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PSEG
Nuclear LLC

Technical Specification Section 6.9.1.7(Salem)
Technical Specification Section 6.9.1.6 (Hope Creek)

LR-N18-0048

APR 26 2018

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington DC 20555-001

Salem Nuclear Generating Station, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-70 and DPR-75
NRC Docket NOS. 50-272 and 50-311

Hope Creek Generating Station
Renewed Facility Operating License No. NPF-57
Docket No. 50-354

Subject: 2017 Annual Radiological Environmental Operating Report

As required with Section 6.9.1.7 of Appendix A to Renewed Facility Operating License Nos. DPR-70 (Unit 1) and DPR-75 (Unit 2) for SGS, and Section 6.9.1.6 of Appendix A to Renewed Facility Operating License NPF-57 for HCGS, PSEG Nuclear hereby transmits one (1) copy of the combined 2017 Annual Radiological Environmental Operating Report (Enclosure 1). This report summarizes the results of the radiological environmental surveillance program for 2017 in the vicinity of the Salem and Hope Creek Generating Stations. The result of this program for 2017 was specifically compared to the result of the pre-operational program.

There are no regulatory commitments contained in this letter.

If you have any questions or comments on this transmittal, please contact Mr. Rick Heathwaite at (856) 339-2076.

Sincerely,

Patrick A. Martino	Edward T. Casulli
Plant Manager	Plant Manager
Salem Generating Stations	Hope Creek Generating Station

Enclosure 1: 2017 Annual Radiological Environmental Operating Report for Salem and Hope Creek Generating Stations

Enclosure 2: Revision 28 of Salem and Hope Creek Generating Stations' Offsite Dose Calculation Manual

cc: Mr. David Lew, Administrator - Region I - USNRC
Mr. James Kim, Project Manager - USNRC
Ms. Lisa Regner, Project Manager - USNRC
Mr. Patrick Finney, Salem Senior Resident Inspector - USNRC
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Mr. Joseph T. Furia, NRC Inspector - Region I - USNRC
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Mr. Lee Marabella, Corporate Commitment Tracking Coordinator - w/o attachment
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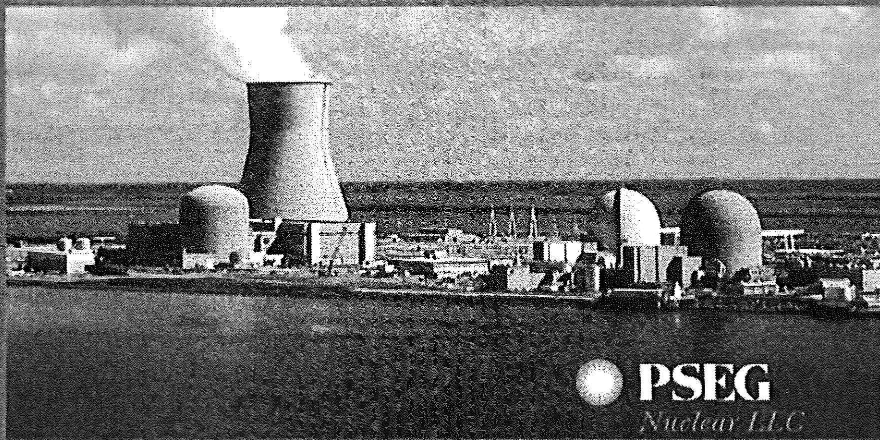
Mr. Thomas MacEwen, Hope Creek Commitment Tracking Coordinator - w/o attachment

LR-N18-0048

Enclosure 1

2017 Annual Radiological Environmental Operating Report

Salem and Hope Creek Generating Stations



2017 Annual Radiological Environmental Operating Report

January 1 through December 31, 2017

PSEG Nuclear

Salem and Hope Creek Generating Stations

Radiological Environmental Monitoring Program

Report Prepared by: ______________________ Date 03/28/2018
Rick Heathwaite (REMP/REC Program Manager)

Station Reviews and Approvals

Salem	Hope Creek
______________ Date 4/10/18 Paul Martitz (RP Superintendent)	H W TRIMBLE ______________ Date 4/10/18 Harold Trimble (RP Manager)
______________ Date 4/10/18 Michael Brummitt (Chem. Manager)	______________ Date 4/19/18 Shelly Kugler (Chem. Manager)
______________ Date 4/10/18 Patrick Martino (Plant Manager)	______________ Date 4/20/18 Edward Casulli (Plant Manager)

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

LIST OF TABLES

LIST OF TABLES (cont'd)

LIST OF MAPS

LIST OF FIGURES

LIST OF ACRONYMS OR TERMS (in alphabetical order)

%	Percent
A	Acceptable
a posteriori	An "after the fact" limit representing the capability of a measurement system
a priori	A "before the fact" limit representing the capability of a measurement system
AIO	Air Iodine
Analyte	The substance being identified and measured in a chemical analysis
APT	Air Particulates
AREOR	Annual Radiological Environmental Operating Report
Bq	Bequerels
C	Control
CAP	Corrective Action Program
CARR	Corrective/Preventive Action Request and Report (GEL CAP)
CVCS	Chemical Volume Control System
DOE	Department of Energy
Dpm	Disintegrations per minute
ECH	Crabs
ERA	Environmental Resource Associates
ESF	Fish
ESS	Sediment
EZA	Eckert & Ziegler Analytics, Inc.
FPL	Broad Leafy Vegetation
FPV	Vegetables
GAM	Game
GEL	General Engineering Laboratories; Duplicate sample analysis vendor
Gr-A	Gross alpha
Gr-B	Gross beta
H-3	Tritium
HCGS	Hope Creek Generating Station
IDM	Immersion Dose Monitor
ISFSI	Independent Spent Fuel Storage Installation
Kg	Kilogram
keV	Kilo-electron volts
L	Liter
LIMS	Laboratory Information Management System
LLD	Lower Limit of Detection
LTS	Laboratory Testing Services
m^3	Cubic meter
MAPEP	Mixed Analyte Performance Evaluation Program
MDC	Minimum Detectable Concentration
mL	Milliliter

MLK	Milk
mR	MilliRoentgen: a unit of radiation, used to measure the exposure of somebody or something to X-rays and gamma rays, defined in terms of the ionization effect on air.
mrem	Millirem: a unit for measuring amounts of radiation, equal to the effect that one roentgen of X-rays or gamma-rays would produce in a human being. It is used in radiation protection and monitoring.
MWe	Megawatt Electric
MWt	Megawatt Thermal
N	Not Acceptable
NCR	Nonconformance Report (TBE CAP)
NELAC	National Environmental Laboratory Conference
NRC	U.S. Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
pCi	Picocuries
PD	Passive Dosimeter
PE	Performance Evaluation
PSEG	Public Service Enterprise Group
PT	Performance Testing
PWR	Potable (drinking) Water - Raw
PWT	Potable (drinking) Water - Treated
QA	Quality Assurance
REMP	Radiological Environmental Monitoring Program
RGPP	Radiological Groundwater Protection Program
SA	Salem
SAR	Safety Analysis Report
SCFM	Standard Cubic Feet per Minute
SGS	Salem Generating Station
SOL	Soil
SOP	Standard Operating Procedures
Standard Quarter	Standard Quarter = 92 days
SWA	Surface Water
TBE	Teledyne Brown Engineering; Primary sample analysis vendor
TEDA	Triethylene-diamine
TLD	Thermoluminescent Dosimeter: A TLD measures ionizing radiation exposure by measuring the intensity of visible light emitted from a crystal in the detector when the crystal is heated. The intensity of light emitted is dependent upon the radiation exposure.
TS	Technical Specifications
uCi	Microcuries
USEPA	United States Environmental Protection Agency
VGT	Fodder Crops
W	Warning
WWA	Ground (well) Water

I. EXECUTIVE SUMMARY

PSEG Nuclear, LLC (PSEG) operates Salem Generating Station (SGS) and Hope Creek Generating Station (HCGS) (collectively, the Site) and implements a Radiological Environmental Monitoring Program (REMP) in accordance with the Site Offsite Dose Calculation Manuals (ODCMs).

In 2017 the REMP identified no plant-related radioactive materials detected in the environment that could be attributable to Site operations. The data obtained during the Reporting Period were comparable to the results obtained during the preoperational phase of the program, and are lower than the applicable limits. Combined with historical results collected since commercial operation, it can be concluded that the observed results were as expected and therefore, we conclude that the operation of the Site had no significant radiological impact on the health and safety of the public or on the environment.

II. INTRODUCTION

The REMP monitors and evaluates the environment surrounding the Site to ensure that there are no adverse impacts on the health and safety of the public or on the environment. The results of the REMP are published annually in this Report, the Annual Radiological Environmental Operating Report (AREOR). This AREOR provides a summary and interpretation of the data collected from January 1 through December 31, 2017 (the Reporting Period).

No cultural or historic resources officially identified and confirmed by regulatory agencies are known to exist at PSEG.

The REMP is based on NRC guidance as reflected in the Site ODCMs and establishes sample media, sampling locations, sampling frequency and analytical sensitivity requirements. It also identifies indicator and control locations established for comparison purposes to distinguish plant related radioactivity from naturally occurring or other radioactivity from man-made sources. The environmental monitoring program also verifies the projected and anticipated radionuclide concentrations in the environment and evaluates exposures associated with releases of radionuclides from the Site as described by the ODCM.

This program satisfies the requirements of Section IV.B.2 of Appendix I to 10 CFR 50 and provides surveillance of all appropriate critical exposure pathways to man. The REMP also complies with the following Technical Specifications and ODCM requirements:

Unit	Technical Specifications	ODCM
SGS U1	6.8.4.h	3/4. 12.1 6.9.1.7
SGS U2	6.8.4.h	3/4. 12.1 6.9.1.7
HCGS U1	6.8.4.h	3/4. 12.1 6.9.1.6

To demonstrate compliance with the requirements, samples of air particulates, air iodine, milk, surface water, ground (well) water, potable (drinking) water, vegetables, fodder crops, fish, crabs, oysters, game, and sediment were collected and analyzed. External radiation dose measurements were also made in the vicinity of the Site using passive dosimeters. These environmental media were analyzed for one or more of the following: gamma emitting isotopes, tritium (H-3), iodine-131 (I-131), gross alpha, gross beta, direct and immersion dose. Measurements made in the vicinity of the Site were compared to background or control measurements and the preoperational REMP study performed before SGS Unit 1 became operational. The results of these analyses were used to assess the impact on the health and safety of the public or on the environment of Site operations, thereby demonstrating compliance with the applicable Technical Specifications, ODCMs, and Federal regulations.

For the Reporting Period, there were a total of 1,743 analyses performed on 1,427 environmental samples. The radioactive materials noted in this Report are either naturally occurring in the environment such as K-40 or Be-7, or a result of other non-plant related human activities, such as historical atmospheric nuclear weapons testing or medical wastes from offsite. The majority of the remaining samples did not contain plant related radionuclides above detection limits.

The detection capabilities for environmental samples, required by the Site ODCMs, were achieved for the Reporting Period. Any exceptions to the program are noted in the Report and the associated PSEG Nuclear corrective action identifier was included in parenthesis.

III. THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The Site is located in Lower Alloway's Creek Township, Salem County, New Jersey. SGS consists of two operating pressurized water nuclear power reactors. SGS Unit 1 has a net rating of 1,180 megawatt electric (MW_e) and SGS Unit 2 has a net rating of 1,178 MW_e. The licensed core power for both Units is 3,459 megawatt thermal (MW_{th}). HCGS consists of an operating boiling water nuclear power reactor, which has a net rating of 1,212 MW_e. The licensed core power is 3,840 MW_{th}.

The Site is located on a man-made peninsula on the east bank of the Delaware River called Artificial Island. The peninsula was created by the deposition of hydraulic fill from dredging operations. The surrounding environment is characterized mainly by the Delaware River Estuary, extensive tidal marshlands, and low-lying meadowlands. These land types make up a vast majority of the land area within five miles of the Site, with most of the remaining land used for agriculture.

Since 1968, a Radiological Environmental Monitoring Program (REMP) has been conducted at the Site. Starting in December 1972, a more extensive radiological monitoring program was initiated in preparation for the operation of SGS Unit 1. The operational REMP was initiated in December 1976 when SGS Unit 1 achieved criticality.

An overview of the 2017 REMP is provided in Table B-1. Radioanalytical data from samples collected under this program were compared with results from the preoperational phase and historical operational results. This report presents the results from January 1 through December 31, 2017 (the Reporting Period) for the Site REMP.

A. Objectives of the Operational REMP:

The objectives of the Operational REMP as described in the Site ODCMs are:

1. To determine whether any significant increases occur in the concentration of radionuclides in critical pathways of exposure in the vicinity of Artificial Island.
2. To determine if the operation of the Site has resulted in any increase in the inventory of long lived radionuclides in the environment.
3. To detect any change in ambient gamma radiation levels.

   To verify that Site operations do not have detrimental effects on the health and safety of the public or on the environment.

B. Implementation of the Objectives:

The following describes the actions taken by PSEG to meet the REMP objectives listed above:

1. Samples of various media were selected for monitoring due to the potential radiological dose impact to humans. The selection of samples was based on:
   a. Established critical pathways for the transfer of plant related radionuclides through the environment to man, and
   b. Experience gained during the preoperational phase. Sampling locations were determined based on site meteorology, Delaware River Estuary hydrology, local demography, and land uses.

2. Sampling locations are divided into two classes: indicator and control. Indicator locations are those which have the potential to be influenced by Site operations. Control samples are collected at locations which are believed to be unaffected by Site operations, usually at 15 to 30 kilometers (9.3 to 18.6 miles) away from the Site. Fluctuations in the levels of radionuclides and direct radiation at indicator locations are evaluated with respect to analogous fluctuations at control locations. Indicator and control location data are also evaluated relative to preoperational data.
3. Appendix A describes the coding system which identifies sample type and location and describes and summarizes the analytical results in accordance with Section 6.9.1.7 of the SGS ODCM and Section 6.9.1.6 of the HCGS ODCM. Table A-1 summarizes average, minimum and maximum activities of the indicator locations, control locations and the location with the highest mean using values above the Minimum Detectable Concentration (MDC).
4. Appendix B Table B-1 lists the types of samples collected, sample frequency, and analysis types. Table B-2 lists location codes, locations, and latitude and longitude coordinate.
5. The sampling locations are also indicated on Maps B-1 for on-site sampling locations out to 1 mile; B-2 for off-site sampling locations 1 to 10 miles; and B-3 for off-site sampling locations greater than 10 miles.

IV. PROGRAM DESCRIPTION

A. Data Interpretation

Results of analyses are grouped according to sample type and presented in Appendix C data tables. All results above the Lower Limit of Detection (LLD) are at a confidence level of ± 2 sigma. This represents the range of values into which 95% of repeated analyses of the same sample should fall. As defined in NRC NUREG-1301 and NUREG-1302, LLD is 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." The equation for determining LLD is:

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

4.66 is the statistical factor from NUREG 1301 and 1302,

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

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide (sec-1), and

Δt for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting (sec).

The LLD is an *a priori* number, which represents the capability of the measurement system (including instrumentation, procedure and sample type) and not an after the fact criteria for the presence of activity. All analyses are designed to achieve the required detection limits for environmental sample analysis as described in the Site ODCMs.

The Minimum Detectable Concentration (MDC) is defined as above with the exception that the measurement is an *a posteriori* (after the fact) estimate of the presence of activity. The MDC should be lower than the required LLD.

The grouped data were averaged and standard deviations calculated. The ± 2 sigma deviations of the averaged data represent sample and not analytical variability. Averages are calculated using positive values. Results are considered positive if the activity exceeds the MDC and exceeds 3 sigma uncertainty. Additionally, for gamma analysis, the peak must be identified in the gamma spectrum.

B. Program Anomalies and Exceptions.

For the purpose of this report, a **Program Exception** is considered when a sample is missed; meaning that no scientifically valid data can be obtained (i.e. a forgotten or lost sample). Conversely, **Sample Anomalies** are instances where a partial sample was obtained, and despite potentially not meeting all the data objectives it still represents scientifically valid data (failed sample pump, defective TLD element, etc.). During the reporting period, anomalies and exceptions to REMP sampling requirements involved Air Sample weekly run times and Direct Radiation Monitoring dosimeters. In all air sampling instances, sufficient sample was collected during the week to meet the required LLD. One dosimeter was damaged and could not be read, and two dosimeters were identified as being placed on inner fences (closer to the site) than is described in the ODCM.

Air Sampling Locations

- **Sample Anomaly:** Air sample station SA-APT/AIO-1F1 (Estuary Enhancement Garage located on Hancock's Bridge - Fort E Road in Elsinboro, NJ) operated approximately 7.3 hours less than expected from 3/13/2017 to 3/20/2017 due to storm related loss of power. The sampler resumed operating normally once power had been restored (CAP: 80119427).
- **Sample Anomaly:** Air sample station SA-APT/AIO-1F1 (Estuary Enhancement Garage located on Hancock's Bridge - Fort E Road in Elsinboro, NJ) had been found to be inoperable on 8/28/2017. Although the sample pump did not trip on thermal overload, it was making excessive noise and the indicated flow rate was zero. The gas totalizer had accumulated 9,100 cubic feet during the weekly sample period, which would normally be closer to 14,000 - 15,000 cubic feet. The approximate run time was determined by using the established flow rate and actual volume to calculate a failure time of 8/25/2017 3:00. The estimated run time was 104 hours out of a possible 169 hours.

  TBE stated they only needed 100 cubic meters (3,531 cubic feet) to meet the LLD for the sample. In this instance approximately 2.5 times the minimally required sample volume was achieved, so the LLD was met.

  The LTS Technician carries a spare sample assembly in the truck, so the unit was replaced at the time of discovery, and station SA-APT/AIO-1F1 resumed normal opration. The old sample pump was rebuilt at LTS and used as a spare.

  The sample pump vanes are known to fail after a few years of operation. LTS does a good job pro-actively replacing sample pumps every 2 years so that this does not happen. The Salem/Hope Creek REMP has had very high pump reliability relative to the rest of the industry as a result of these pump replacements (CAP: 20774358).
- **Sample Anomaly:** For the week of 10/23/17 to 10/31/17, air particulate filter at location 14G1 (located in Delaware, approximately 13.38 miles WNW of the plant) had lower than expected gross beta activity. An investigation on 11/09/17 identified the filter was improperly positioned and slightly offset from center such that some sample flow could bypass the particulate filter. This event was discussed with the LTS Technician to ensure representative sample integrity is not challenged in the future (CAP: 80119427).

- **Sample Anomaly:** It was identified that the LTS Technician had been using Hi-Q TC-12 low efficiency filters. The collection efficiency for these filters was between 77% and 82% (dependent on sample flow rates) based on performance curves found on the cartridge spec sheet. TBE and GEL were contacted to see if they were correcting for low efficiency, but were not because they had never been directed to do so. On May 5th 2017, the vendor was instructed to incorporate a conservative collection efficiency of 75% for future analysis until high efficiency cartridges were implemented for effluent and environmental sampling.

  The conservative correction of 75% efficiency was based on a flow of 1.7 scfm that LTS establishes through the air samplers (1.5 scfm +/- 2 scfm) and the performance curve of the filter (~ 77% efficient @ 1.7 scfm) found on the product specification sheet.

  During this evaluation period, all analysis results were re-calculated to obtain a corrected activity and to ensure LLDs were met. Of the 2,185 samples, there were no instances were iodine was identified in REMP sample cartridges. However, there were 77 instances out of 2,185 samples where the ODCM required *a priori* (based on theoretical parameters before the analysis) LLD of 0.07 pCi/m^3 had not been met. This accounted for approximately 3% of the sample population, and the maximum LLD exceedance was 28.6% above the specified *a priori* LLD of 0.07 pCi/m^3. The maximum *a posteriori* (based on empirical data after the analysis) Minimum Detectable Activity (MDA) was found to be 0.09 pCi/m^3.

  This condition was NOT considered to be immediately reportable as defined in the controls section of the station ODCM's. Required detection capability was met and the highest LLD was an order of magnitude below the threshold of reporting. Therefore, PSEG was able to demonstrate there were no exceedances of plant related-radionuclides in the environment. More pertinent to this notification is that REMP air samples remained below the reporting level of 0.9 pCi/m^3 in accordance with Hope Creek ODCM Table 3.12.1-2 and Salem ODCM Table 3.12-2 (CAP: 20765154).

Direct Radiation Monitors

- **Program Exception:** Radiological Environmental Monitoring Program (REMP) Environmental Dosimeter TLD 8F1 was discovered to be missing at the end of the first quarter of 2017 during the quarterly TLD change out. Personnel searched in the area near the TLD location, but the TLD could not be located. It appears that TLD 8F1 was subject to vandalism. A new TLD for second quarter was installed at the location as part of the routine surveillance. TLD 8F1 is located in Delaware approximately 9 miles in the SE direction from the plant (CAP: 20760175).
- **Sample Anomaly:** REMP Environmental Dosimetry location 13S1 located near the Salem Unit 2 fence showed a net dose of 5.7 mrem per standard quarter during the second quarter of 2017. (CAP: 20772941). Subsequently, TLDs for 13S1 and 12S1 were mounted to an inner security fence that was about half the intended distance. This could have contributed to the elevated TLD reading for 13S1 for the second quarter. TLD locations were corrected and LTS was provided feedback regarding sample location adherence despite perceived obstacles (CAP: 20777951).

- **Program Exception:** During review of the 3Q 2017 REMP TLD data provided by Mirion, it was revealed that REMP TLD SA-IDM-3E1 (4.13 Miles NE of the station reference point) was damaged. Apparently the TLD was waterlogged and would not yield meaningful data. The TLD was replaced during the surveillance (CAP: 20785115).

Management Audit samples

- **Sample Anomaly:** On December 20, 2017 a soil sample was obtained from sample location 6S2 by the LTS Technician and then sent to TBE for analysis. This sample is not a part of the formal REMP, but was directed by the E-Plan staff as part of an Emergency Preparedness (EP) function. LTS Work Instruction, SMPLLOC (ADM 2) "EP/REMP Field Location Listing", identifies location 6S2 as approximately 0.24 miles ESE of the plant.

  The soil from 6S2 was analyzed by TBE on January 4, 2018 and confirmed after a re-count on January 22, 2018 to have positive detection of Cs-137 at 4.566E+01 ± 2.526E+01 pCi/kg .

  Historically, Cs-137 has been observed in soil samples and attributed to weapons testing. The values observed in these samples are below the predicted values of Cs-137 for the New Jersey area as a result of weapons testing. According to plant procedure EN-AA-170-1000, soil concentrations found in the New Jersey area due to weapons testing in the 1950s and 1960s could be in the range of 285 to 383 pCi/kg at a depth of 10 cm or approximately 111 pCi/kg at a depth of 30 cm (these values are decay corrected to 2017) (CAP: 20786249).

C. Program Changes

Both the SGS and HCGS ODCMs were revised in 2017. Revision 28 of both ODCMs were issued in September 2017. These changes can be reviewed in the Revision Summary of each individual station ODCM, which were included as supplements to this report.

In addition to the ODCM changes described above, the following program changes were made to the REMP, but were outside the requirement of the ODCM:

- Revised REMP Implementing Procedure EN-AA-170-1001 for calculating direct dose using environmental dosimeters in accordance with ANSI N13.37.
- Added management audit TLD 1S2, located 382 feet north of TLD 1S1 (0.62 miles from site center point as referenced in the ODCM.

D. Quality Assurance Program

Teledyne Brown Engineering

The results reported by TBE are consistent with the Quality Assurance Program as described in the TBE Quality Assurance Manual and the TBE Procedure Manual.

GEL Laboratories

The results reported by GEL Laboratories, LLC (GEL) are consistent with the Quality System described in GEL's Quality Assurance Manual and the requirements of ISO17025:2005.

E. Inter-laboratory Comparison Program

Inter-laboratory Comparison Programs are independent checks on the precision and accuracy of laboratory analyses. These checks are performed as part of the REMP and are part of the quality assurance program.

TBE analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation and water matrices, as appropriate for 173 analyses (Appendix D, Tables D-1 through D-3).

GEL analyzed PE samples of air particulate, air iodine, milk, soil, vegetation and water matrices, as appropriate for 462 analyses (Appendix D, Tables D-4 through D-7).

The PE samples, supplied by Eckert & Ziegler Analytics, Inc. (EZA), Environmental Resource Associates (ERA), and the Department of Energy's (DOE) Mixed Analyte Performance Evaluation Program (MAPEP), were evaluated against the following acceptance criteria:

1. EZA Evaluation Criteria

   EZA's evaluation report provides a ratio of reported results and EZA's known value. Since flag acceptance criteria values are not assigned by EZA, TBE evaluated the reported ratios based on internal QC requirements, which are based on the DOE MAPEP criteria.

2. ERA Evaluation Criteria

   ERA's evaluation report provides an acceptance range for control and warning limits with associated flag values. ERA's acceptance limits are established in accordance with the United States Environmental Protection Agency (USEPA), National Environmental Laboratory Conference (NELAC) performance testing (PT) program requirements, or ERA's standard operating procedure (SOP) for the Generation of Performance Acceptance Limits, as applicable. The acceptance limits are either determined by a regression equation specific to each analyte or a fixed percentage limit promulgated under the appropriate regulatory document.

3. DOE Evaluation Criteria

   MAPEP's evaluation report provides an acceptance range with associated flag values. The MAPEP defines three levels of performance: Acceptable (flag = "A"), Acceptable with Warning (flag = "W"), and Not Acceptable (flag = "N"). Performance is considered acceptable when a mean result for the specified analyte is ± 20% of the reference value. Performance is "acceptable with warning" when a mean result falls in the range from ± 20% to ± 30% of the reference value (i.e., 20% < bias <

30%). If the mean result is greater than 30%, the results are deemed not acceptable.

Teledyne Brown Engineering

The DOE MAPEP samples are created to mimic conditions found at DOE sites which do not resemble typical environmental samples obtained at commercial nuclear power facilities.

Summary of Results – Inter-laboratory Comparison Program (ICP)

The TBE Laboratory analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation, and water matrices for various analytes. The PE samples supplied by EZA, ERA, and DOE MAPEP, were evaluated against the following pre-set acceptance criteria:

1. EZA Evaluation Criteria

   EZA's evaluation report provides a ratio of TBE's result and EZA's known value. Since flag values are not assigned by EZA, TBE evaluates the reported ratios based on internal QC requirements based on the DOE MAPEP criteria.

2. ERA Evaluation Criteria

   ERA's evaluation report provides an acceptance range for control and warning limits with associated flag values. ERA's acceptance limits are established per the USEPA, National Environmental Laboratory Accreditation Conference (NELAC), state-specific Performance Testing (PT) program requirements or ERA's SOP for the Generation of Performance Acceptance Limits, as applicable. The acceptance limits are either determined by a regression equation specific to each analyte or a fixed percentage limit promulgated under the appropriate regulatory document.

3. DOE Evaluation Criteria

   MAPEP's evaluation report provides an acceptance range with associated flag values. MAPEP defines three levels of performance:

   - Acceptable (flag = "A") - result within ± 20% of the reference value
   - Acceptable with Warning (flag = "W") - result falls in the ± 20% to ± 30% of the reference value
   - Not Acceptable (flag = "N") – bias is greater than 30% of the reference value

   Note: DOE MAPEP samples are created to mimic conditions found at DOE sites which do not resemble typical environmental samples obtained at commercial nuclear power facilities.

168 out of 173 analyses performed by the TBE Radiochemistry laboratory met the specified acceptance criteria. Five (5) analyses did not meet the specified acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program, and are detailed as follows:

1. The April 2017 ERA was evaluated as *Not Acceptable* for two nuclides (NCR 17-09).
    a. The Zn-65 result of 39.3 pCi/L, exceeded the lower acceptance limit of 47.2. The known value was unusually low for this study. The sample was run in duplicate on two different detectors. The results of each were 39.3 ± 18.2 pCi/L (46% error and lower efficiency) and 59.3 ± 8.23 pCi/L (13.9% error and higher efficiencyF). The result from the 2nd detector would have been well within the acceptable range (47.2 – 65.9) and 110.2% of the known value of 53.8 pCi/L.
    b. The Sr-89 result of 40.7 pCi/L exceeded the lower acceptance limit of 53.8. All associated QC and recoveries were reviewed and no apparent cause could be determined for the failure. The prior three cross-check results were from 99 – 115% of the known values and the one that followed this sample (November, 2017) was 114% of the known value.

2. In August 2017, the DOE MAPEP air particulate U-238 result of 0.115 ± 0.025 Bq/sample was higher than the known value of 0.087 ± 0.002 with a ratio of 1.32, therefore the upper ratio of 1.30 (acceptable with warning) was exceeded. TBE's result with error easily overlaps with the acceptable range. MAPEP does not evaluate results with any associated error. Also, the spike level for this sample was very low (2.35 pCi) compared to TBE's normal Laboratory Control Spike (LCS) of 6 pCi. TBE considers this result as passing (NCR 17-15).

3. The EZA September 2017 soil Cr-51 result was evaluated as *Not Acceptable* (Ratio of TBE to known result at 0.65). The reported value was 0.230 ± 0.144 pCi/g and the known value was 0.355 ± 0.00592 pCi/g. The sample was counted overnight for 14 hours, however the Cr-51 was spiked at a very low level and had a counting error of 65%. Cr-51 has a 27-day half-life, making low-level quantification even more difficult. The error does not appear to have been taken into consideration for this result. If it had been evaluated with the error, the highest result would have been 105% of the reference value, which is acceptable. Also, the known value is significantly lower than TBE's typical MDC for this nuclide in a soil matrix and would typically not be reported to clients (unless specified). The results of all of the previous cross-checks have been in the acceptable (80 – 120%) range. TBE will evaluate further upon completion of the next ICP sample (NCR 17-16).

4. The November 2017 ERA water sample was evaluated as *Not Acceptable* for Sr-90. TBE's result of 27.1 pCi/L exceeded the lower acceptance range (30.8 – 48.0 pCi/L). After reviewing the associated QC data for this sample, it was determined that although the spike recovery for Sr-90 was within the laboratory guidelines (70% - 130%), both the spike result and the ERA result were biased low. The original cross-check sample was completely consumed and TBE was unable to reanalyze before submitting the result. TBE modified their preparation process to avoid this situation for future cross-check samples. Instead of just running a duplicate, TBE enhanced their data management program to force a Laboratory Control Spike Duplicates (LCSD) when a workgroup includes cross-check samples (NCR 17-19).

GEL

In 2017, forty-five (45) radioisotopes associated with seven (7) matrix types were analyzed under GEL's PE program in participation with ERA, MAPEP, and EZA. Matrix types were representative of client analyses performed during 2017. Of the four hundred sixty-two (462) total results, 99.4% (459 of 462) were found to be acceptable within the PT providers three sigma or other statistical criteria. The list below contains the type of matrix evaluated by GEL.

- Air Filter
- Cartridge
- Water
- Milk
- Soil
- Liquid
- Vegetation

EZA provided samples for ninety-two (92) individual environmental analyses. The accuracy of each result reported to EZA, Inc. is measured by the ratio of GEL's result to the known value. All results fell within GEL's acceptance criteria (100% within acceptance).

MAPEP Series 36 and 37 were analyzed by the laboratory. All one hundred twenty-four (124) analyses fell within the PT provider's acceptance criteria (100% within acceptance).

The ERA MRad program provided samples (MRAD-26 and MRAD-27) for one hundred ninety-seven (197) individual environmental analyses. All analyses fell within the PT provider's acceptance criteria (100% within acceptance).

The ERA program provided samples (RAD-108, RAD-109, RAD-110) for forty-nine (49) individual environmental analyses. Of the 49 analyses, 93.9% (46 out of 49) of all results fell within the PT provider's acceptance criteria.

CARR 170227-1085 documents the unacceptable result of Gross Alpha in water (two methods) from Study RAD-108, CARR170828-1125 documents the unacceptable result of Iodine-131 in water from Study RAD-110. All corrective actions are summarized below.

ISO Documentation of PT Failures in RAD108 for Gross Alpha EPA 00-02 and EPA 9310 (CARR170227-1085): It was determined that an unknown error occurred during the preparation and/or analysis of these samples because all quality control criteria were met for the batch. The following steps were taken to prove that this positive bias was an isolated occurrence and that our overall process is within control.

1. The batch quality control samples were reviewed and found to be compliant. The Laboratory Control Standard (LCS) recovered at 119% (EPA 00-02) and 96.9% (EPA 900 & 9310).
2. The sample was duplicated within each batch and met criteria with RPDs of 2.52% & 3.48%. (EPA 00-02) and 0.211% and 16.4% (EPA 900.0 & 9310).
3. The LCS control charts were review for biases. None were noted.

Permanent Corrective/Preventive Actions or Improvements:
The laboratory must assume unidentified random errors caused the biases because all quality control criteria were met for the batches. The sample was re-analyzed after the "Not Acceptable" rating was received and a result that fell within the acceptance range was obtained.

ISO Documentation of PT Failure in RAD110 for I-131 (CARR170828-1125). After a review of data, it was determined that an unknown error occurred during the analysis of these samples because all quality control criteria were met for the batch.

The following steps were taken to prove that this positive bias was an isolated occurrence and that the laboratory's overall process is in control:

1. The batch quality control samples were reviewed and found to be compliant.
2. The sample was duplicated within the batch and met criteria. The duplicate result is within the acceptance limits of the study.
3. The control charts were reviewed for biases and none were noted.

Permanent Corrective/Preventive Actions or Improvements were not needed. The laboratory must assume unidentified random errors caused the biases because all quality control criteria were met for the batches.

F. Summary of Results: Split Sample Comparison Program

Duplicate samples were obtained for some samples of weekly air iodine and particulates, quarterly air particulate, sediment, broad leaf vegetation, milk, and surface water. These samples were analyzed by GEL as comparison and validation of TBE results. The GEL duplicate analysis results are shown in Table C-20.

1. Air Iodine

   All 53 duplicate sample results from GEL and TBE were less than MDC for I-131.

2. Air Particulates

   Gross beta was detected by GEL in all 53 and by TBE in 51 of the 53 duplicate weekly APT samples. GEL detects significantly higher gross beta results due to different calibration energy sources used by each lab.

   All four duplicate quarterly composite samples analyzed had positive results for Be-7.

AIR PARTICULATE COMPOSITES												
TBE						GEL			TBE / GEL Comparison			
CRS #	Collection Date	Nuclide	Decay Corrected Activity	1 Sigma Error	Resolution	CRS #	Nuclide	Decay Corrected Activity	Ratio	Acceptance Criteria		Agreement
L72551	Q1	Be-7	5.45E-02	5.83E-03	9	420354	BE-7	7.91E-02	1.45	0.6	1.66	YES
L73587	Q2	Be-7	1.02E-01	1.42E-02	7	429912	BE-7	7.20E-02	0.71	0.5	2	YES
L73587	Q2	Be-7	4.74E-02	6.55E-03	7	429912	BE-7	7.20E-02	1.52	0.5	2	YES
L74854	Q3	Be-7	7.53E-02	9.19E-03	8	435640	Be-7	6.45E-02	0.86	0.6	1.66	YES
L75917	Q4	Be-7	4.92E-02	8.31E-03	6	441625	Be-7	6.14E-02	1.25	0.5	2	YES

3. Milk

Naturally occurring K-40 was detected in all 19 duplicate samples and are all in agreement based on Criteria for Accepting the Licensee's Measurements in NRC Inspection Procedure 84525.

MILK												
TBE						GEL			TBE / GEL Comparison			
CRS #	Collection Date	Nuclide	Decay Corrected Activity	1 Sigma Error	Resolution	CRS #	Nuclide	Decay Corrected Activity	Ratio	Acceptance Criteria		Agreement
L71177	01/03/17	K-40	1.36E+03	7.05E+01	19	413780	K-40	1.25E+03	0.92	0.75	1.33	YES
L71612	02/06/17	K-40	1.43E+03	1.17E+02	12	416070	K-40	1.28E+03	0.90	0.6	1.66	YES
L71897	03/06/17	K-40	1.56E+03	9.65E+01	16	418179	K-40	1.32E+03	0.85	0.75	1.33	YES
L72266	04/03/17	K-40	1.38E+03	8.35E+01	17	419973	K-40	1.50E+03	1.09	0.75	1.33	YES
L72765	05/08/17	K-40	1.31E+03	7.35E+01	18	422901	K-40	1.43E+03	1.09	0.75	1.33	YES
L73145	06/05/17	K-40	1.36E+03	9.20E+01	15	425027	K-40	1.36E+03	1.00	0.6	1.66	YES
L73484	07/03/17	K-40	1.38E+03	8.70E+01	16	427255	K-40	1.40E+03	1.01	0.6	1.66	YES
L74048	08/07/17	K-40	1.46E+03	9.25E+01	16	430244	K-40	1.39E+03	0.95	0.6	1.66	YES
L74365	09/05/17	K-40	1.19E+03	7.85E+01	15	432355	K-40	1.46E+03	1.23	0.6	1.66	YES
L74765	10/02/17	K-40	1.30E+03	9.45E+01	14	434331	K-40	1.35E+03	1.04	0.6	1.66	YES
L75341	11/13/17	K-40	1.28E+03	9.09E+01	14	438066	K-40	1.57E+03	1.22	0.6	1.66	YES
L75577	12/04/17	K-40	1.44E+03	7.55E+01	19	439536	K-40	1.49E+03	1.03	0.75	1.33	YES

4. Surface Water

Naturally occurring K-40 was detected in all four GEL results and in two of the corresponding TBE results. All detections were in agreement based on Criteria for Accepting the Licensee's Measurements in NRC Inspection Procedure 84525.

SURFACE WATER												
TBE						GEL			TBE / GEL Comparison			
CRS #	Collection Date	Nuclide	Decay Corrected Activity	1 Sigma Error	Resolution	CRS #	Nuclide	Decay Corrected Activity	Ratio	Acceptance Criteria		Agreement
L72118	03/21/17	K-40	8.76E+01	4.01E+01	2	419293	K-40	1.39E+02	1.59	0.4	2.25	YES
L73398	06/01/17	K-40	3.67E+01	2.64E+01	1	426537	K-40	5.85E+01	1.59	0.4	2.25	YES
L75490	09/20/17	K-40	6.48E+01	2.45E+01	3	433432	K-40	4.46E+01	0.69	0.4	2.25	YES
LI75784	12/19/17	K-40	9.05E+01	1.83E+01	5	440688	K-40	7.65E+01	0.85	0.5	2	YES

5. Broad Leaf Vegetation

Naturally occurring K-40 was detected by GEL and TBE in all 4 duplicate samples analyzed. GEL detected Be-7 in one of the samples while TBE did not detect Be-7 on any of the samples. All results are in agreement based on Criteria for Accepting the Licensee's Measurements in NRC Inspection Procedure 84525.

VEGETATION												
TBE						GEL			TBE / GEL Comparison			
CRS #	Collection Date	Nuclide	Decay Corrected Activity	1 Sigma Error	Resolution	CRS #	Nuclide	Decay Corrected Activity	Ratio	Acceptance Criteria		Agreement
L73812	07/26/17	K-40	5.79E+03	4.40E+02	13	429158	K-40	5.41E+03	0.93	0.6	1.66	YES
L74292	08/29/17	K-39	8.72E+03	3.07E+02	28	431947	K-40	7.58E+03	0.87	0.75	1.33	YES
L74764	10/03/17	K-40	6.54E+03	2.89E+02	23	434321	K-40	5.38E+03	0.82	0.75	1.33	YES
L75495	11/27/17	K-40	5.11E+03	3.13E+02	16	438929	K-40	4.22E+03	0.83	0.75	1.33	YES

6. Sediment

Naturally occurring K-40 was detected in both samples by both GEL and TBE. Naturally occurring Ra-226 was detected in both samples by GEL. The Ra-226 detections by GEL were at levels below the MDC of TBE so a direct comparison could not be performed. Results are in agreement based on Criteria for Accepting the Licensee's Measurements in NRC Inspection Procedure 84525.

SEDIMENT												
TBE						GEL			TBE / GEL Comparison			
CRS #	Collection Date	Nuclide	Decay Corrected Activity	1 Sigma Error	Resolution	CRS #	Nuclide	Decay Corrected Activity	Rati o	Acceptance Criteria		Agreement
L73119	06/01/17	K-40	4.66E+03	4.58E+02	10	424919	K-40	6.44E+03	1.38	0.6	1.66	YES
L75583	11/30/17	K-40	4.70E+03	4.77E+02	10	439539	K-40	4.71E+03	1.00	0.6	1.66	YES

7. Fish

Naturally occurring K-40 was detected in both samples by both GEL and TBE. Results are in agreement based on Criteria for Accepting the Licensee's Measurements in NRC Inspection Procedure 84525.

