUS DISCHARGES

PATHWAY - GROUND PLANE DEPOSITION AGE GROUP - INFANT

ORGAN DOSE FACTOR (SQ. METER - MREM/YR PER μCi/Sec)

NUCLIDE	WHOLE BODY
H-3	0.
CR-51	6.68E+06
MN-54	1.10E+09
FE-59	3.92E+08
CO-57	1.64E+08
CO-58	5.27E+08
CO-60	4.40E+09
ZN-65	6.87E+08
RB-86	1.29E+07
SR-89	3.07E+04
SR-90	5.94E+05
Y-91	1.53E+06
ZR-95	6.94E+08
NB-95	1.95E+08
RU-103	1.57E+08
RU-106	2.99E+08
AG-110	3.18E+09

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

TABLE G-3

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P (I) FOR GASEOUS DISCHARGES

PATHWAY - GROUND PLANE DEPOSITION AGE GROUP - INFANT

ORGAN DOSE FACTOR (SQ. METER - MREM/YR PER μCi/Sec)

NUCLIDE	WHOLE BODY
SN-126	4.80E+09
SB-124	8.42E+08
SB-125	7.56E+08
TE-125M	2.19E+06
TE-127M	1.15E+06
TE-129M	5.49E+07
I-130	7.90E+06
I-131	2.46E+07
I-132	1.78E+06
I-133	3.54E+06
I-134	6.43E+05
I-135	3.66E+06
CS-134	2.82E+09
CS-136	2.13E+08
CS-137	1.15E+09
BA-140	2.39E+08
CE-141	1.95E+07
CE-144	9.52E+07

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R (I) FOR GASEOUS DISCHARGES

PATHWAY - GROUND PLANE DEPOSITION AGE GROUP - CHILD - TEEN-ADULT & INFANT

ORGAN DOSE FACTOR (SQ. METER - MREM/YR PER μCi/Sec)

NUCLIDE	WHOLE BODY
H-3	0.
C-14	0
CR-51	4.68E+06
MN-54	1.38E+09
FE-59	2.75E+08
CO-57	1.89E+08
CO-58	3.80E+08
CO-60	2.15E+10
ZN-65	7.43E+08
RB-86	9.01E+06
SR-89	2.17E+04
SR-90	5.35E+06
Y-91	1.08E+06
ZR-95	5.01E+08
NB-95	1.36E+08
RU-103	1.10E+08
RU-106	4.19E+08
AG-110	3.58E+09

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R (I) FOR GASEOUS DISCHARGES

PATHWAY - GROUND PLANE DEPOSITION AGE GROUP - CHILD - TEEN-ADULT & INFANT

ORGAN DOSE FACTOR (SQ. METER - MREM/YR PER μCi/Sec)

NUCLIDE	WHOLE BODY
SN-126	5.16E+10
SB-124	5.98E+08
SB-125	2.30E+09
TE-125M	1.55E+06
TE-127M	8.79E+05
TE-129M	3.85E+07
I-130	5.53E+06
I-131	1.72E+07
I-132	1.25E+06
I-133	2.48E+06
I-134	4.50E+05
I-135	2.56E+06
CS-134	6.99E+09
CS-136	1.49E+08
CS-137	1.03E+10
BA-140	1.68E+08
CE-141	1.37E+07
CE-144	1.13E+08

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

TABLE G-5

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I)/P(I) FOR GASEOUS DISCHARGES

PATHWAY - INHALATION AGE GROUP - INFANT

ORGAN DOSE FACTOR (MREM/YR PER μCi/Cu Meter)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H-3	0.	4.30E+02	4.30E+02	1.88E+02	4.30E+02	4.30E+02	4.30E+02
C-14	5.04E+03	4.28E+03	4.28E+03	5.98E+02	4.28E+03	4.28E+03	4.28E+03
P-32	2.31E+05	1.35E+04	0.	0.	0.	1.51E+04	8.78E+03
CR-51	0.	0.	1.40E+01	3.99E+00	2.52E+03	5.81E+02	1.75E+01
MN-54	0.	6.93E+03	0.	1.72E+03	2.45E+05	1.35E+04	1.10E+03
FE-59	2.06E+03	4.86E+06	0.	0.	1.78E+05	3.29E+04	1.85E+03
CO-57	0.	1.21E+02	0.	0.	6.47E+04	5.50E+03	1.18E+02
CO-58	0.	1.18E+02	0.	0.	8.79E+05	1.21E+04	1.68E+02
CO-60	0.	8.40E+02	0.	0.	5.57E+06	3.28E+04	1.17E+03
ZN-65	5.67E+03	1.81E+04	0.	1.21E+04	1.53E+05	9.35E+03	8.15E+03
RB-86	0.	2.37E+04	0.	0.	0.	2.91E+03	1.03E+04
SR-89	4.31E+04	0.	0.	0.	2.31E+06	6.80E+04	1.24E+03
SR-90	1.32E+07	0.	0.	0.	1.53E+07	1.39E+05	8.06E+05
Y-91	5.98E+04	0.	0.	0.	2.63E+06	7.17E+04	1.60E+03
ZR-95	1.08E+04	2.73E+03	0.	9.48E+03	1.81E+06	1.41E+04	1.95E+03
NB-95	1.28E+03	5.75E+02	0.	1.35E+03	4.77E+05	1.21E+04	3.37E+02
RU-103	1.69E+02	0.	0.	1.02E+03	5.66E+05	1.58E+04	5.85E+01
RU-106	9.31E+03	0.	0.	2.34E+04	1.50E+07	1.76E+05	1.14E+03
AG-110	1.89E+03	1.75E+03	0.	3.44E+03	8.12E+05	5.29E+04	1.04E+03

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

TABLE G-5

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I)/P(I) FOR GASEOUS DISCHARGES

PATHWAY - INHALATION   AGE GROUP - INFANT

ORGAN DOSE FACTOR (MREM/YR PER µCi/Cu Meter)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	3.11E+04	6.45E+02	6.45E+02	0.	3.61E+06	5.99E+04	1.02E+03
SN-126	2.21E+05	5.85E+03	1.72E+03	0.	1.64E+06	2.23E+04	8.40E+03
SB-124	5.46E+03	1.03E+02	1.32E+01	0.	4.34E+05	7.11E+04	2.17E+03
SB-125	1.16E+04	1.25E+02	1.03E+01	0.	3.85E+05	1.76E+04	2.32E+03
TE-125M	4.54E+02	1.95E+02	1.53E+02	2.17E+03	4.96E+05	1.36E+04	6.16E+01
TE-127M	2.21E+03	9.83E+02	5.75E+02	8.01E+03	1.68E+05	2.62E+04	2.74E+02
TE-129M	1.32E+03	5.80E+02	5.08E+02	6.40E+03	1.83E+06	7.32E+04	2.06E+02
I-130	8.02E+02	2.35E+03	3.05E+05	3.65E+03	0.	1.35E+03	9.25E+02
I-131	3.63E+04	4.27E+04	1.41E+07	1.07E+04	0.	1.07E+03	2.51E+04
I-132	2.03E+02	5.70E+02	7.67E+04	9.09E+02	0.	7.11E+01	2.03E+02
I-133	1.34E+04	1.93E+04	4.66E+06	4.55E+03	0.	2.28E+03	5.87E+03
I-134	1.13E+02	3.02E+02	4.02E+04	4.82E+02	0.	1.76E-01	1.08E+02
I-135	4.70E+02	1.22E+03	1.64E+05	1.95E+03	0.	9.18E+02	4.51E+02
CS-134	4.80E+05	8.25E+05	0.	5.04E+04	1.01E+05	1.37E+03	7.32E+04
CS-136	6.85E+03	2.56E+04	0.	1.50E+04	2.10E+03	2.04E+03	1.95E+04
CS-137	6.86E+05	7.31E+05	0.	3.89E+04	9.45E+04	1.32E+03	4.41E+04
BA-140	5.70E+03	4.27E+00	0.	2.93E+00	1.64E+06	3.88E+03	2.95E+02
CE-141	2.52E+03	1.55E+03	0.	1.10E+03	5.24E+05	2.06E+04	1.81E+02
CE-144	4.68E+05	1.82E+05	0.	1.48E+05	1.27E+07	1.61E+05	2.49E+04

Based on 1 µCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

TABLE G-6

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I)/P(I) FOR GASEOUS DISCHARGES

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - INFANT

ORGAN DOSE FACTOR (SQ. METER - MREM/YR PER μi/Sec)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H-3	0.	2.37E+03	2.37E+03	1.04E+03	2.37E+03	2.37E+03	2.37E+03
C-14	6.55E+05	6.55E+05	6.55E+05	7.55E+04	6.55E+05	6.55E+05	6.55E+05
P-32	1.82E+10	1.14E+09	0.	0.	0.	2.05E+09	7.05E+08
CR-51	0.	0.	1.82E+04	6.72E+03	4.04E+04	7.66E+06	3.05E+04
MN-54	0.	8.96E+06	0.	2.67E+06	0.	2.74E+07	1.71E+06
FE-59	3.17E+07	7.52E+07	0.	0.	2.09E+07	2.48E+08	2.86E+07
CO-57	0.	1.36E+06	0.	0.	0.	3.46E+07	2.27E+06
CO-58	0.	2.55E+07	0.	0.	0.	6.60E+07	6.24E+07
CO-60	0.	8.73E+07	0.	0.	0.	2.16E+08	2.09E+08
ZN-65	1.46E+09	4.65E+09	0.	3.11E+09	0.	2.93E+09	2.10E+09
RB-86	0.	2.77E+09	0.	0.	0.	5.45E+08	1.29E+09
SR-89	1.47E+10	0.	0.	0.	0.	2.75E+08	4.22E+08
SR-90	1.65E+11	0.	0.	0.	0.	1.61E+09	4.21E+10
Y-91	8.12E+04	0.	0.	0.	0.	5.37E+06	2.16E+03
ZR-95	2.12E+05	9.41E+04	0.	1.86E+04	0.	7.47E+07	5.56E+04
NB-95	5.49E+05	2.47E+05	0.	4.84E+04	0.	1.98E+08	1.45E+05
RU-103	8.30E+03	0.	0.	4.16E+03	0.	1.04E+05	2.86E+03
RU-106	2.01E+05	0.	0.	4.20E+04	0.	1.56E+06	2.46E+04
AG-110	6.21E+07	5.75E+07	0.	1.13E+08	0.	2.35E+10	3.42E+07

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

Note: The units for C-14 and H-3 are (MREM/YR Per μCi/Cu. Meter)

TABLE G-6

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I)/P(I) FOR GASEOUS DISCHARGES

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - INFANT

ORGAN DOSE FACTOR (SQ. METER - MREM/YR PER μCi/Sec)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-126	1.75E+09	3.48E+07	1.01E+07	0.	4.97E+06	1.16E+09	5.25E+07
SB-124	2.75E+07	5.19E+05	6.64E+04	0.	2.13E+07	7.78E+08	1.09E+07
SB-125	3.59E+07	3.27E+06	2.93E+06	3.96E+06	2.83E+09	2.43E+08	6.62E+06
TE-125M	1.57E+08	5.30E+07	5.18E+07	7.05E+07	0.	7.57E+07	2.10E+07
TE-127M	5.54E+07	1.93E+07	1.79E+07	2.00E+08	0.	3.24E+08	7.38E+06
TE-129M	5.87E+08	2.02E+08	2.21E+08	2.70E+08	0.	3.54E+08	8.95E+07
I-130	4.54E+05	1.35E+06	1.71E+08	2.09E+06	0.	1.15E+06	5.29E+05
I-131	2.59E+09	3.09E+09	9.94E+11	7.24E+08	0.	1.16E+08	1.81E+09
I-132	1.78E-01	4.76E-01	6.26E+01	7.58E-01	0.	8.93E-02	1.69E-01
I-133	3.75E+07	5.48E+07	1.30E+10	1.29E+07	0.	9.74E+06	1.66E+07
I-134	0.	0.	1.06E-09	0.	0.	0.	0.
I-135	1.49E+04	3.94E+04	5.15E+06	6.26E+04	8.07E-02	4.41E+04	1.44E+04
CS-134	4.43E+10	7.97E+10	0.	4.65E+09	9.12E+09	1.90E+08	6.75E+09
CS-136	2.78E+08	1.10E+09	0.	6.11E+08	8.37E+07	1.25E+08	7.90E+08
CS-137	6.44E+10	7.21E+10	0.	3.66E+09	8.69E+09	1.86E+08	4.14E+09
BA-140	2.45E+08	2.47E+05	0.	1.22E+04	1.51E+05	8.13E+06	1.27E+07
CE-141	2.65E+05	1.62E+05	0.	9.72E+03	0.	7.87E+07	1.90E+04
CE-144	2.10E+07	8.29E+06	0.	5.67E+05	0.	8.66E+08	1.13E+06

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

Note: The units for C-14 and H-3 are (MREM/YR Per μCi/Cu. Meter)

TABLE G-7

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I)/P(I) FOR GASEOUS DISCHARGES

PATHWAY - GOATS MILK (CONTAMINATED FORAGE) AGE GROUP - INFANT

ORGAN DOSE FACTOR (SQ. METER - MREM/YR PER μCi/Sec)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H-3	0.	4.84E+03	4.84E+03	2.11E+03	4.84E+03	4.84E+03	4.84E+03
C-14	6.55E+05	6.55E+05	6.55E+05	7.75E+04	6.55E+05	6.55E+05	6.55E+05
P-32	2.19E+10	1.37E+09	0.	0.	0.	2.46E+09	8.46E+08
CR-51	0.	0.	2.19E+03	8.07E+02	4.85E+03	9.19E+05	3.66E+03
MN-54	0.	1.08E+06	0.	3.20E+05	0.	3.29E+06	2.05E+05
FE-59	4.12E+05	9.78E+05	0.	0.	2.72E+05	3.23E+06	3.72E+05
CO-57	0.	1.64E+05	0.	0.	0.	4.15E+06	2.72E+05
CO-58	0.	3.06E+06	0.	0.	0.	7.92E+06	7.49E+06
CO-60	0.	1.05E+07	0.	0.	0.	2.59E+07	2.51E+07
ZN-65	1.76E+08	5.57E+08	0.	3.73E+08	0.	3.51E+08	2.52E+08
RB-86	0.	3.32E+08	0.	0.	0.	6.54E+07	1.55E+08
SR-89	3.09E+10	0.	0.	0.	0.	5.77E+08	8.87E+08
SR-90	3.46E+11	0.	0.	0.	0.	3.35E+09	8.83E+10
Y-91	9.74E+03	0.	0.	0.	0.	6.45E+05	2.60E+02
ZR-95	2.54E+04	1.13E+04	0.	2.23E+03	0.	8.95E+06	6.67E+03
NB-95	6.59E+04	2.97E+04	0.	5.81E+03	0.	2.37E+07	1.75E+04
RU-103	9.96E+02	0.	0.	4.99E+02	0.	1.24E+04	3.43E+02
RU-106	2.41E+04	0.	0.	5.04E+03	0.	1.87E+05	2.96E+03
AG-110	7.45E+06	6.90E+06	0.	1.36E+07	0.	2.81E+09	4.10E+06

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

Note: The units for C-14 and H-3 are (MREM/YR Per μCi/Cu. Meter)

TABLE G-7

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I)/P(I) FOR GASEOUS DISCHARGES

PATHWAY - GOATS MILK (CONTAMINATED FORAGE) AGE GROUP - INFANT

ORGAN DOSE FACTOR (SQ. METER - MREM/YR PER μCi/Sec)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-126	2.10E+08	4.17E+06	1.22E+06	0.	5.97E+05	1.40E+08	6.30E+06
SB-124	3.30E+06	6.22E+04	7.97E+03	0.	2.56E+06	9.33E+07	1.30E+06
SB-125	4.31E+06	3.92E+05	3.52E+05	4.76E+05	3.40E+08	2.92E+07	7.94E+05
TE-125M	1.89E+07	6.36E+06	6.21E+06	8.46E+06	0.	9.09E+06	2.52E+06
TE-127M	6.64E+06	2.31E+06	2.15E+06	2.40E+07	0.	3.88E+07	8.85E+05
TE-129M	7.05E+07	2.42E+07	2.66E+07	3.23E+07	0.	4.25E+07	1.07E+07
I-130	5.45E+05	1.61E+06	2.05E+08	2.51E+06	0.	1.38E+06	6.35E+05
I-131	3.11E+09	3.70E+09	1.19E+12	9.28E+08	0.	1.39E+08	2.17E+09
I-132	2.13E-01	5.71E-01	7.51E+01	9.10E-01	0.	1.07E-01	2.03E-01
I-133	4.50E+07	6.57E+07	1.55E+10	1.55E+07	0.	1.17E+07	1.99E+07
I-134	0.	0.	1.27E-09	0.	0.	0.	0.
I-135	1.79E+04	4.72E+04	6.18E+06	7.51E+04	2.42E-01	5.29E+04	1.73E+04
CS-134	1.33E+11	2.39E+11	0.	1.39E+10	2.74E+10	5.69E+08	2.02E+10
CS-136	8.34E+08	3.29E+09	0.	1.83E+09	2.51E+08	3.74E+08	2.37E+09
CS-137	1.93E+11	2.16E+11	0.	1.10E+10	2.61E+10	5.59E+08	1.24E+10
BA-140	2.95E+07	2.96E+04	0.	1.47E+03	1.81E+04	9.76E+05	1.52E+06
CE-141	3.17E+04	1.95E+04	0.	1.17E+03	0.	9.44+06	2.28E+03
CE-144	2.52E+06	9.95E+05	0.	6.80E+04	0.	1.04E+08	1.36E+05