FISH												
TBE						GEL			TBE / GEL Comparison			
CRS #	Collection Date	Nucli de	Decay Corrected Activity	1 Sigma Error	Resolution	CRS #	Nuclide	Decay Corrected Activity	Rati o	Acceptance Criteria		Agreement
L75422	11/13/17	K-40	3.58E+03	2.31E+02	15	446538	K-40	3.09E+03	0.86	0.6	1.66	YES

V. RESULTS AND DISCUSSION

The analytical results of the 2017 REMP samples were divided into categories based on exposure pathways: atmospheric, direct radiation, terrestrial, and aquatic. The ingestion pathway was evaluated under the terrestrial and aquatic categories. The analytical results for the Reporting Period are summarized in Appendix A, Radiological Environmental Monitoring Program Summary. The data for individual samples are presented in Appendix C data tables. The data are compared to the preoperational REMP data (1973-1976) and to historical data since Site operation commenced. The samples collected and analysis results indicate that the Site REMP was conducted in compliance with the Site Technical Specifications and ODCMs.

Effluent monitoring for the Site has historically included samples and analyses not specifically required by the Site ODCMs in addition to those required. Management Audit Samples are samples that are taken to augment the radiological effluent monitoring program, but do not fulfill any regulatory requirement. These analyses are referenced throughout the Report as Management Audit Samples. PSEG Nuclear continues to collect these samples. In addition to summarizing the required samples as part of the REMP, Table A-1, "Radiological Environmental Monitoring Program Summary", of this report includes Management Audit Samples referenced in Table E-1 of each station's ODCM. Additionally, Appendix C of this report includes a series of tables with analytical analysis results for all samples collected as the broader scope of the REMP. These tables also contain results for Management Audit Samples, including those not specified in ODCM Table E-1.

The following is a list and quantity of the Management audit samples collected in 2017:

Management Audit Sample Type	Number of Samples
Vegetables	21
Well Water	12
Potable Water (raw / treated)	12 / 12
Fodder Crops	4
Soil	0
Game	3
Oysters	4

A. Atmospheric

APT (Air Particulate) samples were collected on glass fiber filters with low-volume air samplers sampling at approximately 1.5 SCFM. Air sample volumes were measured with calibrated dry-gas meters.

AIO samples (Air Iodine) were collected from the air by adsorption on triethylene-diamine (TEDA) impregnated charcoal cartridges connected in series after the APT filters.

1. Air Particulates

   APT samples were collected weekly at seven indicator locations (5S1, 7S2, 15S2, 5D1, 16E1, 1F1, and 2F6), one duplicate location (5S2) and one control location (14G1). Each weekly sample collected was analyzed for gross beta by TBE. Quarterly composites of the weekly samples from each location were analyzed for specific gamma emitters. The duplicate air location sample was shipped to GEL for analysis (Tables C-1, C-2 and C-20) (CAP 20760175).

   Gamma Spectroscopy

   Gamma spectroscopy was performed on each of the 32 quarterly composite samples. Naturally occurring Be-7 was detected and no other gamma emitters were detected in any of the samples.

   Naturally occurring Be-7, attributed to cosmic ray activity in the atmosphere, was detected in 28 of 28 indicator location composites at concentrations ranging from 37E-03 pCi/m^3 to 174E-03 pCi/m^3 with an average concentration of 92E-03 pCi/m^3, and in the four control location composites ranging in concentration from 59E-03 pCi/m^3 to 130E-03 pCi/m^3 with an average concentration of 98E-03 pCi/m^3. The maximum preoperational level detected was 330E-03 pCi/m^3 with an average concentration of 109E-03 pCi/m^3 (Table C-1 and Reference [1] RMC-TR-77-03).

   Gross Beta

   Gross beta activity was detected in 362 of 371 of the indicator location samples at concentrations ranging from 4E-03 pCi/m^3 to 22E-03 pCi/m^3 with an average concentration of 12E-03 pCi/m^3, and in 52 of 53 of the control location samples at concentrations ranging from 5E-03 pCi/m^3 to 20E-03 pCi/m^3 with an average of 13E--03 pCi/m^3. Gross beta activity was less than ten times the yearly mean of control samples. Therefore, per the ODCM gamma isotopic analysis was not required to performed on the individual samples. The maximum preoperational level detected was 920E-03 pCi/m^3 with an average concentration of 74E-03 pCi/m^3 (Table C-2 and Reference [1] RMC-TR-77-03). See Figure 1 (Appendix C).

2. Air Iodine

   AIO were collected weekly at seven indicator locations (5S1, 7S2, 15S2, 5D1, 16E1, 1F1, and 2F6), one duplicate location (5S2) and one control location (14G1). The duplicate air location sample was shipped to GEL for duplicate analysis. Each sample was analyzed for I-131, and all 424 samples were less than the MDC for both indicator and control samples during the Reporting Period. The maximum preoperational level detected was 42E-03 pCi/m^3 (Table C-3 and Reference [1] RMC-TR-77-03).

B. Direct Radiation

Ambient radiation levels in the environment were monitored at locations on the Site and in the surrounding areas with pairs of passive dosimeters (PD) supplied and analyzed by Mirion Technologies. Packets containing the PDs were placed in the owner-controlled area, around the Site at various distances, and in each land based meteorological sector. Six were placed in control locations and the balance of measurement locations were placed at areas of interest such as population centers, nearby residences, and schools.

A total of 58 Immersion Dose Monitor (IDM) locations were established to monitor for direct radiation during 2017, including:

- 21 on-site locations:

  1S1, 1S2, 2S2, 2S4, 3S1, 4S1, 5S1, 6S2, 7S1, 8S1, 9S1, 10S1, 11S1, 12S1, 13S1, 14S1, 15S1, 15S2, 16S1, 16S2, and 16S3

- 32 off-site locations within the 10 mile zone:

  4D2, 5D1, 10D1, 14D1, 15D1, 2E1, 3E1, 11E2, 12E1, 13E1, 16E1, 1F1, 2F2, 2F5, 2F6, 3F2, 3F3, 4F2, 5F1, 6F1, 7F2, 8F1, 9F1, 10F2, 11F1, 12F1, 13F2, 13F3, 13F4, 14F2, 15F3, and 16F2

- 6 control locations beyond 10 miles:

  1G3, 3G1, 10G1, 14G1, 16G1, and 3H1.

The PDs at each location are changed and analyzed quarterly.

Two PDs (Panasonic type UD-814) are placed at each location. The laboratory utilizes a Panasonic based system using UD-814 dosimeters that are constructed of three rectangular, lead-shielded (protects against low-energy gamma radiation) teflon wafers, impregnated with 25% calcium sulfate phosphor ($CaSO_4$:Dy) to monitor gamma radiation. Additionally, each PD has one lithium borate (LiBO:Mn) element to monitor beta radiation (which is not used).

Commencing with the 2017 data, PSEG implemented American National Standards Institute (ANSI) N13.37-2014 ENVIRONMENTAL DOSIMETRY - CRITERIA FOR SYSTEM DESIGN AND IMPLEMENTATION for comparing each PD location dose result to its historical background dose. Per the standard a well-functioning dosimetry system should be able to detect a 5 mrem difference in the quarterly data and a 10 mrem difference in the yearly data above background.

Using this methodology most of the net dose and annual dose for each PD location was determined that No Dose (ND) above background was detected (Table C-4). Location 13S1 in the second quarter showed a net dose of 5.7 mrem/Standard Quarter. An investigation (CAP 20772941) revealed that the PD was moved closer to Salem Unit 1 due to security fence issues that prevented easy access to the location. The PD was moved back to its original placement and a new route to that location was determined.

Location 7F2 did not show any quarterly net dose issues; however, the annual net dose was determined to be 14.2 mrem. Reviewing the historical data trend for this location from 1999 – 2016 indicated that a shift of several mrem higher occurred beginning in 2011 and continued through 2017. This location is located 9.1 miles SE of the site and should not be impacted by operations of the site (CAP 20790645) was written to document this trend and to determine a cause for the elevated readings.

The two site boundary locations 1S1 and 16S2 showed measurable dose rates above background. The net dose radiation levels as measured by these site boundary locations ranged from 9.7 to 15.73 mrem/Standard Quarter and an annual dose of 50.4 mrem for Locations 1S1 and 57.9 mrem for Location 16S2.

Dose to the nearest resident due to direct radiation from ISFSI was calculated to be 0.00625 mrem for the year which was a very small fraction of limit (40 CFR 190 and 10 CFR 72.104 both limit the dose to a real member of the public to 25 mrem in a year to the total body). The calculation was performed using the formula provided in ANSI/HPS N13.37-2014 as follows:

$$D_2 = OF * \left(\left(D_1 * R_1^2\right) / R_2^2\right)$$

Where:

D_1 = Dose that was measured from TLD Location 16S2

D_2 = Dose that will be extrapolated to Nearest Resident

R_1 = Distance from the source to the location where D1 was obtained. (Distance from ISFSI to TLD at 16S2)

R_2 = Distance from ISFSI to the location that dose will be extrapolated (Nearest Resident)

OF = Occupancy Factor (1 = full time)

Location	R_1 (ft)	D_1 Net Dose (mrem)	R_2 (ft)	OF	D_2 Dose (mrem)
Nearest Resident	203	57.9	19,536	1.0	6.25 E-03

C. Terrestrial

Terrestrial REMP sampling includes the collection of milk, well water, potable water, vegetables, and fodder crop samples.

Milk samples (MLK) were taken semi-monthly when cows were on pasture and monthly when cows were not grazing on open pasture, from three indicator locations (13E3, 14F4, 2G3) and one control location (3G1). Animals were considered on pasture from April to November of each year. Samples were collected in new polyethylene containers, sodium bisulfite was added as a sample preservative, and then samples were frozen and transported in ice chests to TBE.

Well water samples (WWA) were collected monthly from one location (3E1). Separate raw water (PWR) and treated potable water (PWT) composite samples were collected monthly from one location (2F3). Each monthly composite was made up of weekly samples. All samples were collected in new polyethylene containers and shipped to TBE for analysis.

Locally grown vegetables (FPV) were collected at the time of harvest at seven locations (2F9, 3F8, 15F4, 1G1, 2G2, and 3H5); fodder crops (VGT) were sampled at four locations (13E3, 14F4, 2G3, and 3G1); and broad leaf vegetation (FPL) was sampled at six locations (1S1, 7S2, 15S2, 16S1, 10D1, and 3H5). The vegetables and fodder samples are additional samples (Management Audit) taken to enhance the radiological monitoring program. There is no dairy farm within three miles of the Site and there is only one dairy farm within five miles. Therefore, broadleaf vegetation is grown, maintained and harvested monthly during the growing season. All samples were weighed, packaged and shipped to TBE for analysis.

1. Milk

Milk samples were collected from two farms in New Jersey (2G3 and 3G1) and two farms in Delaware (13E3 and 14F4). Each sample was analyzed for I-131 and gamma emitters.

I-131

I-131 was not detected above MDC in any of the 80 samples analyzed. The maximum preoperational level detected was 65 pCi/L, which occurred following a period of atmospheric nuclear weapons tests (Table C-5 and Reference [1] RMC-TR-77-03).

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator or control location milk samples.

Naturally occurring K-40 was detected in all 80 milk samples with concentrations for the 60 indicator location samples ranging from 1,110 pCi/L to 1,710 pCi/L with an average concentration of 1,347 pCi/L, and the 20 control location sample concentrations ranging from 1,028 pCi/L to 1,511 pCi/L, with an average concentration of 1,302 pCi/L. The maximum preoperational level detected was 2,000 pCi/L with an average concentration of 1,437 pCi/L (Table C-5 and Reference [1] RMC-TR-77-03).

2. Well Water (Ground Water)

Although offsite wells in the vicinity of the Site are not directly affected by plant operations, well water samples were collected monthly from one farm (3E1). Samples from this well are considered Management Audit samples.

Gross Alpha

Gross alpha activity was not detected above the MDC in any of the well water samples. The maximum preoperational level detected was 9.6 pCi/L (Table C-6 and Reference [1] RMC-TR-77-03).

Gross Beta

Gross beta activity was detected in three of 12 well water samples above the MDC with concentrations ranging from 2.5 pCi/L to 2.7 pCi/L, with an average concentration of 2.6 pCi/L. The preoperational results ranged from <2.1 pCi/L to 38 pCi/L, with an average value of 9 pCi/L (Table C-6 and Reference [1] RMC-TR-77-03).

Tritium

Tritium activity was not detected above the MDC in any of the well water samples. The maximum preoperational level detected was 380 pCi/L (Table C-6 and Reference [1] RMC-TR-77-03).

I-131

I-131 activity was not detected in any of the well water samples. No preoperational data were available for comparison, since I-131 was not analyzed as a specific radionuclide prior to 1989. However, I-131 analytical results to date have been below the MDC (Table C-7 and Reference [1] RMC-TR-77-03).

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator or control location well water samples. Naturally occurring K-40 was not detected in any of the well water samples. The maximum preoperational levels detected were 30 pCi/L (Table C-7 and Reference [1] RMC-TR-77-03).

3. Potable Water (Drinking Water)

Both raw and treated potable water samples were collected and composited at the local water treatment facility. Each sample consisted of weekly aliquots composited into a monthly sample. The raw water source for this plant is a combination of surface water from Laurel Lake and groundwater from its adjacent wells. These are Management Audit samples as no liquid effluents discharged from the Site directly affect this pathway.

Gross Alpha

No Gross alpha activity was detected in any of the raw or treated water samples. The maximum preoperational level detected was 2.7 pCi/L (Table C-8 and Reference [1] RMC-TR-77-03).

Gross Beta

Gross beta activity was detected in 12 of the 12 raw water samples and in 12 of the 12 treated water samples. The concentrations for the raw samples ranged from 2.9 pCi/L to 8.6 pCi/L, with an average concentration of 5.9 pCi/L. Concentrations for the treated water ranged from 4.8 pCi/L to 8.6 pCi/L, with an average concentration of 6.6 pCi/L. The maximum preoperational level detected was 9.0 pCi/L with an average concentration of 4.2 pCi/L (Table C-8 and Reference [1] RMC-TR-77-03).

Tritium

Tritium activity was not detected in any of the raw or treated water samples. The maximum preoperational level detected was 350 pCi/L with an average of 179 pCi/L (Table C-8 and Reference [1] RMC-TR-77-03).

I-131

I-131 activity was not detected in any of the raw or treated water samples. No preoperational data were available for comparison, since I-131 was not analyzed as a specific radionuclide prior to 1989. However, I-131 analytical results to date have been below the MDC (Table C-9 and Reference [1] RMC-TR-77-03).

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the potable water samples. Naturally occurring K-40 was not detected in any of the raw or treated water samples. No preoperational data were available for comparison. Naturally occurring Ra-226 was not detected in any raw or treated water samples. The maximum preoperational level detected for Ra-226 was 1.4 pCi/L (Table C-9 and Reference [1] RMC-TR-77-03).

4. Broadleaf Vegetation

Broadleaf vegetation was grown by PSEG personnel at four onsite locations and one offsite location in Delaware at 3.9 miles SSW for purposes of REMP sampling. These broadleaf vegetation samples were collected since there were no dairy farms operating within the five km (three mile) radius of the Site. The closest dairy farm (13E3) was located in Odessa, DE at 5.0 miles to the West.

All samples were analyzed for gamma emitters and included kale, cabbage, and collards. These samples were obtained from five indicator locations (49 samples) and one control locations (1 samples). The results for these samples are discussed below.

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator or control location broadleaf vegetation samples.

Naturally occurring Be-7, attributed to cosmic ray activity in the atmosphere, was detected above the MDC in two of the 49 indicator location samples with concentrations ranging from 358 pCi/kg (wet) to 466 pCi/kg (wet), with an average concentration of 412 pCi/kg (wet). Be-7 was not detected in the control location sample. No preoperational Be-7 data was available for comparison (Table C-10).

Naturally occurring K-40 was detected in all 49 indicator samples, with concentrations ranging from 2,019 pCi/kg (wet) to 10,690 pCi/kg (wet) with an average concentration of 4,684 pCi/kg (wet), and in the control location sample at 2,035 pCi/kg (wet). The maximum preoperational level detected was 4,800 pCi/kg (wet) with an average concentration of 2,140 pCi/kg (wet) (Table C-10 and Reference [1] RMC-TR-77-03).

5. Vegetables

There are no farm products that are irrigated with water in which plant effluents have been discharged. The Delaware River at the location of the Site is brackish and therefore is not used for irrigation.

A variety of food products were sampled on and around the Site; however, the variety was dependent on the farmer's preference. These vegetables were collected as Management Audit samples.

All samples were analyzed for gamma emitters and included asparagus, sweet corn, peppers, tomatoes, and peaches. These samples were obtained from seven indicator locations (21 samples). The results for these samples are discussed below.

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator or control location vegetable samples.

Naturally occurring Be-7, attributed to cosmic ray activity in the atmosphere, was not detected above the MDC in any of the vegetables samples.

Naturally occurring K-40 was detected in all 21 indicator samples, with concentrations ranging from 1,155 pCi/kg (wet) to 2,741 pCi/kg (wet) with an average concentration of 1,845 pCi/kg (wet). The maximum preoperational level detected was 4,800 pCi/kg (wet) with an average concentration of 2,140 pCi/kg (wet) (Table C-10 and Reference [1] RMC-TR-77-03).

6. Fodder Crops

Although not required by the Site ODCMs, four samples of silage normally used as cattle feed were collected from three indicator locations and one control location. It was determined that these products could be an element in the food-chain pathway. These fodder crops were collected as Management Audit samples and analyzed for gamma emitters. All four locations from which samples were collected are milk sampling locations.

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator or control location fodder crop samples. Naturally occurring Be-7, attributed to cosmic ray activity in the atmosphere, was detected in one of the three indicator samples with a concentration of 657 pCi/kg (wet) and in the control location sample with a concentration of 820 pCi/kg (wet). The maximum preoperational level detected for fodder was 4,700 pCi/kg (wet) with an average concentration of 2,000 pCi/kg (wet) (Table C-11 and Reference [1] RMC-TR-77-03).

Naturally occurring K-40 was detected in all three indicator samples at concentrations ranging from 4,256 pCi/kg (wet) to 6,332 pCi/kg (wet) with an average concentration of 5,006 pCi/kg (wet), and in the control location sample at a concentration of 6,645 pCi/kg (wet). Preoperational results averaged 7,000 pCi/kg (wet) (Table C-11 and Reference [1] RMC-TR-77-03).

7. Soil

Soil is sampled every three years and was not sampled in 2017. It will next be sampled in 2019.

8. Game

Although not required by the Site ODCMs, three muskrat samples were collected from three indicator locations. The game samples were collected as Management Audit samples and analyzed for gamma emitters.

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator game samples. Naturally occurring K-40 was detected in all samples at concentrations ranging from 2,500 to 2,839 pCi/kg (wet) with an average concentration of 2,688 pCi/kg (wet). No preoperational data was available for comparison (Table C-13 and Reference [1] RMC-TR-77-03).

D. Aquatic

This sample set includes edible fish, shoreline and riverbed sediment, surface water, crabs, and oysters.

Surface water samples were collected offshore in new polyethylene containers that were rinsed twice with the sample medium prior to collection. The surface water samples were transported to TBE for analysis.

Edible fish were collected using gill nets while crabs were caught in commercial traps.

These samples were processed by separating the flesh from the bone and shell. The flesh was placed in sealed containers and frozen before being transported in ice chests to TBE for analysis.

Sediment samples were taken with a bottom grab sampler and frozen in sealed polyethylene containers before being transported in ice chests to TBE. For the river bottom sediment, a marine GPS was used to locate the correct site and the sampling boat was maneuvered over the area until the correct amount of sample was obtained (grabbed) with the sediment dredge.

Location 6S2 shoreline sediment sample (an onsite location) was sampled as follows: A square area, measuring one meter on each side was staked out and then divided into a grid of nine smaller boxes, three per side. A one inch deep scoop from the center of each of the small grids was taken. All the aliquots were combined and the total sample transported in the ice chest to TBE.

Oyster samples were collected by personnel licensed to harvest oysters by the State of New Jersey. Oysters in the vicinity of the plant were not large enough to be sold to the public, so they were added to the REMP as Management Audit samples. Oysters were collected and shucked; then the flesh and internal fluids were placed in sealed containers and frozen before being transported in ice chests to TBE for analysis.

1. Surface Water

   Surface water samples were collected twice a month at four indicator locations and one control location in the Delaware River Estuary. The two samples for the month were combined to create a single monthly composite sample that was then analyzed. One location (11A1) is at the outfall area (which is the area potentially impacted by effluents discharged from the Site into the Delaware River), one location is downstream from the outfall area (7E1), and one location is directly west of the outfall area at the mouth of the Appoquinimink River (12C1). Samples were collected upstream in the Delaware River (1F2) and at the mouth of the Chesapeake and Delaware Canal (16F1) the latter being sampled when the flow was from the Canal into the river.

   Location 12C1, located directly west of the Site, at the mouth of the Appoquinimink River, serves as the control. 12C1 was chosen as the control location because the physical characteristics of this location more closely resemble those of the outfall area than do those at the farther upstream location (1F2). As discussed in the preoperational summary report, due to its tidal nature, there were flow rate and salinity variations in the Delaware River Estuary. These variations accounted for the differences in K-40 concentrations.

   <u>Tritium</u>

   Tritium activity was not detected in any of the indicator or control sample locations. The maximum preoperational level detected was 600 pCi/L, with an average concentration of 210 pCi/L (Table C-14 and Reference [1] RMC-TR-77-03). See Figure 3 for graphical presentation.

   <u>Gamma Spectroscopy</u>

   No plant related gamma emitters were detected above the MDC in any of the indicator or control surface water samples.

   Naturally occurring K-40 was detected in 17 of the 48 indicator location samples at concentrations ranging from 63 pCi/L to 177 pCi/L with an average concentration of 105 pCi/L, and in 4 of the 12 control location samples at concentrations ranging from 49 pCi/L to 151 pCi/L and an average of 92 pCi/L. The maximum preoperational level detected for K-40 was 200 pCi/L with an average concentration of 48 pCi/L (Table C-15 and Reference [1] RMC-TR-77-03).

I-131

I-131 was not detected above the MDC in any of the 48 indicator samples or in any of the control location samples (Table C-15).

2. Fish

Edible species of fish were collected semi-annually at two indicator locations and one control location and analyzed for gamma emitters in edible flesh. Sample species collected in 2017 were perch, striped bass and catfish.

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator or control location fish samples. Naturally occurring K-40 was detected in all ten indicator location samples at concentrations ranging from 2,313 pCi/kg (wet) to 7,052 pCi/kg (wet) with an average concentration of 4,306 pCi/kg (wet), and all three control location samples at concentrations ranging from 3,409 pCi/kg (wet) to 4,805 pCi/kg (wet) with an average concentration of 3,885 pCi/kg (wet). The maximum preoperational level detected was 13,000 pCi/kg (wet) with an average concentration of 2,900 pCi/kg (wet) (Table C-16 and Reference [1] RMC-TR-77-03).

3. Blue Crab

Blue crab samples were collected twice during the season at one indicator and one control location. The edible portions were analyzed for gamma emitters.

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator or control location blue crab samples. Naturally occurring K-40 was detected in both indicator location samples at concentrations of 2,859 pCi/kg (wet) and 3,110 pCi/kg (wet) with an average concentration of 2,985 pCi/kg (wet), and in both control location samples at concentrations of 2,922 pCi/kg (wet) and 3,073 pCi/kg (wet) with an average concentration of 2,998 pCi/kg (wet). The maximum preoperational level for K-40 detected was 12,000 pCi/kg (wet) with an average concentration of 2,835 pCi/kg (wet). All other gamma emitters were less than the MDC (Table C-17 and Reference [1] RMC-TR-77-03).

4. Sediment

Sediment samples were collected semi-annually from six indicator locations and one control location. Location 6S2 was the only shoreline sediment sample location that was directly subjected to tidal fluctuations. The remaining locations were located offshore.

Gamma Spectroscopy

Naturally occurring K-40 was detected in all 12 indicator location samples at concentrations ranging from 2,325 pCi/kg (dry) to 12,930 pCi/kg (dry), with an average concentration of 6,691 pCi/kg (dry), and at both control locations samples at concentrations of 8,840 pCi/kg (dry) and 9,698 pCi/kg (dry) with an average concentration of 9,269 pCi/kg (dry). The maximum preoperational level detected was 21,000 pCi/kg (dry) with an average concentration of 15,000 pCi/kg (dry) (Table C-18 and Reference [1] RMC-TR-77-03).

Cs-137 was not detected in any of the indicator samples. The maximum preoperational level detected was 400 pCi/kg (dry) with an average concentration of 150 pCi/kg (dry) (Table C-18 and Reference [1] RMC-TR-77-03).

Naturally occurring Ra-226 was detected in six of the 12 indicator location samples at concentrations ranging from 1,689 pCi/kg (dry) to 2,513 pCi/kg (dry) with an average concentration of 2,091 pCi/kg (dry) and was not detected above the MDC in the control location samples. The maximum preoperational level detected was 1,200 pCi/kg (dry) with an average concentration of 760 pCi/kg (dry) (Table C-18 and Reference [1] RMC-TR-77-03).

Naturally occurring Th-232 was detected in eleven of the 12 indicator location samples at concentrations ranging from 288 pCi/kg (dry) to 832 pCi/kg (dry) with an average concentration of 561 pCi/kg (dry), and in both of the control location samples at concentrations of 823 pCi/kg (dry) and 899 pCi/kg (dry) with an average concentration of 861 pCi/kg (dry). The maximum preoperational level detected was 1,300 pCi/kg (dry) with an average concentration of 840 pCi/kg (dry). All other gamma emitters were less than the MDC (Table C-18 and Reference [1] RMC-TR-77-03).

5. Oysters

Oyster samples were collected twice during the season at one indicator and one control location. The edible portions were analyzed for gamma emitters.

Gamma Spectroscopy

No plant related gamma emitters were detected above the MDC in any of the indicator or control location oyster samples.

Naturally occurring K-40 was detected in both indicator location samples at concentrations of 1,481 and 2,653 pCi/kg (wet) with an average concentration of 2,067 pCi/kg, and in both control location samples at concentration of 929 and 1,319 pCi/kg (wet) with an average concentration of 1,124 pCi/kg (wet). There were no preoperational analyses preformed on oysters as there were no significant quantities of oysters or other shellfish within 5 miles of the plant discharge. All other gamma emitters were less than the MDC (Table C-19 and Reference [6]).

E. Land Use Census

A land use census was conducted during the reporting period in each of the 16 meteorological sectors to identify, within a distance of 8 km (5 miles), the location of the nearest milk animal, the nearest meat animal, the nearest residence and the nearest garden of greater than 50 m^2 (500 ft^2) producing broad leaf vegetation. In accordance with the Site ODCMs, the survey was performed using a visual survey, Post Office inquiries, Yellow Pages, and Google Earth mapping software.

No cultural or historic resource officially identified and confirmed by regulatory agencies is known to exist at PSEG.

A comparison of the identified locations from the 2017 table with the 2016 table shows that there was no change to the nearest resident or vegetable garden larger than 50 m^2 (500 ft^2) with broadleaf vegetation. Dose evaluations do not need to be updated and no changes to the Site ODCMs are required. The 2017 Land Use Survey results are summarized below:

Meteorological Sector	Milk Animal *August, 2017* km (miles)	Nearest Residence *August, 2017* km (miles)	Vegetable Garden *August, 2017* km (miles)	Meat Animal *August, 2017* km (miles)
N	None	None	None	None
NNE	None	**8.0 (5.0)**	None	None
NE	None	**6.2 (3.9)**	None	**6.8 (4.2)**
ENE	None	**6.2 (3.9)**	None	None
E	None	None	None	None
ESE	None	None	None	None
SE	None	None	None	None
SSE	None	None	None	None
S	None	None	None	None
SSW	None	**6.2 (3.9)**	None	None
SW	None	**6.9 (4.3)**	None	**7.3 (4.6)**
WSW	None	**7.1 (4.4)**	None	None
W	**8.0 (5.0)**	**6.5 (4.0)**	None	None
WNW	None	**5.5 (3.4)**	None	None
NW	None	**5.9 (3.7)**	None	None
NNW	None	**6.8 (4.2)**	None	None

VI. ANNOTATIONS TO PREVIOUS AREOR

In the 2016 AREOR Section E "Land Use Census", the nearest meat animal was listed as being from a farm located 4.2 miles NNE (GPS coordinate 39.502124, -75.475914) of the site's center reference. In the 2017 Land Use Census the same farm was again identified as the nearest meat animal. The address and GPS coordinates are the same, but the compass heading was more accurately stated in 2017 to be NE of the site's center reference.

VII. HOPE CREEK TECHNICAL SPECIFICATION LIMIT FOR PRIMARY WATER IODINE CONCENTRATION

The HCGS primary coolant results for Dose Equivalent Iodine-131, Total Gamma, and Total Beta were reviewed. The specific activity of the primary coolant did not exceed 0.2 micro curies per gram Dose Equivalent I-131 (DEI).

Hope Creek Dose Equivalent Iodine Concentrations in 2017

Sample Date & Time	HC DEI (uCi/mL)	Sample Date & Time	HC DEI (uCi/mL)	Sample Date & Time	HC DEI (uCi/mL)	Sample Date & Time	HC DEI (uCi/mL)	Sample Date & Time	HC DEI (uCi/mL)	Sample Date & Time	HC DEI (uCi/mL)
12/30/2017 1:42	1.99E-05	10/16/2017 0:06	2.25E-05	8/2/2017 9:17	2.39E-05	5/19/2017 2:32	2.61E-05	3/16/2017 9:49	3.28E-05	1/11/2017 0:18	1.82E-05
12/29/2017 0:28	2.07E-05	10/14/2017 0:20	2.18E-05	7/31/2017 1:49	2.42E-05	5/17/2017 3:12	2.37E-05	3/16/2017 1:02	3.30E-05	1/9/2017 0:48	2.37E-05
12/27/2017 1:02	2.07E-05	10/13/2017 3:16	2.40E-05	7/29/2017 1:59	2.37E-05	5/15/2017 1:01	2.37E-05	3/15/2017 1:17	3.36E-05	1/7/2017 0:48	2.35E-05
12/25/2017 1:19	2.39E-05	10/11/2017 9:28	2.21E-05	7/28/2017 0:28	2.30E-05	5/13/2017 1:20	2.37E-05	3/14/2017 0:22	2.77E-05	1/6/2017 0:27	2.40E-05
12/23/2017 1:04	2.01E-05	10/9/2017 9:09	2.28E-05	7/26/2017 0:29	2.42E-05	5/12/2017 0:47	2.66E-05	3/13/2017 0:15	2.28E-05	1/4/2017 9:58	2.44E-05
12/22/2017 1:02	2.40E-05	10/7/2017 0:19	1.93E-05	7/24/2017 0:40	2.73E-05	5/10/2017 3:52	2.62E-05	3/11/2017 0:17	2.37E-05	1/2/2017 0:52	2.32E-05
12/20/2017 1:37	1.99E-05	10/6/2017 0:17	2.24E-05	7/22/2017 0:08	2.47E-05	5/10/2017 1:26	2.61E-05	3/10/2017 2:30	2.29E-05		
12/18/2017 1:20	1.93E-05	10/4/2017 1:39	2.37E-05	7/21/2017 0:18	2.42E-05	5/8/2017 2:34	2.60E-05	3/8/2017 0:55	2.43E-05		
12/16/2017 0:49	1.91E-05	10/2/2017 1:40	1.85E-05	7/19/2017 9:07	2.48E-05	5/6/2017 0:25	2.43E-05	3/6/2017 2:01	2.33E-05		
12/15/2017 2:50	2.56E-05	9/30/2017 2:07	2.39E-05	7/17/2017 0:16	2.60E-05	5/5/2017 1:07	2.47E-05	3/5/2017 22:21	2.62E-05		
12/13/2017 1:19	2.08E-05	9/29/2017 1:16	1.88E-05	7/15/2017 3:47	2.60E-05	5/3/2017 9:55	2.62E-05	3/4/2017 1:49	1.74E-05	Max DEI (uCi/mL)	3.41E-05
12/11/2017 0:40	2.52E-05	9/27/2017 1:00	2.27E-05	7/14/2017 0:33	2.57E-05	5/1/2017 3:30	2.84E-05	3/3/2017 0:05	2.39E-05		
12/9/2017 1:32	2.48E-05	9/25/2017 2:14	2.27E-05	7/12/2017 8:51	2.57E-05	4/29/2017 0:19	2.39E-05	3/1/2017 11:03	2.32E-05		
12/8/2017 9:34	2.53E-05	9/23/2017 2:00	2.29E-05	7/10/2017 0:52	3.16E-05	4/28/2017 0:11	2.49E-05	3/1/2017 0:22	2.29E-05		
12/6/2017 1:10	2.09E-05	9/22/2017 1:23	2.11E-05	7/8/2017 0:10	3.21E-05	4/26/2017 0:15	2.50E-05	2/27/2017 10:24	2.42E-05		
12/4/2017 2:08	2.42E-05	9/20/2017 0:36	1.88E-05	7/7/2017 0:15	2.50E-05	4/24/2017 2:21	2.45E-05	2/25/2017 1:23	2.50E-05	Min DEI (uCi/mL)	1.74E-05
12/2/2017 0:20	2.00E-05	9/18/2017 0:06	1.91E-05	7/5/2017 2:22	2.58E-05	4/22/2017 3:37	2.59E-05	2/24/2017 14:45	2.33E-05		
12/1/2017 0:13	2.00E-05	9/16/2017 1:51	2.35E-05	7/3/2017 1:42	3.14E-05	4/19/2017 12:55	2.75E-05	2/22/2017 0:17	2.26E-05		
11/29/2017 0:45	2.05E-05	9/15/2017 0:47	1.96E-05	7/1/2017 2:10	2.56E-05	4/19/2017 0:14	2.15E-05	2/20/2017 0:05	2.30E-05		
11/27/2017 0:16	2.12E-05	9/13/2017 7:58	1.97E-05	6/30/2017 2:41	3.16E-05	4/17/2017 0:10	2.49E-05	2/18/2017 0:25	2.31E-05		
11/25/2017 1:00	2.03E-05	9/11/2017 0:09	1.86E-05	6/28/2017 8:53	2.56E-05	4/15/2017 0:09	2.48E-05	2/17/2017 0:07	2.54E-05		
11/24/2017 1:25	2.00E-05	9/9/2017 0:20	1.89E-05	6/26/2017 1:00	2.72E-05	4/14/2017 4:07	2.53E-05	2/15/2017 0:07	2.35E-05		
11/22/2017 0:29	2.01E-05	9/8/2017 0:25	2.71E-05	6/24/2017 0:53	2.69E-05	4/12/2017 0:59	2.47E-05	2/13/2017 0:18	2.37E-05		
11/20/2017 0:40	1.86E-05	9/6/2017 8:37	1.97E-05	6/23/2017 0:43	2.71E-05	4/10/2017 0:18	2.50E-05	2/11/2017 0:17	2.30E-05		
11/18/2017 0:42	2.83E-05	9/4/2017 0:25	2.49E-05	6/21/2017 0:20	2.84E-05	4/8/2017 1:03	2.48E-05	2/10/2017 2:30	2.27E-05		
11/17/2017 0:14	2.58E-05	9/2/2017 0:48	2.35E-05	6/19/2017 1:40	2.77E-05	4/7/2017 0:13	2.57E-05	2/8/2017 2:19	2.32E-05		
11/15/2017 9:40	2.77E-05	9/1/2017 1:08	2.42E-05	6/17/2017 2:53	2.69E-05	4/5/2017 10:29	2.57E-05	2/6/2017 1:58	2.28E-05		
11/13/2017 1:26	2.27E-05	8/30/2017 0:48	2.38E-05	6/16/2017 9:11	2.63E-05	4/3/2017 0:13	2.52E-05	2/4/2017 2:14	2.34E-05		
11/11/2017 0:31	2.95E-05	8/28/2017 0:45	1.87E-05	6/14/2017 0:22	2.68E-05	4/1/2017 0:26	2.48E-05	2/3/2017 1:05	2.30E-05		
11/10/2017 0:54	2.63E-05	8/26/2017 0:25	1.88E-05	6/12/2017 0:08	2.80E-05	3/31/2017 2:10	2.50E-05	2/1/2017 9:54	2.34E-05		
11/8/2017 1:07	2.36E-05	8/25/2017 0:25	2.47E-05	6/10/2017 1:02	2.69E-05	3/29/2017 1:39	3.00E-05	2/1/2017 2:45	2.34E-05		
11/6/2017 1:18	1.87E-05	8/23/2017 0:57	1.97E-05	6/9/2017 1:47	2.72E-05	3/28/2017 2:03	3.41E-05	1/30/2017 0:13	2.22E-05		
11/4/2017 0:29	1.99E-05	8/21/2017 1:59	1.92E-05	6/7/2017 8:08	2.76E-05	3/27/2017 7:48	3.27E-05	1/28/2017 3:11	2.44E-05		
11/3/2017 0:35	2.37E-05	8/19/2017 1:36	1.91E-05	6/5/2017 2:30	2.66E-05	3/26/2017 0:06	3.32E-05	1/28/2017 3:10	2.44E-05		
11/1/2017 1:22	1.78E-05	8/18/2017 1:07	2.43E-05	6/3/2017 1:51	2.72E-05	3/25/2017 3:34	3.23E-05	1/27/2017 0:17	2.37E-05		
10/30/2017 0:05	2.16E-05	8/16/2017 0:05	1.84E-05	6/2/2017 2:22	2.56E-05	3/24/2017 0:17	3.38E-05	1/25/2017 0:17	1.80E-05		
10/28/2017 1:05	1.86E-05	8/14/2017 1:43	1.92E-05	5/31/2017 9:26	2.52E-05	3/23/2017 0:14	3.05E-05	1/23/2017 2:05	2.37E-05		
10/27/2017 0:13	2.37E-05	8/12/2017 1:05	2.33E-05	5/29/2017 1:26	2.40E-05	3/22/2017 0:16	3.37E-05	1/21/2017 1:46	2.43E-05		
10/25/2017 0:54	1.94E-05	8/11/2017 1:25	2.49E-05	5/27/2017 0:45	2.48E-05	3/21/2017 0:30	3.13E-05	1/20/2017 0:57	2.27E-05		
10/23/2017 0:27	1.96E-05	8/9/2017 0:53	2.37E-05	5/26/2017 1:40	2.47E-05	3/20/2017 1:53	3.25E-05	1/18/2017 0:32	2.66E-05		
10/21/2017 0:51	1.92E-05	8/7/2017 0:48	1.90E-05	5/24/2017 2:01	2.32E-05	3/19/2017 1:31	3.20E-05	1/16/2017 9:11	2.03E-05		
10/20/2017 1:00	1.86E-05	8/5/2017 1:28	2.42E-05	5/22/2017 1:03	2.34E-05	3/18/2017 1:54	3.18E-05	1/14/2017 0:14	1.87E-05		
10/18/2017 0:53	2.26E-05	8/4/2017 0:59	1.75E-05	5/20/2017 2:14	2.37E-05	3/17/2017 1:27	3.27E-05	1/13/2017 1:02	2.44E-05		

VIII. CONCLUSIONS

The Radiological Environmental Monitoring Program for the Site was conducted during 2017 in accordance with the Site ODCMs. The required sample analysis LLD values were achieved (See Appendix A and Appendix C) and the REMP objectives were met. The data collected demonstrates that the Site was operated in compliance with the Site ODCMs' REMP requirements.

The concentration of radioactive material in the environment that could be attributable to Site operations was only a small fraction of the total radioactivity when compared to the concentration of naturally occurring and non-plant related man-made radioactivity in the environment.

Since these results were comparable to the results obtained during the preoperational phase of the program, which ran from 1973 to 1976, and with historical results collected since commercial operation, it can be concluded that the operation of the Site had no significant radiological impact on the health and safety of the public or on the environment.

IX. REFERENCES

[1] Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - Reoperation Summary - 1973 through 1976". RMC-TR-77-03, 1978.

[2] Public Service Enterprise Group. "Offsite Dose Calculation Manual" - Salem Generating Station. Revisions 27 and 28.

[3] Public Service Enterprise Group. "Offsite Dose Calculation Manual" - Hope Creek Generating Station. Revisions 27 and 28.

[4] U.S. Nuclear Regulatory Commission: NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors", published April 1991.

[5] U.S. Nuclear Regulatory Commission: NUREG-1302, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors", published April 1991.

[6] U.S. Atomic Energy Commission, Docket NOS. 50-272/50-311, "Salem Nuclear Generating Station Units 1 and 2, Environmental Report, Operating License Stage".

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING

PROGRAM SUMMARY

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SAMPLE DESIGNATION

Samples locations are identified by a three part code. 1) The first two letters are the program identification code. Because of the proximity of the SGS and HCGS, a common environmental surveillance program is conducted. The identification code, "SA", has been applied to SGS and HCGS. 2) The next three letters identify the media sampled.

AIO = Air Iodine	IDM = Immersion Dose (TLD)
APT = Air Particulate	MLK = Milk
ECH = Hard Shell Blue Crab	PWR = Potable Water (Raw)
ESF = Edible Fish	PWT = Potable Water (Treated)
ESS = Sediment	SOL = Soil
FPL = Green Leaf Vegetables	SWA = Surface Water
FPV = Vegetables (Various)	VGT = Fodder Crops (Various)
GAM = Game (Muskrat)	WWA= Well Water

3) The last three or four symbols are a location code based on direction and distance from a standard reference point. The reference point is located at the midpoint between the center of the SGS Unit 1 and Unit 2 containments. Of these, the first one or two represent each of the sixteen angular sectors of 22.5 degrees centered about the reactor site. Sector one is divided evenly by the north axis and other sectors are numbered in a clockwise direction as follows:

1 = N	5 = E	9 = S	13 = W
2 = NNE	6 = ESE	10 = SSW	14 = WNW
3 = NE	7 = SE	11 = SW	15 = NW
4 = ENE	8 = SSE	12 = WSW	16= NNW

The next digit is a letter which represents the radial distance from the reference point:

S = On-site location	E = 4-5 miles off-site
A = 0-1 miles off-site	F = 5-10 miles off-site
B = 1-2 miles off-site	G = 10-20 miles off-site
C = 2-3 miles off-site	H = >20 miles off-site
D = 3-4 miles off-site	

The last number is the location numerical designation within each sector and zone; e.g. 1,2,3,...etc. For example, the designation SA-WWA-3E1 would indicate a sample in the SGS and HCGS program (SA) consisting of well water (WWA) which was collected in sector number 3, centered at 45 degrees (north east) with respect to the midpoint between SGS Units 1 and 2 Containments at a radial distance of 4 to 5 miles offsite, (therefore, radial distance E). The number 1 indicates that this is sampling location number 1 in that particular sector.

SAMPLING LOCATIONS

All sampling locations and specific information about the individual locations are given in Appendix B, Table B-2. Additionally Maps B-1, B-2, and B-3 of Appendix B show the locations of sampling locations with respect to the Site. Not all locations in Table B-2 are required sample locations. Some of the locations identified in Table B-2 are used for management audit samples.

Table A-1

2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SALEM GENERATING STATION — **DOCKET NO. 50-272/-311**
HOPE CREEK GENERATING STATION — **DOCKET NO. 50-354**
SALEM COUNTY, NEW JERSEY — REPORTING PERIOD: January 1, 2017 to December 31, 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND *TOTAL NUMBER* OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD*)	ALL INDICATOR LOCATIONS MEAN (f) ** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (f) ** (RANGE)	CONTROL LOCATION MEAN (f) ** (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
I. AIRBORNE							
AIR PARTICULATE (E-3 pCi/m^3)	**Gr-B** *424*	10	12 (362/371) *(4/22)*	SA-APT-5S1 0.86 MILES E	13 (51/53) *(5/21)*	13 (52/53) *(5/20)*	0
	GAMMA *32*						
	Be-6	N/A	92.1 (28/28) *(36.7/173.7)*	SA-APT-15S2 0.59 MILES NW	104.1 (4/4) *(61.2/173.7)*	97.6 (4/4) *(58.7/129.6)*	0
	K-40	N/A	<MDC	N/A	N/A	<MDC	0
	Cs-134	50	<MDC	N/A	N/A	<MDC	0
	Cs-137	60	<MDC	N/A	N/A	<MDC	0
AIR IODINE (E-3 pCi/m^3)	**GAMMA** *424* I-131	70	<MDC	N/A	N/A	<MDC	0
II. DIRECT							
DIRECT RADIATION (mR/standard quarter)	**TLD-QUARTERLY** *230*	N/A	13.4 (206/206) *(9/29.3)*	SA-IDM-16S2 0.60 MILES NNW	28.1 (4/4) *(26.9/29.3)*	13.3 (24/24) *(11.2/15.7)*	0
III. TERRESTRIAL							
MILK (pCi/L)	**I-131 (LOW LVL)** *80*	1	<MDC	N/A	N/A	<MDC	0
	GAMMA *80* K-40	N/A	1347 (60/60) *(1110/1710)*	SA-MLK-14F4 8.0 MILES WNW	1361 (20/20) *(1189/1561)*	1302 (20/20) *(1028/1511)*	0
	Cs-134	15	<MDC	N/A	N/A	<MDC	0
	Cs-137	18	<MDC	N/A	N/A	<MDC	0
	BaLa-140	15	<MDC	N/A	N/A	<MDC	0
	Ra-226	N/A	243 (1/60)	SA-MLK-2G3 11.8 MILES NNE	243 (1/20)	<MDC	0
WELL WATER (pCi/L)	**Gr-A** *12*	3	<MDC	N/A	N/A	N/A	0
	Gr-B *12*	4	2.6 (3/12) *(2.5/2.7)*	SA-WWA-3E1 4.2 MILES NE	2.6 (3/12) *(2.5/2.7)*	N/A	0
	H-3 *12*	200	<MDC	N/A	N/A	N/A	0

2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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HOPE CREEK GENERATING STATION — **DOCKET NO. 50-354**
SALEM COUNTY, NEW JERSEY — REPORTING PERIOD: January 1, 2017 to December 31, 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSIS PERFORMED		LOWER LIMIT OF DETECTION (LLD*)	ALL INDICATOR LOCATIONS MEAN (f) ** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (f) ** (RANGE)	CONTROL LOCATION MEAN (f) ** (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
WELL WATER (cont.) (pCi/L)	I-131 (LOW LVL)	12	1	<MDC	N/A	N/A	N/A	0
	GAMMA	12						
	K-40		N/A	<MDC	N/A	N/A	N/A	0
	Mn-54		15	<MDC	N/A	N/A	N/A	0
	Co-58		15	<MDC	N/A	N/A	N/A	0
	Fe-59		30	<MDC	N/A	N/A	N/A	0
	Co-60		15	<MDC	N/A	N/A	N/A	0
	Zn-65		30	<MDC	N/A	N/A	N/A	0
	ZrNb-95		15	<MDC	N/A	N/A	N/A	0
	Cs-134		15	<MDC	N/A	N/A	N/A	0
	Cs-137		18	<MDC	N/A	N/A	N/A	0
	BaLa-140		15	<MDC	N/A	N/A	N/A	0
	Ra-226		N/A	<MDC	N/A	N/A	N/A	0
POTABLE WATER (RAW) (pCi/L)	Gr-A	12	3	<MDC	N/A	N/A	N/A	0
	Gr-B	12	4	5.9 (12/12) (2.9/8.6)	SA-PWR-2F3 8.0 MILES NNE	5.9 (12/12) (2.9/8.6)	N/A	0
	H-3	12	200	<MDC	N/A	N/A	N/A	0
	I-131 (LOW LVL)	12	1	<MDC	N/A	N/A	N/A	0
	GAMMA	12						
	K-40		N/A	<MDC	N/A	N/A	N/A	0
	Mn-54		15	<MDC	N/A	N/A	N/A	0
	Co-58		15	<MDC	N/A	N/A	N/A	0
	Fe-59		30	<MDC	N/A	N/A	N/A	0
	Co-60		15	<MDC	N/A	N/A	N/A	0
	Zn-65		30	<MDC	N/A	N/A	N/A	0

Table A-1

2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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HOPE CREEK GENERATING STATION — **DOCKET NO. 50-354**
SALEM COUNTY, NEW JERSEY — REPORTING PERIOD: January 1, 2017 to December 31, 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND *TOTAL NUMBER* OF ANALYSIS PERFORMED		LOWER LIMIT OF DETECTION (LLD*)	ALL INDICATOR LOCATIONS MEAN (f) ** *(RANGE)*	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (f) ** *(RANGE)*	CONTROL LOCATION MEAN (f) ** *(RANGE)*	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
POTABLE WATER (RAW) (cont.) (pCi/L)	ZrNb-95		15	<MDC	N/A	N/A	N/A	0
	Cs-134		15	<MDC	N/A	N/A	N/A	0
	Cs-137		18	<MDC	N/A	N/A	N/A	0
	BaLa-140		15	<MDC	N/A	N/A	N/A	0
	Ra-226		N/A	<MDC	N/A	N/A	N/A	0
POTABLE WATER (TREATED) (pCi/L)	**Gr-A**	***12***	3	<MDC	N/A	N/A	N/A	0
	Gr-B	***12***	4	6.6 (12/12) *(4.8/8.6)*	SA-PWT-2F3 8.0 MILES NNE	6.6 (12/12) *(4.8/8.6)*	N/A	0
	H-3	***12***	200	<MDC	N/A	N/A	N/A	0
	I-131 (LOW LVL)	***12***	1	<MDC	N/A	N/A	N/A	0
	GAMMA	***12***						
	K-40		N/A	<MDC	N/A	N/A	N/A	0
	Mn-54		15	<MDC	N/A	N/A	N/A	0
	Co-58		15	<MDC	N/A	N/A	N/A	0
	Fe-59		30	<MDC	N/A	N/A	N/A	0
	Co-60		15	<MDC	N/A	N/A	N/A	0
	Zn-65		30	<MDC	N/A	N/A	N/A	0
	ZrNb-95		15	<MDC	N/A	N/A	N/A	0
	Cs-134		15	<MDC	N/A	N/A	N/A	0
	Cs-137		18	<MDC	N/A	N/A	N/A	0
POTABLE WATER (TREATED) (cont.) (pCi/L)	BaLa-140		15	<MDC	N/A	N/A	N/A	0
	Ra-226		N/A	<MDC	N/A	N/A	N/A	0
BROAD-LEAF VEGETATION, FPL (pCi/kg wet)	**GAMMA**	***50***						
	Be-7		N/A	412 (2/49) *(358/466)*	SA-FPL-10D1 3.9 MILES SSW	412 (2/9) *(358/466)*	<MDC	0

2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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SALEM COUNTY, NEW JERSEY — REPORTING PERIOD: January 1, 2017 to December 31, 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD*)	ALL INDICATOR LOCATIONS MEAN (f) ** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (f) ** (RANGE)	CONTROL LOCATION MEAN (f) ** (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
BROAD-LEAF VEGETATION, FPL (pCi/kg wet) (Cont.)	K-40	N/A	4684 (49/49) (2019/10690)	SA-FPL-7S2 0.12 MILES SE	5817 (11/11) (3370-10690)	2035 (1/1)	0
	I-131	60	<MDC	N/A	N/A	<MDC	0
	Cs-134	60	<MDC	N/A	N/A	<MDC	0
	Cs-137	80	<MDC	N/A	N/A	<MDC	0
	Ra-226	N/A	<MDC	N/A	N/A	<MDC	0
	Th-232	N/A	<MDC	N/A	N/A	<MDC	0
VEGETABLES, FPV (pCi/kg wet)	**GAMMA** 21						
	Be-7	N/A	<MDC	N/A	N/A	N/A	0
	K-40	N/A	1845 (21/21) (1155/2741)	SA-FPV-2F9 7.5 MILES NNE	1966 (5/5) (1496/2728)	N/A	0
	I-131	60	<MDC	N/A	N/A	N/A	0
	Cs-134	60	<MDC	N/A	N/A	N/A	0
	Cs-137	80	<MDC	N/A	N/A	N/A	0
	Ra-226	N/A	<MDC	N/A	N/A	N/A	0
	Th-232	N/A	<MDC	N/A	N/A	N/A	0
FODDER CROPS (pCi/kg wet)	**GAMMA** 4						
	Be-7	N/A	657 (1/3)	SA-VGT-3G1 17 MILES NE	820 (1/1)	820 (1/1)	0
	K-40	N/A	5006 (3/3) (4256/6322)	SA-VGT-3G1 17 MILES NE	6645 (1/1)	6645 (1/1)	0
	I-131	60	<MDC	N/A	N/A	<MDC	0
	Cs-134	60	<MDC	N/A	N/A	<MDC	0
	Cs-137	80	<MDC	N/A	N/A	<MDC	0
	Ra-226	N/A	<MDC	N/A	N/A	<MDC	0
	Th-232	N/A	<MDC	N/A	N/A	<MDC	0

2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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HOPE CREEK GENERATING STATION — **DOCKET NO. 50-354**
SALEM COUNTY, NEW JERSEY — REPORTING PERIOD: January 1, 2017 to December 31, 2017

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND *TOTAL NUMBER* OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD*)	ALL INDICATOR LOCATIONS MEAN (f) ** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (f) ** (RANGE)	CONTROL LOCATION MEAN (f) ** (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SOIL	**GAMMA** *0*						
(pCi/kg dry)	Be-7	N/A	N/A	N/A	N/A	N/A	0
	K-40	N/A	N/A	N/A	N/A	N/A	0
*Soils are sampled triennially will be sampled again in 2019	Cs-134	150	N/A	N/A	N/A	N/A	0
	Cs-137	180	N/A	N/A	N/A	N/A	0
	Ra-226	N/A	N/A	N/A	N/A	N/A	0
	Th-232	N/A	N/A	N/A	N/A	N/A	0
GAME	**GAMMA** *3*						
(pCi/kg wet)	Be-7	N/A	<MDC	N/A	N/A	N/A	0
	K-40	N/A	2688 (3/3) *(2500/2839)*	SA-GAM-13E3 5.0 MILES W	2839 (1/1)	N/A	0
	I-131	60	<MDC	N/A	N/A	N/A	0
	Cs-134	60	<MDC	N/A	N/A	N/A	0
	Cs-137	80	<MDC	N/A	N/A	N/A	0
SURFACE WATER (pCi/L)	**H-3** *60*	200	<MDC	N/A	N/A	<MDC	0
	I-131 (LOW LVL) *60*	1	<MDC	N/A	N/A	<MDC	0
	GAMMA *60*						
	K-40	N/A	105 (17/48) *(63/177)*	SA-SWA-7E1 4.5 MILES SE	126 (8/12) *(84/177)*	92 (4/12) *(49/151)*	0
	Mn-54	15	<MDC	N/A	N/A	<MDC	0
	Co-58	15	<MDC	N/A	N/A	<MDC	0
	Fe-59	30	<MDC	N/A	N/A	<MDC	0
	Co-60	15	<MDC	N/A	N/A	<MDC	0
	Zn-65	30	<MDC	N/A	N/A	<MDC	0
	ZrNb-95	15	<MDC	N/A	N/A	<MDC	0
	Cs-134	15	<MDC	N/A	N/A	<MDC	0

Table A-1

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD*)	ALL INDICATOR LOCATIONS MEAN (f) ** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (f) ** (RANGE)	CONTROL LOCATION MEAN (f) ** (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SURFACE WATER (cont.) (pCi/L)	Cs-137	18	<MDC	N/A	N/A	<MDC	0
	BaLa-140	15	<MDC	N/A	N/A	<MDC	0
FISH (pCi/kg wet)	**GAMMA** 13						
	K-40	N/A	4306 (10/10) (2313/7052)	SA-ESF-11A1 0.20 MILES SW	4335 (5/5) (3324/7052)	3885 (3/3) (3409/4805)	0
	Mn-54	130	<MDC	N/A	N/A	<MDC	0
	Co-58	130	<MDC	N/A	N/A	<MDC	0
	Fe-59	260	<MDC	N/A	N/A	<MDC	0
	Co-60	130	<MDC	N/A	N/A	<MDC	0
	Zn-65	260	<MDC	N/A	N/A	<MDC	0
	Cs-134	130	<MDC	N/A	N/A	<MDC	0
	Cs-137	150	<MDC	N/A	N/A	<MDC	0
	Ra-226	N/A	<MDC	N/A	N/A	<MDC	0
BLUE CRABS (pCi/kg wet)	**GAMMA** 4						
	K-40	N/A	2985 (2/2) (2859/3110)	SA-ECH-12C1 2.5 MILES WSW	2998 (2/2) (2922/3073)	2998 (2/2) (2922/3073)	0
	Mn-54	130	<MDC	N/A	N/A	<MDC	0
	Co-58	130	<MDC	N/A	N/A	<MDC	0
	Fe-59	260	<MDC	N/A	N/A	<MDC	0
	Co-60	130	<MDC	N/A	N/A	<MDC	0
	Zn-65	260	<MDC	N/A	N/A	<MDC	0
	Cs-134	130	<MDC	N/A	N/A	<MDC	0
	Cs-137	150	<MDC	N/A	N/A	<MDC	0
	Ra-226	N/A	<MDC	N/A	N/A	<MDC	0
SEDIMENT (pCi/kg dry)	**GAMMA** 14						
	Be-7	N/A	<MDC	N/A	N/A	<MDC	0

2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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HOPE CREEK GENERATING STATION **DOCKET NO. 50-354**
SALEM COUNTY, NEW JERSEY **REPORTING PERIOD: January 1, 2017 to December 31, 2017**

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND *TOTAL NUMBER* OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD*)	ALL INDICATOR LOCATIONS	LOCATION WITH HIGHEST MEAN		CONTROL LOCATION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
			MEAN (f) ** *(RANGE)*	NAME DISTANCE AND DIRECTION	MEAN (f) ** *(RANGE)*	MEAN (f) ** *(RANGE)*	
SEDIMENT (cont.) (pCi/kg dry)	K-40	N/A	6691 (12/12) *(2325/12930)*	SA-ESS-7E1 4.5 MILES SE	11925 (2/2) *(11420/12430)*	9269 (2/2) *(8840/9698)*	0
	Cs-134	150	<MDC	N/A	N/A	<MDC	0
	Cs-137	180	<MDC	N/A	N/A	<MDC	0
	Ra-226	N/A	2091 (6/12) *(1689/2513)*	SA-ESS-7E1 4.5 MILES SE	2467 (2/2) (2420/2513)	<MDC	0
	Th-232	N/A	561 (11/12) *(288/832)*	SA-ESS-12C1 2.5 MILES WSW	861 (2/2) *(823/899)*	861 (2/2) *(823/899)*	0
OYSTERS (EOY) (pCi/kg wet)	**GAMMA** *4*						
	K-40	N/A	2067 (2/2) *(1481/2653)*	SA-EOY-7C1 2 MILES SE	2067 (2/2) (1481/2653)	1124 (2/2) (929/1319)	0
	Mn-54	130	<MDC	N/A	N/A	<MDC	0
	Co-58	130	<MDC	N/A	N/A	<MDC	0
	Fe-59	260	<MDC	N/A	N/A	<MDC	0
	Co-60	130	<MDC	N/A	N/A	<MDC	0
	Zn-65	260	<MDC	N/A	N/A	<MDC	0
	Cs-134	130	<MDC	N/A	N/A	<MDC	0
	Cs-137	150	<MDC	N/A	N/A	<MDC	0

* The LLD listed is the Lower Limit of Detection, which was requested by PSEG to be achieved.
** Mean was calculated using values above the MDC only. f = the fraction of measurements above the MDC.
(C) = Control Location
N/A = Not Applicable

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APPENDIX B

SAMPLE DESIGNATION

AND

LOCATIONS

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Table B-1

SALEM AND HOPE CREEK GENERATING STATIONS' RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS	SAMPLING AND COLLECTION FREQUENCY	TYPE / FREQUENCY OF ANALYSIS	
1. DIRECT RADIATION				
a. **Dodsimeters (IDM)**	Fifty-eight routine monitoring locations with two or more dosimeters placed as follows: An inner ring of locations, one in each land based meteorological sector in the general area of the SITE BOUNDARY. An outer ring of locations, one in each land based meteorological sector in the 5 to 11 km (3.1 - 6.8 miles) range from the site ; and The balance of the locations placed in areas of special interest such as population centers, nearby residences, and schools and in six areas beyond 10 miles to serve as control locations.	Quarterly	Gamma Dose:	quarterly
2. ATMOSPHERIC				
a. **Air Particulate (APT)**	Three samples from close to the Site Boundary: 5S1, 7S2, 15S2. One duplicate sample from close to the site boundary: 5S2. 3 Samples in different land based sectors: 1F1, 2F6, 5D1.	Continuous sampler operation with sample collection weekly or more frequently if required by dust loading	Gross Beta: Gamma Isotopic:	weekly quarterly composite*
b. **Air Iodne (AIO)**	One sample from the vicinity of a community having a highest annual average ground level D/Q: 16E1. One sample from a control location; for example 15 - 30 km distant (9.3 - 18.6 miles) and in the least prevalent wind direction: 14G1.	Continuous sampler operation with sample collection weekly or more frequently if required by dust loading	Iodine-131:	weekly
3. TERRESTRIAL				
a. **Milk (MLK)**	Samples from milking animals in 3 locations within 5 km distance (3.1 miles) having the highest dose potential. If there are none, then 1 sample from milking animals in each of 3 areas between 5 - 8 km distant (3.1 - 5.0 miles) where doses are calculated to be greater than 1 mrem per yr: 13E3, 14F4, 2G3(1).	Semi-monthly: (when animals are on pasture)	Gamma Scan: Iodine-131:	semi-monthly semi-monthly
	1 Sample from milking animals at a control location 15 30 km distant (9.3 - 18.6 miles): 3G1.	Monthly: (when animals are on pasture)	Gamma Scan: Iodine-131:	monthly monthly
b. **Well Water (i.e. Groundwater) (WWA)**	Although wells in the vicinity of SGS/HCGS are not directly affected by plant operations so sampling is not required by SGS/HCGS ODCM, samples of 3E1 farm's well are collected as management audit samples.	Monthly	Gamma Isotopic: Gross Alpha: Gross Beta: Tritium:	monthly monthly monthly monthly
c. **Potable Water (i.e. Drinking Water) (PWR, PWT)**	Although no potable water samples are required as liquid effluents discharged from SGS/HCGS do not directly affect this pathway and it is not required by SGS/HCGS ODCM, one raw and one treated water sample from a public water supply (City of Salem Water and Sewer Department) are collected: 2F3 as management audit samples.	Monthly (composited weekly)	Gamma Isotopic: Gross Alpha: Gross Beta: Iodine-131: Tritium:	monthly monthly monthly monthly monthly

Table B-1

SALEM AND HOPE CREEK GENERATING STATIONS' RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS	SAMPLING AND COLLECTION FREQUENCY	TYPE / FREQUENCY OF ANALYSIS	
3. TERRESTRIAL (cont.)				
d. **Vegetation (i.e. Leafy and Vegetables) (FPL, FPV)**	Although the Delaware River at the location of SGS/HCGS is a brackish water source and is not used for irrigation of food products and so sampling is not required by SGS/HCGS ODCM, samples of vegetables are collected as management audit samples from various locations during harvest. In addition, broad leaf vegetation is collected from various offsite locations as well as being planted & collected onsite (1S1, 7S2, 15S2, 16S1). This is in lieu of having a milk farm within 5 km (3.1 miles) of the Site[1].	Monthly (during growing season)	Gamma Isotopic:	on collection
e. **Fodder Crops (VGT)**	Although not required by SGS/HCGS ODCM, samples of crops normally used as cattle feed (silage) were collected from milk farms as management audit samples: 14F4, 3G1, 2G3, 13E3.	Annually (at harvest)	Gamma Isotopic:	on collection
e. **Soil (SOL)**	Although not required by SGS/HCGS ODCM, samples of soil are collected as management audit samples.	Every 3 years (2013, 2016, 2019, 2022, etc.))	Gamma Isotopic:	on collection
4. AQUATIC ENVIRONMENT				
a. **Surface Water (SWA)**	One sample upstream: 1F2. One sample downstream: 7E1. One sample outfall: 11A1. One sample cross-stream (mouth of Appoquinimink River): 12C1[2]. And an additional location in the Chesapeake & Delaware Canal: 16F1.	Semi-monthly:	Gamma Scan: Tritioum:	semi-monthly monthly**
b. **Edible Fish (ESF)**	One sample of each commercially and recreationally important species in vicinity of plant discharge area: 11A1. One sample of same species in area not influenced by plant discharge: 12C1[2] and an additional location downstream: 7E1.	Semi-annually:	Gamma Isotopic: (flesh)	on collection
c. **Blue Crabs (ECH)**	One sample of each commercially and recreationally important species in vicinity of plant discharge area 11A1. One sample of same species in area not influenced by plant discharge: 12C1[2].	Semi-annually:	Gamma Isotopic: (flesh)	on collection
d. **Sediment (ESS)**	One sample from downstream area: 7E1. One sample from cross-stream area and control location: 12C1(2). One sample from outfall area: 11A1. One sample from upstream, the C & D Canal: 16F1. One sample from shoreline area: 6S2. One sample from Cooling Tower Blowdown discharge: 15A1. One sample south storm drain discharge line: 16A1.	Semi-annually:	Gamma Isotopic:	on collection

SALEM AND HOPE CREEK GENERATING STATIONS' RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS	SAMPLING AND COLLECTION FREQUENCY	TYPE / FREQUENCY OF ANALYSIS
4. AQUATIC ENVIRONMENT (cont.)			
e. Oysters (3) (EOY)	One sample near plant discharge area (Hope Creek Oyster Bed Area, approximately 2 miles SE of Site) as a management audit sample (7C1) One sample in area not influenced by plant discharge (Bennies Oyster Beds Area, approximately 19 miles SE of Site) as a management audit sample (7H1)	Twice per year, once near start and once near end of NJ harvest season.	Gamma Isotopic: (flesh and liquids) on collection

* Except for Passive Dosimeters, the quarterly analysis is performed on a composite of individual samples collected during the quarter.

** ODCM requires a minimum of semi-monthly sample collection with monthly composites for gamma isiotopic analysis, and quarterly composites for tritium analysis. However, it was decided to analyze surface waters on a monthly basis for tritium as a program enhancement.

(1) While these milk locations are not within the 5 km range, they are the closest farms in the Site vicinity.
Since broad leaf vegetation is acceptable in lieu of milk collections, gardens were planted and harvested at four locations on Site (1S1, 7S2, 15S2, and 16S1) and one in Delaware (10D1).

(2) Location 12C1 was made the operational control (1975) for aquatic samples since the physical characteristics of this location more closely resemble those of the outfall area than do those at the upstream location originally chosen. This is due to the distance from Liston Point, which is the boundary between the Delaware River and Delaware Bay. As discussed extensively in the SGS/HCGS Pre-operational reports, the sampling locations further upstream show significantly lower background levels due to tidal flow.

(3) Oysters were added to the REMP as a management audit sample in 2015. The oysters from the indicator location (7C1) are impacted by bacteria and are considered too small to be sold to the public. The

Table B-2

REMP SAMPLING LOCATIONS

Station Code (Sector Distance Sample)	Station Location	GPS Coordinates (Deicimal Degrees) Latitudinal	Longitudinal
On-Site Locactions			
1 **S** 1	0.58 mi. N	39.471148	-75.537016
1 **S** 2	0.62 mi. N	39.47175	-75.536044
2 **S** 2	0.4 mi. NNE	39.4685	-75.53318333
2 **S** 4	0.6 mi. NNE	39.47071667	-75.53075
3 **S** 1	0.58 mi. NE	39.46901667	-75.52796667
4 **S** 1	0.60 mi. ENE	39.46705	-75.52573333
5 **S** 1	0.86 mi. E	39.46113333	-75.51978333
5 **S** 2	0.86 mi. E	39.46086667	-75.51968333
6 **S** 2	0.23 mi. ESE	39.46198333	-75.53186667
6 **S** 2	0.24 mi. ESE	39.461411	-75.531646
7 **S** 1	0.12 mi. SE	39.46168333	-75.53411667
7 **S** 2	0.17 mi. SE	39.46171667	-75.53255
8 **S** 1	0.14 mi. SE	39.46138333	-75.53428333
9 **S** 1	0.17 mi. SSE	39.4606	-75.53485
10 **S** 1	0.14 mi. SSW	39.46166667	-75.536
11 **S** 1	0.09 mi. SW	39.46198333	-75.53708333
12 **S** 1	0.09 mi. W	39.4626	-75.53726667
13 **S** 1	0.11 mi. WNW	39.46335	-75.53778333
14 **S** 1	0.17 mi. NNW	39.46476667	-75.53796667
15 **S** 1	0.57 mi. NW	39.46935	-75.54208333
15 **S** 2	0.57 mi. NNW	39.46988333	-75.54216667
15 **S** 2	0.61 mi. NNW	39.47033333	-75.54046667
16 **S** 1	0.57 mi. NNW	39.47033333	-75.54046667
16 **S** 2	0.60 mi. N	39.47125	-75.5381
16 **S** 3	0.74 mi NNW	39.47451667	-75.54283333
0 - 1 Mile			
11 **A** 1	0.2 mi. SW	39.46051135	-75.53809583
11 **A** 01A	0.15 mi. SE	39.461667	-75.53375

Table B-2

REMP SAMPLING LOCATIONS

Station Code (Sector Distance Sample)	Station Location	GPS Coordinates (Deicimal Degrees) Latitudinal	Longitudinal
0 - 1 Mile (cont.)			
15 **A** 1	0.65 mi. NW; cooling tower blown down discharge line	39.4709	-75.5434
16 **A** 1	0.24 mi. NNW; south storm drain discharge line	39.47066667	-75.543
Locations 2 - 3 Miles			
5 **C** 1	3.14 mi. ENE	39.4735	-75.478598
7 **C** 1	2.1 mi. ESE	39.443703	-75.5054
12 **C** 1	2.5 mi. WSW; west bank of Delaware River	39.45366667	-75.568
12 **C** 01A	3.7 mi. WSW; located at the tip of Augustine Beach Boat Ramp	39.50472222	-75.58
Locations 3 - 4 Miles			
4 **D** 2	3.7 mi. ENE; Alloway Creek Neck Road	39.4882	-75.46958333
5 **D** 1	3.5 mi. E; local farm	39.47326667	-75.47223333
10 **D** 1	3.9 mi. SSW; Taylor's Bridge Spur	39.41021667	-75.56221667
14 **D** 1	3.4 mi. WNW; Bay View, Delaware	39.48766667	-75.59201667
15 **D** 1	3.8 mi. NW; Rt. 9, Augustine Beach	39.50208333	-75.588
Locations 4 - 5 Miles			
2 **E** 1	4.4 mi. NNE; local farm	39.523	-75.50713333
3 **E** 1	4.2 mi. NE; local farm	39.50163333	-75.47743333
7 **E** 1	4.5 mi. SE; 1 mi. W of Mad Horse Creek	39.418	-75.47733333
7 **E** 01A	8.87 mi. SE; Located at the end of Bayside Road	39.37616667	-75.404
11 **E** 2	5.0 mi. SW; Rt. 9	39.40546667	-75.59243333
12 **E** 1	4.4 mi. WSW; Thomas Landing	39.4477	-75.61613333
13 **E** 1	4.2 mi. W; Silver Run Road (Rt. 9)	39.46648333	-75.61225
13 **E** 3	5.0 mi. W; Local Farm, Odessa, DE	39.45283333	-75.62166667
16 **E** 1	4.1 mi. NNW; Port Penn	39.5127	-75.57633333
Locations 5 - 10 Miles			
1 **F** 1	5.8 mi. N; Fort Elfsborg	39.54488333	-75.51873333
1 **F** 2	7.1 mi. N; midpoint of Delaware River	39.56783333	-75.55166667
2 **F** 2	8.5 mi. NNE; Pole at Corner of 5th & Howell, Salem	39.5748	-75.46938333

Table B-2

REMP SAMPLING LOCATIONS

Station Code (Sector Distance Sample)	Station Location	GPS Coordinates (Deicimal Degrees) Latitudinal	Longitudinal
Locations 5 - 10 Miles (cont.)			
2 **F** 3	8.0 mi. NNE; Salem Water Company	39.55666667	-75.453
2 **F** 5	7.4 mi. NNE; Salem High School	39.55746667	-75.47523333
2 **F** 6	7.3 mi. NNE; Southern Training Center	39.56188333	-75.48031667
2 **F** 9	7.5 mi. NNE; Local Farm, Tilbury Rd, Salem	39.565437	-75.491373
2 **F** 10	9.2 mi. NNE; Local Farm, South Broadway (Rt. 49), Pennsville	39.593177	-75.49626
3 **F** 2	5.1 mi. NE; Hancocks Bridge Municipal Bld	39.50683333	-75.45963333
3 **F** 3	8.6 mi. NE; Quinton Township School	39.5436	-75.41225
3 **F** 6	6.5 mi. NE; Local Farm, Salem/Hancocks BridgeRoad	39.533687	-75.470354
3 **F** 7	7.2 mi. NE; Local Farm, Beasley Neck Road, RD#3	39.535049	-75.429295
3 **F** 8	9.28 mi. NNE Circle “M” Orchard	39.566358	-75.424528
4 **F** 2	6.0 mi. ENE; Mays Lane, Harmersville	39.49921667	-75.4346
5 **F** 1	6.5 mi. E; Canton	39.47266667	-75.41718333
6 **F** 1	6.4 mi. ESE; Stow Neck Road	39.43993333	-75.41913333
7 **F** 2	9.1 mi. SE; Bayside, New Jersey	39.38285	-75.40435
8 **F** 1	5.2 mi. S; Collins Beach Boat Ramp.	39.33221667	-75.47438333
9 **F** 1	5.3 mi. S; D.P.A.L. 48912-30217	39.38403333	-75.54916667
10 **F** 2	5.8 mi. SSW; Rt. 9	39.3839	-75.5692
11 **F** 1	6.2 mi. SW; Taylor’s Bridge Delaware	39.41276667	-75.6272
12 **F** 1	9.4 mi. WSW; Townsend Elementary School	39.3963	-75.68851667
13 **F** 2	6.5 mi. W; Odessa, Delaware	39.45495	-75.6562
13 **F** 3	9.3 mi. W; Redding Middle School, Middletown Delaware	39.45358333	-75.70905
13 **F** 4	9.8 mi. W; Middletown, Delaware	39.44761667	-75.71851667
14 **F** 2	6.7 mi. WNW; Boyds Corner	39.49965	-75.6507
14 **F** 4	7.6 mi. WNW; local farm	39.50733333	-75.67533333
15 **F** 3	5.4 mi. NW	39.51645	-75.60976667
15 **F** 4	7.0 mi. NW; local farm; Port Penn Road; Delaware	39.522633	-75.641983
16 **F** 1	6.9 mi. NNW; C&D Canal	39.55916667	-75.57083333
16 **F** 01A	6.84 mi. NNW; located at the C&D Canal tip	39.55566667	-75.55933333
16 **F** 2	8.1 mi. NNW; Delaware City Public School	39.5719	-75.59048333

Table B-2

REMP SAMPLING LOCATIONS

Station Code (Sector Distance Sample)	Station Location	GPS Coordinates (Deicimal Degrees) Latitudinal	Longitudinal
Locations 10 - 20 Miles			
1 **G** 1	10.9 mi. NNE; Rte. 49, South Broadway	39.619694	-75.505244
1 **G** 3	19 mi. N; N. Church St. Wilmington, Del (Old Swedish Church Yard Park)	39.73811667	-75.54186667
2 **G** 2	13.5 mi. NNE; Local Farm; Pointers Auburn Road (Rt. 540), Salem, NJ 08079	39.637801	-75.43578
2 **G** 3	11.8 mi. NNE; Local Milk Farm, Corner of Routes 540 & 45, Mannington, NJ	39.6035	-75.40883333
2 **G** 4	11.3 mi. NNE; large family garden; Rt 45 & Welchville Rd,Mannington, NJ	39.600615	-75.422602
3 **G** 1	16.5 mi. NE; Milk Farm; Daretown-Alloway Road, Woodstown	39.59855	-75.28006667
9 **G** 1	10.3 mi. S; Local Farm, Woodland Beach Rd., Smyrna, Delaware	39.313005	-75.564196
9 **G** 2	10.7 mi. S; Local Farm, Woodland Beach Rd, Smyrna, Delaware	39.310858	-75.56966
10 **G** 1	12 mi. SSW; Smyrna, Delaware	39.30371667	-75.60158333
14 **G** 1	11.8 mi. WNW; Rte. 286/Bethel Church Road; Delaware	39.5215	-75.77491667
16 **G** 1	15 mi. NNW; Across from Greater Wilmington Airport	39.67728333	-75.59283333
Locations Beyond 20 Miles			
3 **H** 1	32 mi. NE; National Park, New Jersey	39.85998333	-75.19933333
3 **H** 5	25 mi. NE; Farm Market, Rt 77	39.683563	-75.205981
7 **H** 1	19.1 mi. ESE	39.259421	-75.29259

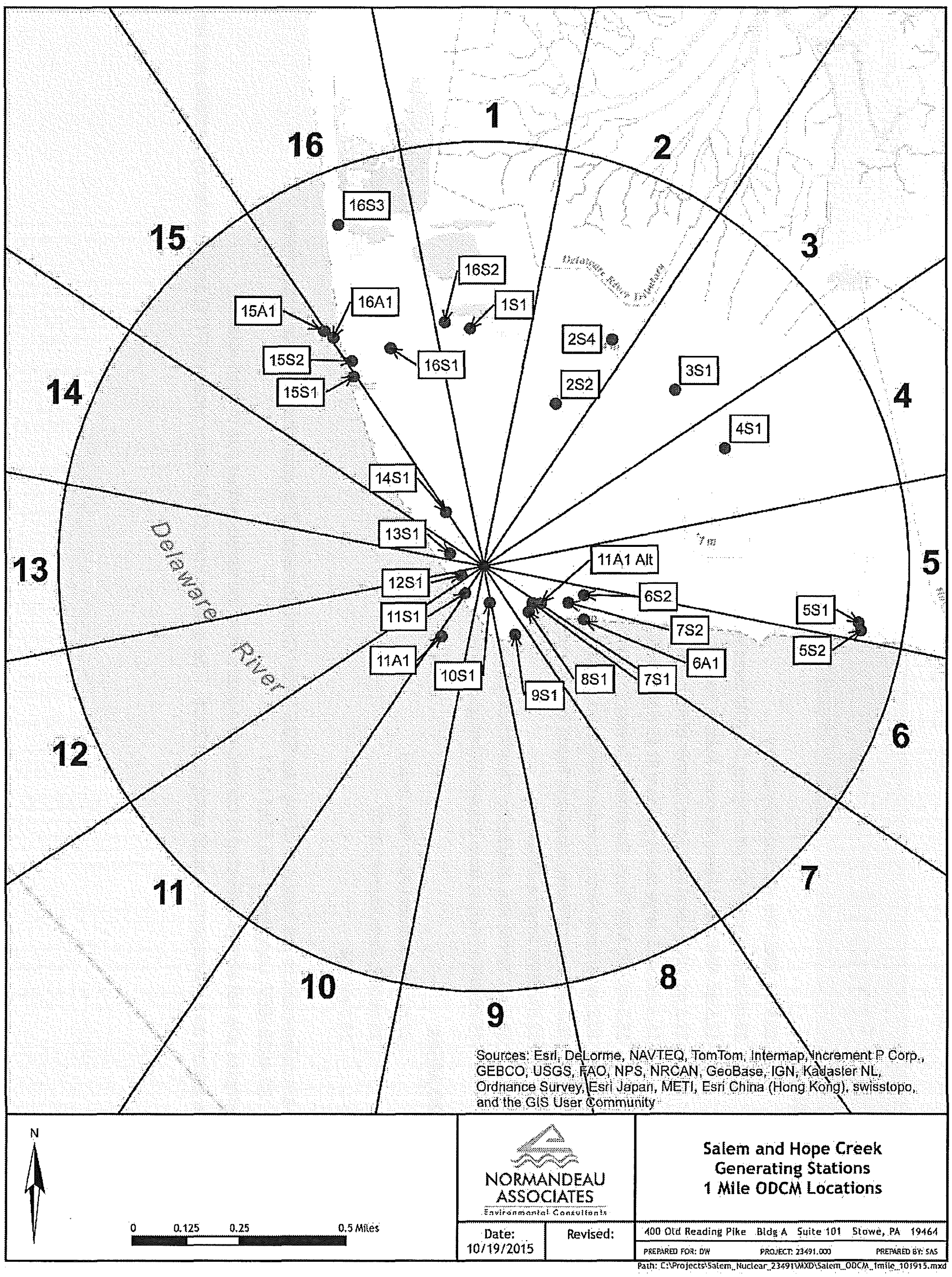
NOTE: All locations are referenced to the midpoint of the two SGS Units' Containments. The coordinates of this location are:
Latitude: 39.46291667, Longitude: -75.53611111

Vegetable samples are not always collected in consecutive years from the same farmer due to crop rotation.