Based on 1 μCi/sec release rate of each isotope in and a Value of 1. for X/Q, depleted X/Q and Relative Deposition

Note: The units for C-14 and H-3 are (MREM/YR Per μCi/Cu. Meter)

TABLE G-8
ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES
PATHWAY - INHALATION AGE GROUP - CHILD
ORGAN DOSE FACTOR (MREM/YR PER μCi/CU. METER)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	7.51E+02	7.51E+02	4.96E+02	7.51E+02	7.51E+02	7.51E+02
C-14	6.25E+03	6.25E+03	6.25E+03	1.58E+03	6.25E+03	6.25E+03	6.25E+03
P---32	6.11E+05	3.57E+04	0.	0.	0.	4.00E+04	2.32E+04
CR--51	0.	0.	2.75E+01	1.06E+01	6.66E+03	1.54E+03	4.63E+01
MN--54	0.	1.83E+04	0.	4.55E+03	6.48E+05	3.58E+04	2.91E+03
FE--59	5.44E+03	1.28E+07	0.	0.	4.70E+05	8.70E+04	4.88E+03
CO--57	0.	3.20E+02	0.	0.	1.71E+05	1.45E+04	3.10E+02
CO--58	0.	1.52E+02	0.	0.	1.13E+06	3.62E+04	2.68E+02
CO--60	0.	1.07E+03	0.	0.	6.92E+06	9.36E+04	1.88E+03
ZN--65	1.50E+04	4.77E+04	0.	3.19E+04	4.03E+05	2.47E+04	2.15E+04
RB--86	0.	6.25E+04	0.	0.	0.	7.70E+03	2.73E+04
SR--89	5.37E+04	0.	0.	0.	2.24E+06	1.69E+05	1.54E+03
SR--90	1.64E+07	0.	0.	0.	1.48E+07	3.45E+05	9.99E+05
Y---91	7.44E+04	0.	0.	0.	2.55E+06	1.78E+05	1.98E+03
ZR--95	1.41E+04	3.28E+03	0.	2.51E+04	2.12E+06	5.74E+04	2.98E+03
NB--95	1.70E+03	7.25E+02	0.	3.58E+03	5.85E+05	3.32E+04	5.33E+02
RU-103	2.16E+02	0.	0.	2.70E+03	6.33E+05	4.22E+04	8.73E+01
RU-106	1.15E+04	0.	0.	6.18E+04	1.45E+07	4.37E+05	1.44E+03
AG110	5.00E+03	4.63E+03	0.	9.10E+03	2.15E+06	1.40E+05	2.75E+03

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-8

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - INHALATION AGE GROUP - CHILD

ORGAN DOSE FACTOR (MREM/YR PER μCi/CU. METER)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	3.85E+04	6.44E+02	6.81E+02	0.	3.50E+06	1.49E+05	1.27E+03
SN-126	5.85E+05	1.55E+04	4.55E+03	0.	4.33E+06	5.88E+04	2.22E+04
SB-124	1.44E+04	2.72E+02	3.49E+01	0.	1.15E+06	1.88E+05	5.74E+03
SB-125	3.06E+04	3.30E+02	2.72E+01	0.	1.02E+06	4.66E+04	6.14E+03
TE 125M	5.62E+02	1.94E+02	1.61E+02	5.74E+03	4.81E+05	3.38E+04	7.62E+01
TE 127M	5.85E+03	2.60E+03	1.52E+03	2.12E+04	4.44E+05	6.92E+04	7.25E+02
TE 129M	1.64E+03	5.85E+02	5.40E+02	1.69E+04	1.80E+06	1.82E+05	2.60E+02
I--130	2.12E+03	6.22E+03	8.07E+05	9.66E+03	0.	3.56E+03	2.45E+03
I--131	4.55E+04	4.63E+04	1.54E+07	2.84E+04	0.	2.65E+03	3.50E+04
I--132	5.37E+02	1.51E+03	2.03E+05	2.40E+03	0.	1.88E+02	5.37E+02
I--133	1.68E+04	2.05E+04	5.03E+06	1.20E+04	0.	5.55E+03	8.03E+03
I--134	2.98E+02	7.99E+02	1.06E+05	1.27E+03	0.	4.66E-01	2.85E+02
I--135	1.24E+03	3.23E+03	4.33E+05	5.14E+03	0.	2.43E+03	1.19E+03
CS-134	6.22E+05	9.95E+05	0.	1.33E+05	1.19E+05	3.77E+03	2.23E+05
CS-136	1.81E+04	6.77E+04	0.	3.96E+04	5.55E+03	5.40E+03	5.14E+04
CS-137	8.66E+05	7.99E+05	0.	1.03E+05	1.00E+05	3.41E+03	1.25E+05
BA-140	7.14E+03	4.66E+00	0.	7.73E+00	1.74E+06	9.92E+03	4.22E+02
CE-141	3.13E+03	1.57E+03	0.	2.90E+03	5.14E+05	5.44E+04	2.33E+02
CE-144	5.81E+05	1.82E+05	0.	3.92E+05	1.23E+07	4.00E+05	3.10E+04

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-9
ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES
PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - CHILD
ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER µCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	1.57E+03	1.57E+03	1.04E+03	1.57E+03	1.57E+03	1.57E+03
C-14	3.08E+05	3.08E+05	3.08E+05	7.75E+04	3.08E+05	3.08E+05	3.08E+05
P---32	1.82E+10	1.14E+09	0.	0.	0.	2.05E+09	7.05E+08
CR--51	0.	0.	1.82E+04	6.72E+03	4.04E+04	7.66E+06	3.05E+04
MN--54	0.	8.96E+06	0.	2.67E+06	0.	2.74E+07	1.71E+06
FE--59	3.17E+07	7.52E+07	0.	0.	2.09E+07	2.48E+08	2.86E+07
CO--57	0.	1.36E+06	0.	0.	0.	3.46E+07	2.27E+06
CO--58	0.	1.25E+07	0.	0.	0.	7.41E+07	3.76E+07
CO--60	0.	4.22E+07	0.	0.	0.	2.33E+08	1.27E+08
ZN--65	1.46E+09	4.65E+09	0.	3.11E+09	0.	2.93E+09	2.10E+09
RB--86	0.	2.77E+09	0.	0.	0.	5.45E+08	1.29E+09
SR--89	6.92E+09	0.	0.	0.	0.	2.58E+08	1.98E+08
SR--90	1.13E+11	0.	0.	0.	0.	1.52E+09	2.87E+10
Y---91	3.80E+04	0.	0.	0.	0.	5.05E+06	1.01E+03
ZR--95	1.06E+05	4.47E+04	0.	1.86E+04	0.	7.68E+07	3.29E+04
NB--95	2.75E+05	1.18E+05	0.	4.84E+04	0.	2.03E+08	8.63E+04
RU-103	3.99E+03	0.	0.	4.16E+03	0.	1.05E+05	1.61E+03
RU-106	9.39E+04	0.	0.	4.20E+04	0.	1.46E+06	1.17E+04
AG110	6.21E+07	5.75E+07	0.	1.13E+08	0.	2.35E+10	3.42E+07

Based on 1 µCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per µCi/cu. meter)

TABLE G-9

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - CHILD

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	1.75E+09	3.48E+07	1.01E+07	0.	4.97E+06	1.16E+09	5.25E+07
SB-124	2.75E+07	5.19E+05	6.64E+04	0.	2.13E+07	7.78E+08	1.09E+07
SB-125	3.13E+07	1.41E+06	1.18E+06	3.96E+06	2.83E+09	2.43E+08	5.99E+06
TE 125M	7.38E+07	2.00E+07	2.07E+07	7.05E+07	0.	7.12E+07	9.84E+06
TE 127M	5.18E+07	1.78E+07	1.46E+07	2.00E+08	0.	2.99E+08	6.60E+06
TE 129M	2.77E+08	7.73E+07	8.85E+07	2.70E+08	0.	3.33E+08	4.28E+07
I--130	4.54E+05	1.35E+06	1.71E+08	2.09E+06	0.	1.15E+06	5.29E+05
I--131	1.24E+09	1.27E+09	4.12E+11	7.74E+08	0.	1.09E+08	9.56E+08
I--132	1.78E-01	4.76E-01	6.26E+01	7.58E-01	0.	8.93E-02	1.69E-01
I--133	1.78E+07	2.20E+07	5.30E+09	1.29E+07	0.	8.90E+06	8.63E+06
I--134	0.	0.	1.06E-09	0.	0.	0.	0.
I--135	1.49E+04	3.94E+04	5.15E+06	6.26E+04	8.07E-02	4.41E+04	1.44E+04
CS-134	2.17E+10	3.65E+10	0.	4.65E+09	4.06E+09	1.97E+08	7.76E+09
CS-136	2.78E+08	1.10E+09	0.	6.11E+08	8.37E+07	1.25E+08	7.90E+08
CS-137	3.08E+10	2.98E+10	0.	3.66E+09	3.49E+09	1.81E+08	4.44E+09
BA-140	1.17E+08	1.02E+05	0.	1.22E+04	6.09E+04	7.75E+06	6.84E+06
CE-141	1.24E+05	6.22E+04	0.	9.72E+03	0.	7.80E+07	9.26E+03
CE-144	1.00E+07	3.14E+06	0.	5.67E+05	0.	8.15E+08	5.34E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-10
ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES
PATHWAY - GOATS MILK (CONTAMINATED FORAGE) AGE GROUP - CHILD
ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	3.20E+03	3.20E+03	2.11E+03	3.20E+03	3.20E+03	3.20E+03
C-14	3.08E+05	3.08E+05	3.08E+05	7.75E+04	3.08E+05	3.08E+05	3.08E+05
P---32	2.19E+10	1.37E+09	0.	0.	0.	2.46E+09	8.46E+08
CR--51	0.	0.	2.19E+03	8.07E+02	4.85E+03	9.19E+05	3.66E+03
MN--54	0.	1.08E+06	0.	3.20E+05	0.	3.29E+06	2.05E+05
FE--59	4.12E+05	9.78E+05	0.	0.	2.72E+05	3.23E+06	3.72E+05
CO--57	0.	1.64E+05	0.	0.	0.	4.15E+06	2.72E+05
CO--58	0.	1.50E+06	0.	0.	0.	8.90E+06	4.51E+06
CO--60	0.	5.06E+06	0.	0.	0.	2.80E+07	1.52E+07
ZN--65	1.76E+08	5.57E+08	0.	3.73E+08	0.	3.51E+08	2.52E+08
RB--86	0.	3.32E+08	0.	0.	0.	6.54E+07	1.55E+08
SR--89	1.45E+10	0.	0.	0.	0.	5.43E+08	4.16E+08
SR--90	2.37E+11	0.	0.	0.	0.	3.16E+09	6.02E+10
Y---91	4.56E+03	0.	0.	0.	0.	6.06E+05	1.22E+02
ZR--95	1.27E+04	5.37E+03	0.	2.23E+03	0.	9.22E+06	3.96E+03
NB--95	3.30E+04	1.41E+04	0.	5.81E+03	0.	2.44E+07	1.04E+04
RU-103	4.79E+02	0.	0.	4.99E+02	0.	1.26E+04	1.94E+02
RU-106	1.13E+04	0.	0.	5.04E+03	0.	1.75E+05	1.40E+03
AG110	7.45E+06	6.90E+06	0.	1.36E+07	0.	2.81E+09	4.10E+06

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-10

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - GOATS MILK (CONTAMINATED FORAGE) AGE GROUP - CHILD

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	2.10E+08	4.17E+06	1.22E+06	0.	5.97E+05	1.40E+08	6.30E+06
SB-124	3.30E+06	6.22E+04	7.97E+03	0.	2.56E+06	9.33E+07	1.30E+06
SB-125	3.75E+06	1.70E+05	1.43E+05	4.76E+05	3.40E+08	2.92E+07	7.19E+05
TE 125M	8.85E+06	2.40E+06	2.49E+06	8.46E+06	0.	8.54E+06	1.18E+06
TE 127M	6.21E+06	2.14E+06	1.75E+06	2.40E+07	0.	3.58E+07	7.92E+05
TE 129M	3.32E+07	9.27E+06	1.06E+07	3.23E+07	0.	4.00E+07	5.15E+06
I--130	5.45E+05	1.61E+06	2.05E+08	2.51E+06	0.	1.38E+06	6.35E+05
I--131	1.48E+09	1.52E+09	4.94E+11	9.28E+08	0.	1.30E+08	1.15E+09
I--132	2.13E-01	5.71E-01	7.51E+01	9.10E-01	0.	1.07E-01	2.03E-01
I--133	2.14E+07	2.64E+07	6.36E+09	1.55E+07	0.	1.07E+07	1.04E+07
I--134	0.	0.	1.27E-09	0.	0.	0.	0.
I--135	1.79E+04	4.72E+04	6.18E+06	7.51E+04	2.42E-01	5.29E+04	1.73E+04
CS-134	6.50E+10	1.10E+11	0.	1.39E+10	1.22E+10	5.92E+08	2.33E+10
CS-136	8.34E+08	3.29E+09	0.	1.83E+09	2.51E+08	3.74E+08	2.37E+09
CS-137	9.23E+10	8.93E+10	0.	1.10E+10	1.05E+10	5.44E+08	1.33E+10
BA-140	1.40E+07	1.23E+04	0.	1.47E+03	7.31E+03	9.30E+05	8.21E+05
CE-141	1.49E+04	7.46E+03	0.	1.17E+03	0.	9.36E+06	1.11E+03
CE-144	1.20E+06	3.76E+05	0.	6.80E+04	0.	9.78E+07	6.41E+04

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-11

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - MEAT (CONTAMINATED FORAGE) AGE GROUP - CHILD

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	2.33E+02	2.33E+02	1.54E+02	2.33E+02	2.33E+02	2.33E+02
C-14	9.87E+04	9.87E+04	9.87E+04	2.49E+04	9.87E+04	9.87E+04	9.87E+04
P---32	1.74E+09	1.09E+08	0.	0.	0.	1.96E+08	6.73E+07
CR--51	0.	0.	1.58E+03	5.82E+02	3.50E+03	6.63E+05	2.64E+03
MN--54	0.	3.42E+06	0.	1.02E+06	0.	1.05E+07	6.54E+05
FE--59	9.95E+07	2.36E+08	0.	0.	6.55E+07	7.79E+08	8.98E+07
CO--57	0.	2.10E+06	0.	0.	0.	5.33E+07	3.50E+06
CO--58	0.	1.69E+07	0.	0.	0.	1.00E+08	5.10E+07
CO--60	0.	6.77E+07	0.	0.	0.	3.75E+08	2.03E+08
ZN--65	1.33E+08	4.22E+08	0.	2.82E+08	0.	2.66E+08	1.91E+08
RB--86	0.	1.82E+08	0.	0.	0.	3.59E+07	8.50E+07
SR--89	5.04E+08	0.	0.	0.	0.	1.88E+07	1.44E+07
SR--90	1.05E+10	0.	0.	0.	0.	7.02E+08	2.67E+09
Y---91	1.76E+06	0.	0.	0.	0.	2.33E+08	4.69E+04
ZR--95	4.62E+06	1.51E+06	0.	7.47E+05	0.	2.22E+09	1.20E+06
NB--95	2.68E+06	1.15E+06	0.	4.72E+05	0.	1.98E+09	8.41E+05
RU-103	1.45E+08	0.	0.	1.51E+08	0.	3.81E+09	5.87E+07
RU-106	4.51E+09	0.	0.	2.02E+09	0.	7.01E+10	5.61E+08
AG110	2.50E+06	2.31E+06	0.	4.55E+06	0.	9.44E+08	1.38E+06