* Oysters were added as a management audit sample in 2015. The oysters from the indicator location (7C1) are impacted by bacteria and are considered too small to

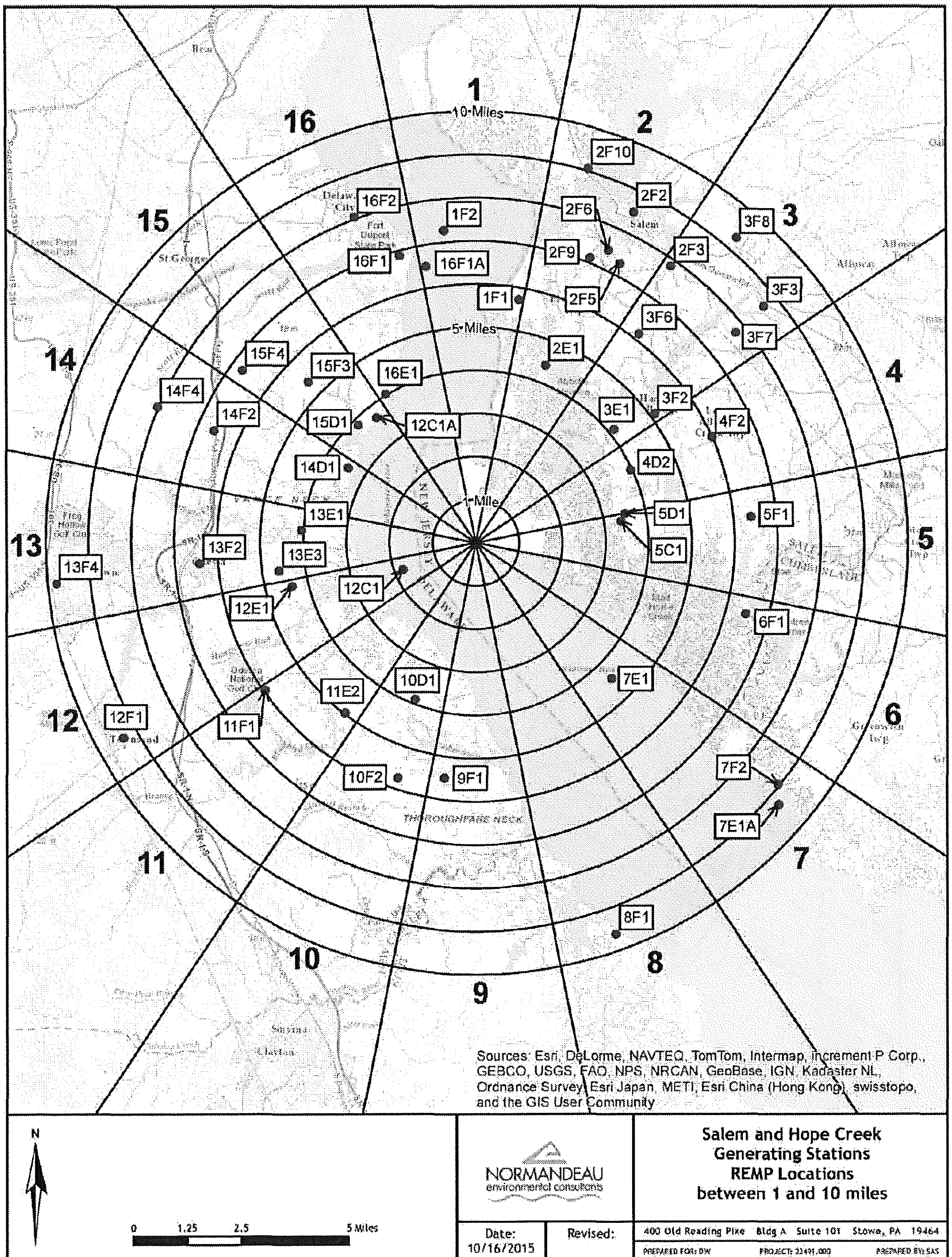
MAP B-1

SALEM AND HOPE CREEK GENERATING STATIONS' RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ON-SITE SAMPLING LOCATIONS OUT TO 1 MILE



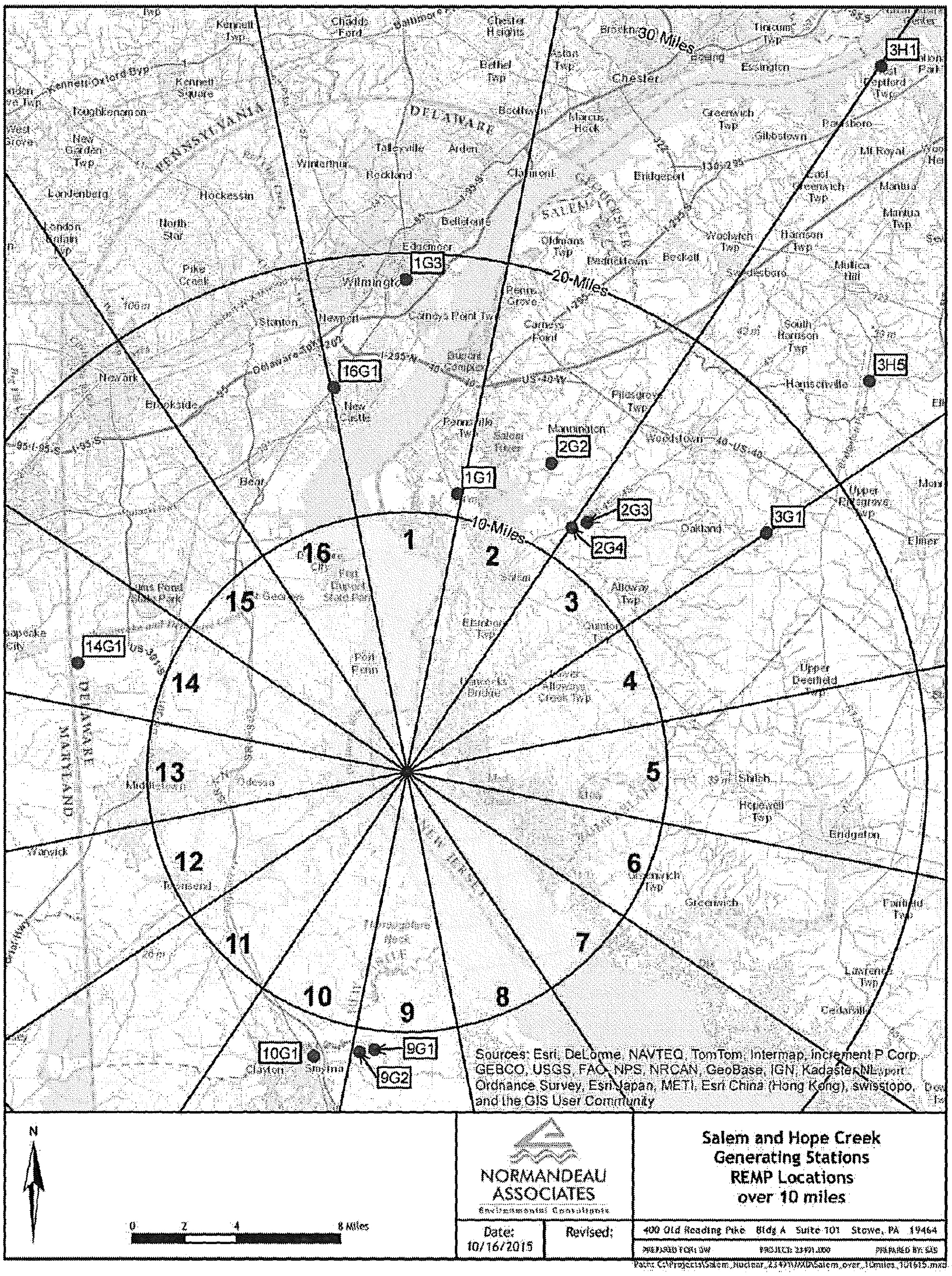
MAP B-2

SALEM AND HOPE CREEK GENERATING STATIONS' RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM OFF-SITE SAMPLING LOCATIONS 1 TO 10 MILES



MAP B-3

SALEM AND HOPE CREEK GENERATING STATIONS' RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM OFF-SITE SAMPLING LOCATIONS GREATER THAN 10 MILES



APPENDIX C

DATA TABLES AND FIGURES

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Table C-1

2017 CONCENTRATIONS OF GAMMA EMMITTERS IN QUARTERLY COMPOSITES OF AIR PARTICULATES (TBE)

Results in units of E-03 pCi/m^3, ± 2σ

STATION ID	COLLECTION PERIOD START		STOP	Be-7		K-40	Cs-134	Cs-137
SA-APT-14G1 (C)	01/03/17	-	04/03/17	**127**	± 42	< 33	< 3	< 2
	04/03/17	-	07/03/17	**130**	± 27	< 15	< 2	< 2
	07/03/17	-	10/02/17	**75**	± 22	< 11	< 2	< 1
	10/02/17	-	01/02/18	**59**	± 14	< 20	< 2	< 2
			AVERAGE*	**98**	± 72	-	-	-
SA-APT-5S1	01/03/17	-	04/03/17	**134**	± 29	< 32	< 2	< 2
	04/03/17	-	07/03/17	**102**	± 28	< 29	< 2	< 2
	07/03/17	-	10/02/17	**75**	± 18	< 24	< 1	< 1
	10/02/17	-	01/02/18	**49**	± 17	< 28	< 2	< 2
			AVERAGE*	**90**	± 73	-	-	-
SA-APT-7S2	01/03/17	-	04/03/17	**131**	± 31	< 30	< 2	< 1
	04/03/17	-	07/03/17	**122**	± 28	< 44	< 3	< 2
	07/03/17	-	10/02/17	**57**	± 15	< 30	< 2	< 2
	10/02/17	-	01/02/18	**56**	± 14	< 31	< 2	< 2
			AVERAGE*	**91**	± 81	-	-	-
SA-APT-15S2	01/03/17	-	04/03/17	**174**	± 34	< 13	< 2	< 2
	04/03/17	-	07/03/17	**120**	± 30	< 33	< 2	< 2
	07/03/17	-	10/02/17	**62**	± 15	< 25	< 2	< 2
	10/02/17	-	01/02/18	**61**	± 11	< 21	< 1	< 1
			AVERAGE*	**104**	± 108	-	-	-
SA-APT-5D1	01/03/17	-	04/03/17	**138**	± 29	< 27	< 2	< 1
	04/03/17	-	07/03/17	**130**	± 26	< 34	< 2	< 2
	07/03/17	-	10/02/17	**58**	± 15	< 24	< 1	< 1
	10/02/17	-	01/02/18	**58**	± 16	< 38	< 2	< 2
			AVERAGE*	**96**	± 88	-	-	-
SA-APT-16E1	01/03/17	-	04/03/17	**115**	± 27	< 30	< 2	< 1
	04/03/17	-	07/03/17	**124**	± 32	< 42	< 3	< 2
	07/03/17	-	10/02/17	**54**	± 17	< 31	< 2	< 1
	10/02/17	-	01/02/18	**53**	± 12	< 31	< 2	< 1
			AVERAGE*	**87**	± 76	-	-	-
SA-APT-1F1	01/03/17	-	04/03/17	**129**	± 27	< 32	< 2	< 2
	04/03/17	-	07/03/17	**105**	± 24	< 32	< 2	< 1
	07/03/17	-	10/02/17	**53**	± 13	< 27	< 1	< 2
	10/02/17	-	01/02/18	**53**	± 12	< 19	< 2	< 2
			AVERAGE*	**85**	± 76	-	-	-
SA-APT-2F6	01/03/17	-	04/03/17	**123**	± 44	< 48	< 3	< 3
	04/03/17	-	07/03/17	**159**	± 30	< 25	< 2	< 2
	07/03/17	-	10/02/17	**37**	± 19	< 42	< 2	< 2
	10/02/17	-	01/02/18	**48**	± 12	< 32	< 2	< 2
			AVERAGE*	**92**	± 118	-	-	-
			ALL INDICATOR AVERAGE *	**92**	± 80	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIO

Table C-2

2017 CONCENTRATIONS OF GROSS BETA EMITTERS IN AIR PARTICULATES (TBE)

Results in units of E-03 pCi/m^3, ± 2σ

COLLECTION PERIOD		CONTROL	INDICATORS						
START	STOP	SA-APT-14G1	SA-APT-5S1	SA-APT-7S2	SA-APT-15S2	SA-APT-5D1	SA-APT-16E1	SA-APT-1F1	SA-APT-2F6
01/03/17 -	01/09/17	9 ± 3	8 ± 3	9 ± 3	6 ± 3	6 ± 3	10 ± 3	6 ± 3	8 ± 3
01/09/17 -	01/16/17	7 ± 3	9 ± 3	12 ± 3	11 ± 3	13 ± 3	12 ± 3	12 ± 3	10 ± 3
01/16/17 -	01/23/17	11 ± 3	14 ± 3	11 ± 3	14 ± 3	12 ± 3	13 ± 3	14 ± 3	12 ± 3
01/23/17 -	01/30/17	8 ± 3	8 ± 3	9 ± 3	7 ± 3	6 ± 2	7 ± 3	9 ± 3	6 ± 3
01/30/17 -	02/06/17	10 ± 3	16 ± 3	16 ± 3	11 ± 3	11 ± 3	12 ± 3	12 ± 3	12 ± 3
02/06/17 -	02/13/17	16 ± 3	16 ± 3	16 ± 3	16 ± 3	15 ± 3	16 ± 3	16 ± 3	14 ± 3
02/13/17 -	02/21/17	11 ± 3	14 ± 3	15 ± 3	16 ± 3	9 ± 3	12 ± 3	11 ± 3	13 ± 3
02/21/17 -	02/27/17	10 ± 3	12 ± 3	9 ± 3	9 ± 3	10 ± 3	8 ± 3	11 ± 3	12 ± 3
02/27/17 -	03/06/17	15 ± 3	13 ± 3	14 ± 3	13 ± 3	14 ± 3	13 ± 3	13 ± 3	11 ± 3
03/06/17 -	03/13/17	13 ± 3	7 ± 2	10 ± 3	14 ± 3	12 ± 3	12 ± 3	10 ± 3	9 ± 3
03/13/17 -	03/20/17	13 ± 3	12 ± 3	13 ± 3	13 ± 3	11 ± 3	13 ± 3	11 ± 3 *E*	13 ± 3
03/20/17 -	03/27/17	16 ± 3	17 ± 3	18 ± 3	16 ± 3	16 ± 3	16 ± 3	14 ± 3	16 ± 3
03/27/17 -	04/03/17	8 ± 3	9 ± 3	7 ± 3	6 ± 3	8 ± 3	7 ± 3	7 ± 3	8 ± 3
04/03/17 -	04/08/17	9 ± 4	5 ± 3	6 ± 3	11 ± 4	7 ± 3	7 ± 3	6 ± 3	6 ± 3
04/08/17 -	04/15/17	11 ± 3	12 ± 3	12 ± 3	14 ± 3	11 ± 3	14 ± 3	11 ± 3	11 ± 3
04/15/17 -	04/21/17	6 ± 3	11 ± 3	8 ± 3	11 ± 3	11 ± 3	10 ± 3	10 ± 3	9 ± 3
04/21/17 -	04/26/17	< 5	< 5	< 5	< 5	< 5	5 ± 3	< 5	< 5
04/26/17 -	05/01/17	9 ± 4	13 ± 4	< 5	9 ± 4	7 ± 4	11 ± 4	10 ± 4	6 ± 4
05/01/17 -	05/08/17	8 ± 3	5 ± 2	5 ± 2	5 ± 2	5 ± 2	7 ± 3	7 ± 2	6 ± 3
05/08/17 -	05/15/17	7 ± 3	9 ± 3	8 ± 3	6 ± 3	5 ± 2	6 ± 3	6 ± 3	5 ± 2
05/15/17 -	05/22/17	12 ± 3	9 ± 3	9 ± 3	11 ± 3	12 ± 3	11 ± 3	10 ± 3	9 ± 3
05/22/17 -	05/30/17	7 ± 3	< 3	4 ± 2	5 ± 2	6 ± 2	< 3	5 ± 3	4 ± 2
05/30/17 -	06/05/17	12 ± 3	17 ± 4	12 ± 3	11 ± 3	14 ± 3	12 ± 3	11 ± 3	14 ± 3
06/05/17 -	06/12/17	11 ± 3	12 ± 3	10 ± 3	11 ± 3	8 ± 3	11 ± 3	9 ± 3	14 ± 3
06/12/17 -	06/19/17	17 ± 3	17 ± 3	15 ± 3	15 ± 3	15 ± 3	16 ± 3	17 ± 3	16 ± 3
06/19/17 -	06/26/17	16 ± 3	11 ± 3	17 ± 4	17 ± 4	12 ± 3	16 ± 4	17 ± 4	13 ± 3
06/26/17 -	07/03/17	13 ± 3	13 ± 3	14 ± 3	11 ± 3	12 ± 3	12 ± 3	12 ± 3	14 ± 3
07/03/17 -	07/10/17	14 ± 3	13 ± 3	13 ± 3	12 ± 3	13 ± 3	11 ± 3	11 ± 3	11 ± 3
07/10/17 -	07/17/17	17 ± 3	16 ± 3	22 ± 4	13 ± 3	18 ± 3	14 ± 3	17 ± 3	13 ± 3
07/17/17 -	07/24/17	17 ± 3	14 ± 3	16 ± 3	11 ± 3	10 ± 3	13 ± 3	12 ± 3	16 ± 3
07/24/17 -	07/31/17	10 ± 3	11 ± 3	10 ± 3	8 ± 3	11 ± 3	10 ± 3	8 ± 3	7 ± 3
07/31/17 -	08/07/17	13 ± 3	12 ± 3	12 ± 3	12 ± 3	13 ± 3	9 ± 3	11 ± 3	12 ± 3
08/07/17 -	08/14/17	15 ± 3	10 ± 3	15 ± 3	14 ± 3	12 ± 3	14 ± 3	10 ± 3	12 ± 3
08/14/17 -	08/21/17	14 ± 3	14 ± 3	13 ± 3	17 ± 4	16 ± 3	16 ± 3	16 ± 4	16 ± 3
08/21/17 -	08/28/17	15 ± 3	13 ± 3	14 ± 3	16 ± 3	14 ± 3	15 ± 3	13 ± 4	14 ± 3
08/28/17 -	09/05/17	14 ± 3	14 ± 3	12 ± 3	12 ± 3	13 ± 3	15 ± 3	13 ± 3 *E*	13 ± 3
09/05/17 -	09/11/17	13 ± 3	15 ± 3	14 ± 3	14 ± 3	10 ± 3	9 ± 3	11 ± 3	10 ± 3
09/11/17 -	09/18/17	16 ± 3	15 ± 3	15 ± 3	13 ± 3	16 ± 3	16 ± 3	10 ± 3	13 ± 3
09/18/17 -	09/25/17	15 ± 3	16 ± 3	19 ± 3	19 ± 3	16 ± 3	20 ± 3	14 ± 3	14 ± 3
09/25/17 -	10/02/17	8 ± 3	7 ± 2	8 ± 2	10 ± 3	8 ± 2	7 ± 2	9 ± 3	8 ± 2
10/02/17 -	10/10/17	19 ± 3	14 ± 3	16 ± 3	14 ± 3	12 ± 3	16 ± 3	14 ± 3	14 ± 3
10/10/17 -	10/16/17	8 ± 3	9 ± 3	9 ± 3	9 ± 3	8 ± 3	7 ± 3	10 ± 3	9 ± 3

Table C-2

2017 CONCENTRATIONS OF GROSS BETA EMITTERS IN AIR PARTICULATES (TBE)

Results in units of E-03 pCi/m^3, ± 2σ

COLLECTION PERIOD		CONTROL	INDICATORS						
START	STOP	SA-APT-14G1	SA-APT-5S1	SA-APT-7S2	SA-APT-15S2	SA-APT-5D1	SA-APT-16E1	SA-APT-1F1	SA-APT-2F6
10/16/17	10/23/17	18 ± 3	15 ± 3	15 ± 3	13 ± 3	14 ± 4	9 ± 3	11 ± 3	15 ± 3
10/23/17	10/31/17	5 ± 2 E	14 ± 3	12 ± 3	12 ± 2	12 ± 3	8 ± 2	9 ± 2	10 ± 2
10/31/17	11/06/17	17 ± 3	17 ± 3	16 ± 3	14 ± 3	15 ± 3	17 ± 3	15 ± 3	14 ± 3
11/06/17	11/13/17	14 ± 3	12 ± 3	14 ± 3	12 ± 3	7 ± 3	16 ± 3	10 ± 3	12 ± 3
11/13/17	11/20/17	14 ± 3	12 ± 3	13 ± 3	15 ± 3	17 ± 4	16 ± 3	11 ± 3	10 ± 3
11/20/17	11/27/17	17 ± 3	19 ± 3	19 ± 3	20 ± 3	19 ± 3	18 ± 3	17 ± 3	19 ± 3
11/27/17	12/04/17	18 ± 3	17 ± 3	15 ± 3	16 ± 3	19 ± 3	14 ± 3	16 ± 3	17 ± 3
12/04/17	12/11/17	18 ± 4	21 ± 4	19 ± 4	18 ± 3	19 ± 3	19 ± 4	18 ± 3	16 ± 3
12/11/17	12/18/17	12 ± 3	14 ± 3	11 ± 3	17 ± 3	15 ± 3	13 ± 3	12 ± 3	12 ± 3
12/18/17	12/26/17	18 ± 3	17 ± 3	18 ± 3	17 ± 3	16 ± 3	19 ± 3	16 ± 3	16 ± 3
12/26/17	01/02/18	20 ± 3	15 ± 3	15 ± 3	18 ± 3	18 ± 3	18 ± 3	13 ± 3	14 ± 3
	AVERAGE*	13 ± 8	13 ± 7	13 ± 8	13 ± 7	12 ± 8	12 ± 8	12 ± 3	12 ± 7

ALL INDICATOR AVERAGE* 12 ± 7

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING ONLY THE POSITIVE VALUES.

E SEE 'SAMPLE ANOMOLIES AND PROGRAM EXCEPTIONS' SECTION OF THS REPORT

Table C-3

2017 CONCENTRATIONS OF IODINE-131 IN FILTERED AIR (TBE)

Results in units of E-03 pCi/m^3, ± 2σ

COLLECTION PERIOD		CONTROL	INDICATORS						
START	STOP	SA-AIO-14G1	SA-AIO-5S1	SA-AIO-7S2	SA-AIO-15S2	SA-AIO-5D1	SA-AIO-16E1	SA-AIO-1F1	SA-AIO-2F6
01/03/17	01/09/17	< 26	< 22	< 25	< 24	< 11	< 26	< 20	< 21
01/09/17	01/16/17	< 11	< 29	< 26	< 26	< 29	< 24	< 28	< 28
01/16/17	01/23/17	< 22	< 21	< 21	< 21	< 19	< 21	< 22	< 22
01/23/17	01/30/17	< 21	< 26	< 8	< 20	< 24	< 21	< 27	< 27
01/30/17	02/06/17	< 20	< 24	< 19	< 20	< 23	< 21	< 26	< 23
02/06/17	02/13/17	< 23	< 31	< 23	< 24	< 30	< 23	< 32	< 30
02/13/17	02/21/17	< 24	< 31	< 13	< 27	< 30	< 25	< 32	< 30
02/21/17	02/27/17	< 26	< 36	< 24	< 9	< 35	< 25	< 32	< 35
02/27/17	03/06/17	< 32	< 40	< 30	< 29	< 43	< 16	< 46	< 43
03/06/17	03/13/17	< 30	< 24	< 31	< 30	< 27	< 28	< 25	< 26
03/13/17	03/20/17	< 25	< 18	< 25	< 24	< 16	< 24	< 17 E	< 17
03/20/17	03/27/17	< 23	< 19	< 22	< 12	< 19	< 24	< 19	< 19
03/27/17	04/03/17	< 17	< 23	< 16	< 16	< 23	< 18	< 23	< 24
04/03/17	04/08/17	< 23	< 32	< 22	< 22	< 32	< 22	< 33	< 35
04/08/17	04/15/17	< 27	< 26	< 25	< 25	< 26	< 10	< 24	< 25
04/15/17	04/21/17	< 26	< 25	< 24	< 25	< 25	< 11	< 26	< 26
04/21/17	04/26/17	< 30	< 42	< 32	< 32	< 32	< 10	< 41	< 40
04/26/17	05/01/17	< 14	< 54	< 38	< 38	< 51	< 39	< 51	< 53
05/01/17	05/08/17	< 31	< 28	< 31	< 30	< 14	< 35	< 28	< 29
05/08/17	05/15/17	< 12	< 36	< 32	< 32	< 35	< 32	< 35	< 33
05/15/17	05/22/17	< 20	< 21	< 20	< 20	< 20	< 20	< 8	< 20
05/22/17	05/30/17	< 9	< 30	< 25	< 25	< 29	< 25	< 32	< 29
05/30/17	06/05/17	< 30	< 37	< 28	< 28	< 36	< 30	< 36	< 35
06/05/17	06/12/17	< 26	< 33	< 27	< 10	< 33	< 26	< 31	< 32
06/12/17	06/19/17	< 25	< 27	< 23	< 23	< 29	< 25	< 28	< 28
06/19/17	06/26/17	< 34	< 30	< 36	< 37	< 34	< 36	< 33	< 33
06/26/17	07/03/17	< 43	< 37	< 41	< 17	< 39	< 43	< 37	< 37
07/03/17	07/10/17	< 26	< 35	< 10	< 27	< 37	< 26	< 35	< 35
07/10/17	07/17/17	< 21	< 23	< 20	< 19	< 24	< 20	< 23	< 23
07/17/17	07/24/17	< 8	< 23	< 22	< 23	< 23	< 22	< 24	< 23
07/24/17	07/31/17	< 19	< 25	< 8	< 20	< 26	< 20	< 26	< 25
07/31/17	08/07/17	< 35	< 24	< 17	< 33	< 25	< 34	< 24	< 24
08/07/17	08/14/17	< 23	< 30	< 23	< 24	< 30	< 13	< 30	< 29
08/14/17	08/21/17	< 27	< 18	< 14	< 27	< 36	< 26	< 37	< 35
08/21/17	08/28/17	< 23	< 29	< 12	< 23	< 29	< 22	< 64	< 29
08/28/17	09/05/17	< 18	< 19	< 17	< 18	< 20	< 17	< 19 E	< 8
09/05/17	09/11/17	< 30	< 36	< 30	< 30	< 37	< 29	< 14	< 35
09/11/17	09/18/17	< 19	< 25	< 18	< 19	< 25	< 17	< 22	< 24
09/18/17	09/25/17	< 20	< 29	< 20	< 21	< 30	< 20	< 29	< 28
09/25/17	10/02/17	< 14	< 27	< 13	< 13	< 27	< 13	< 30	< 27
10/02/17	10/10/17	< 26	< 23	< 27	< 26	< 23	< 26	< 25	< 10
10/10/17	10/16/17	< 33	< 33	< 32	< 32	< 33	< 32	< 34	< 17
10/16/17	10/23/17	< 17	< 26	< 19	< 18	< 28	< 15	< 25	< 25
10/23/17	10/31/17	< 20 E	< 21	< 20	< 7	< 21	< 19	< 11	< 21
10/31/17	11/06/17	< 31	< 27	< 31	< 30	< 28	< 29	< 26	< 26
11/06/17	11/13/17	< 21	< 20	< 20	< 19	< 22	< 20	< 20	< 20
11/13/17	11/20/17	< 18	< 24	< 19	< 19	< 28	< 14	< 23	< 25
11/20/17	11/27/17	< 17	< 26	< 16	< 16	< 24	< 16	< 24	< 24
11/27/17	12/04/17	< 16	< 29	< 16	< 15	< 29	< 14	< 27	< 29
12/04/17	12/11/17	< 31	< 24	< 31	< 15	< 23	< 34	< 22	< 24
12/11/17	12/18/17	< 24	< 20	< 24	< 23	< 18	< 24	< 18	< 19
12/18/17	12/26/17	< 36	< 43	< 39	< 39	< 44	< 36	< 20	< 42
12/26/17	01/02/18	< 14	< 30	< 14	< 14	< 28	< 14	< 11	< 29
AVERAGE		-	-	-	-	-	-	-	-

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

E SEE 'SAMPLE ANOMOLIES AND PROGRAM EXCEPTIONS' SECTION OF THS REPORT

Table C-4

2017 DIRECT AND IMMERSION RADIATION MEASUREMENTS (REMP DOSIMETRY RESULTS*)

STATION ID	ANNUAL NET DOSE (mrem)	GROSS ANNUAL DOSE (mrem)	QUARTERLY NET DOSE AND GROSS DOSE (mrem/StandardQuarter) JAN - MAR Net	JAN - MAR Gross	APR - JUN Net	APR - JUN Gross	JUL - SEP Net	JUL - SEP Gross	OCT - DEC Net	OCT - DEC Gross
SA-IDM-1G3 (C)	ND	53.6	ND	13.3	ND	12.7	ND	13.5	ND	14.1
SA-IDM-3G1 (C)	ND	56.4	ND	13.8	ND	13.2	ND	13.7	ND	15.7
SA-IDM-10G1 (C)	ND	55.4	ND	12.8	ND	13.4	ND	14.2	ND	15.0
SA-IDM-14G1 (C)	ND	55.8	ND	14.1	ND	13.3	ND	14.0	ND	14.4
SA-IDM-16G1 (C)	ND	50.2	ND	12.4	ND	12.2	ND	12.5	ND	13.1
SA-IDM-3H1 (C)	ND	47.9	ND	11.9	ND	11.2	ND	11.6	ND	13.2
SA-IDM-1S1 **	**50.4**	105.0	**14.4**	28.0	**9.7**	23.3	**11.5**	25.1	**15.0**	28.6
SA-IDM-1S2	ND	52.0		x		x	ND	13.0	ND	13.0
SA-IDM-2S2	ND	60.6	ND	14.9	ND	14.3	ND	15.5	ND	15.9
SA-IDM-2S4	ND	50.7	ND	11.6	ND	12.6	ND	12.7	ND	13.8
SA-IDM-3S1	ND	46.1	ND	11.4	ND	10.9	ND	11.8	ND	12.0
SA-IDM-4S1	ND	46.8	ND	11.8	ND	11.3	ND	12.1	ND	11.6
SA-IDM-5S1	ND	44.4	ND	11.2	ND	10.4	ND	11.5	ND	11.3
SA-IDM-6S2	ND	60.2	ND	14.4	ND	14.8	ND	15.5	ND	15.5
SA-IDM-7S1	ND	47.7	ND	11.9	ND	11.8	ND	11.3	ND	12.7
SA-IDM-8S1	ND	40.0	ND	10.0	ND	9.0	ND	10.7	ND	10.3
SA-IDM-9S1	ND	42.5	ND	10.7	ND	9.9	ND	10.8	ND	11.1
SA-IDM-10S1	ND	44.9	ND	11.2	ND	10.6	ND	10.6	ND	12.5
SA-IDM-11S1	ND	42.9	ND	10.3	ND	10.3	ND	10.3	ND	12.0
SA-IDM-12S1	ND	53.4	ND	13.4	ND	12.1	ND	12.8	ND	15.1
SA-IDM-13S1	ND	69.8	ND	14.1	**5.7**	20.7	ND	18.3	ND	16.7
SA-IDM-14S1	ND	56.5	ND	13.6	ND	13.6	ND	14.4	ND	14.9
SA-IDM-15S1	ND	43.0	ND	10.1	ND	10.6	ND	10.9	ND	11.4
SA-IDM-15S2	ND	49.4	ND	12.4	ND	11.8	ND	12.1	ND	13.1
SA-IDM-16S1	ND	53.3	ND	12.6	ND	12.7	ND	14.0	ND	14.0
SA-IDM-16S2 **	**57.9**	112.5	**14.0**	27.6	**13.3**	26.9	**15.1**	28.7	**15.7**	29.3
SA-IDM-16S3	ND	44.7	ND	10.8	ND	11.1	ND	11.2	ND	11.6
SA-IDM-4D2	ND	52.7	ND	12.7	ND	12.7	ND	13.6	ND	13.7
SA-IDM-5D1	ND	50.4	ND	12.7	ND	11.9	ND	12.4	ND	13.4
SA-IDM-10D1	ND	55.2	ND	13.7	ND	12.0	ND	15.2	ND	14.3
SA-IDM-14D1	ND	49.2	ND	12.6	ND	11.8	ND	11.9	ND	12.9
SA-IDM-15D1	ND	52.6	ND	13.5	ND	11.9	ND	13.3	ND	13.9
SA-IDM-2E1	ND	49.9	ND	13.1	ND	11.6	ND	12.1	ND	13.1
SA-IDM-3E1	ND	32.6	ND	11.0	ND	10.2		***	ND	11.4
SA-IDM-11E2	ND	56.4	ND	14.2	ND	13.1	ND	13.9	ND	15.2
SA-IDM-12E1	ND	55.2	ND	14.0	ND	13.2	ND	13.7	ND	14.3
SA-IDM-13E1	ND	46.4	ND	11.5	ND	11.1	ND	11.4	ND	12.4
SA-IDM-16E1	ND	51.4	ND	12.4	ND	11.7	ND	13.6	ND	13.7
SA-IDM-1F1	ND	66.7	ND	17.4	ND	15.9	ND	15.8	ND	17.6
SA-IDM-2F2	ND	47.3	ND	12.3	ND	10.2	ND	11.9	ND	12.9
SA-IDM-2F5	ND	52.4	ND	13.4	ND	12.0	ND	12.8	ND	14.2
SA-IDM-2F6	ND	49.9	ND	12.8	ND	11.4	ND	12.5	ND	13.2
SA-IDM-3F2	ND	45.6	ND	11.0	ND	10.2	ND	11.9	ND	12.5
SA-IDM-3F3	ND	46.6	ND	11.2	ND	11.1	ND	11.8	ND	12.5
SA-IDM-4F2	ND	44.2	ND	10.7	ND	10.1	ND	11.2	ND	12.2
SA-IDM-5F1	ND	50.0	ND	12.3	ND	11.6	ND	13.3	ND	12.8
SA-IDM-6F1	ND	40.4	ND	10.0	ND	9.6	ND	9.7	ND	11.1
SA-IDM-7F2	**14.6**	49.9	ND	12.4	ND	11.6	ND	12.6	ND	13.3
SA-IDM-8F1	ND	42.6		***	ND	13.4	ND	14.5	ND	14.7
SA-IDM-9F1	ND	57.2	ND	13.8	ND	13.9	ND	13.9	ND	15.6
SA-IDM-10F2	ND	55.2	ND	13.7	ND	13.3	ND	13.8	ND	14.4
SA-IDM-11F1	ND	56.8	ND	13.9	ND	13.7	ND	14.5	ND	14.7
SA-IDM-12F1	ND	54.4	ND	13.5	ND	13.6	ND	13.5	ND	13.8
SA-IDM-13F2	ND	52.1	ND	13.0	ND	12.5	ND	12.8	ND	13.8
SA-IDM-13F3	ND	55.7	ND	13.7	ND	13.1	ND	14.2	ND	14.7
SA-IDM-13F4	ND	56.7	ND	14.3	ND	13.7	ND	14.0	ND	14.7
SA-IDM-14F2	ND	59.0	ND	15.2	ND	13.7	ND	14.7	ND	15.4
SA-IDM-15F3	ND	58.6	ND	14.6	ND	14.1	ND	14.9	ND	15.0
SA-IDM-16F2	ND	51.4	ND	12.2	ND	12.0	ND	13.5	ND	13.7

ND NOT DETECTABLE ABOVE BACKGROUND
x TLD LOCATION ADDED FOR THIRD QUARTER OF 2017.
* QUARTERLY ELEMENT TLD RESULTS BY MIRION TECHNOLOGIES.
** SAMPLE RESULTS ARE AFFECTED BY THE INDPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)
*** SEE 'SAMPLE ANOMOLIES AND PROGRAM EXCEPTIONS' SECTION OF THIS REPORT.