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-11

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - MEAT (CONTAMINATED FORAGE) AGE GROUP - CHILD

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	6.92E+09	1.37E+08	4.02E+07	0.	2.41E+06	2.31E+09	1.98E+08
SB-124	7.40E+06	1.40E+05	1.79E+04	0.	5.74E+06	2.10E+08	2.93E+06
SB-125	7.66E+07	1.84E+07	1.90E+07	6.47E+07	9.26E+08	1.44E+08	1.08E+07
TE 125M	5.69E+08	1.54E+08	1.60E+08	5.44E+08	0.	5.49E+08	7.59E+07
TE 127M	4.40E+08	1.51E+08	1.24E+08	1.70E+09	0.	2.54E+09	5.61E+07
TE 129M	1.84E+09	5.12E+08	5.87E+08	1.78E+09	0.	2.21E+09	2.84E+08
I--130	8.87E-07	2.63E-06	3.34E-04	4.08E-06	0.	2.25E-06	1.03E-06
I--131	1.58E+07	1.62E+07	5.25E+09	9.86E+06	0.	1.38E+06	1.22E+07
I--132	0.	0.	0.	0.	0.	0.	0.
I--133	6.86E-01	8.47E-01	2.04E+02	4.97E-01	0.	3.43E-01	3.33E-01
I--134	0.	0.	0.	0.	0.	0.	0.
I--135	3.21E-02	2.96E-02	0.	1.12E-02	3.37E-03	6.92E-04	1.32E-02
CS-134	8.83E+08	1.49E+09	0.	1.89E+08	1.65E+08	8.04E+06	3.16E+08
CS-136	4.41E+06	1.74E+07	0.	9.69E+06	1.33E+06	1.98E+06	1.25E+07
CS-137	1.27E+09	1.23E+09	0.	1.51E+08	1.44E+08	7.50E+06	1.84E+08
BA-140	4.37E+07	3.84E+04	0.	4.59E+03	2.29E+04	6.03E+06	2.57E+06
CE-141	2.10E+04	1.05E+04	0.	1.65E+03	0.	1.32E+07	1.57E+03
CE-144	2.38E+06	7.46E+05	0.	1.35E+05	0.	1.94E+08	1.27E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-12

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - FRESH FRUITS AND VEGETABLES AGE GROUP - CHILD

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	2.47E+02	2.47E+02	1.63E+02	2.47E+02	2.47E+02	2.47E+02
C-14	4.04E+04	4.04E+04	4.04E+04	1.02E+04	4.04E+04	4.04E+04	4.04E+04
P---32	4.22E+08	2.64E+07	0.	0.	0.	4.74E+07	1.63E+07
CR--51	0.	0.	4.68E+03	1.73E+03	1.04E+04	1.97E+06	7.83E+03
MN--54	0.	1.98E+07	0.	5.89E+06	0.	6.07E+07	3.78E+06
FE--59	1.48E+07	3.51E+07	0.	0.	9.75E+06	1.16E+08	1.34E+07
CO--57	0.	7.53E+05	0.	0.	0.	1.91E+07	1.25E+06
CO--58	0.	6.94E+06	0.	0.	0.	4.13E+07	2.09E+07
CO--60	0.	2.33E+07	0.	0.	0.	1.29E+08	6.98E+07
ZN--65	2.08E+07	6.59E+07	0.	4.41E+07	0.	4.15E+07	2.98E+07
RB--86	0.	5.28E+07	0.	0.	0.	1.04E+07	2.46E+07
SR--89	4.84E+09	0.	0.	0.	0.	1.81E+08	1.39E+08
SR--90	7.79E+10	0.	0.	0.	0.	1.52E+09	1.98E+10
Y---91	2.12E+06	0.	0.	0.	0.	2.82E+08	5.65E+04
ZR--95	4.06E+05	9.87E+04	0.	6.07E+04	0.	1.08E+08	8.81E+04
NB--95	6.20E+04	2.64E+04	0.	1.09E+04	0.	4.58E+07	1.94E+04
RU-103	2.24E+06	0.	0.	2.34E+06	0.	5.88E+07	9.05E+05
RU-106	5.19E+07	0.	0.	2.32E+07	0.	8.07E+08	6.46E+06
AG110	6.87E+05	6.36E+05	0.	1.25E+06	0.	2.59E+08	3.78E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-12

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - FRESH FRUITS AND VEGETABLES AGE GROUP - CHILD

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	1.71E-05	2.14E-07	2.26E-07	0.	0.	8.50E-06	4.21E-07
SN-126	3.87E+08	7.68E+06	2.25E+06	0.	1.75E+06	3.44E+08	1.19E+07
SB-124	1.02E+07	1.93E+05	2.47E+04	0.	7.93E+06	2.89E+08	4.04E+06
SB-125	1.22E+07	6.99E+05	6.22E+05	2.09E+06	1.04E+09	9.02E+07	2.29E+06
TE 125M	4.12E+07	1.12E+07	1.16E+07	3.94E+07	0.	3.97E+07	5.49E+06
TE 127M	2.88E+07	9.90E+06	8.09E+06	1.11E+08	0.	1.65E+08	3.67E+06
TE 129M	1.56E+08	4.35E+07	4.99E+07	1.51E+08	0.	1.88E+08	2.41E+07
I--130	1.60E+05	4.73E+05	6.02E+07	7.35E+05	0.	4.05E+05	1.86E+05
I--131	1.24E+08	1.27E+08	4.13E+10	7.75E+07	0.	1.09E+07	9.58E+07
I--132	2.26E+01	6.05E+01	7.97E+03	9.65E+01	0.	1.14E+01	2.15E+01
I--133	3.61E+06	4.46E+06	1.08E+09	2.62E+06	0.	1.81E+06	1.75E+06
I--134	4.18E-05	1.14E-04	1.47E-02	1.81E-04	0.	9.89E-08	4.06E-05
I--135	1.64E+04	4.33E+04	5.67E+06	6.89E+04	3.51E-03	4.85E+04	1.59E+04
CS-134	9.97E+08	1.68E+09	0.	2.14E+08	1.87E+08	9.08E+06	3.57E+08
CS-136	1.35E+07	5.32E+07	0.	2.96E+07	4.06E+06	6.05E+06	3.83E+07
CS-137	1.41E+09	1.37E+09	0.	1.68E+08	1.60E+08	8.34E+06	2.04E+08
BA-140	1.70E+08	1.56E+05	0.	1.78E+04	8.87E+04	2.08E+08	9.96E+06
CE-141	1.17E+05	5.84E+04	0.	9.13E+03	0.	7.33E+07	8.69E+03
CE-144	9.23E+06	2.89E+06	0.	5.22E+05	0.	7.51E+08	4.92E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-13

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - INHALATION AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (MREM/YR PER μCI/CU. METER)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	8.48E+02	8.48E+02	1.07E+03	8.48E+02	8.48E+02	8.48E+02
C-14	4.58E+03	4.53E+03	4.53E+03	3.42E+03	4.53E+03	4.58E+03	4.53E+03
P---32	1.32E+06	7.72E+04	0.	0.	0.	8.64E+04	5.02E+04
CR--51	0.	0.	5.95E+01	2.28E+01	1.44E+04	3.32E+03	1.00E+02
MN--54	0.	3.96E+04	0.	9.84E+03	1.40E+06	7.74E+04	6.30E+03
FE--59	1.18E+04	2.78E+07	0.	0.	1.02E+06	1.88E+05	1.06E+04
CO--57	0.	6.92E+02	0.	0.	3.70E+05	3.14E+04	6.71E+02
CO--58	0.	1.76E+02	0.	0.	1.37E+06	9.52E+04	2.34E+02
CO--60	0.	1.24E+03	0.	0.	8.56E+06	2.35E+05	1.65E+03
ZN--65	3.24E+04	1.03E+05	0.	6.90E+04	8.72E+05	5.34E+04	4.66E+04
RB--86	0.	1.35E+05	0.	0.	0.	1.66E+04	5.90E+04
SR--89	3.87E+04	0.	0.	0.	2.50E+06	3.54E+05	1.11E+03
SR--90	1.18E+07	0.	0.	0.	1.66E+07	7.24E+05	7.23E+05
Y---91	5.38E+04	0.	0.	0.	2.86E+06	3.74E+05	1.44E+03
ZR--95	1.09E+04	3.63E+03	0.	5.42E+04	2.56E+06	1.33E+05	2.54E+03
NB--95	1.36E+03	8.24E+02	0.	7.74E+03	7.17E+05	8.80E+04	4.62E+02
RU-103	1.63E+02	0.	0.	5.83E+03	7.51E+05	9.44E+04	7.32E+01
RU-106	8.40E+03	0.	0.	1.34E+05	1.64E+07	9.28E+05	1.06E+03
AG110	1.08E+04	1.00E+04	0.	1.97E+04	4.64E+06	3.02E+05	5.94E+03

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-13

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - INHALATION AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (MREM/YR PER μCI/CU. METER)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	2.79E+04	6.14E+02	4.92E+02	0.	3.91E+06	3.13E+05	9.20E+02
SN-126	1.26E+06	3.34E+04	9.84E+03	0.	9.36E+06	1.27E+05	4.80E+04
SB-124	3.12E+04	5.89E+02	7.55E+01	0.	2.48E+06	4.06E+05	1.24E+04
SB-125	6.61E+04	7.13E+02	5.87E+01	0.	2.20E+06	1.01E+05	1.33E+04
TE 125M	4.07E+02	1.86E+02	1.17E+02	1.24E+04	5.36E+05	7.08E+04	5.53E+01
TE 127M	1.26E+04	5.62E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05	1.57E+03
TE 129M	1.19E+03	5.64E+02	3.90E+02	3.66E+04	2.03E+06	3.84E+05	1.92E+02
I--130	4.58E+03	1.34E+04	1.74E+06	2.09E+04	0.	7.69E+03	5.29E+03
I--131	3.37E+04	4.72E+04	1.39E+07	6.14E+04	0.	5.96E+03	2.82E+04
I--132	1.16E+03	3.26E+03	4.38E+05	5.19E+03	0.	4.06E+02	1.16E+03
I--133	1.23E+04	2.06E+04	3.83E+06	2.60E+04	0.	1.00E+04	6.34E+03
I--134	6.45E+02	1.73E+03	2.30E+05	2.75E+03	0.	1.01E+00	6.16E+02
I--135	2.69E+03	6.99E+03	9.36E+05	1.11E+04	0.	5.25E+03	2.58E+03
CS-134	4.83E+05	1.10E+06	0.	2.88E+05	1.44E+05	8.96E+03	5.44E+05
CS-136	3.91E+04	1.46E+05	0.	8.56E+04	1.20E+04	1.17E+04	1.11E+05
CS-137	6.42E+05	8.24E+05	0.	2.22E+05	1.18E+05	7.68E+03	3.03E+05
BA-140	5.30E+03	4.85E+00	0.	1.67E+01	2.02E+06	2.12E+04	3.42E+02
CE-141	2.27E+03	1.52E+03	0.	6.26E+03	5.83E+05	1.14E+05	1.74E+02
CE-144	4.19E+05	1.74E+05	0.	8.48E+05	1.38E+07	8.40E+05	2.24E+04

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-14

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	9.93E+02	9.93E+02	1.26E+03	9.93E+02	9.93E+02	9.93E+02
C-14	1.25E+05	1.25E+05	1.25E+05	9.39E+04	1.25E+05	1.25E+05	1.25E+05
P---32	2.21E+10	1.38E+09	0.	0.	0.	2.48E+09	8.54E+08
CR--51	0.	0.	2.21E+04	8.15E+03	4.90E+04	9.29E+06	3.69E+04
MN--54	0.	1.09E+07	0.	3.23E+06	0.	3.33E+07	2.07E+06
FE--59	3.84E+07	9.12E+07	0.	0.	2.53E+07	3.01E+08	3.47E+07
CO--57	0.	1.65E+06	0.	0.	0.	4.19E+07	2.75E+06
CO--58	0.	8.10E+06	0.	0.	0.	1.10E+08	1.85E+07
CO--60	0.	2.73E+07	0.	0.	0.	3.27E+08	6.23E+07
ZN--65	1.77E+09	5.63E+09	0.	3.77E+09	0.	3.55E+09	2.55E+09
RB--86	0.	3.35E+09	0.	0.	0.	6.61E+08	1.56E+09
SR--89	2.80E+09	0.	0.	0.	0.	3.03E+08	8.03E+07
SR--90	8.29E+10	0.	0.	0.	3.38E+06	1.76E+09	2.05E+10
Y---91	1.54E+04	0.	0.	0.	0.	5.93E+06	4.12E+02
ZR--95	4.78E+04	2.84E+04	0.	2.25E+04	0.	1.15E+08	1.60E+04
NB--95	1.24E+05	7.46E+04	0.	5.87E+04	0.	3.05E+08	4.21E+04
RU-103	1.69E+03	0.	0.	5.04E+03	0.	1.32E+05	7.56E+02
RU-106	3.83E+04	0.	0.	5.09E+04	0.	1.73E+06	4.81E+03
AG-110	7.53E+07	6.97E+07	0.	1.37E+08	0.	2.84E+10	4.14E+07

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-14

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	2.12E+09	4.21E+07	1.24E+07	0.	6.03E+06	1.41E+09	6.37E+07
SB-124	3.33E+07	6.29E+05	8.05E+04	0.	2.59E+07	9.43E+08	1.32E+07
SB-125	3.45E+07	9.58E+05	5.05E+05	4.80E+06	3.43E+09	2.95E+08	6.82E+06
TE 125M	3.00E+07	1.08E+07	8.47E+06	8.55E+07	0.	8.39E+07	3.98E+06
TE 127M	6.02E+07	2.11E+07	1.59E+07	2.43E+08	0.	3.02E+08	7.45E+06
TE 129M	1.13E+08	4.18E+07	3.61E+07	3.27E+08	0.	3.93E+08	1.78E+07
I--130	5.51E+05	1.63E+06	2.07E+08	2.53E+06	0.	1.40E+06	6.41E+05
I--131	5.12E+08	7.24E+08	2.09E+11	9.38E+08	0.	1.37E+08	4.31E+08
I--132	2.16E-01	5.76E-01	7.59E+01	9.19E-01	0.	1.08E-01	2.05E-01
I--133	7.33E+06	1.24E+07	2.26E+09	1.56E+07	0.	9.02E+06	3.83E+06
I--134	0.	0.	1.29E-09	0.	0.	0.	0.
I--135	1.81E+04	4.77E+04	6.24E+06	7.58E+04	9.79E-02	5.34E+04	1.75E+04
CS-134	9.44E+09	2.28E+10	0.	5.63E+09	2.76E+09	2.63E+08	1.06E+10
CS-136	3.37E+08	1.33E+09	0.	7.41E+08	1.02E+08	1.51E+08	9.58E+08
CS-137	1.28E+10	1.72E+10	0.	4.43E+09	2.28E+09	2.29E+08	6.04E+09
BA-140	4.84E+07	5.95E+04	0.	1.48E+04	3.98E+04	9.16E+06	3.11E+06
CE-141	5.05E+04	3.39E+04	0.	1.18E+04	0.	9.18E+07	3.89E+03
CE-144	4.10E+06	1.68E+06	0.	6.87E+05	0.	9.65E+08	2.17E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition
Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-15

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - GOATS MILK (CONTAMINATED FORAGE) AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	2.03E+03	2.03E+03	2.56E+03	2.03E+03	2.03E+03	2.03E+03
C-14	1.25E+05	1.25E+05	1.25E+05	9.39E+04	1.25E+05	1.25E+05	1.25E+05
P---32	2.65E+10	1.66E+09	0.	0.	0.	2.98E+09	1.03E+09
CR--51	0.	0.	2.65E+03	9.78E+02	5.88E+03	1.11E+06	4.43E+03
MN--54	0.	1.30E+06	0.	3.88E+05	0.	3.99E+06	2.49E+05
FE--59	4.99E+05	1.19E+06	0.	0.	3.29E+05	3.91E+06	4.51E+05
CO--57	0.	1.98E+05	0.	0.	0.	5.03E+06	3.30E+05
CO--58	0.	9.72E+05	0.	0.	0.	1.31E+07	2.22E+06
CO--60	0.	3.28E+06	0.	0.	0.	3.93E+07	7.48E+06
ZN--65	2.13E+08	6.76E+08	0.	4.52E+08	0.	4.26E+08	3.06E+08
RB--86	0.	4.02E+08	0.	0.	0.	7.93E+07	1.88E+08
SR--89	5.87E+09	0.	0.	0.	0.	6.37E+08	1.69E+08
SR--90	1.74E+11	0.	0.	0.	4.05E+05	3.68E+09	4.30E+10
Y---91	1.85E+03	0.	0.	0.	0.	7.11E+05	4.94E+01
ZR--95	5.74E+03	3.41E+03	0.	2.70E+03	0.	1.38E+07	1.93E+03
NB--95	1.49E+04	8.96E+03	0.	7.05E+03	0.	3.66E+07	5.05E+03
RU-103	2.03E+02	0.	0.	6.05E+02	0.	1.58E+04	9.08E+01
RU-106	4.59E+03	0.	0.	6.11E+03	0.	2.08E+05	5.78E+02
AG110	9.04E+06	8.36E+06	0.	1.64E+07	0.	3.41E+09	4.97E+06

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-15

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - GOATS MILK (CONTAMINATED FORAGE) AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	2.54E+08	5.05E+06	1.48E+06	0.	7.23E+05	1.69E+08	7.64E+06
SB-124	4.00E+06	7.54E+04	9.66E+03	0.	3.10E+06	1.13E+08	1.58E+06
SB-125	4.14E+06	1.15E+05	6.06E+04	5.77E+05	4.12E+08	3.54E+07	8.19E+05
TE 125M	3.61E+06	1.29E+06	1.02E+06	1.03E+07	0.	1.01E+07	4.78E+05
TE 127M	7.23E+06	2.52E+06	1.91E+06	2.92E+07	0.	3.63E+07	8.94E+05
TE 129M	1.35E+07	5.02E+06	4.34E+06	3.92E+07	0.	4.72E+07	2.13E+06
I--130	6.61E+05	1.96E+06	2.49E+08	3.04E+06	0.	1.68E+06	7.69E+05
I--131	6.15E+08	8.68E+08	2.50E+11	1.13E+09	0.	1.64E+08	5.17E+08
I--132	2.59E-01	6.92E-01	9.11E+01	1.10E+00	0.	1.30E-01	2.46E-01
I--133	8.79E+06	1.49E+07	2.71E+09	1.88E+07	0.	1.08E+07	4.59E+06
I--134	0.	0.	1.55E-09	0.	0.	0.	0.
I--135	2.17E+04	5.73E+04	7.49E+06	9.10E+04	2.94E-01	6.41E+04	2.10E+04
CS-134	2.83E+10	6.83E+10	0.	1.69E+10	8.27E+09	7.88E+08	3.19E+10
CS-136	1.01E+09	3.99E+09	0.	2.22E+09	3.05E+08	4.54E+08	2.87E+09
CS-137	3.84E+10	5.16E+10	0.	1.33E+10	6.85E+09	6.88E+08	1.81E+10
BA-140	5.81E+06	7.14E+03	0.	1.78E+03	4.78E+03	1.10E+06	3.73E+05
CE-141	6.06E+03	4.07E+03	0.	1.41E+03	0.	1.10E+07	4.66E+02
CE-144	4.92E+05	2.02E+05	0.	8.24E+04	0.	1.16E+08	2.61E+04

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-16

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - MEAT (CONTAMINATED FORAGE) AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	1.93E+02	1.93E+02	2.44E+02	1.93E+02	1.93E+02	1.93E+02
C-14	5.23E+04	5.23E+04	5.23E+04	3.94E+04	5.23E+04	5.23E+04	5.23E+04
P---32	2.76E+09	1.73E+08	0.	0.	0.	3.10E+08	1.07E+08
CR--51	0.	0.	2.50E+03	9.22E+02	5.55E+03	1.05E+06	4.18E+03
MN--54	0.	5.42E+06	0.	1.61E+06	0.	1.66E+07	1.04E+06
FE--59	1.58E+08	3.74E+08	0.	0.	1.04E+08	1.24E+09	1.42E+08
CO--57	0.	3.33E+06	0.	0.	0.	8.45E+07	5.54E+06
CO--58	0.	1.44E+07	0.	0.	0.	1.94E+08	3.27E+07
CO--60	0.	5.73E+07	0.	0.	0.	6.87E+08	1.31E+08
ZN--65	2.11E+08	6.69E+08	0.	4.47E+08	0.	4.21E+08	3.03E+08
RB--86	0.	2.89E+08	0.	0.	0.	5.69E+07	1.35E+08
SR--89	2.66E+08	0.	0.	0.	0.	2.89E+07	7.64E+06
SR--90	1.01E+10	0.	0.	0.	2.79E+08	1.02E+09	2.49E+09
Y---91	9.34E+05	0.	0.	0.	0.	3.59E+08	2.49E+04
ZR--95	2.67E+06	1.24E+06	0.	1.18E+06	0.	4.20E+09	7.61E+05
NB--95	1.58E+06	9.51E+05	0.	7.48E+05	0.	3.88E+09	5.37E+05
RU-103	8.05E+07	0.	0.	2.40E+08	0.	6.28E+09	3.60E+07
RU-106	2.40E+09	0.	0.	3.20E+09	0.	1.09E+11	3.02E+08
AG110	3.97E+06	3.67E+06	0.	7.21E+06	0.	1.50E+09	2.18E+06

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-16

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - MEAT (CONTAMINATED FORAGE) AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	1.10E+10	2.18E+08	6.38E+07	0.	3.82E+06	3.66E+09	3.14E+08
SB-124	1.17E+07	2.21E+05	2.84E+04	0.	9.11E+06	3.32E+08	4.64E+06
SB-125	5.01E+07	1.31E+07	1.02E+07	1.03E+08	1.47E+09	2.25E+08	7.60E+06
TE 125M	3.03E+08	1.08E+08	8.55E+07	8.63E+08	0.	8.47E+08	4.02E+07
TE 127M	6.68E+08	2.34E+08	1.77E+08	2.69E+09	0.	3.35E+09	8.28E+07
TE 129M	9.78E+08	3.63E+08	3.13E+08	2.83E+09	0.	3.41E+09	1.53E+08
I--130	1.41E-06	4.16E-06	5.30E-04	6.47E-06	0.	3.57E-06	1.64E-06
I--131	8.54E+06	1.21E+07	3.48E+09	1.56E+07	0.	2.28E+06	7.19E+06
I--132	0.	0.	0.	0.	0.	0.	0.
I--133	3.69E-01	6.26E-01	1.14E+02	7.88E-01	0.	4.55E-01	1.93E-01
I--134	0.	0.	0.	0.	0.	0.	0.
I--135	5.08E-02	4.69E-02	0.	1.78E-02	5.34E-03	1.10E-03	2.08E-02
CS-134	5.03E+08	1.21E+09	0.	3.00E+08	1.47E+08	1.40E+07	5.66E+08
CS-136	6.99E+06	2.76E+07	0.	1.54E+07	2.11E+06	3.14E+06	1.99E+07
CS-137	6.92E+08	9.31E+08	0.	2.40E+08	1.24E+08	1.24E+07	3.27E+08
BA-140	2.37E+07	2.93E+04	0.	7.28E+03	1.95E+04	9.19E+06	1.53E+06
CE-141	1.12E+04	7.51E+03	0.	2.61E+03	0.	2.03E+07	8.61E+02
CE-144	1.28E+06	5.23E+05	0.	2.14E+05	0.	3.00E+08	6.76E+04

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-17

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - FRESH FRUITS AND VEGETABLES AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	2.09E+02	2.09E+02	2.64E+02	2.09E+02	2.09E+02	2.09E+02
C-14	2.18E+04	2.18E+04	2.18E+04	1.64E+04	2.18E+04	2.18E+04	2.18E+04
P---32	6.81E+08	4.27E+07	0.	0.	0.	7.66E+07	2.64E+07
CR--51	0.	0.	7.56E+03	2.79E+03	1.68E+04	3.18E+06	1.27E+04
MN--54	0.	3.20E+07	0.	9.52E+06	0.	9.80E+07	6.11E+06
FE--59	2.39E+07	5.67E+07	0.	0.	1.57E+07	1.87E+08	2.16E+07
CO--57	0.	1.22E+06	0.	0.	0.	3.09E+07	2.02E+06
CO--58	0.	6.01E+06	0.	0.	0.	8.12E+07	1.37E+07
CO--60	0.	2.01E+07	0.	0.	0.	2.41E+08	4.58E+07
ZN--65	3.35E+07	1.06E+08	0.	7.12E+07	0.	6.70E+07	4.82E+07
RB--86	0.	8.52E+07	0.	0.	0.	1.68E+07	3.97E+07
SR--89	2.61E+09	0.	0.	0.	0.	2.83E+08	7.48E+07
SR--90	7.61E+10	0.	0.	0.	2.41E+08	2.31E+09	1.88E+10
Y---91	1.15E+06	0.	0.	0.	0.	4.41E+08	3.06E+04
ZR--95	2.35E+05	8.19E+04	0.	9.81E+04	0.	1.92E+08	5.61E+04
NB--95	3.72E+04	2.24E+04	0.	1.76E+04	0.	9.14E+07	1.26E+04
RU-103	1.27E+06	0.	0.	3.77E+06	0.	9.87E+07	5.66E+05
RU-106	2.82E+07	0.	0.	3.75E+07	0.	1.28E+09	3.54E+06
AG110	1.11E+06	1.03E+06	0.	2.02E+06	0.	4.19E+08	6.10E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-17

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - FRESH FRUITS AND VEGETABLES AGE GROUP - TEENAGER

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER µCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	9.25E-06	1.53E-07	1.22E-07	0.	0.	1.33E-05	2.28E-07
SN-126	6.25E+08	1.24E+07	3.64E+06	0.	2.83E+06	5.55E+08	1.94E+07
SB-124	1.65E+07	3.12E+05	3.99E+04	0.	1.28E+07	4.67E+08	6.53E+06
SB-125	1.73E+07	5.97E+05	3.48E+05	3.38E+06	1.68E+09	1.45E+08	3.40E+06
TE 125M	2.23E+07	7.99E+06	6.30E+06	6.36E+07	0.	6.24E+07	2.96E+06
TE 127M	4.46E+07	1.55E+07	1.18E+07	1.80E+08	0.	2.23E+08	5.51E+06
TE 129M	8.46E+07	3.14E+07	2.71E+07	2.45E+08	0.	2.95E+08	1.33E+07
I--130	2.58E+05	7.64E+05	9.72E+07	1.19E+06	0.	6.55E+05	3.00E+05
I--131	6.84E+07	9.66E+07	2.79E+10	1.25E+08	0.	1.83E+07	5.76E+07
I--132	3.65E+01	9.77E+01	1.29E+04	1.56E+02	0.	1.84E+01	3.47E+01
I--133	1.98E+06	3.36E+06	6.10E+08	4.23E+06	0.	2.44E+06	1.04E+06
I--134	6.75E-05	1.83E-04	2.38E-02	2.92E-04	0.	1.60E-07	6.56E-05
I--135	2.65E+04	7.00E+04	9.15E+06	1.11E+05	5.67E-03	7.84E+04	2.57E+04
CS-134	5.79E+08	1.40E+09	0.	3.45E+08	1.69E+08	1.61E+07	6.52E+08
CS-136	2.18E+07	8.60E+07	0.	4.78E+07	6.56E+06	9.77E+06	6.19E+07
CS-137	7.83E+08	1.05E+09	0.	2.72E+08	1.40E+08	1.41E+07	3.70E+08
BA-140	9.38E+07	1.21E+05	0.	2.88E+04	7.73E+04	3.19E+08	6.04E+06
CE-141	6.32E+04	4.24E+04	0.	1.47E+04	0.	1.15E+08	4.86E+03
CE-144	5.03E+06	2.06E+06	0.	8.43E+05	0.	1.19E+09	2.67E+05

Based on 1 µCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-18

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - INHALATION AGE GROUP - ADULT

ORGAN DOSE FACTOR (MREM/YR PER μCI/CU. METER)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	1.07E+03	1.07E+03	1.07E+03	1.07E+03	1.07E+03	1.07E+03
C-14	1.82E+04	3.42E+04	3.42E+03	3.42E+03	3.42E+03	3.42E+03	3.42E+03
P---32	1.32E+06	7.72E+04	0.	0.	0.	8.64E+04	5.02E+04
CR--51	0.	0.	5.95E+01	2.28E+01	1.44E+04	3.32E+03	1.00E+02
MN--54	0.	3.96E+04	0.	9.84E+03	1.40E+06	7.74E+04	6.30E+03
FE--59	1.18E+04	2.78E+07	0.	0.	1.02E+06	1.88E+05	1.06E+04
CO--57	0.	6.92E+02	0.	0.	3.70E+05	3.14E+04	6.71E+02
CO--58	0.	1.58E+03	0.	0.	9.28E+05	1.06E+05	2.07E+03
CO--60	0.	1.15E+04	0.	0.	5.98E+06	2.85E+05	1.48E+04
ZN--65	3.24E+04	1.03E+05	0.	6.90E+04	8.72E+05	5.34E+04	4.66E+04
RB--86	0.	1.35E+05	0.	0.	0.	1.66E+04	5.90E+04
SR--89	3.04E+05	0.	0.	0.	1.40E+06	3.50E+05	8.72E+03
SR--90	9.92E+07	0.	0.	0.	9.60E+06	7.22E+05	6.10E+06
Y---91	4.62E+05	0.	0.	0.	1.70E+06	3.85E+05	1.24E+04
ZR--95	1.07E+05	3.44E+04	0.	5.42E+04	1.78E+06	1.50E+05	2.33E+04
NB--95	1.41E+04	7.82E+03	0.	7.74E+03	5.06E+05	1.04E+05	4.21E+03
RU-103	1.53E+03	0.	0.	5.83E+03	5.06E+05	1.10E+05	6.58E+02
RU-106	6.91E+04	0.	0.	1.34E+05	9.44E+06	9.12E+05	8.72E+03
AG110	1.08E+04	1.00E+04	0.	1.97E+04	4.64E+06	3.02E+05	5.94E+03

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-18

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - INHALATION AGE GROUP - ADULT

ORGAN DOSE FACTOR (MREM/YR PER μCI/CU. METER)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	2.42E+05	5.33E+03	4.53E+03	0.	2.30E+06	3.14E+05	7.86E+03
SN-126	1.26E+06	3.34E+04	9.84E+03	0.	9.36E+06	1.27E+05	4.80E+04
SB-124	3.12E+04	5.89E+02	7.55E+01	0.	2.48E+06	4.06E+05	1.24E+04
SB-125	6.61E+04	7.13E+02	5.87E+01	0.	2.20E+06	1.01E+05	1.33E+04
TE 125M	3.42E+03	1.58E+03	1.05E+03	1.24E+04	3.14E+05	7.06E+04	4.67E+02
TE 127M	1.26E+04	5.62E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05	1.57E+03
TE 129M	9.76E+03	4.67E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05	1.58E+03
I--130	4.58E+03	1.34E+04	1.74E+06	2.09E+04	0.	7.69E+03	5.29E+03
I--131	2.52E+04	3.58E+04	1.19E+07	6.14E+04	0.	6.28E+03	2.05E+04
I--132	1.16E+03	3.26E+03	4.38E+05	5.19E+03	0.	4.06E+02	1.16E+03
I--133	8.64E+03	1.49E+04	2.93E+06	2.60E+04	0.	8.72E+03	4.54E+03
I--134	6.45E+02	1.73E+03	2.30E+05	2.75E+03	0.	1.01E+00	6.16E+02
I--135	2.69E+03	6.99E+03	9.36E+05	1.11E+04	0.	5.25E+03	2.58E+03
CS-134	3.74E+05	8.48E+05	0.	2.88E+05	9.76E+04	1.04E+04	7.29E+05
CS-136	3.91E+04	1.46E+05	0.	8.56E+04	1.20E+04	1.17E+04	1.11E+05
CS-137	4.78E+05	6.22E+05	0.	2.22E+05	7.53E+04	8.40E+03	4.29E+05
BA-140	3.90E+04	4.90E+01	0.	1.67E+01	1.27E+06	2.18E+05	2.57E+03
CE-141	1.99E+04	1.35E+04	0.	6.26E+03	3.62E+05	1.20E+05	1.53E+03
CE-144	3.43E+06	1.43E+06	0.	8.48E+05	7.78E+06	8.16E+05	1.84E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-19