Table C-5

2017 CONCENTRATIONS OF IODINE-131 AND GAMMA EMITTERS IN MILK (TBE)

Results in units of pCi/L, ± 2σ

STATION ID	COLLECTION PERIOD START - STOP		<------------- GAMMA EMITTERS ------------->				
		I-131 LL	K-40	Cs-135	Cs-137	BaLa-140	Ra-226
SA-MLK-3G1 (C)	01/02/17 - 01/03/17	< 0.7	**1,399** ± 102	< 5	< 6	< 8	< 148
	02/05/17 - 02/06/17	< 0.8	**1,452** ± 180	< 6	< 7	< 6	< 195
	03/05/17 - 03/06/17	< 0.6	**1,503** ± 196	< 10	< 8	< 10	< 215
	04/02/17 - 04/03/17	< 0.5	**1,131** ± 188	< 8	< 7	< 9	< 201
	04/20/17 - 04/21/17	< 0.9	**1,264** ± 164	< 12	< 12	< 15	< 311
	05/07/17 - 05/08/17	< 0.8	**1,261** ± 153	< 11	< 9	< 10	< 268
	05/21/17 - 05/22/17	< 0.5	**1,404** ± 157	< 9	< 7	< 11	< 182
	06/04/17 - 06/05/17	< 0.7	**1,388** ± 160	< 10	< 9	< 14	< 217
	06/18/17 - 06/19/17	< 0.6	**1,511** ± 195	< 7	< 9	< 11	< 191
	07/02/17 - 07/03/17	< 0.9	**1,279** ± 196	< 11	< 10	< 12	< 187
	07/16/17 - 07/17/17	< 0.7	**1,330** ± 186	< 9	< 9	< 12	< 166
	08/06/17 - 08/07/17	< 0.8	**1,314** ± 152	< 10	< 9	< 9	< 227
	08/20/17 - 08/21/17	< 0.5	**1,297** ± 163	< 13	< 11	< 13	< 280
	09/04/17 - 09/05/17	< 0.7	**1,313** ± 150	< 9	< 10	< 13	< 239
	09/17/17 - 09/18/17	< 0.5	**1,120** ± 168	< 10	< 8	< 11	< 175
	10/01/17 - 10/02/17	< 0.5	**1,286** ± 213	< 8	< 9	< 9	< 208
	10/15/17 - 10/16/17	< 0.6	**1,125** ± 164	< 8	< 8	< 8	< 184
	11/12/17 - 11/13/17	< 0.9	**1,366** ± 115	< 5	< 5	< 15	< 113
	11/26/17 - 11/27/17	< 0.7	**1,028** ± 164	< 12	< 12	< 13	< 299
	12/03/17 - 12/04/17	< 1.0	**1,276** ± 111	< 7	< 7	< 8	< 184
	AVERAGE*	-	1,302 ± 256	-	-	-	-

STATION ID	COLLECTION PERIOD START - STOP		<------------- GAMMA EMITTERS ------------->				
		I-131 LL	K-40	Cs-135	Cs-137	BaLa-140	Ra-226
SA-MLK-13E3	01/02/17 - 01/03/17	< 0.7	**1,443** ± 113	< 4	< 5	< 6	< 127
	02/05/17 - 02/06/17	< 0.7	**1,381** ± 189	< 8	< 8	< 7	< 191
	03/05/17 - 03/06/17	< 0.9	**1,489** ± 249	< 11	< 10	< 13	< 237
	04/02/17 - 04/03/17	< 0.5	**1,110** ± 197	< 11	< 8	< 12	< 187
	04/20/17 - 04/21/17	< 0.7	**1,260** ± 189	< 9	< 9	< 14	< 159
	05/07/17 - 05/08/17	< 0.6	**1,293** ± 140	< 7	< 7	< 9	< 129
	05/21/17 - 05/22/17	< 0.5	**1,522** ± 171	< 13	< 12	< 15	< 312
	06/04/17 - 06/05/17	< 0.8	**1,266** ± 194	< 10	< 10	< 15	< 198
	06/18/17 - 06/19/17	< 0.7	**1,529** ± 188	< 9	< 10	< 10	< 194
	07/02/17 - 07/03/17	< 0.9	**1,423** ± 190	< 8	< 9	< 12	< 200
	07/16/17 - 07/17/17	< 0.6	**1,421** ± 172	< 7	< 7	< 8	< 159
	08/06/17 - 08/07/17	< 0.7	**1,205** ± 159	< 7	< 7	< 6	< 151
	08/20/17 - 08/21/17	< 0.4	**1,425** ± 202	< 11	< 12	< 13	< 216
	09/04/17 - 09/05/17	< 0.5	**1,175** ± 165	< 9	< 9	< 12	< 196
	09/17/17 - 09/18/17	< 0.6	**1,303** ± 158	< 5	< 6	< 9	< 118
	10/01/17 - 10/02/17	< 0.6	**1,422** ± 230	< 8	< 9	< 10	< 185
	10/15/17 - 10/16/17	< 0.7	**1,269** ± 147	< 8	< 8	< 12	< 162
	11/12/17 - 11/13/17	< 0.8	**1,525** ± 179	< 9	< 6	< 10	< 179
	11/26/17 - 11/27/17	< 0.7	**1,175** ± 179	< 9	< 11	< 14	< 221
	12/03/17 - 12/04/17	< 1.0	**1,433** ± 162	< 10	< 8	< 11	< 179
	AVERAGE*	-	1,353 ± 258	-	-	-	-

Table C-5

2017 CONCENTRATIONS OF IODINE-131 AND GAMMA EMITTERS IN MILK (TBE)

Results in units of pCi/L, ± 2σ

STATION ID	COLLECTION PERIOD START - STOP	I-131 LL	K-40	Cs-135	Cs-137	BaLa-140	Ra-226
			<------- GAMMA EMITTERS				------->
SA-MLK-14F4	01/02/17 - 01/03/17	< 0.5	**1,360** ± 141	< 5	< 6	< 9	< 116
	02/05/17 - 02/06/17	< 0.5	**1,425** ± 234	< 8	< 10	< 11	< 233
	03/05/17 - 03/06/17	< 0.8	**1,561** ± 193	< 10	< 9	< 11	< 193
	04/02/17 - 04/03/17	< 0.4	**1,384** ± 167	< 8	< 7	< 10	< 190
	04/20/17 - 04/21/17	< 0.5	**1,189** ± 166	< 8	< 8	< 9	< 153
	05/07/17 - 05/08/17	< 0.6	**1,313** ± 147	< 10	< 8	< 10	< 249
	05/21/17 - 05/22/17	< 0.3	**1,532** ± 163	< 6	< 6	< 10	< 140
	06/04/17 - 06/05/17	< 0.7	**1,362** ± 184	< 10	< 9	< 7	< 189
	06/18/17 - 06/19/17	< 0.7	**1,208** ± 167	< 9	< 7	< 8	< 202
	07/02/17 - 07/03/17	< 0.6	**1,376** ± 174	< 8	< 7	< 11	< 157
	07/16/17 - 07/17/17	< 0.5	**1,458** ± 147	< 6	< 6	< 7	< 153
	08/06/17 - 08/07/17	< 0.6	**1,461** ± 185	< 10	< 9	< 10	< 207
	08/20/17 - 08/21/17	< 0.5	**1,417** ± 166	< 11	< 11	< 13	< 214
	09/04/17 - 09/05/17	< 0.6	**1,194** ± 157	< 10	< 8	< 14	< 204
	09/17/17 - 09/18/17	< 0.6	**1,317** ± 164	< 8	< 7	< 9	< 137
	10/01/17 - 10/02/17	< 0.5	**1,301** ± 189	< 8	< 7	< 12	< 170
	10/15/17 - 10/16/17	< 0.5	**1,294** ± 152	< 6	< 6	< 8	< 129
	11/12/17 - 11/13/17	< 0.9	**1,284** ± 182	< 8	< 9	< 13	< 165
	11/26/17 - 11/27/17	< 0.8	**1,337** ± 194	< 10	< 9	< 12	< 198
	12/03/17 - 12/04/17	< 0.8	**1,438** ± 151	< 7	< 8	< 9	< 211
	AVERAGE*	-	**1,361** ± 206	-	-	-	-

STATION ID	COLLECTION PERIOD START - STOP	I-131 LL	K-40	Cs-135	Cs-137	BaLa-140	Ra-226
			<------- GAMMA EMITTERS				------->
SA-MLK-2G3	01/02/17 - 01/03/17	< 0.9	**1,397** ± 105	< 4	< 4	< 6	< 100
	02/05/17 - 02/06/17	< 0.7	**1,304** ± 203	< 7	< 11	< 15	< 214
	03/05/17 - 03/06/17	< 0.8	**1,413** ± 207	< 8	< 8	< 13	< 222
	04/02/17 - 04/03/17	< 0.4	**1,280** ± 145	< 6	< 6	< 5	< 125
	04/20/17 - 04/21/17	< 0.7	**1,259** ± 151	< 6	< 7	< 8	< 155
	05/07/17 - 05/08/17	< 1.0	**1,370** ± 154	< 7	< 8	< 9	< 188
	05/21/17 - 05/22/17	< 0.5	**1,363** ± 192	< 8	< 8	< 14	< 216
	06/04/17 - 06/05/17	< 0.6	**1,354** ± 153	< 8	< 7	< 7	< 176
	06/18/17 - 06/19/17	< 0.7	**1,146** ± 233	< 9	< 11	< 13	< 201
	07/02/17 - 07/03/17	< 0.8	**1,157** ± 195	< 10	< 9	< 14	< 225
	07/16/17 - 07/17/17	< 0.7	**1,195** ± 127	< 6	< 4	< 7	< 112
	08/06/17 - 08/07/17	< 0.6	**1,451** ± 191	< 10	< 9	< 10	< 172
	08/20/17 - 08/21/17	< 0.4	**1,535** ± 223	< 9	< 8	< 13	< 199
	09/04/17 - 09/05/17	< 0.8	**1,246** ± 158	< 8	< 8	< 10	**243** ± 160
	09/17/17 - 09/18/17	< 0.8	**1,406** ± 178	< 9	< 9	< 14	< 178
	10/01/17 - 10/02/17	< 0.5	**1,137** ± 132	< 8	< 7	< 9	< 139
	10/15/17 - 10/16/17	< 0.6	**1,295** ± 132	< 6	< 5	< 7	< 110
	11/12/17 - 11/13/17	< 0.8	**1,710** ± 161	< 11	< 10	< 11	< 258
	11/26/17 - 11/27/17	< 0.7	**1,273** ± 171	< 8	< 7	< 11	< 199
	12/03/17 - 12/04/17	< 0.8	**1,223** ± 191	< 10	< 9	< 14	< 161
	AVERAGE*	-	**1,326** ± 280	-	-	-	**243** ± 160

	I-131 LL	K-40	Cs-135	Cs-137	BaLa-140	Ra-226
ALL INDICATOR AVERAGE*	-	1,347 ± 247	-	-	-	243 ± 160

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES. IF THERE IS ONLY 1 POSITIVE VALUE, THE AVERAGE AND THE ERROR ARE DISPLAYED.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-6

2017 CONCENTRATIONS OF GROSS ALPHA AND BETA EMITTERS
AND TRITIUM IN WELL WATER**

Results in units of pCi/L, ± 2σ

STATION ID	COLLECTION DATE	Gross Alpha	Gross Beta	H-3
SA-WWA-3E1	01/27/17	< 1.6	< 2.3	< 192
	02/23/17	< 1.1	< 2.2	< 183
	03/23/17	< 0.8	< 2.2	< 190
	04/21/17	< 2.0	**2.5** ± 1.6	< 194
	05/15/17	< 1.8	< 2.3	< 189
	06/19/17	< 2.0	**2.7** ± 1.7	< 191
	07/19/17	< 1.5	**2.5** ± 1.6	< 182
	08/22/17	< 0.8	< 2.2	< 185
	09/25/17	< 0.8	< 2.1	< 173
	10/23/17	< 1.6	< 2.2	< 171
	11/27/17	< 1.2	< 2.3	< 177
	12/18/17	< 1.8	< 2.4	< 188
	AVERAGE*	-	**2.6** ± 0.3	-

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES. IF THERE IS ONLY 1 POSITIVE VALUE THE AVERAGE AND THE ERROR ARE DISPLAYED.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-7

2017 CONCENTRATIONS OF IODINE-131 AND GAMMA EMITTERS IN WELL WATER** (TBE)

Results in units of pCi/L, ± 2σ

STATION ID	COLLECTION DATE	I-131 LL	<-------------- GAMMA EMITTERS -------------->										
			K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	ZrNb-95	Cs-134	Cs-137	BaLa-140	Ra-226
SA-WWA-3E1	01/27/17	< 0.9	< 86	< 5	< 5	< 10	< 5	< 6	< 6	< 5	< 6	< 6	< 151
	02/23/17	< 0.3	< 86	< 6	< 4	< 11	< 5	< 12	< 6	< 6	< 6	< 8	< 151
	03/23/17	< 0.6	< 113	< 5	< 6	< 10	< 6	< 10	< 6	< 5	< 5	< 8	< 164
	04/21/17	< 0.5	< 44	< 7	< 6	< 14	< 7	< 12	< 6	< 6	< 8	< 9	< 171
	05/15/17	< 0.2	< 112	< 4	< 5	< 10	< 5	< 12	< 6	< 5	< 6	< 8	< 131
	06/19/17	< 0.6	< 125	< 7	< 6	< 12	< 7	< 14	< 7	< 8	< 8	< 10	< 188
	07/19/17	< 0.8	< 99	< 5	< 5	< 10	< 4	< 9	< 6	< 6	< 5	< 8	< 133
	08/22/17	< 0.2	< 132	< 7	< 6	< 9	< 6	< 11	< 6	< 7	< 7	< 9	< 179
	09/25/17	< 0.4	< 92	< 5	< 5	< 12	< 6	< 10	< 7	< 6	< 4	< 6	< 149
	10/23/17	< 0.2	< 88	< 4	< 5	< 10	< 6	< 11	< 7	< 5	< 5	< 9	< 137
	11/27/17	< 0.5	< 55	< 6	< 7	< 13	< 9	< 13	< 7	< 10	< 9	< 8	< 192
	12/18/17	< 0.4	< 53	< 6	< 6	< 15	< 7	< 14	< 8	< 6	< 7	< 7	< 189
	AVERAGE*	-	-	-	-	-	-	-	-	-	-	-	-

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES. IF THERE IS ONLY 1 POSITIVE VALUE THE AVERAGE AND THE ERROR ARE DISPLAYED.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-8

CONCENTRATIONS OF GROSS ALPHA AND GROSS BETA EMITTERS AND TRITIUM IN RAW AND TREATED POTABLE WATER**

Results in units of pCi/L, ± 2σ

STATION ID	COLLECTION PERIOD START		STOP	Gross Alpha	Gross Beta	H-3
SA-PWR-2F3	01/03/17	-	01/30/17	< 2.3	**7.1** ± 2.0	< 193
	01/30/17	-	02/27/17	< 0.9	**5.9** ± 2.1	< 197
	02/27/17	-	03/30/17	< 2.4	**7.2** ± 2.0	< 188
	03/30/17	-	04/28/17	< 1.9	**5.8** ± 2.1	< 190
	04/28/17	-	05/30/17	< 1.3	**3.1** ± 1.7	< 185
	05/30/17	-	07/03/17	< 1.9	**6.2** ± 2.1	< 183
	07/03/17	-	07/31/17	< 1.6	**2.9** ± 1.9	< 196
	07/31/17	-	08/28/17	< 2.0	**6.0** ± 1.9	< 181
	08/28/17	-	10/02/17	< 2.4	**8.6** ± 2.4	< 174
	10/02/17	-	10/31/17	< 1.9	**6.6** ± 2.2	< 173
	10/31/17	-	11/27/17	< 1.8	**4.3** ± 1.9	< 178
	11/27/17	-	12/26/17	< 1.0	**6.6** ± 2.0	< 195
	AVERAGE*			-	**5.9** ± 3.4	-
SA-PWT-2F3	01/03/17	-	01/30/17	< 2.3	**8.6** ± 2.1	< 199
	01/30/17	-	02/27/17	< 0.9	**4.8** ± 2.0	< 192
	02/27/17	-	03/30/17	< 2.5	**7.6** ± 2.1	< 189
	03/30/17	-	04/28/17	< 1.8	**5.8** ± 2.0	< 195
	04/28/17	-	05/30/17	< 1.3	**5.7** ± 1.9	< 190
	05/30/17	-	07/03/17	< 1.9	**6.5** ± 2.1	< 183
	07/03/17	-	07/31/17	< 1.6	**6.1** ± 2.1	< 196
	07/31/17	-	08/28/17	< 2.1	**5.8** ± 2.0	< 181
	08/28/17	-	10/02/17	< 2.1	**8.3** ± 2.1	< 174
	10/02/17	-	10/31/17	< 1.6	**7.4** ± 2.0	< 174
	10/31/17	-	11/27/17	< 1.7	**6.0** ± 1.9	< 180
	11/27/17	-	12/26/17	< 1.0	**7.2** ± 2.1	< 193
	AVERAGE*			-	**6.6** ± 2.3	-

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-9

CONCENTRATIONS OF IODINE-131 AND 2017 GAMMA EMITTERS IN RAW AND TREATED POTABLE WATER** (TBE)

Results in units of pCi/L, ± 2σ

STATION ID	COLLECTION PERIOD START	STOP	I-131 LL	< - - - - - - - - - - - - - - GAMMA EMITTERS - - - - - - - - - - - - - - >										
				K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	ZrNb-95	Cs-134	Cs-137	BaLa-140	Ra-226
SA-PWR-2F3	01/03/17	01/30/17	< 0.4	< 109	< 5	< 4	< 11	< 4	< 9	< 5	< 5	< 5	< 9	< 135
	01/30/17	02/27/17	< 0.8	< 134	< 7	< 5	< 13	< 9	< 12	< 6	< 7	< 8	< 5	< 135
	02/27/17	03/30/17	< 0.5	< 36	< 5	< 4	< 9	< 5	< 9	< 5	< 5	< 5	< 6	< 128
	03/30/17	04/28/17	< 0.8	< 57	< 5	< 6	< 14	< 4	< 12	< 5	< 7	< 6	< 8	< 122
	04/28/17	05/30/17	< 0.8	< 53	< 5	< 5	< 11	< 6	< 12	< 5	< 6	< 5	< 9	< 127
	05/30/17	07/03/17	< 0.5	< 103	< 5	< 5	< 11	< 5	< 11	< 5	< 5	< 5	< 6	< 131
	07/03/17	07/31/17	< 0.3	< 45	< 7	< 7	< 13	< 6	< 11	< 7	< 7	< 7	< 9	< 191
	07/31/17	08/28/17	< 0.4	< 176	< 7	< 6	< 11	< 6	< 14	< 7	< 7	< 7	< 8	< 208
	08/28/17	10/02/17	< 0.2	< 54	< 6	< 6	< 13	< 8	< 10	< 6	< 6	< 6	< 8	< 123
	10/02/17	10/31/17	< 0.6	< 149	< 6	< 4	< 12	< 7	< 12	< 5	< 7	< 6	< 7	< 181
	10/31/17	11/27/17	< 0.4	< 104	< 5	< 4	< 9	< 5	< 9	< 5	< 5	< 5	< 6	< 137
	11/27/17	12/26/17	< 0.7	< 49	< 6	< 6	< 14	< 7	< 13	< 7	< 7	< 7	< 12	< 124
	AVERAGE		-	-	-	-	-	-	-	-	-	-	-	-
SA-PWT-2F3	01/03/17	01/30/17	< 0.4	< 38	< 4	< 4	< 8	< 5	< 9	< 5	< 4	< 5	< 7	< 95
	01/30/17	02/27/17	< 0.7	< 59	< 5	< 5	< 10	< 5	< 11	< 5	< 6	< 5	< 7	< 131
	02/27/17	03/30/17	< 0.5	< 41	< 4	< 4	< 8	< 4	< 9	< 5	< 5	< 5	< 7	< 96
	03/30/17	04/28/17	< 0.7	< 113	< 6	< 6	< 11	< 7	< 12	< 6	< 7	< 7	< 9	< 135
	04/28/17	05/30/17	< 0.6	< 95	< 5	< 5	< 11	< 5	< 8	< 4	< 5	< 5	< 9	< 122
	05/30/17	07/03/17	< 0.7	< 55	< 5	< 4	< 8	< 5	< 10	< 5	< 6	< 5	< 6	< 106
	07/03/17	07/31/17	< 0.3	< 175	< 9	< 7	< 15	< 9	< 14	< 9	< 7	< 10	< 10	< 216
	07/31/17	08/28/17	< 0.3	< 141	< 7	< 7	< 13	< 7	< 17	< 6	< 8	< 6	< 10	< 179
	08/28/17	10/02/17	< 0.2	< 114	< 6	< 6	< 12	< 7	< 11	< 6	< 6	< 7	< 9	< 165
	10/02/17	10/31/17	< 0.6	< 58	< 5	< 5	< 13	< 7	< 16	< 6	< 7	< 6	< 7	< 129
	10/31/17	11/27/17	< 0.5	< 134	< 5	< 5	< 10	< 4	< 8	< 6	< 5	< 6	< 6	< 135
	11/27/17	12/26/17	< 0.7	< 91	< 5	< 5	< 8	< 4	< 12	< 5	< 5	< 5	< 9	< 128
	AVERAGE		-	-	-	-	-	-	-	-	-	-	-	-

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES. IF THERE IS ONLY 1 POSITIVE VALUE THE AVERAGE AND THE ERROR ARE DISPLAYED.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-10a

2017 CONCENTRATIONS OF GAMMA EMITTERS IN BROADLEAF VEGETATION, FPL (TBE)

Results in units of pCi/Kg (wet), ± 2σ

STATION ID	COLLECTION DATE	SAMPLE TYPE	GAMMA EMITTERS Be-7	K-40		I-131	Cs-134	Cs-137	Ra-226	Th-232
SA-FPL-3H5 (C)	07/10/17	Cabbage	< 229	2,035	± 396	< 45	< 30	< 30	< 638	< 102
		STATION AVERAGE*	-	2,035	± 396	-	-	-	-	-
SA-FPL-1S1	07/26/17	Cabbage	< 208	2,256	± 433	< 30	< 26	< 21	< 543	< 92
	07/26/17	Kale	< 271	5,081	± 704	< 48	< 36	< 31	< 783	< 145
	07/26/17	Collards	< 376	3,689	± 611	< 56	< 44	< 38	< 844	< 167
	08/29/17	Kale	< 279	4,289	± 567	< 56	< 32	< 30	< 653	< 100
	08/29/17	Cabbage	< 156	2,019	± 386	< 43	< 22	< 18	< 446	< 91
	08/29/17	Collards	< 224	4,100	± 516	< 58	< 28	< 28	< 499	< 93
	10/03/17	Kale	< 316	5,874	± 651	< 56	< 39	< 32	< 655	< 115
	10/03/17	Cabbage	< 322	3,404	± 594	< 54	< 34	< 33	< 709	< 115
	10/03/17	Collards	< 277	4,739	± 709	< 58	< 42	< 34	< 668	< 163
	11/27/17	Cabbage	< 364	2,263	± 628	< 41	< 44	< 33	< 857	< 139
	11/27/17	Kale	< 349	7,233	± 818	< 53	< 45	< 45	< 1166	< 183
	11/27/17	Collards	< 439	4,729	± 833	< 44	< 41	< 37	< 953	< 128
		STATION AVERAGE*	-	4,140	± 3105	-	-	-	-	-
SA-FPL-7S2	07/26/17	Cabbage	< 177	3,370	± 472	< 33	< 21	< 16	< 555	< 82
	07/26/17	Kale	< 387	6,505	± 938	< 57	< 43	< 35	< 902	< 170
	07/26/17	Collards	< 292	4,402	± 703	< 50	< 32	< 30	< 715	< 128
	08/29/17	Cabbage	< 266	4,684	± 529	< 57	< 24	< 26	< 613	< 101
	08/29/17	Kale	< 259	8,715	± 613	< 58	< 29	< 27	< 519	< 117
	08/29/17	collards	< 303	3,492	± 503	< 57	< 28	< 27	< 592	< 111
	10/03/17	Kale	< 268	10,690	± 782	< 55	< 35	< 36	< 603	< 134
	10/03/17	Collards	< 211	6,541	± 578	< 36	< 24	< 22	< 527	< 101
	11/27/17	Kale	< 363	6,529	± 917	< 49	< 52	< 47	< 900	< 178
	11/27/17	Collards	< 239	5,114	± 625	< 29	< 29	< 29	< 636	< 119
	12/20/17	Collards	< 117	3,945	± 271	< 20	< 14	< 13	< 210	< 52
		STATION AVERAGE*	-	5,817	± 4575	-	-	-	-	-
SA-FPL-15S2	07/26/17	Kale	< 247	6,298	± 544	< 40	< 29	< 29	< 670	< 99
	07/26/17	Cabbage	< 212	2,451	± 596	< 39	< 35	< 32	< 550	< 129
	07/26/17	Collards	< 330	5,166	± 691	< 59	< 36	< 36	< 744	< 164
	08/29/17	Cabbage	< 264	5,366	± 571	< 58	< 29	< 23	< 596	< 122
	08/29/17	Kale	< 223	6,419	± 645	< 57	< 26	< 26	< 565	< 115
	08/29/17	Collards	< 280	4,313	± 618	< 56	< 29	< 34	< 646	< 113
	10/03/17	Cabbage	< 176	2,531	± 339	< 28	< 23	< 22	< 464	< 75
	10/03/17	Kale	< 269	6,222	± 697	< 59	< 37	< 34	< 854	< 146
	10/03/17	Collards	< 269	4,416	± 549	< 52	< 33	< 35	< 612	< 133
	11/27/17	Kale	< 356	5,273	± 689	< 48	< 42	< 33	< 774	< 132
	11/27/17	Collards	< 348	4,328	± 714	< 44	< 42	< 40	< 1000	< 169
		STATION AVERAGE*	-	4,798	± 2745	-	-	-	-	-

Table C-10a

2017 CONCENTRATIONS OF GAMMA EMITTERS IN BROADLEAF VEGETATION, FPL (TBE)

Results in units of pCi/Kg (wet), ± 2σ

STATION ID	COLLECTION DATE	SAMPLE TYPE	Be-7	K-40	I-131	Cs-134	Cs-137	Ra-226	Th-232
			<------------------------- GAMMA EMITTERS						------------------------->
SA-FPL-16S1	07/26/17	Kale	< 332	4,452 ± 990	< 55	< 43	< 33	< 913	< 148
	07/26/17	Cabbage	< 321	3,015 ± 482	< 54	< 40	< 37	< 850	< 110
	07/26/17	Collards	< 403	5,785 ± 880	< 58	< 45	< 38	< 850	< 145
	08/29/17	Kale	< 239	4,946 ± 570	< 58	< 30	< 28	< 634	< 107
	08/29/17	Collards	< 284	3,660 ± 463	< 58	< 26	< 28	< 584	< 118
	08/29/17	Cabbage	< 212	2,880 ± 497	< 57	< 28	< 24	< 563	< 95
		STATION AVERAGE*	-	4,123 ± 2286	-	-	-	-	-
SA-FPL-10D1	07/31/17	Kale	< 399	5,624 ± 854	< 52	< 50	< 44	< 996	< 158
	07/31/17	Cabbage	< 318	2,333 ± 522	< 40	< 26	< 36	< 771	< 126
	07/31/17	Collards	< 440	2,607 ± 635	< 46	< 49	< 38	< 725	< 154
	08/29/17	Kale	466 ± 231	5,909 ± 616	< 57	< 29	< 31	< 688	< 120
	08/29/17	Cabbage	< 237	2,639 ± 364	< 56	< 27	< 26	< 564	< 83
	08/29/17	Collards	358 ± 169	4,012 ± 570	< 57	< 23	< 30	< 639	< 110
	10/02/17	Kale	< 277	7,238 ± 800	< 58	< 36	< 27	< 779	< 152
	10/02/17	Collards	< 221	4,772 ± 609	< 45	< 28	< 24	< 488	< 111
	10/02/17	Cabbage	< 207	3,211 ± 480	< 43	< 25	< 21	< 563	< 97
		STATION AVERAGE*	412 ± 152	4,261 ± 2854	-	-	-	-	-
ALL INDICATOR AVERAGE*			412 ± 152	4,684 ± 3,529	-	-	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.
IF THERE IS ONLY 1 POSITIVE VALUE THE AVERAGE AND THE ERROR ARE DISPLAYED.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-10b

2017 CONCENTRATIONS OF GAMMA EMITTERS IN VEGETABLES, FPV (TBE)

Results in units of pCi/Kg (wet), ± 2σ

STATION ID	COLLECTION DATE	SAMPLE TYPE	Be-7	K-40	I-131	Cs-134	Cs-137	Ra-226	Th-232
			<- GAMMA EMITTERS ->						
SA-FPV-2F9**	05/01/17	Asparagus	< 188	**1,762** ± 469	< 30	< 24	< 28	< 588	< 91
	07/06/17	Corn	< 195	**1,496** ± 330	< 35	< 24	< 21	< 457	< 83
	07/06/17	Peaches	< 221	**2,728** ± 513	< 42	< 27	< 27	< 505	< 105
	07/06/17	Peppers	< 218	**1,525** ± 375	< 39	< 28	< 30	< 591	< 106
	07/06/17	Tomatoes	< 206	**2,320** ± 433	< 37	< 19	< 30	< 579	< 92
		STATION AVERAGE*	-	**1,966 ± 1078**	-	-	-	-	-
SA-FPV-3F8**	07/01/17	Peaches	< 195	**1,547** ± 289	< 58	< 26	< 24	< 567	< 83
		STATION AVERAGE*	-	**1,547 ± 289**	-	-	-	-	-
SA-FPV-15F4**	07/18/17	Corn	< 270	**2,741** ± 586	< 45	< 34	< 26	< 696	< 119
	07/18/17	Peppers	< 203	**1,435** ± 386	< 39	< 27	< 29	< 588	< 79
	07/18/17	Tomatoes	< 163	**1,285** ± 327	< 40	< 22	< 23	< 542	< 100
		STATION AVERAGE*	-	**1,820 ± 1602**	-	-	-	-	-
SA-FPV-1G1**	05/08/17	Asparagus	< 273	**2,496** ± 571	< 37	< 35	< 28	< 723	< 156
	07/09/17	Peppers	< 247	**1,348** ± 525	< 44	< 35	< 35	< 643	< 144
	07/09/17	Tomatoes	< 162	**2,351** ± 398	< 28	< 21	< 18	< 559	< 83
	07/17/17	Corn	< 175	**1,625** ± 337	< 25	< 24	< 20	< 438	< 88
		STATION AVERAGE*	-	**1,955 ± 1112**	-	-	-	-	-
SA-FPV-2G2**	05/08/17	Asparagus	< 216	**1,428** ± 460	< 29	< 28	< 24	< 536	< 105
	07/11/17	Tomatoes	< 228	**2,170** ± 522	< 43	< 25	< 30	< 650	< 107
	07/11/17	Corn	< 252	**2,284** ± 397	< 47	< 34	< 31	< 743	< 107
	07/11/17	Peppers	< 180	**1,155** ± 406	< 38	< 29	< 29	< 577	< 100
		STATION AVERAGE*	-	**1,759 ± 1107**	-	-	-	-	-
SA-FPV-3H5**	05/08/17	Asparagus	< 243	**2,101** ± 451	< 36	< 30	< 31	< 624	< 121
	07/11/17	Tomatoes	< 323	**1,567** ± 514	< 54	< 44	< 35	< 803	< 127
	07/11/17	Peppers	< 157	**1,452** ± 330	< 25	< 20	< 20	< 411	< 81
	07/11/17	Corn	< 221	**1,933** ± 446	< 38	< 25	< 26	< 517	< 98
		STATION AVERAGE*	-	**1,763 ± 609**	-	-	-	-	-
ALL INDICATOR AVERAGE*			-	**1,860 ± 984**	-	-	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.
IF THERE IS ONLY 1 POSITIVE VALUE THE AVERAGE AND THE ERROR ARE DISPLAYED.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-11

2017 CONCENTRATIONS OF GAMMA EMITTERS IN FODDER CROPS** (TBE)

Results in units of pCi/kg (wet), ± 2σ

STATION ID	COLLECTION DATE	SAMPLE TYPE	<-------------- GAMMA EMITTERS -------------->						
			Be-7	K-40	I-131	Cs-134	Cs-137	Ra-226	Th-232
SA-VGT-3G1 (C)	11/27/17	Silage	**820** ± 355	**6,645** ± 1,108	< 54	< 44	< 45	< 1,294	< 218
SA-VGT-13E3	11/27/17	Silage	< 241	**4,439** ± 525	< 40	< 29	< 31	< 790	< 112
SA-VGT-14F4	11/27/17	Silage	< 244	**6,322** ± 656	< 38	< 36	< 28	< 608	< 120
SA-VGT-2G3	11/27/17	Silage	**657** ± 299	**4,256** ± 712	< 39	< 32	< 35	< 634	< 134
AVERAGE*			**657** ± 299	**5,416** ± 2,485	-	-	-	-	-
ALL INDICATOR AVERAGE*			**657 ± 299**	**5,006 ± 2287**	-	-	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.
IF THERE IS ONLY 1 POSITIVE VALUE THE AVERAGE AND THE ERROR ARE DISPLAYED.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-12

2017 CONCENTRATIONS OF GAMMA EMITTERS IN SOIL**

Soil is only sampled every 3 years.
Due again in 2019.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

Table C-13

2017 CONCENTRATIONS OF GAMMA EMITTERS IN GAME** (TBE)

Results in units of pCi/Kg (wet), ± 2σ

STATION ID	COLLECTION DATE	SAMPLE TYPE	<- - - - - - GAMMA EMITTERS - - - - - ->				
			Be-7	I-131	K-40	Cs-134	Cs-137
SA-GAM-3E1	03/05/17	Muskrat	< 154	< 25	**2,500** ± 385	< 17	< 17
SA-GAM-13E3	03/06/17	Muskrat	< 138	< 24	**2,839** ± 386	< 20	< 18
SA-GAM-5C1	02/21/17	Muskrat	< 79	< 10	**2,724** ± 250	< 8	< 10
ALL INDICATOR AVERAGE*			-	-	2,688 ± 345	-	-

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES. IF THERE IS ONLY 1 POSITIVE VALUE, THE AVERAGE AND THE ERROR ARE DISPLAYED.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-14

2017 CONCENTRATIONS OF TRITIUM IN SURFACE WATER (TBE)

Results in units of pCi/L, ± 2σ

COLLECTION PERIOD START		STOP	CONTROL	INDICATORS			
			SA-SWA-12C1 (C)	SA-SWA-11A1	SA-SWA-7E1	SA-SWA-1F2	SA-SWA-16F1
01/03/17	-	01/17/17	< 184	< 187	< 187	< 187	< 182
02/06/17	-	02/21/17	< 183	< 182	< 186	< 180	< 185
03/06/17	-	03/21/17	< 190	< 189	< 188	< 191	< 188
04/05/17	-	04/18/17	< 190	< 192	< 193	< 193	< 194
05/04/17	-	05/17/17	< 177	< 171	< 173	< 174	< 179
06/06/17	-	06/21/17	< 188	< 187	< 191	< 192	< 188
07/06/17	-	07/20/17	< 190	< 190	< 188	< 190	< 190
08/08/17	-	08/24/17	< 177	< 176	< 174	< 176	< 175
09/05/17	-	09/18/17	< 174	< 172	< 171	< 175	< 175
10/02/17	-	10/18/17	< 182	< 181	< 178	< 183	< 177
11/06/17	-	11/20/17	< 182	< 178	< 176	< 179	< 177
12/04/17	-	12/19/17	< 196	< 196	< 197	< 193	< 183
AVERAGE*			-	-	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.
IF THERE IS ONLY 1 POSITIVE VALUE, THE AVERAGE AND THE ERROR ARE DISPLAYED.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-15

CONCENTRATIONS OF IODINE-131 AND GAMMA EMITTERS IN SURFACE WATER (TBE)

Results in units of pCi/L, ± 2σ

STATION ID	Collection Date	I-131 LL	<------ GAMMA EMITTERS ------> K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	ZrNb-95	Cs-134	Cs-137	BaLa-140
	01/03/17	< 0.5	< 91	< 5	< 4	< 11	< 6	< 11	< 4	< 4	< 4	< 9
	02/06/17	< 0.3	< 64	< 5	< 4	< 10	< 5	< 12	< 5	< 5	< 6	< 9
	03/06/17	< 0.6	< 37	< 4	< 4	< 9	< 3	< 9	< 4	< 5	< 4	< 7
	04/05/17	< 0.2	< 42	< 5	< 5	< 10	< 5	< 9	< 5	< 6	< 5	< 8
	05/04/17	< 0.7	< 54	< 4	< 5	< 12	< 6	< 12	< 5	< 5	< 4	< 9
SA-SWA-12C1 (C)	06/06/17	< 0.5	< 47	< 4	< 5	< 8	< 5	< 10	< 5	< 6	< 5	< 9
	07/06/17	< 0.6	< 36	< 5	< 5	< 11	< 5	< 11	< 5	< 6	< 5	< 7
	08/08/17	< 0.5	71 ± 46	< 3	< 3	< 7	< 3	< 6	< 3	< 3	< 3	< 7
	09/05/17	< 0.5	< 34	< 4	< 4	< 8	< 4	< 7	< 4	< 4	< 4	< 7
	10/02/17	< 0.6	96 ± 35	< 2	< 2	< 5	< 2	< 4	< 2	< 2	< 2	< 5
	11/06/17	< 0.7	151 ± 56	< 4	< 5	< 10	< 4	< 9	< 4	< 4	< 4	< 6
	12/04/17	< 0.9	49 ± 26	< 2	< 2	< 5	< 2	< 5	< 2	< 2	< 2	< 5
	AVERAGE*	-	92 ± 88	-	-	-	-	-	-	-	-	-
	01/03/17	< 0.5	< 34	< 4	< 4	< 10	< 4	< 8	< 4	< 4	< 4	< 8
	02/06/17	< 0.4	133 ± 75	< 5	< 5	< 11	< 4	< 11	< 6	< 5	< 6	< 8
	03/06/17	< 0.5	< 43	< 6	< 4	< 9	< 6	< 10	< 5	< 5	< 5	< 6
	04/05/17	< 0.2	< 37	< 4	< 4	< 8	< 5	< 8	< 4	< 4	< 4	< 6
	05/04/17	< 0.6	< 43	< 4	< 5	< 9	< 5	< 9	< 5	< 5	< 5	< 8
SA-SWA-11A1	06/06/17	< 0.6	< 54	< 5	< 5	< 11	< 5	< 11	< 6	< 6	< 6	< 8
	07/06/17	< 0.9	< 62	< 5	< 6	< 10	< 5	< 8	< 7	< 6	< 6	< 8
	08/08/17	< 0.6	< 56	< 3	< 3	< 6	< 3	< 7	< 3	< 3	< 3	< 6
	09/05/17	< 0.4	< 39	< 3	< 4	< 8	< 4	< 7	< 3	< 4	< 4	< 7
	10/02/17	< 0.6	124 ± 32	< 2	< 2	< 4	< 2	< 4	< 2	< 2	< 2	< 4
	11/06/17	< 0.9	< 32	< 4	< 4	< 10	< 5	< 9	< 5	< 5	< 5	< 8
	12/04/17	< 0.8	90 ± 36	< 2	< 2	< 5	< 2	< 4	< 2	< 2	< 2	< 5
	AVERAGE*	-	116 ± 44	-	-	-	-	-	-	-	-	-
	01/03/17	< 0.9	177 ± 56	< 4	< 4	< 9	< 4	< 8	< 4	< 4	< 5	< 7
	02/06/17	< 0.4	176 ± 69	< 5	< 6	< 11	< 5	< 13	< 6	< 6	< 6	< 7
	03/06/17	< 0.5	153 ± 69	< 4	< 6	< 10	< 6	< 12	< 7	< 5	< 7	< 9
	04/05/17	< 0.2	< 50	< 5	< 5	< 10	< 5	< 12	< 6	< 6	< 6	< 9
	05/04/17	< 0.9	< 46	< 5	< 5	< 13	< 5	< 9	< 6	< 6	< 5	< 9
SA-SWA-7E1	06/06/17	< 0.7	< 47	< 5	< 5	< 9	< 5	< 10	< 6	< 6	< 5	< 7
	07/06/17	< 0.7	< 46	< 4	< 5	< 8	< 5	< 8	< 6	< 5	< 5	< 7
	08/08/17	< 0.5	94 ± 39	< 2	< 3	< 6	< 3	< 6	< 2	< 3	< 3	< 6
	09/05/17	< 0.4	84 ± 55	< 4	< 4	< 9	< 4	< 8	< 4	< 4	< 4	< 6
	10/02/17	< 0.7	144 ± 27	< 2	< 2	< 4	< 2	< 4	< 2	< 2	< 2	< 4
	11/06/17	< 0.9	90 ± 53	< 4	< 4	< 9	< 4	< 7	< 4	< 4	< 4	< 10
	12/04/17	< 0.8	90 ± 37	< 2	< 3	< 6	< 3	< 5	< 3	< 3	< 3	< 6
	AVERAGE*	-	126 ± 81	-	-	-	-	-	-	-	-	-

Table C-15

CONCENTRATIONS OF IODINE-131 AND GAMMA EMITTERS IN SURFACE WATER (TBE)

Results in units of pCi/L, ± 2σ

STATION ID	Collection Date	I-131 LL	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	ZrNb-95	Cs-134	Cs-137	BaLa-140
			<-------- GAMMA EMITTERS -------->									
SA-SWA-1F2	01/03/17	< 0.7	< 91	< 4	< 5	< 10	< 4	< 8	< 5	< 4	< 4	< 6
	02/06/17	< 0.4	< 83	< 5	< 5	< 11	< 5	< 9	< 6	< 4	< 5	< 10
	03/06/17	< 0.4	< 41	< 5	< 4	< 10	< 4	< 12	< 5	< 5	< 5	< 6
	04/05/17	< 0.2	< 43	< 5	< 5	< 10	< 5	< 11	< 5	< 6	< 6	< 7
	05/04/17	< 0.6	< 43	< 5	< 5	< 10	< 5	< 10	< 5	< 6	< 5	< 8
	06/06/17	< 0.7	< 78	< 5	< 4	< 10	< 6	< 8	< 5	< 5	< 5	< 7
	07/06/17	< 0.7	< 120	< 6	< 6	< 11	< 5	< 10	< 6	< 5	< 6	< 9
	08/08/17	< 0.4	< 31	< 3	< 3	< 7	< 3	< 6	< 3	< 3	< 3	< 6
	09/05/17	< 0.5	< 47	< 4	< 5	< 9	< 4	< 9	< 4	< 5	< 5	< 8
	10/02/17	< 0.5	77 ± 32	< 2	< 2	< 5	< 2	< 4	< 2	< 2	< 2	< 5
	11/06/17	< 0.8	63 ± 41	< 4	< 4	< 7	< 4	< 8	< 4	< 4	< 4	< 8
	12/04/17	< 0.8	< 16	< 2	< 2	< 4	< 2	< 3	< 2	< 2	< 2	< 4
	AVERAGE*	-	70 ± 19	-	-	-	-	-	-	-	-	
SA-SWA-16F1	01/03/17	< 0.6	< 41	< 4	< 4	< 9	< 4	< 11	< 5	< 5	< 6	< 8
	02/06/17	< 0.3	< 52	< 4	< 6	< 11	< 5	< 9	< 6	< 5	< 6	< 9
	03/06/17	< 0.5	63 ± 42	< 5	< 5	< 10	< 6	< 12	< 5	< 5	< 4	< 7
	04/05/17	< 0.2	< 104	< 6	< 6	< 13	< 6	< 12	< 6	< 6	< 6	< 8
	05/04/17	< 0.5	< 53	< 5	< 5	< 11	< 5	< 8	< 5	< 5	< 5	< 9
	06/06/17	< 0.8	< 50	< 5	< 4	< 11	< 4	< 10	< 5	< 5	< 5	< 8
	07/06/17	< 0.7	< 100	< 4	< 4	< 9	< 4	< 8	< 5	< 5	< 5	< 8
	08/08/17	< 0.4	63 ± 35	< 3	< 3	< 6	< 3	< 6	< 3	< 3	< 3	< 6
	09/05/17	< 0.5	< 27	< 3	< 3	< 6	< 3	< 7	< 3	< 3	< 3	< 5
	10/02/17	< 0.6	81 ± 36	< 2	< 2	< 5	< 2	< 4	< 2	< 2	< 2	< 5
	11/06/17	< 0.6	78 ± 48	< 4	< 4	< 7	< 4	< 7	< 4	< 4	< 4	< 7
	12/04/17	< 0.9	< 19	< 2	< 2	< 5	< 2	< 4	< 2	< 2	< 2	< 5
	AVERAGE*	-	71 ± 19	-	-	-	-	-	-	-	-	-
ALL INDICATOR AVERAGE*		-	102 ± 77	-	-	-	-	-	-	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.
IF THERE IS ONLY 1 POSITIVE VALUE, THE AVERAGE AND THE ERROR ARE DISPLAYED.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-16