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - ADULT

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	9.73E+02	9.73E+02	9.73E+02	9.73E+02	9.73E+02	9.73E+02
C-14	3.63E+05	7.28E+04	7.28E+04	7.28E+04	7.28E+04	7.28E+04	7.28E+04
P---32	1.71E+10	1.07E+09	0.	0.	0.	1.92E+09	6.62E+08
CR--51	0.	0.	1.71E+04	6.32E+03	3.80E+04	7.20E+06	2.86E+04
MN--54	0.	8.41E+06	0.	2.50E+06	0.	2.58E+07	1.61E+06
FE--59	2.98E+07	7.06E+07	0.	0.	1.96E+07	2.33E+08	2.69E+07
CO--57	0.	1.28E+06	0.	0.	0.	3.25E+07	2.13E+06
CO--58	0.	4.72E+06	0.	0.	0.	9.56E+07	1.06E+07
CO--60	0.	1.65E+07	0.	0.	0.	3.08E+08	3.62E+07
ZN--65	1.37E+09	4.36E+09	0.	2.92E+09	0.	2.75E+09	1.98E+09
RB--86	0.	2.60E+09	0.	0.	0.	5.12E+08	1.21E+09
SR--89	1.46E+09	0.	0.	0.	0.	2.33E+08	4.17E+07
SR--90	4.70E+10	0.	0.	0.	0.	6.37E+08	1.15E+10
Y---91	8.60E+03	0.	0.	0.	0.	4.73E+06	2.31E+02
ZR--95	3.18E+04	1.75E+04	0.	1.75E+04	0.	1.05E+08	6.95E+03
NB--95	8.26E+04	4.59E+04	0.	4.55E+04	0.	2.79E+08	1.80E+04
RU-103	1.02E+03	0.	0.	3.91E+03	0.	1.19E+05	4.41E+02
RU-106	2.04E+04	0.	0.	3.95E+04	0.	1.32E+06	2.58E+03
AG110	5.84E+07	5.40E+07	0.	1.06E+08	0.	2.20E+10	3.21E+07

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-19
ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES
PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - ADULT

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	1.65E+09	3.27E+07	9.56E+06	0.	4.67E+06	1.09E+09	4.94E+07
SB-124	2.58E+07	4.87E+05	6.24E+04	0.	2.00E+07	7.31E+08	1.02E+07
SB-125	2.64E+07	6.06E+05	2.99E+05	3.72E+06	2.66E+09	2.29E+08	5.23E+06
TE 125M	1.63E+07	5.91E+06	4.91E+06	6.63E+07	0.	6.50E+07	2.18E+06
TE 127M	4.63E+07	1.63E+07	1.21E+07	1.88E+08	0.	2.11E+08	5.72E+06
TE 129M	6.06E+07	2.27E+07	2.09E+07	2.53E+08	0.	3.04E+08	9.61E+06
I--130	4.27E+05	1.26E+06	1.61E+08	1.96E+06	0.	1.08E+06	4.97E+05
I--131	2.96E+08	4.25E+08	1.39E+11	7.27E+08	0.	1.12E+08	2.43E+08
I--132	1.67E-01	4.47E-01	5.88E+01	7.12E-01	0.	8.39E-02	1.59E-01
I--133	4.00E+06	6.94E+06	1.33E+09	1.21E+07	0.	6.10E+06	2.12E+06
I--134	0.	0.	9.98E-10	0.	0.	0.	0.
I--135	1.40E+04	3.70E+04	4.84E+06	5.88E+04	7.58E-02	4.14E+04	1.36E+04
CS-134	5.66E+09	1.35E+10	0.	4.36E+09	1.45E+09	2.36E+08	1.10E+10
CS-136	2.61E+08	1.03E+09	0.	5.74E+08	7.87E+07	1.17E+08	7.43E+08
CS-137	7.39E+09	1.01E+10	0.	3.44E+09	1.14E+09	1.95E+08	6.62E+09
BA-140	2.69E+07	3.38E+04	0.	1.15E+04	1.93E+04	5.70E+07	1.78E+06
CE-141	2.91E+04	1.97E+04	0.	9.13E+03	0.	7.52E+07	2.23E+03
CE-144	2.15E+06	8.97E+05	0.	5.32E+05	0.	7.26E+08	1.15E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-20

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - GOATS MILK (CONTAMINATED FORAGE) AGE GROUP - ADULT

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	1.99E+03	1.99E+03	1.99E+03	1.99E+03	1.99E+03	1.99E+03
C-14	3.63E+05	7.28E+04	7.28E+04	7.28E+04	7.28E+04	7.28E+04	7.28E+04
P---32	2.05E+10	1.29E+09	0.	0.	0.	2.31E+09	7.94E+08
CR--51	0.	0.	2.05E+03	7.58E+02	4.56E+03	8.64E+05	3.43E+03
MN--54	0.	1.01E+06	0.	3.00E+05	0.	3.09E+06	1.93E+05
FE--59	3.87E+05	9.18E+05	0.	0.	2.55E+05	3.03E+06	3.50E+05
CO--57	0.	1.54E+05	0.	0.	0.	3.90E+06	2.55E+05
CO--58	0.	5.67E+05	0.	0.	0.	1.15E+07	1.27E+06
CO--60	0.	1.98E+06	0.	0.	0.	3.70E+07	4.34E+06
ZN--65	1.65E+08	5.24E+08	0.	3.50E+08	0.	3.30E+08	2.37E+08
RB--86	0.	3.12E+08	0.	0.	0.	6.15E+07	1.45E+08
SR--89	3.06E+09	0.	0.	0.	0.	4.89E+08	8.76E+07
SR--90	9.87E+10	0.	0.	0.	0.	1.32E+09	2.41E+10
Y---91	1.03E+03	0.	0.	0.	0.	5.68E+05	2.77E+01
ZR--95	3.82E+03	2.10E+03	0.	2.10E+03	0.	1.26E+07	8.34E+02
NB--95	9.92E+03	5.51E+03	0.	5.46E+03	0.	3.34E+07	2.17E+03
RU-103	1.23E+02	0.	0.	4.69E+02	0.	1.43E+04	5.30E+01
RU-106	2.45E+03	0.	0.	4.73E+03	0.	1.58E+05	3.10E+02
AG110	7.00E+06	6.48E+06	0.	1.27E+07	0.	2.64E+09	3.85E+06

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-20

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - GOATS MILK (CONTAMINATED FORAGE) AGE GROUP - ADULT

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	1.97E+08	3.92E+06	1.15E+06	0.	5.61E+05	1.31E+08	5.92E+06
SB-124	3.10E+06	5.85E+04	7.49E+03	0.	2.40E+06	8.77E+07	1.22E+06
SB-125	3.16E+06	7.28E+04	3.58E+04	4.47E+05	3.19E+08	2.74E+07	6.29E+05
TE 125M	1.96E+06	7.10E+05	5.89E+05	7.95E+06	0.	7.81E+06	2.62E+05
TE 127M	5.57E+06	1.94E+06	1.47E+06	2.26E+07	0.	2.52E+07	6.86E+05
TE 129M	7.27E+06	2.72E+06	2.51E+06	3.04E+07	0.	3.65E+07	1.15E+06
I--130	5.12E+05	1.52E+06	1.93E+08	2.36E+06	0.	1.30E+06	5.96E+05
I--131	3.56E+08	5.10E+08	1.67E+11	8.72E+08	0.	1.34E+08	2.92E+08
I--132	2.00E-01	5.36E-01	7.06E+01	8.55E-01	0.	1.01E-01	1.91E-01
I--133	4.80E+06	8.32E+06	1.60E+09	1.45E+07	0.	7.32E+06	2.54E+06
I--134	0.	0.	1.20E-09	0.	0.	0.	0.
I--135	1.68E+04	4.44E+04	5.80E+06	7.05E+04	2.28E-01	4.97E+04	1.63E+04
CS-134	1.70E+10	4.04E+10	0.	1.31E+10	4.34E+09	7.06E+08	3.30E+10
CS-136	7.84E+08	3.09E+09	0.	1.72E+09	2.36E+08	3.52E+08	2.23E+09
CS-137	2.22E+10	3.03E+10	0.	1.03E+10	3.42E+09	5.83E+08	1.99E+10
BA-140	3.23E+06	4.05E+03	0.	1.38E+03	2.32E+03	6.84E+06	2.13E+05
CE-141	3.49E+03	2.36E+03	0.	1.10E+03	0.	9.02E+06	2.68E+02
CE-144	2.58E+05	1.08E+05	0.	6.39E+04	0.	8.71E+07	1.38E+04

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-21

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - MEAT (CONTAMINATED FORAGE) AGE GROUP - ADULT

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER µCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	4.13E+02	4.13E+02	4.13E+02	4.13E+02	4.13E+02	4.13E+02
C-14	3.33E+05	6.67E+04	6.67E+04	6.67E+04	6.67E+04	6.67E+04	6.67E+04
P---32	4.67E+09	2.93E+08	0.	0.	0.	5.25E+08	1.81E+08
CR--51	0.	0.	4.23E+03	1.56E+03	9.38E+03	1.78E+06	7.07E+03
MN--54	0.	9.18E+06	0.	2.73E+06	0.	2.81E+07	1.75E+06
FE--59	2.67E+08	6.33E+08	0.	0.	1.76E+08	2.09E+09	2.41E+08
CO--57	0.	5.64E+06	0.	0.	0.	1.43E+08	9.38E+06
CO--58	0.	1.83E+07	0.	0.	0.	3.70E+08	4.09E+07
CO--60	0.	7.55E+07	0.	0.	0.	1.41E+09	1.66E+08
ZN--65	3.56E+08	1.13E+09	0.	7.57E+08	0.	7.13E+08	5.12E+08
RB--86	0.	4.89E+08	0.	0.	0.	9.64E+07	2.28E+08
SR--89	3.03E+08	0.	0.	0.	0.	4.84E+07	8.67E+06
SR--90	1.25E+10	0.	0.	0.	0.	1.45E+09	3.05E+09
Y---91	1.14E+06	0.	0.	0.	0.	6.26E+08	3.05E+04
ZR--95	3.78E+06	1.67E+06	0.	2.01E+06	0.	8.30E+09	8.26E+05
NB--95	2.30E+06	1.28E+06	0.	1.27E+06	0.	7.75E+09	5.02E+05
RU-103	1.06E+08	0.	0.	4.06E+08	0.	1.24E+10	4.59E+07
RU-106	2.80E+09	0.	0.	5.41E+09	0.	1.81E+11	3.54E+08
AG110	6.71E+06	6.21E+06	0.	1.22E+07	0.	2.53E+09	3.69E+06

Based on 1 µCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per µCi/cu. meter)

TABLE G-21
ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES
PATHWAY - MEAT (CONTAMINATED FORAGE) AGE GROUP - ADULT

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	0.	0.	0.	0.	0.	0.	0.
SN-126	1.86E+10	3.69E+08	1.08E+08	0.	6.46E+06	6.19E+09	5.33E+08
SB-124	1.99E+07	3.75E+05	4.80E+04	0.	1.54E+07	5.62E+08	7.85E+06
SB-125	6.65E+07	1.58E+07	1.29E+07	1.74E+08	2.49E+09	3.80E+08	1.05E+07
TE 125M	3.59E+08	1.30E+08	1.08E+08	1.46E+09	0.	1.43E+09	4.81E+07
TE 127M	1.13E+09	3.93E+08	2.96E+08	4.56E+09	0.	5.11E+09	1.39E+08
TE 129M	1.14E+09	4.29E+08	3.95E+08	4.79E+09	0.	5.76E+09	1.82E+08
I--130	2.38E-06	7.05E-06	8.96E-04	1.10E-05	0.	6.04E-06	2.77E-06
I--131	1.08E+07	1.55E+07	5.06E+09	2.65E+07	0.	4.07E+06	8.85E+06
I--132	0.	0.	0.	0.	0.	0.	0.
I--133	4.40E-01	7.63E-01	1.47E+02	1.33E+00	0.	6.71E-01	2.33E-01
I--134	0.	0.	0.	0.	0.	0.	0.
I--135	8.60E-02	7.94E-02	0.	3.01E-02	9.04E-03	1.86E-03	3.53E-02
CS-134	6.58E+08	1.57E+09	0.	5.08E+08	1.68E+08	2.74E+07	1.28E+09
CS-136	1.18E+07	4.67E+07	0.	2.60E+07	3.56E+06	5.31E+06	3.36E+07
CS-137	8.73E+08	1.19E+09	0.	4.06E+08	1.35E+08	2.30E+07	7.82E+08
BA-140	2.88E+07	3.63E+04	0.	1.23E+04	2.07E+04	6.87E+07	1.90E+06
CE-141	1.41E+04	9.52E+03	0.	4.41E+03	0.	3.63E+07	1.08E+03
CE-144	1.46E+06	6.10E+05	0.	3.62E+05	0.	4.93E+08	7.83E+04

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

Note - the units for C---14 and H----3 are (mrem/yr per μCi/cu. meter)

TABLE G-22

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - FRESH FRUITS AND VEGETABLES AGE GROUP - ADULT

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
H----3	0.	4.02E+02	4.02E+02	4.02E+02	4.02E+02	4.02E+02	4.02E+02
C-14	1.25E+05	2.50E+04	2.50E+04	2.50E+04	2.50E+04	2.50E+04	2.50E+04
P---32	1.04E+09	6.51E+07	0.	0.	0.	1.17E+08	4.02E+07
CR--51	0.	0.	1.15E+04	4.25E+03	2.56E+04	4.85E+06	1.93E+04
MN--54	0.	4.87E+07	0.	1.45E+07	0.	1.49E+08	9.31E+06
FE--59	3.64E+07	8.64E+07	0.	0.	2.40E+07	2.85E+08	3.29E+07
CO--57	0.	1.85E+06	0.	0.	0.	4.70E+07	3.08E+06
CO--58	0.	6.89E+06	0.	0.	0.	1.40E+08	1.54E+07
CO--60	0.	2.38E+07	0.	0.	0.	4.46E+08	5.23E+07
ZN--65	5.11E+07	1.62E+08	0.	1.09E+08	0.	1.02E+08	7.34E+07
RB--86	0.	1.30E+08	0.	0.	0.	2.56E+07	6.06E+07
SR--89	2.67E+09	0.	0.	0.	0.	4.26E+08	7.64E+07
SR--90	8.49E+10	0.	0.	0.	0.	2.14E+09	2.07E+10
Y---91	1.26E+06	0.	0.	0.	0.	6.92E+08	3.37E+04
ZR--95	2.93E+05	9.82E+04	0.	1.49E+05	0.	3.34E+08	6.38E+04
NB--95	4.87E+04	2.71E+04	0.	2.68E+04	0.	1.64E+08	1.06E+04
RU-103	1.50E+06	0.	0.	5.75E+06	0.	1.76E+08	6.49E+05
RU-106	2.95E+07	0.	0.	5.71E+07	0.	1.91E+09	3.74E+06
AG110	1.69E+06	1.56E+06	0.	3.08E+06	0.	6.38E+08	9.30E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE G-22

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS R(I) FOR GASEOUS DISCHARGES

PATHWAY - FRESH FRUITS AND VEGETABLES AGE GROUP - ADULT

ORGAN DOSE FACTOR (SQ. METER-MREM/YR PER μCI/SEC)

NUCLIDE	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	WHOLE BODY
SN-123	1.00E-05	1.66E-07	1.41E-07	0.	0.	2.04E-05	2.45E-07
SN-126	9.52E+08	1.89E+07	5.54E+06	0.	4.31E+06	8.46E+08	2.94E+07
SB-124	2.52E+07	4.75E+05	6.08E+04	0.	1.95E+07	7.12E+08	9.94E+06
SB-125	2.58E+07	7.23E+05	4.03E+05	5.14E+06	2.56E+09	2.22E+08	5.10E+06
TE 125M	2.38E+07	8.65E+06	7.17E+06	9.69E+07	0.	9.51E+07	3.19E+06
TE 127M	6.75E+07	2.36E+07	1.77E+07	2.73E+08	0.	3.06E+08	8.32E+06
TE 129M	8.93E+07	3.34E+07	3.08E+07	3.73E+08	0.	4.49E+08	1.42E+07
I--130	3.93E+05	1.16E+06	1.48E+08	1.81E+06	0.	9.98E+05	4.58E+05
I--131	7.78E+07	1.12E+08	3.65E+10	1.91E+08	0.	2.94E+07	6.38E+07
I--132	5.57E+01	1.49E+02	1.96E+04	2.38E+02	0.	2.80E+01	5.29E+01
I--133	2.13E+06	3.69E+06	7.10E+08	6.44E+06	0.	3.24E+06	1.13E+06
I--134	1.03E-04	2.79E-04	3.63E-02	4.45E-04	0.	2.43E-07	9.99E-05
I--135	4.04E+04	1.07E+05	1.40E+07	1.70E+05	8.65E-03	1.19E+05	3.91E+04
CS-134	6.82E+08	1.62E+09	0.	5.26E+08	1.74E+08	2.84E+07	1.33E+09
CS-136	3.32E+07	1.31E+08	0.	7.29E+07	9.99E+06	1.49E+07	9.43E+07
CS-137	8.90E+08	1.22E+09	0.	4.14E+08	1.37E+08	2.34E+07	7.98E+08
BA-140	1.03E+08	1.35E+05	0.	4.39E+04	7.38E+04	6.65E+08	6.77E+06
CE-141	7.16E+04	4.85E+04	0.	2.25E+04	0.	1.85E+08	5.49E+03
CE-144	5.19E+06	2.17E+06	0.	1.29E+06	0.	1.75E+09	2.78E+05

Based on 1 μCi/sec release rate of each isotope in and a value of 1. for X/Q, depleted X/Q and relative deposition

TABLE M-1

Selecting the Appropriate Long Term (X/Q) for Dose Calculations Involving Noble Gases for:

(1) Total Body dose from instantaneous releases

(2) Skin dose from instantaneous releases

(3) Gamma air dose (cumulative)

(4) Beta air dose (cumulative)

TYPE OF DOSE CALCULATION	LIMITING RANGE (miles)	LIMITING Sector	(X/Q) VALUE sec/m^3
Instantaneous	0.97	NW	1.6×10^{-6}
1/31 days	0.97	1. Normally (X/Q) = 1.6×10^{-6} sec/m^3 2. May use option of actual meteorological data for time of concern.	
Quarterly Yearly	0.97		
12 Consecutive months	0.97		
Annual Report	0.97	N/A	Note-1

NOTE 1

The (X/Q) has to be calculated based on actual meteorological data that occurred during the period of interest. The sector of interest is N/A because the limiting (X/Q) will be determined from the actual meteorological data and may occur in any sector.