2017 CONCENTRATIONS OF GAMMA EMITTERS IN EDIBLE FISH (TBE)

Results in units of pCi/Kg (wet), ± 2σ

STATION ID	Collection Date	<------------- GAMMA EMITTERS ------------->								
		K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	Ra-226
SA-ESF-12C1 (C)	05/10/17	**3,409** ± 983	< 58	< 54	< 122	< 45	< 106	< 55	< 69	< 908
	11/09/17	**3,440** ± 693	< 34	< 32	< 80	< 32	< 59	< 30	< 33	< 661
	11/13/17	**4,805** ± 1,391	< 107	< 104	< 217	< 98	< 250	< 118	< 100	< 2300
	AVERAGE*	**3,885 ± 1,594**	-	-	-	-	-	-	-	-
SA-ESF-11A1	05/10/17	**3,324** ± 797	< 48	< 40	< 100	< 41	< 119	< 53	< 50	< 1044
	05/10/17	**4,251** ± 746	< 39	< 37	< 91	< 39	< 79	< 49	< 45	< 824
	11/14/17	**3,469** ± 830	< 56	< 54	< 133	< 55	< 142	< 67	< 62	< 1312
	11/14/17	**7,052** ± 1,412	< 81	< 86	< 200	< 96	< 170	< 99	< 95	< 1965
	11/14/17	**3,579** ± 805	< 42	< 47	< 123	< 40	< 118	< 53	< 54	< 989
	AVERAGE*	**4,335 ± 3,120**	-	-	-	-	-	-	-	-
SA-ESF-7E1	05/09/17	**3,990** ± 745	< 33	< 35	< 74	< 34	< 83	< 42	< 42	< 770
	05/09/17	**2,313** ± 645	< 49	< 51	< 105	< 52	< 111	< 52	< 53	< 1135
	05/09/17	**4,585** ± 828	< 43	< 45	< 98	< 29	< 96	< 51	< 40	< 816
	11/15/17	**5,719** ± 1,245	< 51	< 73	< 173	< 73	< 155	< 78	< 56	< 1433
	11/15/17	**4,782** ± 835	< 47	< 54	< 102	< 44	< 102	< 54	< 44	< 1047
	AVERAGE*	**4,278 ± 2,524**								
ALL INDICATOR AVERAGE*		**4,306 ± 2676**	-	-	-	-	-	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.
IF THERE IS ONLY 1 POSITIVE VALUE, THE AVERAGE AND THE ERROR ARE DISPLAYED.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-17

2017 CONCENTRATIONS OF GAMMA EMITTERS IN CRABS (TBE)

Results in units of pCi/Kg (wet) ± 2σ

STATION ID	Collection Date	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	Ra-226
		<- - - - - - - - - - - - - GAMMA EMITTERS - - - - - - - - - - - - - ->								
SA-ECH-12C1 (C)	06/30/17	**3,073** ± 746	< 46	< 39	< 89	< 45	< 85	< 44	< 40	< 820
	07/31/17	**2,922** ± 678	< 59	< 53	< 127	< 66	< 150	< 57	< 59	< 1,244
	AVERAGE*	**2,998 ± 214**	-	-	-	-	-	-	-	-

STATION ID	Collection Date	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	Ra-226
SA-ECH-11A1	06/30/17	**3,110** ± 607	< 27	< 32	< 54	< 34	< 82	< 35	< 35	< 701
	07/31/17	**2,859** ± 748	< 43	< 49	< 96	< 46	< 98	< 58	< 43	< 1,009
	AVERAGE*	**2,985 ± 355**	-	-	-	-	-	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.
IF THERE IS ONLY 1 POSITIVE VALUE, THE AVERAGE AND THE ERROR ARE DISPLAYED.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-18

2017 CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT (TBE)

Results in units of pCi/Kg (dry) ± 2σ

STATION ID	Collection Date	<- - - - GAMMA EMITTERS - - - -> Be-7	K-40		Cs-134	Cs-137	Ra-226		Th-232	
SA-ESS-12C1 (C)	06/01/17	< 776	**8,840**	± 1,797	< 93	< 88	< 1,416		**899**	± 206
	11/30/17	< 977	**9,698**	± 1,842	< 126	< 88	< 1,679		**823**	± 235
	AVERAGE*	-	**9,269**	**± 1,213**	-	-	-		**861**	**± 108**
SA-ESS-6S2	06/05/17	< 499	**2,325**	± 824	< 67	< 55	< 1,084		**288**	± 94
	12/04/17	< 469	**4,298**	± 831	< 58	< 55	< 1,176		< 282	
	AVERAGE*	-	**3,312**	**± 2,790**	-	-	-		**288**	**± 94**
SA-ESS-11A1	06/01/17	< 520	**4,657**	± 916	< 65	< 58	< 1,424		**343**	± 196
	11/30/17	< 501	**4,704**	± 953	< 72	< 69	< 1,235		**400**	± 148
	AVERAGE*	-	**4,681**	**± 66**	-	-	-		**372**	**± 81**
SA-ESS-15A1	06/01/17	< 529	**4,699**	± 907	< 75	< 58	< 1,087		**641**	± 130
	11/30/17	< 473	**5,381**	± 965	< 65	< 60	**1,853**	± 1,119	**381**	± 157
	AVERAGE*	-	**5,040**	**± 964**	-	-	**1,853**	**± 1,119**	**511**	**± 368**
SA-ESS-16A1	06/01/17	< 458	**4,785**	± 848	< 62	< 57	**2,035**	± 1,113	**560**	± 135
	11/30/17	< 492	**3,480**	± 846	< 72	< 61	**1,689**	± 735	**420**	± 144
	AVERAGE*	-	**4,133**	**± 1,846**	-	-	**1,862**	**± 489**	**490**	**± 197**
SA-ESS-7E1	06/01/17	< 592	**12,430**	± 1,377	< 80	< 75	**2,513**	± 1,582	**726**	± 167
	11/30/17	< 632	**11,420**	± 1,508	< 88	< 78	**2,420**	± 1,560	**806**	± 161
	AVERAGE*	-	**11,925**	**± 1,428**	-	-	**2,467**	**± 132**	**766**	**± 114**
SA-ESS-16F1	06/01/17	< 581	**9,183**	± 1,253	< 82	< 68	< 1,615		**832**	± 195
	11/30/17	< 772	**12,930**	± 1,738	< 100	< 96	**2,034**	± 1,289	**774**	± 201
	AVERAGE*	-	**11,057**	**± 5,299**	-	-	**2,034**	**± 1,289**	**803**	**± 82**
ALL INDICATOR AVERAGE*		-	**6,691**	**± 7,457**	-	-	**2,091**	**± 320**	**561**	**± 406**

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES. IF THERE IS ONLY 1 POSITIVE VALUE, THE AVERAGE AND THE ERROR ARE DISPLAYED.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-19

2017 CONCENTRATIONS OF GAMMA EMITTERS IN OYSTERS** (TBE)

Results in units of pCi/Kg (wet) ± 2σ

STATION ID	Collection Date	<- - - - GAMMA EMITTERS - - - ->								
		K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	Ra-226
SA-EOY-7H1 (C)	07/17/17	**929** ± 550	< 56	< 56	< 133	< 53	< 126	< 61	< 53	< 1,225
	10/18/17	**1,319** ± 596	< 33	< 47	< 125	< 41	< 93	< 39	< 42	< 914
	AVERAGE*	**1,124 ± 552**	-	-	-	-	-	-	-	-
		K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	Ra-226
SA-EOY-7C1	07/17/17	**1,481** ± 806	< 55	< 73	< 148	< 66	< 115	< 53	< 62	< 1,104
	10/18/17	**2,653** ± 707	< 43	< 38	< 151	< 51	< 125	< 46	< 53	< 829
	AVERAGE*	**2,067 ± 1657**	-	-	-	-	-	-	-	-

(C) CONTROL LOCATION.

* THE AVERAGE AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES.
IF THERE IS ONLY 1 POSITIVE VALUE THE AVERAGE AND THE ERROR ARE DISPLAYED.

** MANAGEMENT AUDIT SAMPLE: NOT REQUIRED BY ODCM.

\- INDICATES AVERAGE WAS NOT CALCULATED DUE TO NO POSITIVE VALUES FOR THE REPORTING PERIOD.

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Weekly Air Iodine Cartridge					
SA-AIO-5S2(413778002) - Air Cartridge	3-Jan-17	Iodine-131	< 2.12E-02 pCi/m3		U
SA-AIO-5S2(414089002) - Air Cartridge	9-Jan-17	Iodine-131	< 1.84E-02 pCi/m3		U
SA-AIO-5S2(414500002) - Air Cartridge	16-Jan-17	Iodine-131	< 1.33E-02 pCi/m3		U
SA-AIO-5S2(415006002) - Air Cartridge	23-Jan-17	Iodine-131	< 1.55E-02 pCi/m3		U
SA-AIO-5S2(415445002) - Air Cartridge	30-Jan-17	Iodine-131	< 9.75E-03 pCi/m3		U
SA-AIO-5S2(415919002) - Air Cartridge	6-Feb-17	Iodine-131	< 7.29E-03 pCi/m3		U
SA-AIO-5S2(416739002) - Air Cartridge	13-Feb-17	Iodine-131	< 7.37E-03 pCi/m3		U
SA-AIO-5S2(417174002) - Air Cartridge	21-Feb-17	Iodine-131	< 7.33E-03 pCi/m3		U
SA-AIO-5S2(417576002) - Air Cartridge	27-Feb-17	Iodine-131	< 1.18E-02 pCi/m3		U
SA-AIO-5S2(418176002) - Air Cartridge	6-Mar-17	Iodine-131	< 6.57E-03 pCi/m3		U
SA-AIO-5S2(418692002) - Air Cartridge	13-Mar-17	Iodine-131	< 1.56E-02 pCi/m3		U
SA-AIO-5S2(419114002) - Air Cartridge	20-Mar-17	Iodine-131	< 7.24E-03 pCi/m3		U
SA-AIO-5S2(419445002) - Air Cartridge	27-Mar-17	Iodine-131	< 9.40E-03 pCi/m3		U
SA-AIO-5S2(419908002) - Air Cartridge	3-Apr-17	Iodine-131	< 1.36E-02 pCi/m3		U
SA-AIO-5S2(420356002) - Air Cartridge	8-Apr-17	Iodine-131	< 1.72E-02 pCi/m3		U
SA-AIO-5S2(420872002) - Air Cartridge	15-Apr-17	Iodine-131	< 9.64E-03 pCi/m3		U
SA-AIO-5S2(421407002) - Air Cartridge	21-Apr-17	Iodine-131	< 1.64E-02 pCi/m3		U
SA-AIO-5S2(421968002) - Air Cartridge	26-Apr-17	Iodine-131	< 2.58E-02 pCi/m3		U
SA-AIO-5S2(422196002) - Air Cartridge	1-May-17	Iodine-131	< 2.34E-02 pCi/m3		U
SA-AIO-5S2(422807002) - Air Cartridge	8-May-17	Iodine-131	< 6.72E-03 pCi/m3		U
SA-AIO-5S2(423321002) - Air Cartridge	15-May-17	Iodine-131	< 1.23E-02 pCi/m3		U
SA-AIO-5S2(423895002) - Air Cartridge	22-May-17	Iodine-131	< 6.95E-03 pCi/m3		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Weekly Air Iodine Cartridge (Cont.)					
SA-AIO-5S2(424466002) - Air Cartridge	30-May-17	Iodine-131	< 6.24E-03 pCi/m3		U
SA-AIO-5S2(424870002) - Air Cartridge	5-Jun-17	Iodine-131	< 1.44E-02 pCi/m3		U
SA-AIO-5S2(425431002) - Air Cartridge	12-Jun-17	Iodine-131	< 1.05E-02 pCi/m3		U
SA-AIO-5S2(425943002) - Air Cartridge	19-Jun-17	Iodine-131	< 1.45E-02 pCi/m3		U
SA-AIO-5S2(426553002) - Air Cartridge	26-Jun-17	Iodine-131	< 1.74E-02 pCi/m3		U
SA-AIO-5S2(427258002) - Air Cartridge	3-Jul-17	Iodine-131	< 1.03E-02 pCi/m3		U
SA-AIO-5S2(427636002) - Air Cartridge	10-Jul-17	Iodine-131	< 1.43E-02 pCi/m3		U
SA-AIO-5S2(428281002) - Air Cartridge	17-Jul-17	Iodine-131	< 1.24E-02 pCi/m3		U
SA-AIO-5S2(428849002) - Air Cartridge	24-Jul-17	Iodine-131	< 1.22E-02 pCi/m3		U
SA-AIO-5S2(429462002) - Air Cartridge	31-Jul-17	Iodine-131	< 1.52E-02 pCi/m3		U
SA-AIO-5S2(430099002) - Air Cartridge	7-Aug-17	Iodine-131	< 1.36E-02 pCi/m3		U
SA-AIO-5S2(430771002) - Air Cartridge	14-Aug-17	Iodine-131	< 1.09E-02 pCi/m3		U
SA-AIO-5S2(431388002) - Air Cartridge	21-Aug-17	Iodine-131	< 3.30E-02 pCi/m3		U
SA-AIO-5S2(431917002) - Air Cartridge	28-Aug-17	Iodine-131	< 1.55E-02 pCi/m3		U
SA-AIO-5S2(432358002) - Air Cartridge	5-Sep-17	Iodine-131	< 9.92E-03 pCi/m3		U
SA-AIO-5S2(432785002) - Air Cartridge	11-Sep-17	Iodine-131	< 1.20E-02 pCi/m3		U
SA-AIO-5S2(433198002) - Air Cartridge	18-Sep-17	Iodine-131	< 1.60E-02 pCi/m3		U
SA-AIO-5S2(433663002) - Air Cartridge	25-Sep-17	Iodine-131	< 1.17E-02 pCi/m3		U
SA-AIO-5S2(434180002) - Air Cartridge	2-Oct-17	Iodine-131	< 1.31E-02 pCi/m3		U
SA-AIO-5S2(434965002) - Air Cartridge	10-Oct-17	Iodine-131	< 2.40E-02 pCi/m3		U
SA-AIO-5S2(435426002) - Air Cartridge	16-Oct-17	Iodine-131	< 1.28E-02 pCi/m3		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Weekly Air Iodine Cartridge (Cont.)					
SA-AIO-5S2(436179002) - Air Cartridge	23-Oct-17	Iodine-131	< 1.37E-02 pCi/m3		U
SA-AIO-5S2(436862002) - Air Cartridge	31-Oct-17	Iodine-131	< 8.94E-03 pCi/m3		U
SA-AIO-5S2(437435002) - Air Cartridge	6-Nov-17	Iodine-131	< 1.11E-02 pCi/m3		U
SA-AIO-5S2(437929002) - Air Cartridge	13-Nov-17	Iodine-131	< 1.37E-02 pCi/m3		U
SA-AIO-5S2(438520002) - Air Cartridge	20-Nov-17	Iodine-131	< 1.93E-02 pCi/m3		U
SA-AIO-5S2(438825002) - Air Cartridge	27-Nov-17	Iodine-131	< 1.49E-02 pCi/m3		U
SA-AIO-5S2(439327002) - Air Cartridge	4-Dec-17	Iodine-131	< 6.84E-03 pCi/m3		U
SA-AIO-5S2(439955002) - Air Cartridge	11-Dec-17	Iodine-131	< 5.67E-03 pCi/m3		U
SA-AIO-5S2(440414002) - Air Cartridge	18-Dec-17	Iodine-131	< 1.09E-02 pCi/m3		U
SA-AIO-5S2(440793002) - Air Cartridge	26-Dec-17	Iodine-131	< 9.77E-03 pCi/m3		U
Weekly Air Particulate Filter					
SA-APT-5S2(413778001) - Air Particulate	3-Jan-17	BETA	**1.98E-02 pCi/m3**	± 3.15E-03 pCi/m3	
SA-APT-5S2(414089001) - Air Particulate	9-Jan-17	BETA	**1.53E-02 pCi/m3**	± 3.03E-03 pCi/m3	
SA-APT-5S2(414500001) - Air Particulate	16-Jan-17	BETA	**1.28E-02 pCi/m3**	± 2.52E-03 pCi/m3	
SA-APT-5S2(415006001) - Air Particulate	23-Jan-17	BETA	**1.84E-02 pCi/m3**	± 3.14E-03 pCi/m3	
SA-APT-5S2(415445001) - Air Particulate	30-Jan-17	BETA	**1.36E-02 pCi/m3**	± 2.72E-03 pCi/m3	
SA-APT-5S2(415919001) - Air Particulate	6-Feb-17	BETA	**2.99E-02 pCi/m3**	± 3.89E-03 pCi/m3	
SA-APT-5S2(416739001) - Air Particulate	13-Feb-17	BETA	**2.62E-02 pCi/m3**	± 3.68E-03 pCi/m3	
SA-APT-5S2(417174001) - Air Particulate	21-Feb-17	BETA	**2.73E-02 pCi/m3**	± 3.59E-03 pCi/m3	
SA-APT-5S2(417576001) - Air Particulate	27-Feb-17	BETA	**2.07E-02 pCi/m3**	± 3.35E-03 pCi/m3	
SA-APT-5S2(418176001) - Air Particulate	6-Mar-17	BETA	**2.10E-02 pCi/m3**	± 3.01E-03 pCi/m3	

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result		Error (± 2σ)		Result Qualifier
Weekly Air Particulate Filter (Cont.)							
SA-APT-5S2(418692001) - Air Particulate	13-Mar-17	BETA	**2.13E-02**	**pCi/m3**	± 3.16E-03	pCi/m3	
SA-APT-5S2(419114001) - Air Particulate	20-Mar-17	BETA	**2.54E-02**	**pCi/m3**	± 3.52E-03	pCi/m3	
SA-APT-5S2(419445001) - Air Particulate	27-Mar-17	BETA	**2.16E-02**	**pCi/m3**	± 3.17E-03	pCi/m3	
SA-APT-5S2(419908001) - Air Particulate	3-Apr-17	BETA	**1.33E-02**	**pCi/m3**	± 2.60E-03	pCi/m3	
SA-APT-5S2(420356001) - Air Particulate	8-Apr-17	BETA	**1.35E-02**	**pCi/m3**	± 3.27E-03	pCi/m3	
SA-APT-5S2(420872001) - Air Particulate	15-Apr-17	BETA	**2.05E-02**	**pCi/m3**	± 3.27E-03	pCi/m3	
SA-APT-5S2(421407001) - Air Particulate	21-Apr-17	BETA	**1.49E-02**	**pCi/m3**	± 3.13E-03	pCi/m3	
SA-APT-5S2(421968001) - Air Particulate	26-Apr-17	BETA	**6.66E-03**	**pCi/m3**	± 2.57E-03	pCi/m3	**M**
SA-APT-5S2(422196001) - Air Particulate	1-May-17	BETA	**1.54E-02**	**pCi/m3**	± 3.38E-03	pCi/m3	
SA-APT-5S2(422807001) - Air Particulate	8-May-17	BETA	**9.30E-03**	**pCi/m3**	± 2.22E-03	pCi/m3	**M**
SA-APT-5S2(423321001) - Air Particulate	15-May-17	BETA	**9.79E-03**	**pCi/m3**	± 2.32E-03	pCi/m3	**M**
SA-APT-5S2(423895001) - Air Particulate	22-May-17	BETA	**1.74E-02**	**pCi/m3**	± 3.00E-03	pCi/m3	
SA-APT-5S2(424466001) - Air Particulate	30-May-17	BETA	**7.70E-03**	**pCi/m3**	± 1.97E-03	pCi/m3	**M**
SA-APT-5S2(424870001) - Air Particulate	5-Jun-17	BETA	**1.95E-02**	**pCi/m3**	± 3.36E-03	pCi/m3	
SA-APT-5S2(425431001) - Air Particulate	12-Jun-17	BETA	**1.73E-02**	**pCi/m3**	± 3.02E-03	pCi/m3	
SA-APT-5S2(425943001) - Air Particulate	19-Jun-17	BETA	**2.35E-02**	**pCi/m3**	± 3.40E-03	pCi/m3	
SA-APT-5S2(426553001) - Air Particulate	26-Jun-17	BETA	**1.87E-02**	**pCi/m3**	± 3.15E-03	pCi/m3	
SA-APT-5S2(427258001) - Air Particulate	3-Jul-17	BETA	**2.56E-02**	**pCi/m3**	± 3.51E-03	pCi/m3	
SA-APT-5S2(427636001) - Air Particulate	10-Jul-17	BETA	**2.10E-02**	**pCi/m3**	± 3.28E-03	pCi/m3	
SA-APT-5S2(428281001) - Air Particulate	17-Jul-17	BETA	**1.91E-02**	**pCi/m3**	± 3.05E-03	pCi/m3	
SA-APT-5S2(428849001) - Air Particulate	24-Jul-17	BETA	**2.17E-02**	**pCi/m3**	± 3.31E-03	pCi/m3	
SA-APT-5S2(429462001) - Air Particulate	31-Jul-17	BETA	**1.41E-02**	**pCi/m3**	± 2.66E-03	pCi/m3	

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result		Error (± 2σ)		Result Qualifier
Weekly Air Particulate Filter (Cont.)							
SA-APT-5S2(430099001) - Air Particulate	7-Aug-17	BETA	**1.72E-02**	**pCi/m3**	± 2.87E-03	pCi/m3	
SA-APT-5S2(430771001) - Air Particulate	14-Aug-17	BETA	**2.10E-02**	**pCi/m3**	± 3.26E-03	pCi/m3	
SA-APT-5S2(431388001) - Air Particulate	21-Aug-17	BETA	**2.25E-02**	**pCi/m3**	± 3.32E-03	pCi/m3	
SA-APT-5S2(431917001) - Air Particulate	28-Aug-17	BETA	**2.66E-02**	**pCi/m3**	± 3.52E-03	pCi/m3	
SA-APT-5S2(432358001) - Air Particulate	5-Sep-17	BETA	**2.09E-02**	**pCi/m3**	± 2.97E-03	pCi/m3	
SA-APT-5S2(432785001) - Air Particulate	11-Sep-17	BETA	**1.97E-02**	**pCi/m3**	± 3.35E-03	pCi/m3	
SA-APT-5S2(433198001) - Air Particulate	18-Sep-17	BETA	**2.25E-02**	**pCi/m3**	± 3.30E-03	pCi/m3	
SA-APT-5S2(433663001) - Air Particulate	25-Sep-17	BETA	**2.55E-02**	**pCi/m3**	± 3.54E-03	pCi/m3	
SA-APT-5S2(434180001) - Air Particulate	2-Oct-17	BETA	**9.86E-03**	**pCi/m3**	± 2.27E-03	pCi/m3	**M**
SA-APT-5S2(434965001) - Air Particulate	10-Oct-17	BETA	**1.95E-02**	**pCi/m3**	± 3.02E-03	pCi/m3	
SA-APT-5S2(435426001) - Air Particulate	16-Oct-17	BETA	**1.78E-02**	**pCi/m3**	± 3.27E-03	pCi/m3	
SA-APT-5S2(436179001) - Air Particulate	23-Oct-17	BETA	**2.79E-02**	**pCi/m3**	± 3.64E-03	pCi/m3	
SA-APT-5S2(436862001) - Air Particulate	31-Oct-17	BETA	**1.73E-02**	**pCi/m3**	± 2.77E-03	pCi/m3	
SA-APT-5S2(437435001) - Air Particulate	6-Nov-17	BETA	**2.15E-02**	**pCi/m3**	± 3.38E-03	pCi/m3	
SA-APT-5S2(437929001) - Air Particulate	13-Nov-17	BETA	**1.96E-02**	**pCi/m3**	± 3.15E-03	pCi/m3	
SA-APT-5S2(438520001) - Air Particulate	20-Nov-17	BETA	**2.20E-02**	**pCi/m3**	± 3.28E-03	pCi/m3	
SA-APT-5S2(438825001) - Air Particulate	27-Nov-17	BETA	**2.68E-02**	**pCi/m3**	± 3.64E-03	pCi/m3	
SA-APT-5S2(439327001) - Air Particulate	4-Dec-17	BETA	**2.76E-02**	**pCi/m3**	± 3.73E-03	pCi/m3	
SA-APT-5S2(439955001) - Air Particulate	11-Dec-17	BETA	**2.76E-02**	**pCi/m3**	± 3.75E-03	pCi/m3	
SA-APT-5S2(440414001) - Air Particulate	18-Dec-17	BETA	**2.71E-02**	**pCi/m3**	± 3.67E-03	pCi/m3	
SA-APT-5S2(440793001) - Air Particulate	26-Dec-17	BETA	**2.60E-02**	**pCi/m3**	± 3.38E-03	pCi/m3	

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Quarterly Air Particulate Filter					
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Barium-140	< 3.62E-03 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Beryllium-7	**7.91E-02 pCi/m3**	± 1.02E-02 pCi/m3	
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Cerium-141	< 6.55E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Cerium-144	< 1.93E-03 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Cesium-134	< 5.15E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Cesium-137	< 4.32E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Chromium-51	< 4.02E-03 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Cobalt-58	< 5.58E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Cobalt-60	< 6.28E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Iodine-131	< 1.53E-03 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Iron-59	< 1.19E-03 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Lanthanum-140	< 9.19E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Manganese-54	< 5.25E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Niobium-95	< 7.03E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Potassium-40	< 3.99E-03 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Ruthenium-103	< 4.68E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Ruthenium-106	< 3.68E-03 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Zinc-65	< 9.86E-04 pCi/m3		U
SA-APT-5S2(420354001) - Air Particulate	27-Mar-17	Zirconium-95	< 1.07E-03 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Barium-140	< 1.16E-02 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Beryllium-7	**7.20E-02 pCi/m3**	± 1.05E-02 pCi/m3	
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Cerium-141	< 1.33E-03 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Cerium-144	< 2.19E-03 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Cesium-134	< 5.20E-04 pCi/m3		U

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Quarterly Air Particulate Filter (Cont.)					
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Cesium-137	< 4.52E-04 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Chromium-51	< 9.71E-03 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Cobalt-58	< 5.68E-04 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Cobalt-60	< 4.36E-04 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Iodine-131	< 1.91E-02 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Iron-59	< 1.90E-03 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Lanthanum-140	< 7.04E-03 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Manganese-54	< 5.34E-04 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Niobium-95	< 4.27E-04 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Potassium-40	< 4.60E-03 pCi/m3		**UI**
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Ruthenium-103	< 7.79E-04 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Ruthenium-106	< 3.95E-03 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Zinc-65	< 1.07E-03 pCi/m3		U
SA-APT-5S2(429912001) - Air Particulate	26-Jun-17	Zirconium-95	< 1.46E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Barium-140	< 7.58E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Beryllium-7	**6.45E-02 pCi/m3**	± 1.10E-02 pCi/m3	
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Cerium-141	< 7.96E-04 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Cerium-144	< 1.85E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Cesium-134	< 5.51E-04 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Cesium-137	< 4.35E-04 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Chromium-51	< 6.53E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Cobalt-58	< 4.00E-04 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Cobalt-60	< 4.59E-04 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Iodine-131	< 7.13E-03 pCi/m3		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Quarterly Air Particulate Filter (Cont.)					
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Iron-59	< 1.55E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Lanthanum-140	< 2.93E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Manganese-54	< 5.52E-04 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Niobium-95	< 5.75E-04 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Potassium-40	< 8.32E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Ruthenium-103	< 6.71E-04 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Ruthenium-106	< 4.44E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Zinc-65	< 1.21E-03 pCi/m3		U
SA-APT-5S2(435640001) - Air Particulate	25-Sep-17	Zirconium-95	< 9.76E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Barium-140	< 3.09E-03 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Beryllium-7	**6.14E-02 pCi/m3**	± 6.12E-03 pCi/m3	
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Cerium-141	< 4.19E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Cerium-144	< 1.18E-03 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Cesium-134	< 3.81E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Cesium-137	< 2.69E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Chromium-51	< 3.49E-03 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Cobalt-58	< 3.56E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Cobalt-60	< 3.36E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Iodine-131	< 1.53E-03 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Iron-59	< 5.82E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Lanthanum-140	< 9.75E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Manganese-54	< 2.25E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Niobium-95	< 3.67E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Potassium-40	< 3.28E-03 pCi/m3		**UI**
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Ruthenium-103	< 3.32E-04 pCi/m3		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Sediment					
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Ruthenium-106	< 2.75E-03 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Zinc-65	< 6.69E-04 pCi/m3		U
SA-APT-5S2(441625001) - Air Particulate	26-Dec-17	Zirconium-95	< 7.08E-04 pCi/m3		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Barium-140	< 5.60E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Beryllium-7	**1.61E+02 pCi/kg**	± 9.41E+01 pCi/kg	
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Cerium-141	< 2.13E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Cerium-144	< 8.10E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Cesium-134	< 1.63E+01 pCi/kg		**UI**
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Cesium-137	< 1.11E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Chromium-51	< 9.40E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Cobalt-58	< 9.80E+00 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Cobalt-60	< 1.00E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Iodine-131	< 1.96E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Iron-59	< 2.47E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Manganese-54	< 1.11E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Niobium-95	< 1.19E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Potassium-40	**6.44E+03 pCi/kg**	± 3.19E+02 pCi/kg	
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Radium-226	**3.73E+02 pCi/kg**	± 3.68E+01 pCi/kg	
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Ruthenium-103	< 1.08E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Ruthenium-106	< 9.10E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Zinc-65	< 2.32E+01 pCi/kg		U
SA-ESS-11A1(424919001) - Sediment	1-Jun-17	Zirconium-95	< 2.24E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Barium-140	< 6.14E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Beryllium-7	< 8.08E+01 pCi/kg		**UI**

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Sediment (Cont.)					
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Cerium-141	< 2.49E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Cerium-144	< 8.61E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Cesium-134	< 1.43E+01 pCi/kg		**UI**
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Cesium-137	< 1.11E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Chromium-51	< 1.05E+02 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Cobalt-58	< 9.37E+00 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Cobalt-60	< 9.09E+00 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Iodine-131	< 2.71E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Iron-59	< 2.36E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Manganese-54	< 1.04E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Niobium-95	< 1.21E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Potassium-40	**4.71E+03 pCi/kg**	± 2.78E+02 pCi/kg	
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Radium-226	**3.30E+02 pCi/kg**	± 3.44E+01 pCi/kg	
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Ruthenium-103	< 1.10E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Ruthenium-106	< 7.73E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Zinc-65	< 2.37E+01 pCi/kg		U
SA-ESS-11A1(439539001) - Sediment	30-Nov-17	Zirconium-95	< 1.99E+01 pCi/kg		U
Broad Leaf Vegetation					
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Barium-140	< 1.22E+02 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Beryllium-7	**3.20E+02 pCi/kg**	± 1.89E+02 pCi/kg	
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Cerium-141	< 2.53E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Cerium-144	< 8.90E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Cesium-134	< 2.32E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Cesium-137	< 2.78E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Chromium-51	< 1.61E+02 pCi/kg		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Broad Leaf Vegetation (Cont.)					
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Cobalt-58	< 3.13E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Cobalt-60	< 3.82E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Iodine-131	< 3.29E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Iron-59	< 7.45E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Lanthanum-140	< 1.76E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Manganese-54	< 3.06E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Niobium-95	< 2.52E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Potassium-40	**5.41E+03 pCi/kg**	± 7.65E+02 pCi/kg	
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Ruthenium-103	< 2.35E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Ruthenium-106	< 1.76E+02 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Zinc-65	< 5.95E+01 pCi/kg		U
SA-FPL-16S1(429158001) - Collards	26-Jul-17	Zirconium-95	< 4.72E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Barium-140	< 9.47E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Beryllium-7	< 1.86E+02 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Cerium-141	< 3.23E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Cerium-144	< 1.08E+02 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Cesium-134	< 1.77E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Cesium-137	< 2.03E+01 pCi/kg		**UI**
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Chromium-51	< 2.06E+02 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Cobalt-58	< 1.75E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Cobalt-60	< 2.00E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Iodine-131	< 3.84E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Iron-59	< 4.89E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Lanthanum-140	< 2.75E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Manganese-54	< 2.07E+01 pCi/kg		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Broad Leaf Vegetation (Cont.)					
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Niobium-95	< 2.12E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Potassium-40	**7.58E+03 pCi/kg**	± 7.36E+02 pCi/kg	
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Ruthenium-103	< 1.93E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Ruthenium-106	< 2.34E+02 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Zinc-65	< 4.82E+01 pCi/kg		U
SA-FPL-7S2(431947001) - Kale	29-Aug-17	Zirconium-95	< 4.28E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Barium-140	< 7.13E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Beryllium-7	< 1.69E+02 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Cerium-141	< 2.11E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Cerium-144	< 8.94E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Cesium-134	< 1.77E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Cesium-137	< 1.67E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Chromium-51	< 1.24E+02 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Cobalt-58	< 1.69E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Cobalt-60	< 2.00E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Iodine-131	< 1.86E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Iron-59	< 3.91E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Lanthanum-140	< 1.52E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Manganese-54	< 1.69E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Niobium-95	< 1.89E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Potassium-40	**5.38E+03 pCi/kg**	± 5.33E+02 pCi/kg	
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Ruthenium-103	< 1.52E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Ruthenium-106	< 1.14E+02 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Zinc-65	< 3.66E+01 pCi/kg		U
SA-FPL-7S2(434321001) - Collards	3-Oct-17	Zirconium-95	< 2.65E+01 pCi/kg		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Broad Leaf Vegetation (Cont.)					
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Barium-140	< 1.02E+02 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Beryllium-7	< 2.25E+02 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Cerium-141	< 3.08E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Cerium-144	< 1.10E+02 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Cesium-134	< 2.09E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Cesium-137	< 2.64E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Chromium-51	< 1.89E+02 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Cobalt-58	< 2.20E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Cobalt-60	< 2.21E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Iodine-131	< 2.69E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Iron-59	< 3.39E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Lanthanum-140	< 3.52E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Manganese-54	< 2.36E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Niobium-95	< 1.83E+01 pCi/kg		**UI**
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Potassium-40	**4.22E+03 pCi/kg**	± 5.72E+02 pCi/kg	
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Ruthenium-103	< 2.06E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Ruthenium-106	< 1.88E+02 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Zinc-65	< 4.42E+01 pCi/kg		U
SA-FPL-7S2(438929001) - Collards	27-Nov-17	Zirconium-95	< 3.30E+01 pCi/kg		U
Milk					
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Barium-140	< 1.03E+01 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Beryllium-7	< 1.65E+01 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Cerium-141	< 3.25E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Cerium-144	< 1.27E+01 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Cesium-134	< 2.21E+00 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Milk (Cont.)					
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Cesium-137	< 1.96E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Chromium-51	< 1.82E+01 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Cobalt-58	< 2.12E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Cobalt-60	< 1.88E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Iodine-131	< 4.24E-01 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Iodine-131	< 3.56E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Iron-59	< 4.82E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Lanthanum-140	< 3.77E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Manganese-54	< 2.00E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Niobium-95	< 1.93E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Potassium-40	**1.25E+03 pCi/L**	± 6.56E+01 pCi/L	
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Ruthenium-103	< 1.91E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Ruthenium-106	< 1.68E+01 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Zinc-65	< 4.55E+00 pCi/L		U
SA-MLK-14F4(413780001) - Milk	3-Jan-17	Zirconium-95	< 3.63E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Barium-140	< 9.17E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Beryllium-7	< 1.59E+01 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Cerium-141	< 3.30E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Cerium-144	< 1.25E+01 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Cesium-134	< 1.90E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Cesium-137	< 1.85E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Chromium-51	< 1.59E+01 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Cobalt-58	< 1.91E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Cobalt-60	< 2.16E+00 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Milk (Cont.)					
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Iodine-131	< 6.29E-01 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Iodine-131	< 3.72E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Iron-59	< 4.57E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Lanthanum-140	< 2.80E+00 pCi/L		**UI**
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Manganese-54	< 1.76E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Niobium-95	< 1.68E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Potassium-40	**1.28E+03 pCi/L**	± 6.17E+01 pCi/L	
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Ruthenium-103	< 1.81E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Ruthenium-106	< 1.64E+01 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Zinc-65	< 4.55E+00 pCi/L		U
SA-MLK-14F4(416070001) - Milk	6-Feb-17	Zirconium-95	< 3.24E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Barium-140	< 1.06E+01 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Beryllium-7	< 1.56E+01 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Cerium-141	< 2.96E+00 pCi/L		**UI**
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Cerium-144	< 1.24E+01 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Cesium-134	< 2.22E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Cesium-137	< 1.99E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Chromium-51	< 1.65E+01 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Cobalt-58	< 1.98E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Cobalt-60	< 2.01E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Iodine-131	< 4.61E-01 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Iodine-131	< 3.21E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Iron-59	< 4.89E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Lanthanum-140	< 2.66E+00 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Milk (Cont.)					
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Manganese-54	< 1.86E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Niobium-95	< 1.78E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Potassium-40	**1.32E+03 pCi/L**	± 6.35E+01 pCi/L	
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Ruthenium-103	< 2.01E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Ruthenium-106	< 1.68E+01 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Zinc-65	< 4.63E+00 pCi/L		U
SA-MLK-14F4(418179001) - Milk	6-Mar-17	Zirconium-95	< 3.39E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Barium-140	< 6.78E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Beryllium-7	< 1.46E+01 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Cerium-141	< 2.59E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Cerium-144	< 1.12E+01 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Cesium-134	< 1.96E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Cesium-137	< 1.80E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Chromium-51	< 1.44E+01 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Cobalt-58	< 1.55E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Cobalt-60	< 1.68E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Iodine-131	< 4.46E-01 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Iodine-131	< 2.25E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Iron-59	< 3.68E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Lanthanum-140	< 1.91E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Manganese-54	< 1.68E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Niobium-95	< 1.65E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Potassium-40	**1.50E+03 pCi/L**	± 5.91E+01 pCi/L	
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Ruthenium-103	< 1.62E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Ruthenium-106	< 1.51E+01 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Milk (Cont.)					
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Zinc-65	< 4.14E+00 pCi/L		U
SA-MLK-14F4(419973001) - Milk	3-Apr-17	Zirconium-95	< 2.88E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Barium-140	< 1.20E+01 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Beryllium-7	< 2.04E+01 pCi/L		**UI**
SA-MLK-14F4(422901001) - Milk	8-May-17	Cerium-141	< 3.51E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Cerium-144	< 1.38E+01 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Cesium-134	< 3.06E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Cesium-137	< 2.51E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Chromium-51	< 2.17E+01 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Cobalt-58	< 2.18E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Cobalt-60	< 2.68E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Iodine-131	< 4.67E-01 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Iodine-131	< 4.28E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Iron-59	< 6.30E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Lanthanum-140	< 3.93E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Manganese-54	< 2.46E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Niobium-95	< 2.65E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Potassium-40	**1.43E+03 pCi/L**	± 8.66E+01 pCi/L	
SA-MLK-14F4(422901001) - Milk	8-May-17	Ruthenium-103	< 2.57E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Ruthenium-106	< 2.19E+01 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Zinc-65	< 6.11E+00 pCi/L		U
SA-MLK-14F4(422901001) - Milk	8-May-17	Zirconium-95	< 5.17E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Barium-140	< 7.98E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Beryllium-7	< 1.17E+01 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Milk (Cont.)					
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Cerium-141	< 2.64E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Cerium-144	< 9.78E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Cesium-134	< 1.75E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Cesium-137	< 1.67E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Chromium-51	< 1.40E+01 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Cobalt-58	< 1.50E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Cobalt-60	< 1.64E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Iodine-131	< 4.58E-01 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Iodine-131	< 2.96E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Iron-59	< 4.05E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Lanthanum-140	< 2.38E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Manganese-54	< 1.39E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Niobium-95	< 1.54E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Potassium-40	**1.36E+03 pCi/L**	± 5.81E+01 pCi/L	
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Ruthenium-103	< 1.64E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Ruthenium-106	< 1.41E+01 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Zinc-65	< 3.86E+00 pCi/L		U
SA-MLK-14F4(425027001) - Milk	5-Jun-17	Zirconium-95	< 2.85E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Barium-140	< 7.28E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Beryllium-7	< 1.24E+01 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Cerium-141	< 2.82E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Cerium-144	< 1.01E+01 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Cesium-134	< 1.69E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Cesium-137	< 1.54E+00 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Milk (Cont.)					
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Chromium-51	< 1.47E+01 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Cobalt-58	< 1.45E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Cobalt-60	< 1.69E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Iodine-131	< 6.38E-01 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Iodine-131	< 2.78E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Iron-59	< 3.61E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Lanthanum-140	< 1.98E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Manganese-54	< 1.46E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Niobium-95	< 1.53E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Potassium-40	**1.40E+03 pCi/L**	± 5.52E+01 pCi/L	
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Ruthenium-103	< 1.44E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Ruthenium-106	< 1.27E+01 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Zinc-65	< 3.80E+00 pCi/L		U
SA-MLK-14F4(427255001) - Milk	3-Jul-17	Zirconium-95	< 2.48E+00 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Barium-140	< 9.22E+00 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Beryllium-7	< 1.36E+01 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Cerium-141	< 2.69E+00 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Cerium-144	< 1.04E+01 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Cesium-134	< 1.96E+00 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Cesium-137	< 1.93E+00 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Chromium-51	< 1.57E+01 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Cobalt-58	< 1.68E+00 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Cobalt-60	< 1.91E+00 pCi/L		U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Iodine-131	< 5.39E-01 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result		Error (± 2σ)		Result Qualifier
Milk (Cont.)							
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Iodine-131	< 3.36E+00	pCi/L			U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Iron-59	< 3.97E+00	pCi/L			U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Lanthanum-140	< 2.60E+00	pCi/L			U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Manganese-54	< 1.71E+00	pCi/L			U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Niobium-95	< 1.95E+00	pCi/L			U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Potassium-40	**1.39E+03**	**pCi/L**	± 6.13E+01	pCi/L	
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Ruthenium-103	< 1.70E+00	pCi/L			U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Ruthenium-106	< 1.44E+01	pCi/L			U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Zinc-65	< 4.29E+00	pCi/L			U
SA-MLK-14F4(430244001) - Milk	7-Aug-17	Zirconium-95	< 2.98E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Barium-140	< 9.19E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Beryllium-7	< 1.48E+01	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Cerium-141	< 3.19E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Cerium-144	< 1.20E+01	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Cesium-134	< 1.75E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Cesium-137	< 1.77E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Chromium-51	< 1.71E+01	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Cobalt-58	< 1.77E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Cobalt-60	< 1.90E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Iodine-131	< 7.68E-01	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Iodine-131	< 3.77E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Iron-59	< 4.03E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Lanthanum-140	< 2.47E+00	pCi/L			U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Manganese-54	< 1.41E+00	pCi/L			U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Milk (Cont.)					
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Niobium-95	< 1.82E+00 pCi/L		U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Potassium-40	**1.46E+03 pCi/L**	± 6.08E+01 pCi/L	
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Ruthenium-103	< 1.77E+00 pCi/L		U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Ruthenium-106	< 1.35E+01 pCi/L		U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Zinc-65	< 4.08E+00 pCi/L		U
SA-MLK-14F4(432355001) - Milk	5-Sep-17	Zirconium-95	< 3.18E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Barium-140	< 1.15E+01 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Beryllium-7	< 1.74E+01 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Cerium-141	< 3.38E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Cerium-144	< 1.23E+01 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Cesium-134	< 2.26E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Cesium-137	< 2.16E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Chromium-51	< 1.94E+01 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Cobalt-58	< 2.14E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Cobalt-60	< 2.35E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Iodine-131	< 5.06E-01 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Iodine-131	< 4.45E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Iron-59	< 4.78E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Lanthanum-140	< 3.52E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Manganese-54	< 2.12E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Niobium-95	< 2.23E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Potassium-40	**1.35E+03 pCi/L**	± 7.40E+01 pCi/L	
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Ruthenium-103	< 2.14E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Ruthenium-106	< 1.91E+01 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Milk (Cont.)					
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Zinc-65	< 5.45E+00 pCi/L		U
SA-MLK-14F4(434331001) - Milk	2-Oct-17	Zirconium-95	< 4.17E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Barium-140	< 6.55E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Beryllium-7	< 1.15E+01 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Cerium-141	< 2.57E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Cerium-144	< 1.00E+01 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Cesium-134	< 1.79E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Cesium-137	< 1.58E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Chromium-51	< 1.30E+01 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Cobalt-58	< 1.50E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Cobalt-60	< 1.83E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Iodine-131	< 4.78E-01 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Iodine-131	< 2.09E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Iron-59	< 3.53E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Lanthanum-140	< 1.72E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Manganese-54	< 1.65E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Niobium-95	< 1.59E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Potassium-40	**1.57E+03 pCi/L**	± 5.94E+01 pCi/L	
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Ruthenium-103	< 1.48E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Ruthenium-106	< 1.41E+01 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Zinc-65	< 4.05E+00 pCi/L		U
SA-MLK-14F4(438066001) - Milk	13-Nov-17	Zirconium-95	< 2.68E+00 pCi/L		U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Barium-140	< 9.03E+00 pCi/L		U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Beryllium-7	< 1.42E+01 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result			Error (± 2σ)		Result Qualifier
Milk (Cont.)								
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Cerium-141	<	3.16E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Cerium-144	<	1.15E+01	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Cesium-134	<	1.76E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Cesium-137	<	1.95E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Chromium-51	<	1.60E+01	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Cobalt-58	<	1.95E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Cobalt-60	<	2.08E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Iodine-131	<	5.34E-01	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Iodine-131	<	3.41E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Iron-59	<	3.99E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Lanthanum-140	<	2.59E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Manganese-54	<	1.66E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Niobium-95	<	2.05E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Potassium-40		**1.49E+03**	**pCi/L**	± 6.75E+01	pCi/L	
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Ruthenium-103	<	1.79E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Ruthenium-106	<	1.51E+01	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Zinc-65	<	4.87E+00	pCi/L			U
SA-MLK-14F4(439536001) - Milk	4-Dec-17	Zirconium-95	<	3.33E+00	pCi/L			U
Surface Water								
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Barium-140	<	9.58E+00	pCi/L			U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Beryllium-7	<	1.61E+01	pCi/L			U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	BETA		**6.18E+01**	**pCi/L**	± 2.05E+01	pCi/L	
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Cerium-141	<	3.27E+00	pCi/L			U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Cerium-144	<	1.25E+01	pCi/L			U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Surface Water (Cont.)					
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Cesium-134	< 2.04E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Cesium-137	< 2.05E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Chromium-51	< 1.70E+01 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Cobalt-58	< 1.63E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Cobalt-60	< 1.81E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Iodine-131	< 3.14E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Iron-59	< 3.70E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Lanthanum-140	< 2.85E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Manganese-54	< 1.96E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Niobium-95	< 2.16E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Potassium-40	**1.39E+02 pCi/L**	± 3.77E+01 pCi/L	
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Ruthenium-103	< 1.93E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Ruthenium-106	< 1.63E+01 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Tritium	< 3.03E+02 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Zinc-65	< 3.59E+00 pCi/L		U
SA-SWA-11A1(419293001) - Surface Water	21-Mar-17	Zirconium-95	< 3.10E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Barium-140	< 7.75E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Beryllium-7	< 1.25E+01 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	BETA	**5.96E+01 pCi/L**	± 1.48E+01 pCi/L	
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Cerium-141	< 2.43E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Cerium-144	< 9.13E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Cesium-134	< 1.49E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Cesium-137	< 1.45E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Chromium-51	< 1.32E+01 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Surface Water (Cont.)					
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Cobalt-58	< 1.59E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Cobalt-60	< 1.50E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Iodine-131	< 2.78E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Iron-59	< 2.86E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Lanthanum-140	< 2.53E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Manganese-54	< 1.29E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Niobium-95	< 1.48E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Potassium-40	**5.85E+01 pCi/L**	± 2.51E+01 pCi/L	
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Ruthenium-103	< 1.50E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Ruthenium-106	< 1.21E+01 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Tritium	< 2.14E+02 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Zinc-65	< 3.07E+00 pCi/L		U
SA-SWA-11A1(426537001) - Surface Water	21-Jun-17	Zirconium-95	< 2.35E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Barium-140	< 1.00E+01 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Beryllium-7	< 1.52E+01 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	BETA	**7.98E+01 pCi/L**	± 1.90E+01 pCi/L	
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Cerium-141	< 2.51E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Cerium-144	< 9.46E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Cesium-134	< 2.12E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Cesium-137	< 1.67E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Chromium-51	< 1.46E+01 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Cobalt-58	< 1.85E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Cobalt-60	< 1.91E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Iodine-131	< 3.31E+00 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result	Error (± 2σ)	Result Qualifier
Surface Water (Cont.)					
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Iron-59	< 3.96E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Lanthanum-140	< 3.33E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Manganese-54	< 1.92E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Niobium-95	< 2.17E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Potassium-40	**4.46E+01 pCi/L**	± 3.42E+01 pCi/L	
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Ruthenium-103	< 1.61E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Ruthenium-106	< 1.66E+01 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Tritium	< 3.12E+02 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Zinc-65	< 3.95E+00 pCi/L		U
SA-SWA-11A1(433432001) - Surface Water	18-Sep-17	Zirconium-95	< 3.38E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Barium-140	< 8.48E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Beryllium-7	< 1.40E+01 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	BETA	**4.26E+01 pCi/L**	± 1.58E+01 pCi/L	
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Cerium-141	< 2.81E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Cerium-144	< 9.53E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Cesium-134	< 1.80E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Cesium-137	< 1.59E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Chromium-51	< 1.55E+01 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Cobalt-58	< 1.55E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Cobalt-60	< 1.65E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Iodine-131	< 3.44E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Iron-59	< 3.61E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Lanthanum-140	< 3.15E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Manganese-54	< 1.35E+00 pCi/L		U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Niobium-95	< 1.76E+00 pCi/L		U