0.97 miles Corresponds to the minimum site boundary distance in the north direction and 0.97 miles was chosen for all other sectors for ease of calculations when the averaging is done for quarterly reports.

TABLE M-2

Selecting the Appropriate Long Term $(X/Q)_D$ or (D/Q) for Dose

Calculations Involving Radioiodines & 8 D Particulates for:

(1) Inhalation

(2) Tritium (All gas pathways)

(3) Ground Plane

TYPE OF DOSE CALCULATION	LIMITING RANGE (miles)	LIMITING SECTOR (OL)	$(X/Q)_D$ sec/m^3	(D/Q) 1/m^2
Instantaneous	0.97	NW	B 1.3×10^{-6}	
		WNW		8.2×10^{-9}
Annual Report	0.97	A	A, B	
	0.97	A		A
1/31 days, Qtr. yearly, Annual Total Dose	0.97	NW	B 1.3×10^{-6}	
	0.97	WNW		8.2×10^{-9}

(OL) Over land areas only

(A) To be determined by reduction of actual met data occurring during each quarter

(B) For Tritium in the Milk Animal Pathway, the $(X/Q)_D$ value should be that of the respective controlling sector and range where the Milk Animal is located as per Table M-3. Example: If a cow was located at 4.25 miles in NW sector, use the $(X/Q)_D$ for 4.25 miles NW.

TABLE M-3

Selecting the Appropriate Long Term (D/Q) for Dose Calculations Involving Radioiodines and 8D Particulates for Grass-Cow-Milk or Grass-Goat-Milk:

TYPE OF DOSE CALCULATION	LIMITING RANGE	LIMITING SECTOR	(D/Q) Value $1/m^2$
Release Rate	A	A	A
1/31 Days	B	B	B
Quarterly - Yearly	B	B	B
Annual (Calendar Year)	B	B	B
Annual Report	C	C	C

A. The worst cow or goat as per locations from land census. If no milk animal in any sector, assume a cow at 4.25 miles in the highest (D/Q) sector over land.

B. The historical (D/Q) of all land sectors with the worst cow or goat from each sector as reported in the Land Census. A 4.25 mile cow should be assumed in the worst sector over land when no milk animal is reported.

C. The highest (D/Q) at a milk animal location of all milk animals reported in the Land Census Report. (If no milk animals within 5 miles a 4.25 mile cow should be assumed in the sector having the highest (D/Q) at 4.25 miles over land). Actual Met Data should be used for the selection of the worst case milk animal and for the dose calculations. If both goat and milk animals are reported inside 5 miles, dose calculations should be performed on each animal and the higher dose animal contribution should be used.

The historical wind frequency fractions for each sector are listed in Table M-8.

TABLE M-4
TERRAIN CORRECTION FACTORS

Florida Power & Light Company
St. Lucie Unit 1
Hutchinson Island, Florida
Dames and Moore Job No: 4598 - 112

Terrain Correction Factors (PUFF / STRAIGHT LINE)
Period of Record: 8/29/77 to 8/31/78
Base Distance in Miles/Kilometers

AFFECTED SECTOR	DESIGN DISTANCE MILES	.25 .40	.75 1.21	1.25 2.01	1.75 2.82	2.25 3.62	2.75 4.42	3.25 5.23	3.75 6.03	4.25 6.84	4.75 7.64
NNE	0.	1.906	1.576	1.465	1.404	1.338	1.318	1.334	1.386	1.346	1.338
NE	0.	1.887	1.581	1.461	1.391	1.310	1.259	1.164	1.128	1.101	1.116
ENE	0.	1.452	1.230	1.122	1.081	1.047	1.033	.941	.941	.906	.902
E	0.	1.662	1.425	1.277	1.193	1.151	1.123	1.097	1.121	1.123	1.122
ESE	0.	1.690	1.483	1.328	1.260	1.246	1.190	1.134	1.094	1.032	.968
SE	0.	1.818	1.691	1.470	1.427	1.435	1.361	1.366	1.331	1.279	1.239
SSE	0.	1.812	1.586	1.370	1.302	1.270	1.263	1.229	1.193	1.171	1.151
S	0.	1.398	1.321	1.125	1.083	1.108	1.127	1.073	1.063	1.047	1.024
SSW	0.	1.534	1.411	1.296	1.192	1.205	1.132	1.135	1.116	1.077	1.060
SW	0.	1.685	1.492	1.294	1.233	1.200	1.222	1.160	1.160	1.198	1.196
WSW	0.	1.620	1.333	1.210	1.173	1.082	1.091	1.099	1.056	1.034	1.004
W	0.	1.651	1.415	1.290	1.218	1.154	1.099	1.081	1.067	1.093	1.083
WNW	0.	1.720	1.430	1.267	1.185	1.150	1.133	1.125	1.085	1.033	1.045
NW	0.	1.681	1.407	1.257	1.173	1.119	1.078	1.063	.995	.998	.978
NNW	0.	1.739	1.488	1.316	1.212	1.172	1.122	1.135	1.080	1.099	1.091
N	0.	1.816	1.524	1.389	1.285	1.257	1.263	1.285	1.267	1.231	1.213

Note 1: Any interpolations between stated mileages will be done by log-log

TABLE M-5
HISTORICAL LONG TERM - (X/Q) (Frequency corrected)

Terrain / Recirculation Adjusted   Program ANNXOQ9 Version - 11/18/76

Florida Power & Light Company
St. Lucie Unit 1
Hutchinson Island, Florida
Dames and Moore Job No: 1.4598 - 112

Average Annual Relative Concentration (sec/cubic meter)
Period of Record: 9/1/76 to 8/31/78
Base Distance in Miles/Kilometers

AFFECTED SECTOR	DESIGN DISTANCE MILES	.25 .40	.75 1.21	1.25 2.01	1.75 2.82	2.25 3.62	2.75 4.42	3.25 5.23	3.75 6.03	4.25 6.84	4.75 7.64
NNE	0.	1.1E-05	1.7E-06	7.8E-07	4.5E-07	3.1E-07	2.2E-07	1.7E-07	1.5E-07	1.2E-07	1.0E-07
NE	0.	1.3E-05	2.1E-06	8.9E-07	5.1E-07	3.4E-07	2.4E-07	1.7E-07	1.4E-07	1.1E-07	9.8E-08
ENE	0.	9.3E-06	1.4E-06	6.2E-07	3.7E-07	2.5E-07	1.9E-07	1.3E-07	1.1E-07	8.8E-08	7.5E-08
E	0.	9.8E-06	1.6E-06	6.5E-07	3.7E-07	2.5E-07	1.8E-07	1.4E-07	1.2E-07	9.9E-08	8.4E-08
ESE	0.	1.2E-05	1.9E-06	8.1E-07	4.8E-07	3.2E-07	2.4E-07	1.8E-07	1.4E-07	1.1E-07	9.0E-08
SE	0.	1.4E-05	2.4E-06	9.7E-07	5.7E-07	4.0E-07	2.9E-07	2.3E-07	1.9E-07	1.4E-07	1.2E-07
SSE	0.	1.1E-05	1.7E-06	7.3E-07	4.3E-07	2.9E-07	2.1E-07	1.6E-07	1.3E-07	1.1E-07	9.1E-08
S	0.	6.2E-06	1.0E-06	4.2E-07	2.5E-07	1.8E-07	1.4E-07	1.0E-07	8.0E-08	6.6E-08	5.5E-08
SSW	0.	5.7E-06	9.0E-07	4.0E-07	2.3E-07	1.6E-07	1.1E-07	8.9E-08	7.0E-08	5.7E-08	4.8E-08
SW	0.	6.1E-06	9.4E-07	3.9E-07	2.2E-07	1.6E-07	1.1E-07	8.6E-08	7.0E-08	6.0E-08	5.1E-08
WSW	0.	7.3E-06	1.1E-06	4.6E-07	2.7E-07	1.7E-07	1.3E-07	1.0E-07	8.0E-08	6.5E-08	5.4E-08
W	0.	7.6E-06	1.2E-06	5.2E-07	2.9E-07	2.0E-07	1.3E-07	1.0E-07	8.4E-08	7.2E-08	6.1E-08
WNW	0.	1.4E-05	2.1E-06	9.1E-07	5.2E-07	3.4E-07	2.6E-07	2.0E-07	1.5E-07	1.2E-07	1.0E-07
NW	0.	1.6E-05	2.4E-06	1.0E-06	5.9E-07	3.9E-07	2.8E-07	2.1E-07	1.7E-07	1.4E-07	1.2E-07
NNW	0.	1.5E-05	2.2E-06	9.6E-07	5.5E-07	3.6E-07	2.6E-07	2.0E-07	1.6E-07	1.3E-07	1.2E-07
N	0.	9.1E-06	1.4E-06	6.3E-07	3.6E-07	2.4E-07	1.8E-07	1.4E-07	1.2E-07	9.4E-08	7.9E-08

Number of Valid Observations = 17135   Number of Calms Lower Level = 95
Number of Invalid Observations = 385   Number of Calms Upper Level = 0
Note 1 - Any interpolations between stated mileages will be done by log-log

TABLE M-6
HISTORICAL LONG TERM DEPLETED - $(X/Q)_D$ (Frequency corrected)

Terrain / Recirculation Adjusted   Program ANNXOQ9 Version - 11/18/76

Florida Power & Light Company
St. Lucie Unit 1
Hutchinson Island, Florida
Dames and Moore Job No: 4598 - 112

Average Annual Relative Concentration Depleted (sec/cubic meter)
Period of Record: 9/1/76 to 8/31/78
Base Distance in Miles/Kilometers

AFFECTED SECTOR	DESIGN DISTANCE MILES	.25 .40	.75 1.21	1.25 2.01	1.75 2.82	2.25 3.62	2.75 4.42	3.25 5.23	3.75 6.03	4.25 6.84	4.75 7.64
NNE	0.	1.1E-05	1.6E-06	6.6E-07	3.8E-07	2.4E-07	1.7E-07	1.3E-07	1.1E-07	9.2E-08	7.6E-08
NE	0.	1.2E-05	1.7E-06	7.6E-07	4.3E-07	2.8E-07	1.9E-07	1.4E-07	1.1E-07	8.6E-08	7.4E-08
ENE	0.	8.9E-06	1.2E-06	5.3E-07	3.0E-07	2.0E-07	1.4E-07	1.0E-07	8.4E-08	6.6E-08	5.6E-08
E	0.	9.1E-06	1.3E-06	5.6E-07	3.1E-07	2.1E-07	1.5E-07	1.1E-07	9.1E-08	7.5E-08	6.3E-08
ESE	0.	1.2E-05	1.6E-06	6.9E-07	3.9E-07	2.6E-07	1.9E-07	1.4E-07	1.1E-07	8.5E-08	6.7E-08
SE	0.	1.3E-05	2.0E-06	8.2E-07	4.7E-07	3.3E-07	2.3E-07	1.8E-07	1.3E-07	1.1E-07	9.0E-08
SSE	0.	1.1E-05	1.6E-06	6.3E-07	3.5E-07	2.4E-07	1.8E-07	1.4E-07	1.0E-07	8.2E-08	6.8E-08
S	0.	5.9E-06	9.1E-07	3.6E-07	2.1E-07	1.4E-07	1.1E-07	7.7E-08	6.2E-08	5.0E-08	4.1E-08
SSW	0.	5.4E-06	8.0E-07	3.4E-07	1.9E-07	1.3E-07	8.9E-08	6.9E-08	5.5E-08	4.3E-08	3.6E-08
SW	0.	5.7E-06	8.4E-07	3.4E-07	1.8E-07	1.2E-07	9.2E-08	6.7E-08	5.3E-08	4.6E-08	3.8E-08
WSW	0.	7.0E-06	9.6E-07	4.0E-07	2.2E-07	1.4E-07	1.0E-07	8.0E-08	6.1E-08	5.0E-08	4.0E-08
W	0.	7.3E-06	1.1E-06	4.4E-07	2.4E-07	1.6E-07	1.1E-07	8.2E-08	6.4E-08	5.5E-08	4.4E-08
WNW	0.	1.3E-05	1.9E-06	7.9E-07	4.4E-07	2.9E-07	2.0E-07	1.6E-07	1.2E-07	9.3E-08	7.8E-08
NW	0.	1.5E-05	2.1E-06	8.9E-07	4.9E-07	3.1E-07	2.3E-07	1.7E-07	1.3E-07	1.0E-07	8.5E-08
NNW	0.	1.4E-05	2.1E-06	8.3E-07	4.5E-07	2.9E-07	2.0E-07	1.6E-07	1.2E-07	1.0E-07	8.6E-08
N	0.	8.7E-06	1.3E-06	5.4E-07	3.0E-07	2.0E-07	1.4E-07	1.1E-07	8.9E-08	7.0E-08	5.8E-08

Number of Valid Observations = 17135   Number of Calms Lower Level = 95
Number of Invalid Observations = 385   Number of Calms Upper Level = 0
Note 1 - Any interpolations between stated mileages will be done by log-log

TABLE M-7

HISTORICAL LONG TERM - (D/Q) (Frequency corrected)

TERRAIN / RECIRCULATION ADJUSTED PROGRAM ANNXOQ9 VERSION - 11/18/76

Florida Power & Light Company
St. Lucie Unit 1
Hutchinson Island, Florida
Dames and Moore Job No: 4598 - 112

Average Annual Relative Deposition Rate (square meter - 1)
Period of Record: 9/1/76 to 8/31/78
Base Distance in Miles/Kilometers

AFFECTED SECTOR	DESIGN DISTANCE MILES	.25 .40	.75 1.21	1.25 2.01	1.75 2.82	2.25 3.62	2.75 4.42	3.25 5.23	3.75 6.03	4.25 6.84	4.75 7.64
NNE	0.	6.5E-08	9.3E-09	3.7E-09	2.1E-09	1.3E-09	9.0E-10	6.8E-10	5.5E-10	4.3E-10	3.5E-10
NE	0.	6.0E-08	8.9E-09	3.5E-09	1.9E-09	1.2E-09	8.1E-10	5.6E-10	4.3E-10	3.3E-10	2.8E-10
ENE	0.	3.2E-08	4.8E-09	1.9E-09	1.0E-09	6.6E-10	4.6E-10	3.2E-10	2.4E-10	1.9E-10	1.5E-10
E	0.	3.0E-08	4.6E-09	1.8E-09	9.5E-10	6.0E-10	4.2E-10	3.1E-10	2.5E-10	2.0E-10	1.6E-10
ESE	0.	3.7E-08	5.8E-09	2.3E-09	1.2E-09	8.0E-10	5.4E-10	3.9E-10	3.0E-10	2.2E-10	1.7E-10
SE	0.	6.4E-08	1.0E-08	4.0E-09	2.1E-09	1.4E-09	9.7E-10	7.2E-10	5.6E-10	4.3E-10	3.5E-10
SSE	0.	6.2E-08	9.5E-09	3.6E-09	2.0E-09	1.2E-09	8.7E-10	6.4E-10	4.9E-10	3.9E-10	3.1E-10
S	0.	4.2E-08	7.0E-09	2.6E-09	1.4E-09	9.5E-10	6.9E-10	4.9E-10	3.8E-10	3.0E-10	2.5E-10
SSW	0.	3.4E-08	5.4E-09	2.2E-09	1.1E-09	7.5E-10	5.0E-10	3.7E-10	2.9E-10	2.3E-10	1.8E-10
SW	0.	4.5E-08	7.0E-09	2.6E-09	1.5E-09	9.0E-10	6.6E-10	4.6E-10	3.6E-10	3.0E-10	2.5E-10
WSW	0.	5.3E-08	7.7E-09	3.0E-09	1.6E-09	1.0E-09	7.3E-10	5.5E-10	4.1E-10	3.3E-10	2.6E-10
W	0.	5.0E-08	7.5E-09	3.0E-09	1.6E-09	9.8E-10	6.7E-10	5.0E-10	3.8E-10	3.2E-10	2.6E-10
WNW	0.	8.8E-08	1.3E-08	4.9E-09	2.6E-09	1.7E-09	1.1E-09	8.7E-10	6.6E-10	5.1E-10	4.2E-10
NW	0.	8.2E-08	1.2E-08	4.7E-09	2.5E-09	1.6E-09	1.1E-09	7.9E-10	5.8E-10	4.7E-10	3.8E-10
NNW	0.	8.2E-08	1.2E-08	4.6E-09	2.4E-09	1.5E-09	1.1E-09	8.1E-10	5.9E-10	4.8E-10	4.0E-10
N	0.	5.1E-08	7.3E-09	2.9E-09	1.5E-09	9.8E-10	7.1E-10	5.4E-10	4.2E-10	3.2E-10	2.7E-10

Number of Valid Observations = 17135 Number of Calms Lower Level = 95
Number of Invalid Observations = 385 Number of Calms Upper Level = 0
Note 1 - Any interpolations between stated mileages will be done by log-log

TABLE M-8

Joint Wind Frequency Distribution — Data Period: September 1, 1976 - August 31, 1978

All Winds
Data Source: On-Site
Wind Sensor Height 10.00 Meters
Table Generated: 12/05/78. 07.42.18.

St. Lucie Unit 2
Hutchinson Island, Florida
Florida Power & Light Co.
Dames and Moore Job No: 4598 - 112 - 27

Wind Speed Categories (Meters per Second)

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL[1]	MEAN SPEED
NNE	71 .43	206 1.25	318 1.92	71 .43	3 .02	0 0.00	669 4.05	3.32
NE	62 .38	292 1.77	385 2.33	128 .77	0 0.00	0 0.00	867 5.25	3.43
ENE	60 .36	334 2.02	505 3.06	158 .96	0 0.00	0 0.00	1057 6.40	3.51
E	69 .42	355 2.15	510 3.09	76 .46	0 0.00	0 0.00	1010 6.11	3.25
ESE	115 .70	684 4.14	744 4.50	72 .44	1 .01	0 0.00	1616 9.78	3.04
SE	183 1.11	660 3.99	749 4.53	28 .17	0 0.00	0 0.00	1620 9.81	2.88
SSE	129 .78	579 3.50	656 3.97	93 .56	1 .01	0 0.00	1458 8.82	3.10
S	72 .44	310 1.88	407 2.46	99 .60	8 .05	1 .01	897 5.43	3.36
SSW	84 .51	372 2.25	446 2.70	105 .64	33 .20	4 .02	1044 6.32	3.48
SW	129 .78	440 2.66	336 2.03	106 .64	14 .08	0 0.00	1025 6.20	3.10
WSW	155 .94	320 1.94	186 1.13	29 .18	5 .03	0 0.00	695 4.21	2.59
W	174 1.05	267 1.62	119 .72	37 .22	2 .01	0 0.00	599 3.63	2.43
WNW	203 1.23	304 1.84	172 1.04	17 .10	0 0.00	0 0.00	696 4.21	2.34
NW	143 .87	518 3.14	424 2.57	50 .30	0 0.00	0 0.00	1135 6.87	2.85
NNW	85 .51	379 2.29	535 3.24	70 .42	1 .01	0 0.00	1070 6.46	3.22
N	91 .55	194 1.17	531 3.21	148 .90	5 .03	0 0.00	969 5.86	3.69
CALM	95 .57						95 .57	CALM
TOTAL	1920 11.62	6214 37.61	7023 42.51	1287 7.79	73 .44	5 .03	16522 100.00	3.10

NUMBER OF VALID OBSERVATIONS	16522	94.30 PCT.	Key	XXX Number of Occurrences
NUMBER OF INVALID OBSERVATIONS	988	5.70 PCT.		XXX Percent Occurrences
TOTAL NUMBER OF OBSERVATIONS	17520	100.00 PCT.		

[1] - Totals below are given in hours & percent for wind frequency by sectors

END OF APPENDIX A

APPENDIX B
RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE
(Page 1 of 4)

ST. LUCIE PLANT
Key to Sample Locations

PATHWAY	LOCATION	DESCRIPTION	SAMPLES COLLECTED	SAMPLE COLLECTION FREQUENCY	APPROXIMATE DISTANCE (miles)	DIRECTION SECTOR
Direct Radiation	N-1	North of Blind Creek	TLD	Quarterly	1	N
Direct Radiation	NNW-5	Frederick Douglas Beach Entrance	TLD	Quarterly	4.8	NNW
Direct Radiation	NNW-10	Coast Guard Station	TLD	Quarterly	8.7	NNW
Direct Radiation	NW-5	Indian River Drive at Rio Vista Drive	TLD	Quarterly	5.4	NW
Direct Radiation	NW-10	Intersection of SR 68 and 33rd St	TLD	Quarterly	9.6	NW
Direct Radiation	WNW-2	Cemetery South of 7107 Indian River Drive	TLD	Quarterly	2.3	WNW
Direct Radiation	WNW-5	US-1 at SR 712	TLD	Quarterly	5.1	WNW
Direct Radiation	WNW-10	SR 70, Just West of I-95	TLD	Quarterly	10	WNW
Direct Radiation	W-2	Power Line - 77609 Indian River Drive	TLD	Quarterly	2	W
Direct Radiation	W-5	Oleander and Sager Streets	TLD	Quarterly	5.4	W
Direct Radiation	W-10	I-95 and SR 709	TLD	Quarterly	10.3	W
Direct Radiation	WSW-2	8503 Indian River Drive	TLD	Quarterly	1.8	WSW
Direct Radiation	WSW-5	Prima Vista Blvd. at Yacht Club	TLD	Quarterly	5.6	WSW
Direct Radiation	WSW-10	Del Rio and Davis Streets	TLD	Quarterly	10	WSW
Direct Radiation	SW-2	9205 Indian River Drive	TLD	Quarterly	2	SW
Direct Radiation	SW-5	FPL Walton Svc Ctr	TLD	Quarterly	4.5	SW
Direct Radiation	SW-10	Port St. Lucie Blvd. and Cairo Road	TLD	Quarterly	10.2	SW
Direct Radiation	SSW-2	10307 Indian River Drive	TLD	Quarterly	2.6	SSW

APPENDIX B
RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE
(Page 2 of 4)

ST. LUCIE PLANT
Key to Sample Locations

PATHWAY	LOCATION	DESCRIPTION	SAMPLES COLLECTED	SAMPLE COLLECTION FREQUENCY	APPROXIMATE DISTANCE (miles)	DIRECTION SECTOR
Direct Radiation	SSW-5	Port St. Lucie Blvd. and US 1	TLD	Quarterly	6	SSW
Direct Radiation	SSW-10	Pine Valley and Westmoreland Roads	TLD	Quarterly	8	SSW
Direct Radiation	S-5	13189 Indian River Drive	TLD	Quarterly	5.2	S
Direct Radiation	S-10	US 1 and Palm City Ave	TLD	Quarterly	10.8	S
Direct Radiation	S/SSE-10	Indian River Drive and Quail Run Lane	TLD	Quarterly	9.9	SSE
Direct Radiation	SSE-5	North of Entrance to Miramar	TLD	Quarterly	5.1	SSE
Direct Radiation	SSE-10	Elliot Museum	TLD	Quarterly	10.2	SSE
Direct Radiation	SE-1	South of Cooling Canal	TLD	Quarterly	1	SE
Direct Radiation	*H-32	U. of Florida - 1FAS Entomology Lab Vero Beach	TLD	Quarterly	18.1	NNW
Airborne	H08	FPL Substation - Weatherbee Road	Radioiodine & Particulates	Weekly	6	WNW
Airborne	*H12	FPL Substation - SR 76, Stuart	Radioiodine & Particulates	Weekly	12	S
Airborne	H14	Onsite - near south property line	Radioiodine & Particulates	Weekly	1	SE
Airborne	H30	Power Line - 7609 Indian River Drive	Radioiodine & Particulates	Weekly	2	W

* Denotes Control Sample

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

(Page 3 of 4)

ST. LUCIE PLANT

Key to Sample Locations

PATHWAY	LOCATION	DESCRIPTION	SAMPLES COLLECTED	SAMPLE COLLECTION FREQUENCY	APPROXIMATE DISTANCE (miles)	DIRECTION SECTOR
Airborne	H34	Onsite - At Meteorological Tower	Radioiodine & Particulates	Weekly	0.5	N
Waterborne	H15	Atlantic Ocean vicinity of public beaches east side of Route A1A	Surface Water (ocean) Sediment from shoreline	Weekly Semi-Annually	< 1	ENE/E/ESE
Waterborne	*H59	Near south end of Hutchinson Island	Surface Water (ocean) Sediment from shoreline	Monthly Semi-Annually	10-20	S/SSE
Food Products	H15	Ocean side vicinity of St. Lucie Plant (NOTE 1)	Crustacea Fish	Semi-Annually Semi-Annually	<1	ENE/E/ESE
Food Products	H51	Offsite near north property line	Broad Leaf vegetation	Monthly (when available)	1	N/NNW

* Denotes Control Sample

APPENDIX B
RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE
(Page 4 of 4)

ST. LUCIE PLANT
Key to Sample Locations

PATHWAY	LOCATION	DESCRIPTION	SAMPLES COLLECTED	SAMPLE COLLECTION FREQUENCY	APPROXIMATE DISTANCE (miles)	DIRECTION SECTOR
Food Products	H52	Offsite near south property line	Broad leaf vegetation	Monthly (when available)	1	S/SSE
Food Products	*H59	Near south end of Hutchinson Island	Crustacea Fish Broad leaf vegetation	Semi-Annually Semi-Annually Monthly	10-20	S/SSE

* Denotes control sample

It is the policy of Florida Power & Light Company (FPL) that the St. Lucie 1 & 2 Radiological Environmental Monitoring Programs are conducted by the State of Florida Department of Health (DOH) and Bureau of Radiation Control (BRC), pursuant to an Agreement between FPL and DOH and; that coordination of the Radiological Environmental Monitoring Programs with DOH and compliance with the Radiological Environmental Monitoring Program Controls are the responsibility of the Nuclear Plant Support Services Department.

NOTE 1
These samples may be collected from or supplemented by samples collected from the plant intake canal if the required analyses are unable to be performed due to unavailability or inadequate quantity of sample from the ocean side location.

END OF APPENDIX B

APPENDIX B-1

ST. LUCIE SUPPLEMENTAL REMP SAMPLING

(Page 1 of 3)

The sampling and analysis program outlined in this appendix is performed in addition to the St. Lucie REMP sample and analysis program required by Control 3.12.1. These samples are not required to satisfy the REMP Program nor required to be reported in the Annual Radiological Environmental Operating Report. Supplemental samples are performed to provide a broader data base for the Radiological Environmental Monitoring Program.

NOTE

* Approximate Distance from plant in miles

Pathway: Direct Exposure via TLD

Sampling and Collection Frequency: Quarterly Collection

Name	Sector	Distance *	Description
H-08	WNW	6	FPL Substation (White City Sub), Weatherbee Rd
H-09	SSW	7	FPL Substation (Jensen Sub), US-1 South of St. Lucie County Line
H-12	S	12	FPL Substation (Stuart Sub), SR-76, West of Stuart by High School
H-14	SE	1	South Site Property Line
H-33	ESE	<1	On-site, North of Intake Canal, West of Dunes
H-34	N	0.5	On-site, Meteorology Tower
H-60	NE	<1	Utility Pole, A1A, East of TAB
H-61 & H-62	SW	<1	Canal Dredging Spoils Mound

Pathway: Airborne Radioiodines and Particulates

Sampling and Collection Frequency: Samples Collected Weekly;

1. Iodine - Gamma-Spec Analysis
2. Particulate - Gross Beta and Composite Gamma-Spec Analysis

Name	Sector	Distance *	Description
H-09	SSW	7	FPL Substation (Jensen Sub), US-1 South of St. Lucie County Line
H-32	NNW	19	HRS Entomology Lab., East of US-1, Vero Beach
H-33	ESE	<1	On-site, North of Intake Canal, West of Dunes

APPENDIX B-1
ST. LUCIE SUPPLEMENTAL REMP SAMPLING
(Page 2 of 3)

NOTE
* Approximate Distance from plant in miles.

Pathway: Waterborne, Surface Water

Sampling and Collection Frequency: Monthly Collection; Gamma-Spec and Tritium Analysis

Name	Sector	Distance *	Description
H-13	NNW/N	<1	On-site, North Bank of Big Mud Creek, Between Pump Station and Meteorology Tower
H-36	NE/ENE	<1	On-site, Discharge Canal, West Side A1A 5/6/96 On-site, Discharge Canal, Near Bridge

Pathway: Waterborne, Sediment

Sampling and Collection Frequency: Semi-Annual Collection and Gamma-Spec Analysis

Name	Sector	Distance *	Description
H-13	NNW/N	<1	On-site, North Bank of Big Mud Creek, Between Pump Station and Meteorology Tower
H-16	N	1	Ocean Covered Sand, Beach Opposite Blind Creek, North of Discharge Canal
H-19	SE	1	Ocean Covered Sand, Beach South of Intake Canal
H-36	NE/ENE	<1	On-site, Discharge Canal, West Side A1A

Pathway: Waterborne, Beach Sand

Sampling and Collection Frequency: Semi-Annual Collection and Gamma-Spec Analysis

Name	Sector	Distance *	Description
H-15	NE/ENE/E	<1	On-site, Beach Near Discharge Structure
H-16	N	1	Ocean Covered Sand, Beach Opposite Blind Creek, North of Discharge Canal
H-19	SE	1	Ocean Covered Sand, Beach South of Intake Canal

APPENDIX B-1
ST. LUCIE SUPPLEMENTAL REMP SAMPLING
(Page 3 of 3)

NOTE

* Approximate Distance from plant in miles.

\# Although the Name remains the same, the locations can vary with sample availability.

Pathway: Ingestion, Garden Crop

Sampling and Collection Frequency: Annual Collection and Gamma-Spec Analysis

Name #	Sector	Distance *	Description
H-41	W	2	Private Residence, Indian River Dr.

Pathway: Ingestion, Citrus

Sampling and Collection Frequency: Annual Collection and Gamma-Spec Analysis

Name #	Sector	Distance *	Description
H-23	W	5	Vicinity of US-1 and Easy St.