Table C-20

2017 Concentrations of Samples Analyzed by GEL

Sample ID [Location(report #) - Type]	Collection Date	Analysis	Reported Result		Error (± 2σ)		Result Qualifier
Surface Water (Cont.)							
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Potassium-40	**7.65E+01**	**pCi/L**	± 3.00E+01	pCi/L	
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Ruthenium-103	< 1.60E+00	pCi/L			U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Ruthenium-106	< 1.26E+01	pCi/L			U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Tritium	< 2.33E+02	pCi/L			U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Zinc-65	< 3.48E+00	pCi/L			U
SA-SWA-11A1(440688001) - Surface Water	17-Dec-17	Zirconium-95	< 2.82E+00	pCi/L			U

Notes:

LLDs are a-priori values.

MDCs are calculated a-posteriori values.

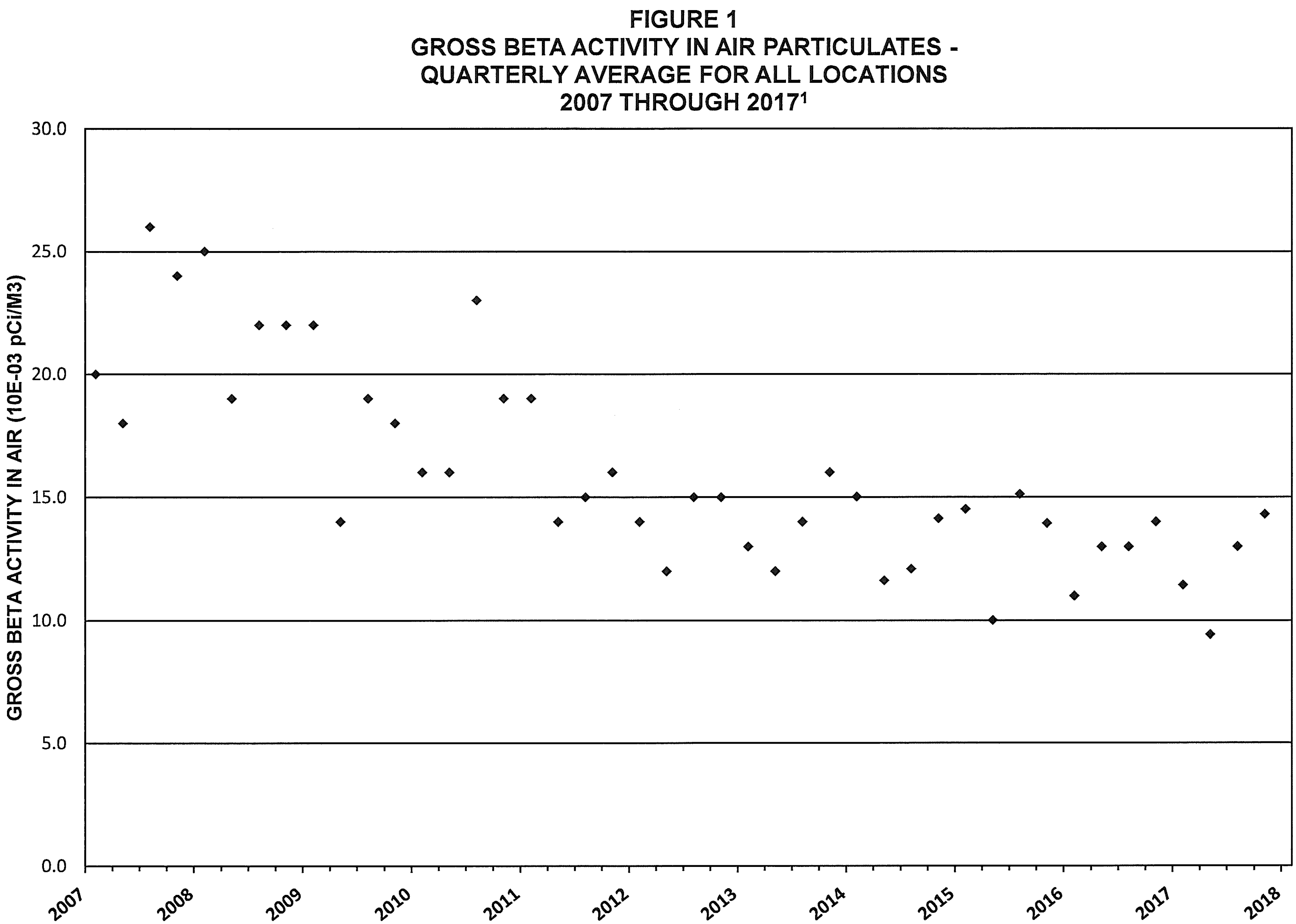
Gamma spectroscopy analysis results are calculated from a measurement using only one gamma energy line.

Qualifiers:

U = Target isotope was analyzed for, but not detected above the MDC and LLD.

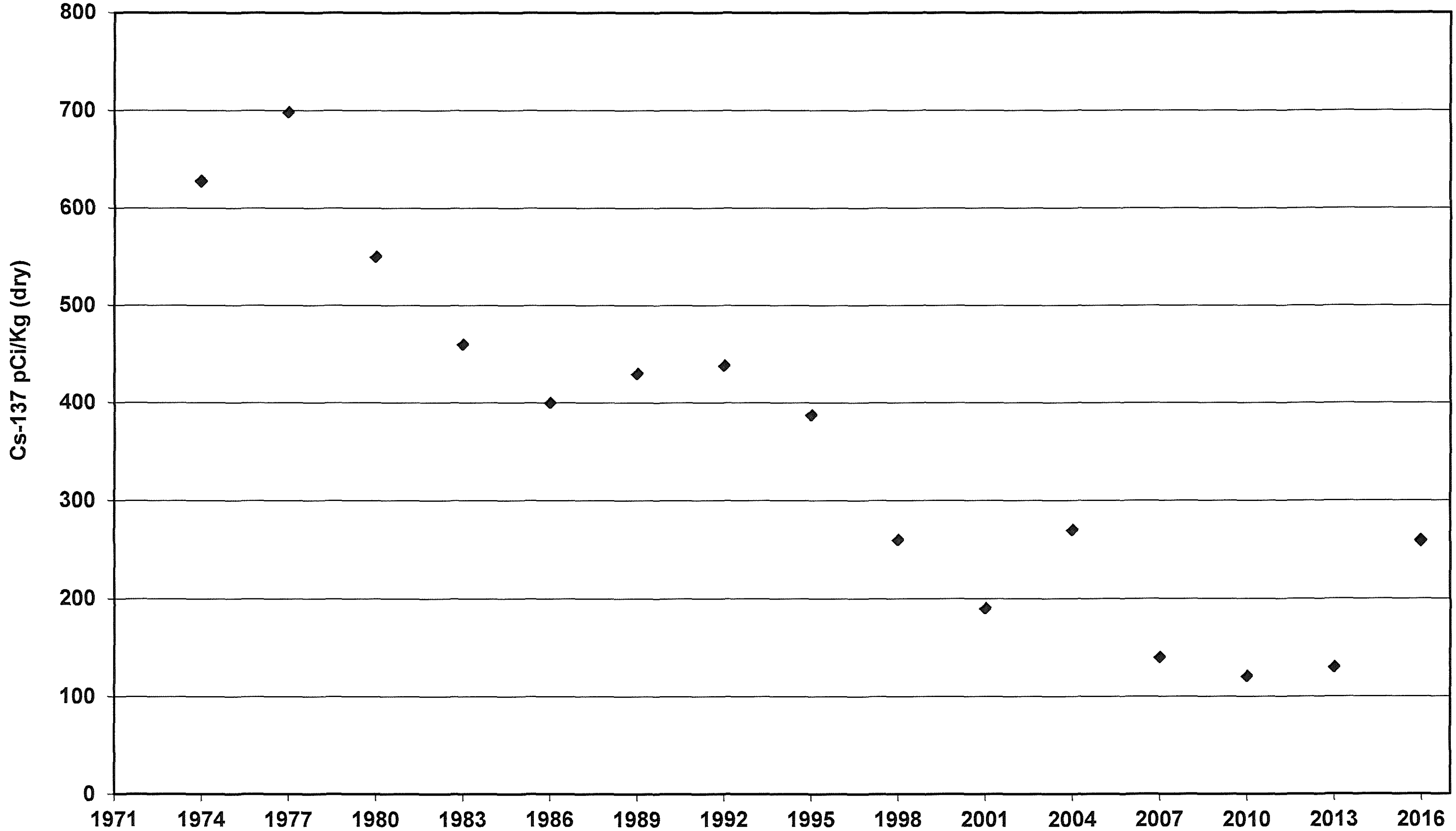
UI = Analysis Determined to be False Positive Identification (i.e. low abundance, high peak width, no valid peak, etc.)

M = Result is less than the LLD, but greater than the MDC.



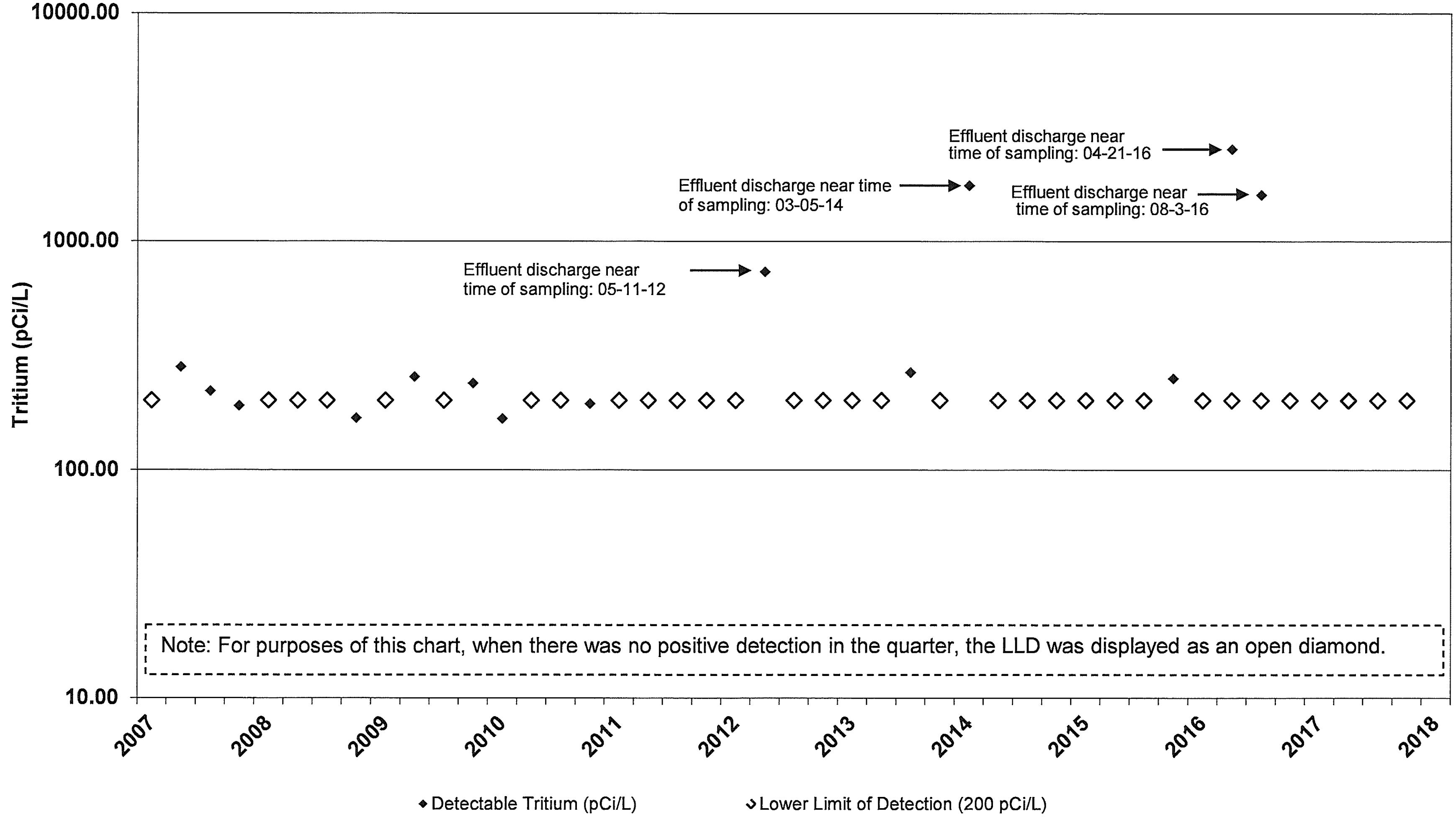
1 - 2013 data included temporary sampling locations

FIGURE 2
CESIUM-137 ACTIVITY IN SOIL 1974 THROUGH 2017
(TRIENNIAL)



Soil is sampled every three years. Last samples were taken in 2016. Annual values are an average of the results from the ten soil sites.

FIGURE 3
TRITIUM ACTIVITY IN SURFACE WATER - QUARTERLY AVERAGE
2007 THROUGH 2017



APPENDIX D

SUMMARY OF INTER-LABORATORY COMPARISON PROGRAM

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Table D-1

2017 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM (TBE)

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
March 2017	E11811	Milk	Sr-89	pCi/L	87	97.7	0.89	A
			Sr-90	pCi/L	12.4	16.2	0.77	A
	E11812	Milk	Ce-141	pCi/L	135	145	0.93	A
			Co-58	pCi/L	153	150	1.02	A
			Co-60	pCi/L	182	183	1.00	A
			Cr-51	pCi/L	258	290	0.89	A
			Cs-134	pCi/L	104	120	0.87	A
			Cs-137	pCi/L	142	140	1.02	A
			Fe-59	pCi/L	135	129	1.05	A
			I-131	pCi/L	92.6	97.9	0.95	A
			Mn-54	pCi/L	173	164	1.05	A
			Zn-65	pCi/L	208	199	1.04	A
	E11813	Charcoal	I-131	pCi	92	93.9	0.98	A
	E11814	AP	Ce-141	pCi	99.9	101	0.99	A
			Co-58	pCi	95.4	104	0.92	A
			Co-60	pCi	140	127	1.10	A
			Cr-51	pCi	211	201	1.05	A
			Cs-134	pCi	82.1	83.2	0.99	A
			Cs-137	pCi	92.8	97.0	0.96	A
			Fe-59	pCi	107	89.3	1.20	A
			Mn-54	pCi	106	114	0.93	A
			Zn-65	pCi	137	138	0.99	A
	E11816	Soil	Ce-141	pCi/g	0.258	0.250	1.03	A
			Co-58	pCi/g	0.241	0.258	0.93	A
			Co-60	pCi/g	0.312	0.315	0.99	A
			Cr-51	pCi/g	0.439	0.500	0.88	A
			Cs-134	pCi/g	0.176	0.207	0.85	A
			Cs-137	pCi/g	0.304	0.317	0.96	A
			Fe-59	pCi/g	0.210	0.222	0.95	A
			Mn-54	pCi/g	0.292	0.283	1.03	A
			Zn-65	pCi/g	0.353	0.344	1.03	A
	E11815	Water	Fe-55	pCi/L	1600	1890	0.85	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:
A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Table D-1

2017 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM (TBE)

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
June 2017	E11844	Milk	Sr-89	pCi/L	81.3	92.6	0.88	A
			Sr-90	pCi/L	12.1	13.5	0.90	A
	E11846	Milk	Ce-141	pCi/L	142	151	0.94	A
			Co-58	pCi/L	147	155	0.95	A
			Co-60	pCi/L	185	191	0.97	A
			Cr-51	pCi/L	321	315	1.02	A
			Cs-134	pCi/L	168	188	0.89	A
			Cs-137	pCi/L	148	150	0.99	A
			Fe-59	pCi/L	116	115	1.01	A
			I-131	pCi/L	102	93.6	1.09	A
			Mn-54	pCi/L	168	172	0.98	A
			Zn-65	pCi/L	195	204	0.96	A
	E11847	Charcoal	I-131	pCi	87.9	84.8	1.04	A
	E11845	AP	Sr-89	pCi	70.8	79.1	0.90	A
			Sr-90	pCi	9.10	11.5	0.79	W
	E11848	AP	Ce-141	pCi	112	116	0.96	A
			Co-58	pCi	119	119	1.00	A
			Co-60	pCi	171	146	1.17	A
			Cr-51	pCi	270	241	1.12	A
			Cs-134	pCi	152	144	1.05	A
			Cs-137	pCi	114	115	0.99	A
			Fe-59	pCi	94.1	88.3	1.07	A
			Mn-54	pCi	139	132	1.06	A
			Zn-65	pCi	141	156	0.90	A
	E11849	Water	Fe-55	pCi/L	1840	1890	0.97	A
July 2017	E11901	AP	GR-A	pCi	50.1	44.2	1.13	A
			GR-B	pCi	218	233	0.93	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Table D-1

2017 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM (TBE)

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Ratio of TBE to Analytics Result	Evaluation [(b)]
September 2017	E11914	Milk	Sr-89	pCi/L	84.3	82.7	1.02	A
			Sr-90	pCi/L	12.6	12.1	1.04	A
	E11915	Milk	Ce-141	pCi/L	93.9	87.0	1.08	A
			Co-58	pCi/L	115	117	0.98	A
			Co-60	pCi/L	265	262	1.01	A
			Cr-51	pCi/L	273	217	1.26	W
			Cs-134	pCi/L	186	201	0.93	A
			Cs-137	pCi/L	175	172	1.02	A
			Fe-59	pCi/L	137	125	1.09	A
			I-131	pCi/L	78.0	71.0	1.10	A
			Mn-54	pCi/L	128	123	1.04	A
			Zn-65	pCi/L	206	184	1.12	A
	E11916	Charcoal	I-131	pCi	71.9	64.4	1.12	A
	E11917	AP	Ce-141	pCi	80.1	86.3	0.93	A
			Co-58	pCi	110	116	0.95	A
			Co-60	pCi	277	260	1.07	A
			Cr-51	pCi	275	215	1.28	W
			Cs-134	pCi	192	199	0.96	A
			Cs-137	pCi	165	170	0.97	A
			Fe-59	pCi	122	124	0.98	A
			Mn-54	pCi	120	122	0.99	A
			Zn-65	pCi	175	183	0.96	A
	E11918	Water	Fe-55	pCi/L	1630	1630	1.00	A
	E11919	Soil	Ce-141	pCi/g	0.136	0.142	0.96	A
			Co-58	pCi/g	0.179	0.191	0.94	A
			Co-60	pCi/g	0.405	0.429	0.94	A
			Cr-51	pCi/g	0.230	0.355	0.65	N [(1)]
			Cs-134	pCi/g	0.272	0.328	0.83	A
			Cs-137	pCi/g	0.336	0.356	0.94	A
			Fe-59	pCi/g	0.210	0.205	1.02	A
			Mn-54	pCi/g	0.210	0.201	1.05	A
			Zn-65	pCi/g	0.301	0.301	1.00	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:
- *A = Acceptable - reported result falls within ratio limits of 0.80-1.20*
- *W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30*
- *N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30*

(1) See NCR 17-16

Table D-1

2017 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM (TBE)

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value (a)	Ratio of TBE to Analytics Result	Evaluation (b)
December 2017	E12054	Milk	Sr-89	pCi/L	92.1	92.3	1.00	A
			Sr-90	pCi/L	18.3	16.9	1.09	A
	E12055	Milk	Ce-141	pCi/L	97.8	98.3	0.99	A
			Co-58	pCi/L	92.3	89.9	1.03	A
			Co-60	pCi/L	176	173	1.02	A
			Cr-51	pCi/L	226	242	0.93	A
			Cs-134	pCi/L	118	125	0.95	A
			Cs-137	pCi/L	148	141	1.05	A
			Fe-59	pCi/L	123	113	1.08	A
			I-131	pCi/L	66.0	57.8	1.14	A
			Mn-54	pCi/L	173	161	1.08	A
			Zn-65	pCi/L	233	211	1.10	A
	E12056	Charcoal	I-131	pCi	48.1	47.5	1.01	A
	E12057A	AP	Ce-141	pCi	108	111	0.97	A
			Co-58	pCi	89.5	102	0.88	A
			Co-60	pCi	223	196	1.14	A
			Cr-51	pCi	311	274	1.13	A
			Cs-134	pCi	141	142	1.00	A
			Cs-137	pCi	162	160	1.01	A
			Fe-59	pCi	121	129	0.94	A
			Mn-54	pCi	177	182	0.97	A
			Zn-65	pCi	203	239	0.85	A
	E12058	Water	Fe-55	pCi/L	1970	1740	1.13	A
	E12059	AP	Sr-89	pCi	71.2	87.4	0.81	A
			Sr-90	pCi	12.9	16.0	0.81	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:
A = Acceptable - reported result falls within ratio limits of 0.80-1.20
W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30
N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Table D-2

DOE's MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP) (TBE)

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [a]	Acceptance Range	Evaluation [b]
February 2017	17-MaS36	Soil	Ni-63	Bq/kg	-5.512		*(1)*	A
			Sr-90	Bq/kg	571	624	437 - 811	A
	17-MaW36	Water	Am-241	Bq/L	0.693	0.846	0.592 - 1.100	A
			Ni-63	Bq/L	13.4	12.2	8.5 - 15.9	A
			Pu-238	Bq/L	0.7217	0.703	0.492 - 0.914	A
			Pu-239/240	Bq/L	0.9277	0.934	0.654 - 1.214	A
	17-RdF36	AP	U-234/233	Bq/sample	0.0911	0.104	0.073 - 0.135	A
			U-238	Bq/sample	0.0967	0.107	0.075 - 0.139	A
	17-RdV36	Vegetation	Cs-134	Bq/sample	6.44	6.95	4.87 - 9.04	A
			Cs-137	Bq/sample	4.61	4.60	3.22 - 5.98	A
			Co-57	Bq/sample	-0.0229		*(1)*	A
			Co-60	Bq/sample	8.52	8.75	6.13 - 11.38	A
			Mn-54	Bq/sample	3.30	3.28	2.30 - 4.26	A
			Sr-90	Bq/sample	1.30	1.75	1.23 - 2.28	W
			Zn-65	Bq/sample	5.45	5.39	3.77 - 7.01	A
August 2017	17-MaS37	Soil	Ni-63	Bq/kg	1130	1220	854 - 1586	A
			Sr-90	Bq/kg	296	289	202 - 376	A
	17-MaW37	Water	Am-241	Bq/L	0.838	0.892	0.624 - 1.160	A
			Ni-63	Bq/L	-0.096		*(1)*	A
			Pu-238	Bq/L	0.572	0.603	0.422 - 0.784	A
			Pu-239/240	Bq/L	0.863	0.781	0.547 - 1.015	A
	17-RdF37	AP	U-234/233	Bq/sample	0.103	0.084	0.059 - 0.109	W
			U-238	Bq/sample	0.115	0.087	0.061 - 0.113	N [(2)]
	17-RdV37	Vegetation	Cs-134	Bq/sample	2.34	2.32	1.62 - 3.02	A
			Cs-137	Bq/sample	0.05		*(1)*	A
			Co-57	Bq/sample	3.32	2.8	2.0 - 3.6	A
			Co-60	Bq/sample	2.09	2.07	1.45 - 2.69	A
			Mn-54	Bq/sample	2.90	2.62	1.83 - 3.41	A
			Sr-90	Bq/sample	1.17	1.23	0.86 - 1.60	A
			Zn-65	Bq/sample	6.07	5.37	3.76 - 6.98	A

(a) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) DOE/MAPEP evaluation:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) False positive test

(2) See NCR 17-15

Table D-3

2017 ERA ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM (TBE)

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value [(a)]	Acceptance Limits	Evaluation [(b)]
March 2017	MRAD-26	AP	GR-A	pCi/sample	76.3	85.5	28.6 - 133	A
April 2017	RAD-109	Water	Ba-133	pCi/L	49.2	49.7	40.8 - 55.1	A
			Cs-134	pCi/L	83.2	90.1	74.0 - 99.1	A
			Cs-137	pCi/L	202	206	185 - 228	A
			Co-60	pCi/L	51.2	54.7	49.2 - 62.7	A
			Zn-65	pCi/L	39.3	53.8	47.2 - 65.9	N [(1)]
			GR-A	pCi/L	53.6	75.0	39.5 - 92.3	A
			GR-B	pCi/L	42.7	38.5	25.5 - 46.0	A
			U-Nat	pCi/L	50.1	55.6	45.2 - 61.7	A
			H-3	pCi/L	7080	6850	5920 - 7540	A
			Sr-89	pCi/L	40.7	66.2	53.8 - 74.3	N [(1)]
			Sr-90	pCi/L	26.9	26.7	19.3 - 31.1	A
			I-131	pCi/L	26.7	29.9	24.9 - 34.9	A
September 2017	MRAD-27	AP	GR-A	pCi/sample	40.9	50.1	16.8 - 77.8	A
		AP	GR-B	pCi/sample	58.0	61.8	39.1 - 90.1	A
October 2017	RAD-111	Water	Ba-133	pCi/L	71.3	73.7	61.7 - 81.1	A
			Cs-134	pCi/L	43.0	53.0	42.8 - 58.3	A
			Cs-137	pCi/L	48.2	52.9	47.6 - 61.1	A
			Co-60	pCi/L	69.0	69.5	62.6 - 78.9	A
			Zn-65	pCi/L	335	348	313 - 406	A
			GR-A	pCi/L	32.5	35.6	18.3 - 45.8	A
			GR-B	pCi/L	24.3	25.6	16.0 - 33.6	A
			U-Nat	pCi/L	36.6	37.0	30.0 - 40.9	A
			H-3	pCi/L	6270	6250	5390 - 6880	A
			I-131	pCi/L	26.4	24.2	20.1 - 28.7	A
November 2017	111317O	Water	Sr-89	pCi/L	57.1	50.0	39.4 - 57.5	A
			Sr-90	pCi/L	27.1	41.8	30.8 - 48.0	N [(2)]

(a) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(b) ERA evaluation:

A = Acceptable - Reported value falls within the Acceptance Limits

N = Not Acceptable - Reported value falls outside of the Acceptance Limits

(1) See NCR 17-09

(2) See NCR 17-19

Table D-4

2017 ECKERT & ZIEGLER ANALYTICS PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Ratio	Evaluation
EZA	1st/2017	07/07/17	E11818	Cartridge	pCi	Iodine-131	9.93E+01	9.46E+01	1.05	Acceptable
EZA	1st/2017	07/07/17	E11819	Milk	pCi/L	Strontium-89	8.86E+01	9.96E+01	0.89	Acceptable
EZA	1st/2017	07/07/17	E11819	Milk	pCi/L	Strontium-90	1.97E+01	2.55E+01	0.77	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Iodine-131	9.57E+01	9.68E+01	0.99	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cerium-141	1.21E+02	1.19E+02	1.02	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Chromium-51	1.76E+02	2.12E+02	0.83	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cesium-134	1.71E+02	1.89E+02	0.9	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cesium-137	2.31E+02	2.27E+02	1.02	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cobalt-58	1.89E+02	1.78E+02	1.06	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Manganese-54	2.74E+02	2.49E+02	1.1	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Iron-59	1.35E+02	1.27E+02	1.06	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Zinc-65	3.22E+02	2.96E+02	1.09	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cobalt-60	2.85E+02	2.93E+02	0.97	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Iodine-131	9.68E+01	8.79E+01	1.1	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cerium-141	1.24E+02	1.19E+02	1.05	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Chromium-51	2.43E+02	2.11E+02	1.15	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cesium-134	1.84E+02	1.88E+02	0.98	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cesium-137	2.49E+02	2.26E+02	1.1	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cobalt-58	1.88E+02	1.77E+02	1.06	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Manganese-54	2.79E+02	2.48E+02	1.13	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Iron-59	1.46E+02	1.27E+02	1.15	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Zinc-65	3.36E+02	2.95E+02	1.14	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cobalt-60	3.07E+02	2.92E+02	1.05	Acceptable
EZA	2nd/2017	08/02/17	E11873	Cartridge	pCi	Iodine-131	8.65E+01	8.46E+01	1.02	Acceptable
EZA	2nd/2017	08/02/17	E11874	Milk	pCi/L	Strontium-89	8.88E+01	9.26E+01	0.96	Acceptable
EZA	2nd/2017	08/02/17	E11874	Milk	pCi/L	Strontium-90	9.50E+00	1.35E+01	0.71	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cerium-141	1.62E+02	1.51E+02	1.07	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cobalt-58	1.53E+02	1.55E+02	0.98	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cobalt-60	2.07E+02	1.91E+02	1.08	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Chromium-51	3.65E+02	3.15E+02	1.16	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cesium-134	1.74E+02	1.88E+02	0.92	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cesium-137	1.57E+02	1.50E+02	1.05	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Iron-59	1.28E+02	1.15E+02	1.11	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Iodine-131	9.93E+01	9.36E+01	1.06	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Manganese-54	1.95E+02	1.72E+02	1.14	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Zinc-65	2.18E+02	2.04E+02	1.07	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cerium-141	2.09E+02	1.99E+02	1.05	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cobalt-58	2.11E+02	2.04E+02	1.04	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cobalt-60	2.57E+02	2.50E+02	1.03	Acceptable

Table D-4

2017 ECKERT & ZIEGLER ANALYTICS PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Ratio	Evaluation
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Chromium-51	4.41E+02	4.13E+02	1.07	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cesium-134	2.38E+02	2.47E+02	0.96	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cesium-137	2.20E+02	1.97E+02	1.12	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Iron-59	1.64E+02	1.51E+02	1.09	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Iodine-131	8.69E+01	8.12E+01	1.07	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Manganese-54	2.43E+02	2.25E+02	1.08	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Zinc-65	2.95E+02	2.67E+02	1.10	Acceptable
EZA	3rd/2017	11/10/17	E11926	Cartridge	pCi	Iodine-131	6.30E+01	6.48E+01	0.97	Acceptable
EZA	3rd/2017	11/10/17	E11927	Milk	pCi/L	Strontium-89	7.50E+01	8.27E+01	0.91	Acceptable
EZA	3rd/2017	11/10/17	E11927	Milk	pCi/L	Strontium-90	1.01E+01	1.21E+01	0.84	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Iodine-131	7.35E+01	7.10E+01	1.04	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cerium-141	8.31E+01	8.70E+01	0.95	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Chromium-51	2.37E+02	2.17E+02	0.92	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cesium-134	1.85E+02	2.01E+02	0.92	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cesium-137	1.67E+02	1.72E+02	0.97	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cobalt-58	1.21E+02	1.17E+02	1.03	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Manganese-54	1.28E+02	1.23E+02	1.04	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Iron-59	1.56E+02	1.25E+02	1.24	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Zinc-65	1.97E+02	1.84E+02	1.07	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cobalt-60	2.59E+02	2.62E+02	0.99	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Iodine-131	8.08E+01	7.92E+01	1.02	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cerium-141	1.09E+02	9.95E+01	1.1	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Chromium-51	2.47E+02	2.48E+02	1	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cesium-134	2.06E+02	2.29E+02	0.9	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cesium-137	2.00E+02	1.96E+02	1.02	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cobalt-58	1.41E+02	1.34E+02	1.05	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Manganese-54	1.50E+02	1.40E+02	1.07	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Iron-59	1.58E+02	1.43E+02	1.10	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Zinc-65	2.37E+02	2.10E+02	1.13	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cobalt-60	3.18E+02	2.99E+02	1.06	Acceptable
EZA	4th/2017	02/02/18	E12067	Cartridge	pCi	Iodine-131	4.84E+01	4.81E+01	1.01	Acceptable
EZA	4th/2017	02/02/18	E12068	Milk	pCi/L	Strontium-89	9.54E+01	9.23E+01	1.03	Acceptable
EZA	4th/2017	02/02/18	E12068	Milk	pCi/L	Strontium-90	1.34E+01	1.69E+01	0.79	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cerium-141	1.07E+02	9.83E+01	1.09	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cobalt-58	9.29E+01	8.99E+01	1.03	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cobalt-60	1.95E+02	1.73E+02	1.13	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Chromium-51	2.69E+02	2.42E+02	1.11	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cesium-134	1.20E+02	1.25E+02	0.96	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cesium-137	1.63E+02	1.41E+02	1.15	Acceptable