END OF APPENDIX B-1

APPENDIX B-2
RADIOLOGICAL ENVIRONMENTAL SAMPLING IN SUPPORT OF THE GROUNDWATER PROTECTION INITIATIVE
(Page 1 of 2)

ST. LUCIE PLANT
Key to Sample Locations

STATE ID	PSL ID	SAMPLES COLLECTED	SAMPLE FREQUENCY	LOCATION DESCRIPTION
H70	GIS-MW-ES	Tritium / Gamma	Quarterly	West of A1A; between the discharge canal and Gate “B”
H71	GIS-MW-EI	Tritium / Gamma	Quarterly	West of A1A; between the discharge canal and Gate ”B”
H72	GIS-MW-SI	Tritium / Gamma	Quarterly	South of Intake canal and the adjacent access road
H73	GIS-MW-SWS	Tritium / Gamma	Quarterly	S/W corner of Intake canal and the adjacent access road
H74	GIS-MW-SWI	Tritium / Gamma	Quarterly	S/W corner of Intake canal and the adjacent access road
H75	GIS-MW-WI	Tritium / Gamma	Quarterly	West of plant site and intake canal; South of switchyard
H76	H76	Tritium / Gamma	Quarterly	North of Simulator; South of Big Mud Creek
H77	H77	Tritium / Gamma	Quarterly	East of Barge Slip; By LU bldg
H78	H78	Tritium / Gamma	Quarterly	South of North Warehouse
H79	H79	Tritium / Gamma	Quarterly	West of A1A and East of Parking Lot

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APPENDIX B-2

RADIOLOGICAL ENVIRONMENTAL SAMPLING IN SUPPORT OF THE GROUNDWATER PROTECTION INITIATIVE

(Page 2 of 2)

Until further notice, sample collection points, sampling periodicity, and analyses to be performed in support of the Groundwater Protection INITIATIVE (NEI 07-07) shall be at the discretion of the Chemistry Manager.

END OF APPENDIX B-2

FIGURE 1-1

SITE AREA MAP & ENVIRONMENTAL SAMPLE LOCATIONS

(Page 1 of 1)

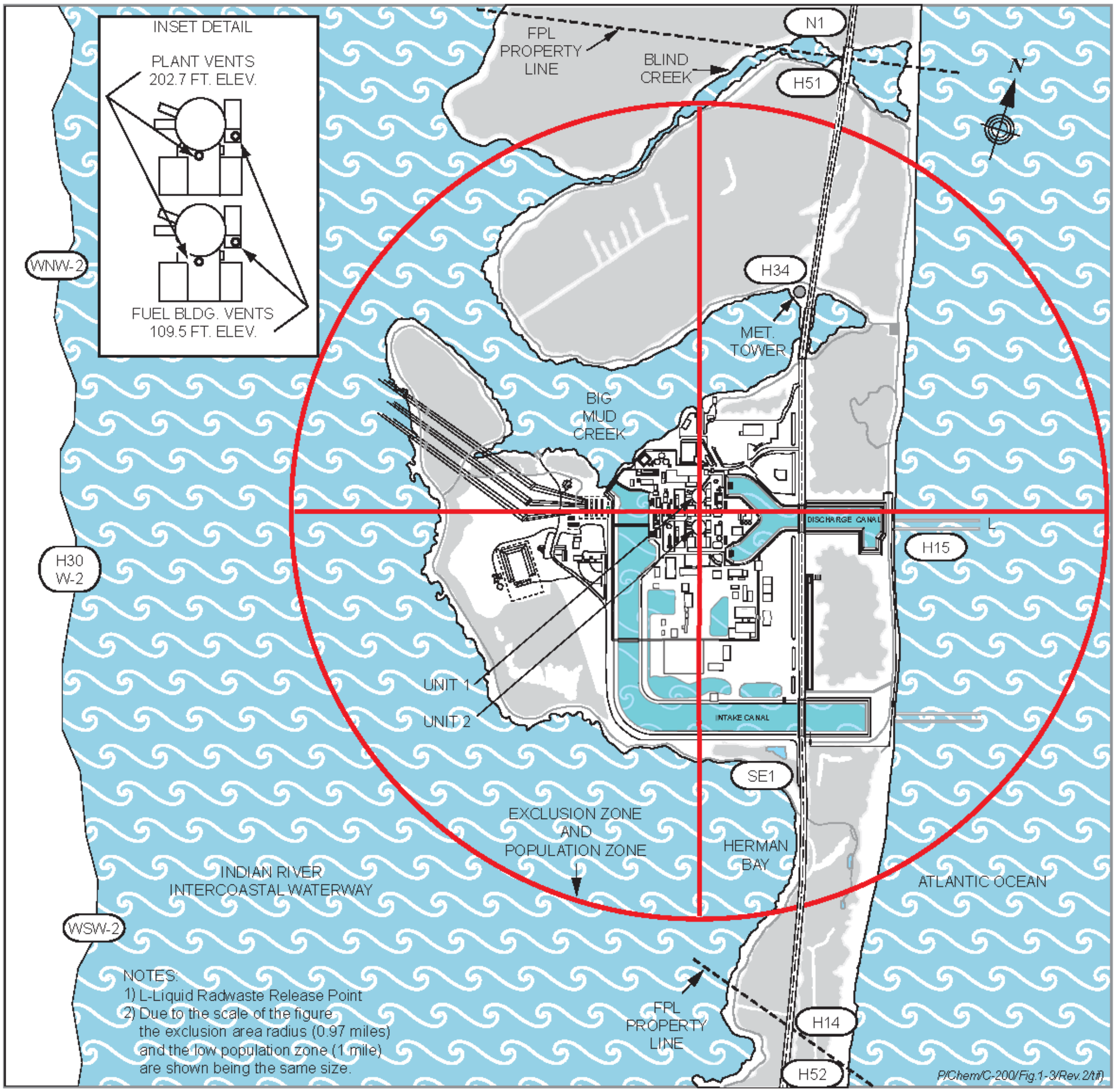
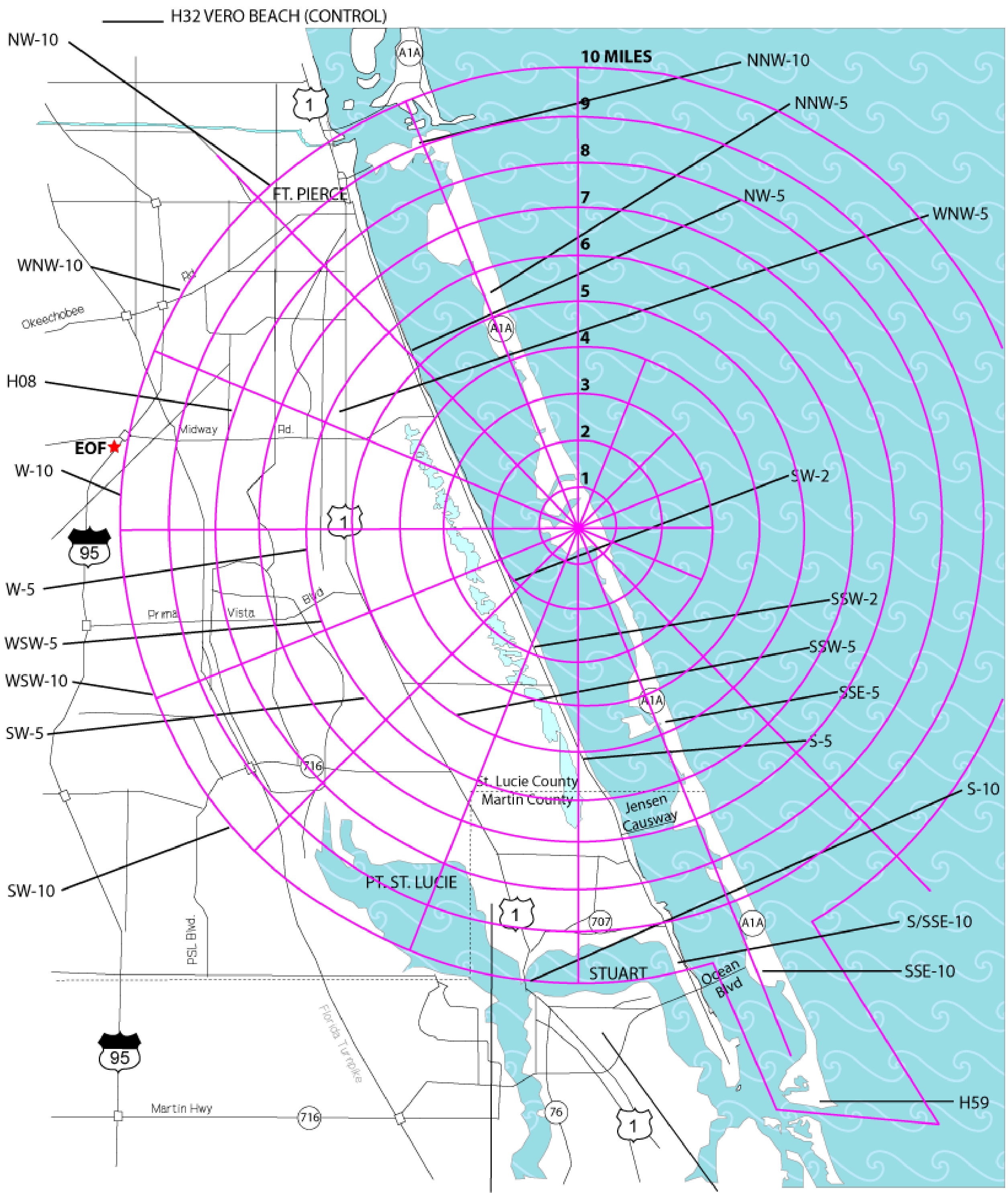


FIGURE 1-2

ENVIRONMENTAL SAMPLE LOCATIONS (10 MILES)

(Page 1 of 1)

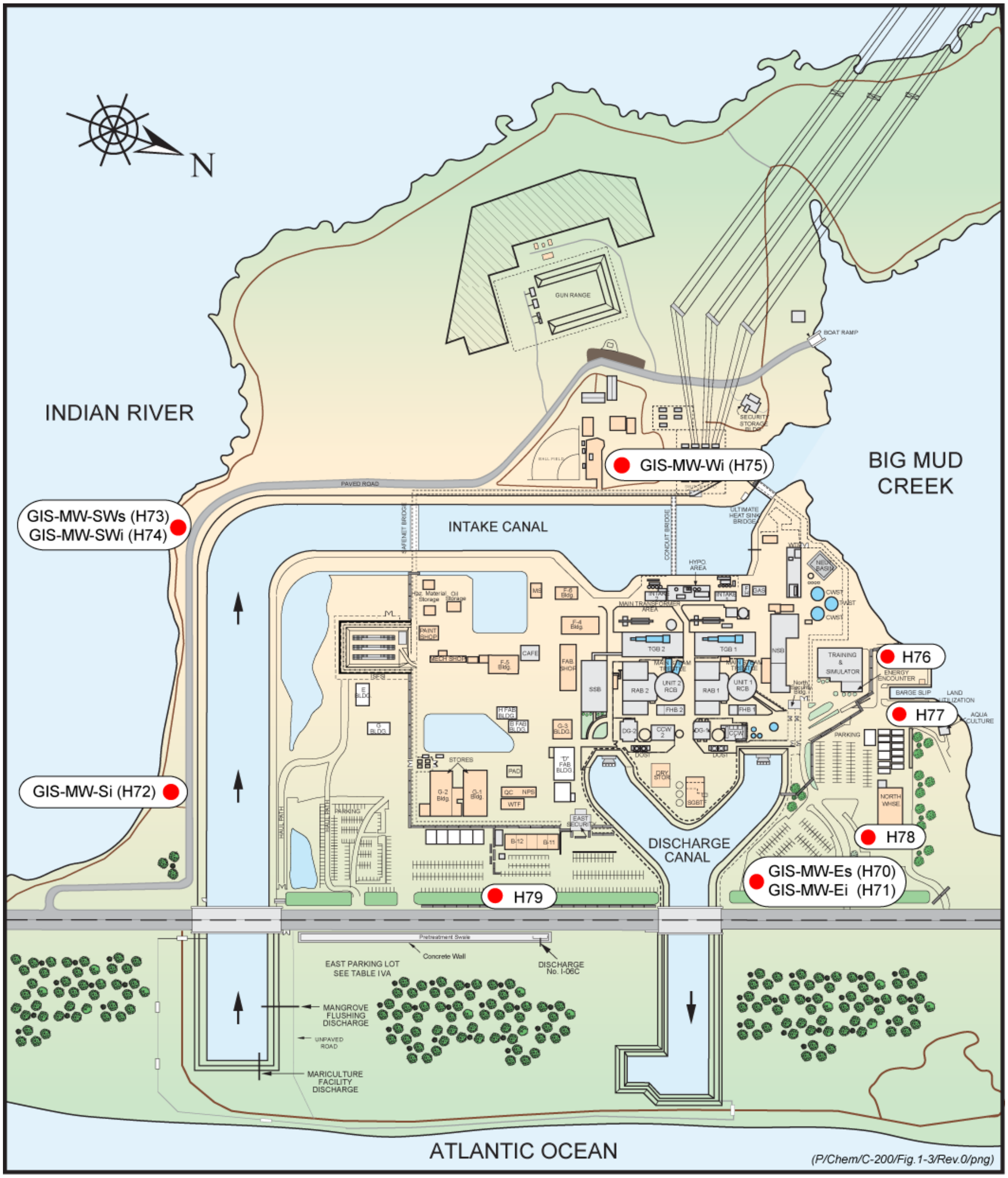


(P/Chem/C-200/Fig.1-2/Rev.3/png)

FIGURE 1-3

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS IN SUPPORT OF THE GROUNDWATER PROTECTION INITIATIVE

(Page 1 of 1)



APPENDIX C

METEOROLOGICAL DISPERSION FORMULAS*

(Page 1 of 1)

For X/Q:

$$X/Q = \frac{2.032}{(\bar{u}) D \sqrt{(\sigma_z^2 + \frac{cV^2}{\pi})}} \qquad \text{EQ (1)}$$

$$X/Q = \frac{2.032}{\sqrt{3}\ \sigma z (\bar{u})\ D} \qquad \text{EQ (2)}$$

Where:

C = .5

V = 207.5 ft. (63.2 meters)

$(\bar{u})$ = a name for one term

X/Q was calculated using each of the above EQs for each hour. The highest X/Q from EQ (1) or EQ (2) was selected. The total integrated relative concentration at each sector and distance was then divided by the total number of hours in the data base.

* Terrain correction factors given by Table M-4 were also applied to Dispersion Formulas

For Depleted X/Q:

$(X/Q)_D$ = (X/Q) X (Depletion factor of Figure 2 of R.G. 1.111-R1)

For Deposition (D/Q):

D/Q = RDep/(2 sin [11.25] X) X (Freq. distribution)

Where:

D/Q = Ground deposition rate

X = Calculation distance

RDep = Relative ground deposition rate from Figure 6 of R.G. 1.111, R1

APPENDIX D

DESCRIPTION OF THE INTERLABORATORY COMPARISON PROGRAM (ICP)

(Page 1 of 2)

The State of Florida, Department of Health-Bureau of Radiation Control (BRC) Laboratory shall participate in an INTERLABORATORY COMPARISON PROGRAM.

1. The sample matrices and analytical methods shall be:

   A. Gamma isotopic on a filter sample simulating airborne radioiodine and particulate collection.

   B. Gamma isotopic on a water sample simulating a surface water grab sample.

   C. Gamma isotopic on either sediment (or soil) or broad leaf vegetation.

   > **NOTE**
   > Steps D, E and F reference NRC IR 99-04, PMAI 99-0716.

   D. Gross Beta on an Air Filter matrix.

   E. Tritium in water, using method employed in REMP.

   F. Gamma isotopic on a water sample (above) is used for milk matrix if milk samples are being obtained per land use census identified milk animals within 5 miles of the plant site.

2. The source of samples for this program:

   A. A Federal Government Laboratory Program (e.g., DOE-MAPEP, EPA Safe Drinking Water Program)

   B. A State, Federal, or private (commercial) laboratory capable of providing NIST traceable samples. To be eligible, a Commercial Laboratory shall meet the FPL Quality Assurance criteria of "Quality Related".

   C. For Gamma Analysis only, a FPL Nuclear Site Laboratory may prepare sample matrices using known quantities of radioactivity from isotopes provided by a FPL Contract Laboratory currently approved as PC-1 Level vendor. These prepared matrices may be prepared by the vendor, or by FPL personnel, but shall not exceed the participant(s) form and/or license quantities for allowed radioactivity.

3. Analysis of Matrix samples shall be capable of achieving ODCM Table 4.12-1 prescribed LLDs on a blank sample.

APPENDIX D

DESCRIPTION OF THE INTERLABORATORY COMPARISON PROGRAM (ICP)

(Page 2 of 2)

4. Results within 20% of expected shall be considered acceptable. Results exceeding 20% but within 35% require a description of probable cause and actions performed to bring the analysis into conformance. Results exceeding 35% are considered Not Acceptable; the Matrix shall be replaced and reanalyzed.

5. The frequency for performing the interlaboratory comparison program shall be annually with a maximum of 15 months between comparisons of similar matrices.