Table D-4

2017 ECKERT & ZIEGLER ANALYTICS PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Ratio	Evaluation
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Iron-59	1.27E+02	1.13E+02	1.12	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Iodine-131	6.59E+01	5.78E+01	1.14	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Manganese-54	1.79E+02	1.61E+02	1.11	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Zinc-65	2.34E+02	2.11E+02	1.11	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cerium-141	6.60E+01	6.24E+01	1.06	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cobalt-58	5.95E+01	5.70E+01	1.04	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cobalt-60	1.15E+02	1.10E+02	1.05	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Chromium-51	1.68E+02	1.54E+02	1.09	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cesium-134	7.47E+01	7.92E+01	0.94	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cesium-137	9.31E+01	8.97E+01	1.04	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Iron-59	8.74E+01	7.19E+01	1.22	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Iodine-131	5.36E+01	4.95E+01	1.08	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Manganese-54	1.14E+02	1.02E+02	1.12	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Zinc-65	1.57E+02	1.34E+02	1.17	Acceptable

Table D-5

2017 DEPARTMENT OF ENERGY MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP) RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range	Evaluation
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Americium-241	65.7	67.0	46.9 - 87.1	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Cesium-134	1470	1550	1085 - 2015	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Cesium-137	679	611	428 - 794	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Cobalt-57	0.812		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Cobalt-60	958	891	624 - 1158	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Iron-55	804	812	568 - 1056	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Manganese-54	1080	967	677 - 1257	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Nickel-63	-46		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Plutonium-238	0.574	0.41	Sens. Eval.	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Plutonium-239/240	51.2	59.8	41.9 - 77.7	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Potassium-40	624	607	425-789	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Strontium-90	548	624	437 - 811	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Technetium-99	641	656	459 - 853	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	U-234/233	56.9	48.1	33.7 - 62.5	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Uranium-238	53.9	48.8	34.2 - 63.7	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Zinc-65	-4.0		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Americium-241	0.8070	0.846	0.592-1.1	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Cesium-134	0.037		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Cesium-137	12.2	11.1	7.8 - 14.4	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Cobalt-57	29.0	28.5	20.0 - 37.1	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Cobalt-60	12.8	12.3	8.6 - 16.0	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Hydrogen-3	245	249	174 - 324	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Iron-55	2.01	1.7	Sens. Eval.	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Manganese-54	15.7	14.9	10.4 - 19.4	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Nickel-63	13.6	12.2	8.5 - 15.9	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Plutonium-238	0.635	0.703	0.492 - 0.914	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Plutonium-239/240	0.841	0.934	0.654 - 1.214	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Potassium-40	276	254	178 - 330	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Radium-226	0.443	0.504	0.353 - 0.655	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Strontium-90	9.27	10.1	7.1 - 13.1	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Technetium-99	5.81	6.25	4.38 - 8.13	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Uranium-234/233	1.11	1.16	0.81 - 1.51	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Uranium-238	1.16	1.20	0.84 - 1.56	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Zinc-65	-0.0504		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- XaW36	Water	Bq/L	Iodine-129	0.01		False Pos Test	Acceptable

Table D-5

2017 DEPARTMENT OF ENERGY MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP) RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range	Evaluation
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	ug/sample	Uranium-235	0.058	0.0623	0.0436 - 0.0810	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	ug/sample	Uranium-238	8.49	8.6	6.0 - 11.2	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	ug/sample	Uranium-Total	8.55	8.7	6.1 - 11.3	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Americium-241	0.0386	0.0376	0.0263 - 0.0489	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Cesium-134	1.38	1.42	0.99 - 1.85	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Cesium-137	0.781	0.685	0.480 - 0.891	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Cobalt-57	1.77	1.70	1.19 - 2.21	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Cobalt-60	0.863	0.78	0.55 - 1.01	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Manganese-54	-0.0344		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Plutonium-238	0.0539	0.0598	0.0419 - 0.0777	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Plutonium-239/240	0.0419	0.046	0.0322 - 0.0598	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Strontium-90	0.543	0.651	0.456 - 0.846	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Uranium-234/233	0.105	0.104	0.073 - 0.135	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Uranium-238	0.106	0.107	0.075 - 0.139	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Zinc-65	1.34	1.29	0.9 - 1.68	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Americium-241	0.000411		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Cesium-134	6.56	6.95	4.87 - 9.04	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Cesium-137	4.84	4.60	3.22 - 5.98	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Cobalt-57	0.0141		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Cobalt-60	9.35	8.75	6.13 - 11.38	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Manganese-54	3.39	3.28	2.3 - 4.26	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Plutonium-238	0.0506	0.0598	0.0419 - 0.0777	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Plutonium-239/240	0.0754	0.089	0.062 - 0.166	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Strontium-90	1.50	1.75	1.23 - 2.28	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Uranium-234/233	0.19	0.179	0.125 - 0.233	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Uranium-238	1.930	0.186	0.130 - 0.242	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Zinc-65	6.26	5.39	3.77 - 7.01	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Americium-241	63.1	59	41.2 - 76.4	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Cesium-134	414.00	448	314 - 582	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Cesium-137	772	722	505 - 939	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Cobalt-57	1500	1458	1021- 1895	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Cobalt-60	0.179	0	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Iron-55	933	1010	707 - 1313	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Manganese-54	894.00	825	578 - 1073	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Nickel-63	1240	1220	854 - 1586	Acceptable

Table D-5

2017 DEPARTMENT OF ENERGY MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP) RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range	Evaluation
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Plutonium-238	85.8	92.0	64 - 120	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Plutonium-239/240	64.9	68.8	48.2 - 89.4	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Potassium-40	631	592	414 -770	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Strontium-90	240	289	202 - 376	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Technetium-99	1170	1195	837 - 1554	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	U-234/233	72	69	48 - 90	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Uranium-238	209	219	153 - 285	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Zinc-65	633.0	559	391 - 727	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Americium-241	0.874	0.892	0.624 - 1.160	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Cesium-134	10.50	11.5	8.1 - 15.0	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Cesium-137	16.800	16.3	11.2 - 21.2	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Cobalt-57	12.1	12.1	8.5-15.7	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Cobalt-60	10.800	10.7	7.5 - 13.9	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Hydrogen-3	250	258	181 - 335	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Iron-55	20.1	19.4	13.6 - 25.2	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Manganese-54	15.5	14.9	10.4 - 19.4	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Nickel-63	0.764	0	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Plutonium-238	0.528	0.60	0.422 - 0.784	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Plutonium-239/240	0.654	0.781	0.547 - 1.015	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Potassium-40	-1.2	0	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Radium-226	0.774	0.86	0.601 - 1.115	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Strontium-90	7.04	8	5.44 - 10.10	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Technetium-99	6.41	6.73	4.71 - 8.75	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Uranium-234/233	1.09	1.01	0.71-1.31	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Uranium-238	1.140	1.040	0.73 - 1.35	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Zinc-65	17.3	15.5	10.9	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- XaW37	Alk. Water	Bq/L	Iodine-129	2.590	2.310	1.62 - 3.00	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	ug/sample	Uranium-235	0.0521	0.0507	0.0355 - 0.0659	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	ug/sample	Uranium-238	7.8	7.0	4.90 - 9.10	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	ug/sample	Uranium-Total	7.84	7.05	4.94 - 9.17	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Americium-241	0.053300	0	0.0458 - 0.0796	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Cesium-134	1.0300	1.00	0.7-1.30	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Cesium-137	0.88	0.82	0.57-1.07	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Cobalt-57	0.01	0.00	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Cobalt-60	0.75	0.68	0.48 - 0.88	Acceptable

Table D-5

2017 DEPARTMENT OF ENERGY MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP) RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range	Evaluation
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Manganese-54	1.48	1.30	0.91 - 1.69	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Plutonium-238	0.0257	0.0298	0.0209 - 0.0387	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Plutonium-239/240	0.0408	0.0468	0.0328 - 0.0608	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Strontium-90	0.608	0.801	0.561 - 1.041	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Uranium-234/233	0.086	0.084	0.059 - 0.109	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Uranium-238	0.093	0.087	0.061-0.113	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Zinc-65	1.2500	1.08	0.76 - 1.40	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Americium-241	0.080	0.077	0.054 - 0.1	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Cesium-134	2.30	2.32	1.62 - 3.02	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Cesium-137	0.0191	0.00	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Cobalt-57	2.92	2.80	2.0 - 3.6	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Cobalt-60	2.24	2.07	1.45 - 2.69	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Manganese-54	2.78	2.62	1.83-3.41	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Plutonium-238	0.0762	0.0830	0.058 - 0.108	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Plutonium-239/240	0.104	0.108	0.076 - 0.140	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Strontium-90	0.960	1.23	0.86 - 1.6	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Uranium-234/233	0.162	0.159	0.111 - 0.207	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Uranium-238	0.166	0.163	0.114 - 0.212	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Zinc-65	5.93	5.37	3.76 - 6.98	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Barium-133	86.7	85.6	72.0 - 94.2	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Cesium-134	51.2	52.6	42.4 - 57.9	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Cesium-137	118	112	101 - 126	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Cobalt-60	118	113	102 - 126	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Zinc-65	202	189	170 - 222	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Gross Alpha	71.6	52.3	27.3 - 65.5	Not Acceptable[1]
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Gross Alpha	69.6	52.3	27.3 - 65.5	Not Acceptable[1]
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Gross Beta	37.6	41.6	27.7 - 49.0	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Radium-226	12.3	12.7	9.48 - 14.7	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Radium-226	13.1	12.7	9.48 - 14.7	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Radium-226	14.2	12.7	9.48 - 14.7	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Radium-228	6.31	6.2	3.83 - 8.08	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Radium-228	6.36	6.2	3.83 - 8.08	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Uranium (Nat)	12.2	12.6	9.91 - 14.4	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	µg/L	Uranium (Nat) mass	19.7	18.4	14.5 - 21.1	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	µg/L	Uranium (Nat) mass	18.9	18.4	14.5 - 21.1	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Tritium	11300	12500	10900 - 13800	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Tritium	11600	12500	10900 - 13800	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Strontium-89	60.2	55.5	44.3 - 63.2	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Strontium-89	54.5	55.5	44.3 - 63.2	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Strontium-90	35.9	43.1	31.8 - 49.5	Acceptable
ERA	1st/2017	2/27/17	RAD-108	Water	pCi/L	Strontium-90	37.7	43.1	31.8 - 49.5	Acceptable
EZA	1st/2017	07/07/17	E11818	Cartridge	pCi	Iodine-131	9.93E+01	9.46E+01	1.05	Acceptable
EZA	1st/2017	07/07/17	E11819	Milk	pCi/L	Strontium-89	8.86E+01	9.96E+01	0.89	Acceptable
EZA	1st/2017	07/07/17	E11819	Milk	pCi/L	Strontium-90	1.97E+01	2.55E+01	0.77	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Iodine-131	9.57E+01	9.68E+01	0.99	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cerium-141	1.21E+02	1.19E+02	1.02	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Chromium-51	1.76E+02	2.12E+02	0.83	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cesium-134	1.71E+02	1.89E+02	0.9	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cesium-137	2.31E+02	2.27E+02	1.02	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cobalt-58	1.89E+02	1.78E+02	1.06	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Manganese-54	2.74E+02	2.49E+02	1.1	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Iron-59	1.35E+02	1.27E+02	1.06	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Zinc-65	3.22E+02	2.96E+02	1.09	Acceptable
EZA	1st/2017	07/07/17	E11820	Milk	pCi/L	Cobalt-60	2.85E+02	2.93E+02	0.97	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Iodine-131	9.68E+01	8.79E+01	1.1	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cerium-141	1.24E+02	1.19E+02	1.05	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Chromium-51	2.43E+02	2.11E+02	1.15	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cesium-134	1.84E+02	1.88E+02	0.98	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cesium-137	2.49E+02	2.26E+02	1.1	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cobalt-58	1.88E+02	1.77E+02	1.06	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Manganese-54	2.79E+02	2.48E+02	1.13	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Iron-59	1.46E+02	1.27E+02	1.15	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Zinc-65	3.36E+02	2.95E+02	1.14	Acceptable
EZA	1st/2017	07/07/17	E11821	Water	pCi/L	Cobalt-60	3.07E+02	2.92E+02	1.05	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Americium-241	65.7	67.0	46.9 - 87.1	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Cesium-134	1470	1550	1085 - 2015	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Cesium-137	679	611	428 - 794	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Cobalt-57	0.812		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Cobalt-60	958	891	624 - 1158	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Iron-55	804	812	568 - 1056	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Manganese-54	1080	967	677 - 1257	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Nickel-63	-46		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Plutonium-238	0.574	0.41	Sens. Eval.	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Plutonium- 239/240	51.2	59.8	41.9 - 77.7	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Potassium-40	624	607	425 - 789	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Strontium-90	548	624	437 - 811	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Technetium-99	641	656	459 - 853	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	U-234/233	56.9	48.1	33.7 - 62.5	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Uranium-238	53.9	48.8	34.2 - 63.7	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaS36	Soil	Bq/Kg	Zinc-65	-4.0		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Americium-241	0.8070	0.846	0.592 - 1.1	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Cesium-134	0.037		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Cesium-137	12.2	11.1	7.8 - 14.4	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Cobalt-57	29.0	28.5	20.0 - 37.1	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Cobalt-60	12.8	12.3	8.6 - 16.0	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Hydrogen-3	245	249	174 - 324	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Iron-55	2.01	1.7	Sens. Eval.	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Manganese-54	15.7	14.9	10.4 - 19.4	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Nickel-63	13.6	12.2	8.5 - 15.9	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Plutonium-238	0.635	0.703	0.492 - 0.914	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Plutonium-239/240	0.841	0.934	0.654 - 1.214	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Potassium-40	276	254	178-330	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Radium-226	0.443	0.504	0.353-0.655	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Strontium-90	9.27	10.1	7.1 - 13.1	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Technetium-99	5.81	6.25	4.38 - 8.13	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Uranium-234/233	1.11	1.16	0.81 - 1.51	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Uranium-238	1.16	1.20	0.84 - 1.56	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- MaW36	Water	Bq/L	Zinc-65	-0.0504		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- XaW36	Water	Bq/L	Iodine-129	0.01		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	ug/sample	Uranium-235	0.058	0.0623	0.0436 - 0.0810	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	ug/sample	Uranium-238	8.49	8.6	6.0 - 11.2	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	ug/sample	Uranium-Total	8.55	8.7	6.1 - 11.3	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Americium-241	0.0386	0.0376	0.0263 - 0.0489	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Cesium-134	1.38	1.42	0.99 - 1.85	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Cesium-137	0.781	0.685	0.480 - 0.891	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Cobalt-57	1.77	1.70	1.19 - 2.21	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Cobalt-60	0.863	0.78	0.55 -1.01	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Manganese-54	-0.0344		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Plutonium-238	0.0539	0.0598	0.0419 - 0.0777	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Plutonium-239/240	0.0419	0.046	0.0322 - 0.0598	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Strontium-90	0.543	0.651	0.456 - 0.846	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Uranium-234/233	0.105	0.104	0.073 - 0.135	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Uranium-238	0.106	0.107	0.075 - 0.139	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdF36	Filter	Bq/sample	Zinc-65	1.34	1.29	0.9 - 1.68	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Americium-241	0.000411		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Cesium-134	6.56	6.95	4.87 - 9.04	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Cesium-137	4.84	4.60	3.22 - 5.98	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Cobalt-57	0.0141		False Pos Test	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Cobalt-60	9.35	8.75	6.13 - 11.38	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Manganese-54	3.39	3.28	2.3 - 4.26	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Plutonium-238	0.0506	0.0598	0.0419 - 0.0777	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Plutonium-239/240	0.0754	0.089	0.062 - 0.166	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Strontium-90	1.50	1.75	1.23 - 2.28	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Uranium-234/233	0.19	0.179	0.125 - 0.233	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Uranium-238	1.930	0.186	0.130 - 0.242	Acceptable
MAPEP	2nd/2017	06/13/17	MAPEP-17- RdV36	Vegetation	Bq/sample	Zinc-65	6.26	5.39	3.77 - 7.01	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Actinium-228	1240	1240	795 - 1720	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Americium-241	480	448	262 - 582	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Bismuth-212	929	1240	330 - 1820	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Bismuth-214	2790	2750	1660 - 3960	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Cesium-134	8660	8860	5790 - 10600	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Cesium-137	8300	7500	5750 - 9650	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Cobalt-60	4620	4430	3000 - 6100	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Lead-212	1300	1240	812 - 1730	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Lead-214	3170	2890	1690 - 4310	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Manganese-54	<38.6	<1000	0.00 - 1000	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Plutonium-238	494	648	390 - 894	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Plutonium-239	442	484	316 - 669	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Potassium-40	11000	10600	7740 - 14200	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Strontium-90	6150	9150	3490 - 14500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Thorium-234	3360	1940	614 - 3650	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-234	1820	1950	1190 - 2500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-234	2030	1950	1190 - 2500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-234	2410	1950	1190 - 2500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-238	1800	1940	1200 - 2460	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-238	1970	1940	1200 - 2460	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-238	1450	1940	1200 - 2460	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-Total	3540	3980	2160 - 5250	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-Total	3750	3980	2160 - 5250	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-Total	4090	3980	2160 - 5250	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total	3860	3980	2160 - 5250	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total (mass)	5280	5800	3200 - 7290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total (mass)	5420	5800	3200 - 7290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total (mass)	5900	5800	3200 - 7290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total (mass)	4440	5800	3200 - 7290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Zinc-65	7020	6090	4850 - 8090	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Americium-241	1700	1860	1140 - 2470	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Cesium-134	1660	1830	1180 - 2380	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Cesium-137	2470	2500	1810 - 3480	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Cobalt-60	1350	1390	959 - 1940	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Curium-244	629	734	360 - 1140	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Manganese-54	<32.2	<300	0.00 - 300	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Plutonium-238	2880	3250	1940 - 4450	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Plutonium-239	1990	2150	1320 - 2960	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Potassium-40	30900	30900	22300 - 43400	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Strontium-90	701	726	414 - 963	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-234	2720	3090	2030 - 3970	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-234	3080	3090	2030 - 3970	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-238	2820	3060	2040 - 3890	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-238	3020	3060	2040 - 3890	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-Total	5970	6290	4260 - 7830	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-Total	5690	6290	4260 - 7830	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-Total	6238	6290	4260 - 7830	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	µg/kg	Uranium-Total (mass)	8910	9250	6200 - 11700	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	µg/kg	Uranium-Total (mass)	8440	9250	6200 - 11700	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	µg/kg	Uranium-Total (mass)	9030	9250	6200 - 11700	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Zinc-65	907	853	615 - 1200	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Americium-241	80.6	76.4	47.1 - 103	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Cesium-134	1140	1100	700 - 1360	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Cesium-137	1490	1390	1040 - 1830	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Cobalt-60	1120	1030	797 - 1290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Iron-55	242	256	79.4 - 500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Manganese-54	<7.53	<50.0	0.00 - 50.0	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Plutonium-238	54.1	54.3	37.2 - 71.4	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Plutonium-239	58.2	62	44.9 - 81.0	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Strontium-90	52.2	52.4	25.6 - 78.5	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-234	71.1	73.1	45.3 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-234	79	73.1	45.3 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-238	70.7	72.4	46.8 - 100	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-238	77.1	72.4	46.8 - 100	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-Total	154	149	82.5 - 227	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-Total	145	149	82.5 - 227	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-Total	159.5	149	82.5 - 227	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	µg/Filter	Uranium-Total (mass)	230	217	139 - 306	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	µg/Filter	Uranium-Total (mass)	212	217	139 - 306	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	µg/Filter	Uranium-Total (mass)	231	217	139 - 306	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Zinc-65	1160	984	705 - 1360	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Gross Alpha	112	85.5	28.6 - 133	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Gross Beta	54.9	45.2	28.6 - 65.9	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Americium-241	150	140	94.3 - 188	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Cesium-134	2380	2510	1840 - 2880	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Cesium-137	1480	1400	1190 - 1680	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Cobalt-60	2570	2540	2210 - 2970	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Iron-55	923	984	587 - 1340	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Manganese-54	<6.36	<100	0.00 - 100	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Plutonium-238	108	128	94.7 - 159	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Plutonium-239	73.3	85.8	66.6 - 108	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performance Evaluation
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Strontium-90	685	714	465 - 944	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-234	82.1	90.3	67.8 - 116	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-234	92	90.3	67.8 - 116	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-234	87.1	90.3	67.8 - 116	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-238	86.7	89.5	68.2 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-238	84.1	89.5	68.2 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-238	98	89.5	68.2 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-Total	181	184	135 - 238	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-Total	173	184	135 - 238	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-Total	180	184	135 - 238	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-Total	185	184	135 - 238	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	µg/L	Uranium-Total (mass)	270	268	214 - 324	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	µg/L	Uranium-Total (mass)	260	268	214 - 324	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	µg/L	Uranium-Total (mass)	252	268	214 - 324	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	µg/L	Uranium-Total (mass)	276	268	214 - 324	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Zinc-65	2160	1960	1630 - 2470	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Gross Alpha	125	89.5	31.8 - 139	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Gross Beta	59.6	61	34.9 - 90.4	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Tritium	18900	19400	13000 - 27700	Acceptable
ERA	2nd/2017	05/30/17	RAD-109	Water	pCi/L	Gross Alpha	79.7	75	39.5 - 92.3	Acceptable
ERA	2nd/2017	05/30/17	RAD-109	Water	pCi/L	Gross Alpha	72.9	75	39.5 - 92.3	Acceptable
ERA	2nd/2017	05/30/17	RAD-109	Water	pCi/L	Gross Alpha	72.9	75	39.5 - 92.3	Acceptable
EZA	2nd/2017	08/02/17	E11873	Cartridge	pCi	Iodine-131	8.65E+01	8.46E+01	1.02	Acceptable
EZA	2nd/2017	08/02/17	E11874	Milk	pCi/L	Strontium-89	8.88E+01	9.26E+01	0.96	Acceptable
EZA	2nd/2017	08/02/17	E11874	Milk	pCi/L	Strontium-90	9.50E+00	1.35E+01	0.71	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cerium-141	1.62E+02	1.51E+02	1.07	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cobalt-58	1.53E+02	1.55E+02	0.98	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cobalt-60	2.07E+02	1.91E+02	1.08	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Chromium-51	3.65E+02	3.15E+02	1.16	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cesium-134	1.74E+02	1.88E+02	0.92	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Cesium-137	1.57E+02	1.50E+02	1.05	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Iron-59	1.28E+02	1.15E+02	1.11	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Iodine-131	9.93E+01	9.36E+01	1.06	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Manganese-54	1.95E+02	1.72E+02	1.14	Acceptable
EZA	2nd/2017	08/02/17	E11875	Milk	pCi/L	Zinc-65	2.18E+02	2.04E+02	1.07	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cerium-141	2.09E+02	1.99E+02	1.05	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cobalt-58	2.11E+02	2.04E+02	1.04	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cobalt-60	2.57E+02	2.50E+02	1.03	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Chromium-51	4.41E+02	4.13E+02	1.07	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cesium-134	2.38E+02	2.47E+02	0.96	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Cesium-137	2.20E+02	1.97E+02	1.12	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Iron-59	1.64E+02	1.51E+02	1.09	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Iodine-131	8.69E+01	8.12E+01	1.07	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Manganese-54	2.43E+02	2.25E+02	1.08	Acceptable
EZA	2nd/2017	08/02/17	E11876	Water	pCi/L	Zinc-65	2.95E+02	2.67E+02	1.10	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Barium-133	68.8	66.3	55.2 - 72.9	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Cesium-134	24.7	24.4	18.7 - 27.2	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Cesium-137	51.7	51.6	46.4 - 59.6	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Cobalt-60	97	88.6	79.7 - 99.8	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Zinc-65	39.7	32.7	27.3 - 41.6	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Gross Alpha	26.3	25.7	13.0 - 34.1	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Gross Alpha	31.9	25.7	13.0 - 34.1	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Gross Beta	54.4	63	43.5 - 69.6	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Radium-226	1.6	1.29	1.07 - 1.95	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Radium-226	1.21	1.29	1.07 - 1.95	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Radium-228	6.49	5.66	3.45 - 7.47	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Radium-228	5.59	5.66	3.45 - 7.47	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Uranium (Nat)	65	66.7	54.3 - 73.9	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Uranium (Nat)	66.2	66.7	54.3 - 73.9	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	µg/L	Uranium (Nat) mass	97	98.1	79.8 - 109	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	µg/L	Uranium (Nat) mass	104.7	98.1	79.8 - 109	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Tritium	5120	5060	4340 - 5570	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Tritium	4620	5060	4340 - 5570	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Strontium-89	29.9	26.4	18.4 - 32.9	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Strontium-89	28.2	26.4	18.4 - 32.9	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Strontium-90	37.8	36	26.4 - 41.5	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Strontium-90	34	36	26.4 - 41.5	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Iodine-131	28	25.5	21.2 - 30.1	Acceptable
ERA	3rd / 2017	08/28/17	RAD - 110	Water	pCi/L	Iodine-131	33	25.5	21.2 - 30.1	Not Acceptable[2]
EZA	3rd/2017	11/10/17	E11926	Cartridge	pCi	Iodine-131	6.30E+01	6.48E+01	0.97	Acceptable
EZA	3rd/2017	11/10/17	E11927	Milk	pCi/L	Strontium-89	7.50E+01	8.27E+01	0.91	Acceptable
EZA	3rd/2017	11/10/17	E11927	Milk	pCi/L	Strontium-90	1.01E+01	1.21E+01	0.84	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Iodine-131	7.35E+01	7.10E+01	1.04	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cerium-141	8.31E+01	8.70E+01	0.95	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Chromium-51	2.37E+02	2.17E+02	0.92	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cesium-134	1.85E+02	2.01E+02	0.92	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cesium-137	1.67E+02	1.72E+02	0.97	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cobalt-58	1.21E+02	1.17E+02	1.03	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Manganese-54	1.28E+02	1.23E+02	1.04	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Iron-59	1.56E+02	1.25E+02	1.24	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Zinc-65	1.97E+02	1.84E+02	1.07	Acceptable
EZA	3rd/2017	11/10/17	E11928	Milk	pCi/L	Cobalt-60	2.59E+02	2.62E+02	0.99	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Iodine-131	8.08E+01	7.92E+01	1.02	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cerium-141	1.09E+02	9.95E+01	1.1	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Chromium-51	2.47E+02	2.48E+02	1	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cesium-134	2.06E+02	2.29E+02	0.9	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cesium-137	2.00E+02	1.96E+02	1.02	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cobalt-58	1.41E+02	1.34E+02	1.05	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Manganese-54	1.50E+02	1.40E+02	1.07	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Iron-59	1.58E+02	1.43E+02	1.10	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Zinc-65	2.37E+02	2.10E+02	1.13	Acceptable
EZA	3rd/2017	11/10/17	E11929	Water	pCi/L	Cobalt-60	3.18E+02	2.99E+02	1.06	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Americium-241	63.1	59	41.2 - 76.4	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Cesium-134	414.00	448	314 - 582	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Cesium-137	772	722	505 - 939	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Cobalt-57	1500	1458	1021 - 1895	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Cobalt-60	0.179	0	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Iron-55	933	1010	707 - 1313	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Manganese-54	894.00	825	578 - 1073	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Nickel-63	1240	1220	854 - 1586	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Plutonium-238	85.8	92.0	64 - 120	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Plutonium-239/240	64.9	68.8	48.2 - 89.4	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Potassium-40	631	592	414 - 770	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Strontium-90	240	289	202 - 376	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Technetium-99	1170	1195	837 - 1554	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	U-234/233	72	69	48 - 90	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Uranium-238	209	219	153 - 285	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaS37	Soil	Bq/Kg	Zinc-65	633.0	559	391 - 727	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Americium-241	0.874	0.892	0.624 - 1.160	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Cesium-134	10.50	11.5	8.1 - 15.0	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Cesium-137	16.800	16.3	11.2 - 21.2	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Cobalt-57	12.1	12.1	8.5 - 15.7	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Cobalt-60	10.800	10.7	7.5 - 13.9	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Hydrogen-3	250	258	181 - 335	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Iron-55	20.1	19.4	13.6 - 25.2	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Manganese-54	15.5	14.9	10.4 - 19.4	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Nickel-63	0.764	0	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Plutonium-238	0.528	0.60	0.422 - 0.784	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Plutonium-239/240	0.654	0.781	0.547 - 1.015	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Potassium-40	-1.2	0	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Radium-226	0.774	0.86	0.601 - 1.115	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Strontium-90	7.04	8	5.44 - 10.10	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Technetium-99	6.41	6.73	4.71 - 8.75	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Uranium-234/233	1.09	1.01	0.71 - 1.31	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Uranium-238	1.140	1.040	0.73 - 1.35	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- MaW37	Water	Bq/L	Zinc-65	17.3	15.5	10.9	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- XaW37	Alk. Water	Bq/L	Iodine-129	2.590	2.310	1.62 - 3.00	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	ug/sample	Uranium-235	0.0521	0.0507	0.0355 - 0.0659	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	ug/sample	Uranium-238	7.8	7.0	4.90 - 9.10	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	ug/sample	Uranium-Total	7.84	7.05	4.94 - 9.17	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Americium-241	0.053300	0	0.0458 - 0.0796	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Cesium-134	1.0300	1.00	0.7 - 1.30	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Cesium-137	0.88	0.82	0.57 - 1.07	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Cobalt-57	0.01	0.00	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Cobalt-60	0.75	0.68	0.48 - 0.88	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Manganese-54	1.48	1.30	0.91 - 1.69	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Plutonium-238	0.0257	0.0298	0.0209 - 0.0387	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Plutonium-239/240	0.0408	0.0468	0.0328 - 0.0608	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Strontium-90	0.608	0.801	0.561 - 1.041	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Uranium- 234/233	0.086	0.084	0.059 - 0.109	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Uranium-238	0.093	0.087	0.061 - 0.113	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
MAPEP	4th/2017	12/01/17	MAPEP-17- RdF37	Filter	Bq/sample	Zinc-65	1.2500	1.08	0.76-1.40	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Americium-241	0.080	0.077	0.054 - 0.1	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Cesium-134	2.30	2.32	1.62 - 3.02	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Cesium-137	0.0191	0.00	False Pos Test	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Cobalt-57	2.92	2.80	2.0 - 3.6	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Cobalt-60	2.24	2.07	1.45 - 2.69	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Manganese-54	2.78	2.62	1.83 - 3.41	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Plutonium-238	0.0762	0.0830	0.058 - 0.108	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Plutonium- 239/240	0.104	0.108	0.076 - 0.140	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Strontium-90	0.960	1.23	0.86 - 1.6	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Uranium- 234/233	0.162	0.159	0.111 - 0.207	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Uranium-238	0.166	0.163	0.114 - 0.212	Acceptable
MAPEP	4th/2017	12/01/17	MAPEP-17- RdV37	Vegetation	Bq/sample	Zinc-65	5.93	5.37	3.76 - 6.98	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Actinium-228	1200	1240	795 - 1720	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Americium-241	1180	1140	667 - 1480	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Bismuth-212	1600	1240	330 - 1820	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Bismuth-214	1460	1890	1140 - 2720	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Cesium-134	5770	6320	4130 - 7590	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Cesium-137	3940	3830	2930 - 4930	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Cobalt-60	4110	4130	2790 - 5690	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Lead-212	1270	1240	812 - 1730	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Lead-214	1720	1980	1160 - 2950	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Manganese-54	<29.2	<1000	<1000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Plutonium-238	508	615	370 - 849	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Plutonium-239	578	506	331 - 699	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Potassium-40	10600	10600	7740 - 14200	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Strontium-90	2530	3460	1320 - 5470	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Thorium-234	4160	3690	1170 - 6940	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-234	4310	3720	2270 - 4770	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-234	3350	3720	2270 - 4770	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-234	3400	3720	2270 - 4770	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-238	3590	3690	2280 - 4680	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-238	4380	3690	2280 - 4680	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-238	3260	3690	2280 - 4680	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-Total	7732	7580	4110 - 10000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-Total	7190	7580	4110 - 10000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-Total	7780	7580	4110 - 10000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-Total	8090	7580	4110 - 10000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	µg/kg	Uranium-Total (mass)	12100	11100	6120 - 14000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	µg/kg	Uranium-Total (mass)	10800	11100	6120 - 14000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	µg/kg	Uranium-Total (mass)	12200	11100	6120 - 14000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	µg/kg	Uranium-Total (mass)	9770	11100	6120 - 14000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Zinc-65	7380	6660	5300 - 8850	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Americium-241	681	670	410 - 891	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Cesium-134	1530	1670	1070 - 2170	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Cesium-137	1890	1840	1330 - 2560	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Cobalt-60	2320	2180	1500 - 3050	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Curium-244	2380	2790	1370 - 4350	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Manganese-54	<36.1	<300	<300	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Plutonium-238	3340	4180	2490 - 5720	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Plutonium-239	950	1060	651 - 1460	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Potassium-40	34900	30900	22300 - 43400	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Strontium-90	2580	2650	1510 - 3510	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-234	985	995	654 - 1280	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-234	1100	995	654 - 1280	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-238	1040	987	659 - 1250	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-238	821	987	659 - 1250	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-Total	2320	2030	1380 - 2530	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-Total	1845	2030	1380 - 2530	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-Total	2390	2030	1380 - 2530	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	µg/kg	Uranium-Total (mass)	3200	2980	2000 - 3780	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	µg/kg	Uranium-Total (mass)	2460	2980	2000 - 3780	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	µg/kg	Uranium-Total (mass)	3460	2980	2000 - 3780	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Zinc-65	1670	1400	1010 - 1970	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Americium-241	15.4	14.9	9.18 - 20.2	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Cesium-134	1410	1440	916 - 1790	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Cesium-137	1010	954	717 - 1250	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Cobalt-60	296	271	210 - 339	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Iron-55	1010	1080	335 - 2110	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Manganese-54	<3.18	<50.0	<50.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Plutonium-238	61.8	63.9	43.8 - 84.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Plutonium-239	40.2	44.4	32.1 - 58.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Strontium-90	115	121	59.1 - 181	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-234	42.8	41.5	25.7 - 62.6	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-234	38.5	41.5	25.7 - 62.6	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-238	41.1	41.2	26.6 - 57.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-238	37.5	41.2	26.6 - 57.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-Total	82	84.6	46.8 - 129	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-Total	86.7	84.6	46.8 - 129	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-Total	83	84.6	46.8 - 129	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	µg/Filter	Uranium-Total (mass)	129	123	78.7 - 173	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	µg/Filter	Uranium-Total (mass)	124	123	78.7 - 173	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	µg/Filter	Uranium-Total (mass)	113	123	78.7 - 173	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Zinc-65	146	123	88.1 - 170	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Gross Alpha	60	50.1	16.8 - 77.8	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Gross Beta	68.3	61.8	39.1 - 90.1	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Americium-241	176	158	106 - 212	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Cesium-134	1340	1400	1030 - 1610	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Cesium-137	390	378	321 - 453	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Cobalt-60	1990	1830	1590 - 2140	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Iron-55	1550	1640	978 - 2230	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Manganese-54	<9.38	<100	<100	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Plutonium-238	136	158	117 - 197	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Plutonium-239	114	134	104 - 169	Acceptable

Table D-6

2017 RADIOLOGICAL PROFICIENCY TESTING RESULTS AND ACCEPTANCE CRITERIA (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Units	Analyte	Reported Value	Assigned Value	Acceptance Limits/Ratio	Performan ce Evaluation
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Strontium-90	218	222	145 - 293	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-234	163	160	120 - 206	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-234	153	160	120 - 206	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-234	157	160	120 - 206	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-238	169	158	120 - 194	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-238	136	158	120 - 194	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-Total	306	325	239 - 420	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-Total	310	325	239 - 420	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-Total	343	325	239 - 420	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	µg/L	Uranium-Total (mass)	510	474	378 - 573	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	µg/L	Uranium-Total (mass)	463	474	378 - 573	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	µg/L	Uranium-Total (mass)	407	474	378 - 573	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Zinc-65	2090	1750	1460 - 2210	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Gross Alpha	109	113	40.1 - 175	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Gross Beta	127	130	74.4 - 193	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Tritium	21100	22500	15100 - 32100	Acceptable
EZA	4th/2017	02/02/18	E12067	Cartridge	pCi	Iodine-131	4.84E+01	4.81E+01	1.01	Acceptable
EZA	4th/2017	02/02/18	E12068	Milk	pCi/L	Strontium-89	9.54E+01	9.23E+01	1.03	Acceptable
EZA	4th/2017	02/02/18	E12068	Milk	pCi/L	Strontium-90	1.34E+01	1.69E+01	0.79	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cerium-141	1.07E+02	9.83E+01	1.09	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cobalt-58	9.29E+01	8.99E+01	1.03	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cobalt-60	1.95E+02	1.73E+02	1.13	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Chromium-51	2.69E+02	2.42E+02	1.11	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cesium-134	1.20E+02	1.25E+02	0.96	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Cesium-137	1.63E+02	1.41E+02	1.15	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Iron-59	1.27E+02	1.13E+02	1.12	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Iodine-131	6.59E+01	5.78E+01	1.14	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Manganese-54	1.79E+02	1.61E+02	1.11	Acceptable
EZA	4th/2017	02/02/18	E12069	Milk	pCi/L	Zinc-65	2.34E+02	2.11E+02	1.11	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cerium-141	6.60E+01	6.24E+01	1.06	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cobalt-58	5.95E+01	5.70E+01	1.04	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cobalt-60	1.15E+02	1.10E+02	1.05	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Chromium-51	1.68E+02	1.54E+02	1.09	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cesium-134	7.47E+01	7.92E+01	0.94	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Cesium-137	9.31E+01	8.97E+01	1.04	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Iron-59	8.74E+01	7.19E+01	1.22	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Iodine-131	5.36E+01	4.95E+01	1.08	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Manganese-54	1.14E+02	1.02E+02	1.12	Acceptable
EZA	4th/2017	02/02/18	E12070	Water	pCi/L	Zinc-65	1.57E+02	1.34E+02	1.17	Acceptable

Notes:

[1] Non Agreement Investigation CARR 170227-1085
See Section 'E' of this report for details.

[2] Non Agreement Investigation CARR 170828-1125
See Section 'E' of this report for details.

Table D-7

2017 ERA PROGRAM (MRAD) PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Actinium-228	1240	1240	795 - 1720	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Americium-241	480	448	262 - 582	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Bismuth-212	929	1240	330 - 1820	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Bismuth-214	2790	2750	1660 - 3960	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Cesium-134	8660	8860	5790 - 10600	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Cesium-137	8300	7500	5750 - 9650	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Cobalt-60	4620	4430	3000 - 6100	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Lead-212	1300	1240	812 - 1730	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Lead-214	3170	2890	1690 - 4310	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Manganese-54	<38.6	<1000	0.00 - 1000	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Plutonium-238	494	648	390 - 894	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Plutonium-239	442	484	316 - 669	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Potassium-40	11000	10600	7740 - 14200	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Strontium-90	6150	9150	3490 - 14500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Thorium-234	3360	1940	614 - 3650	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-234	1820	1950	1190 - 2500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-234	2030	1950	1190 - 2500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-234	2410	1950	1190 - 2500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-238	1800	1940	1200 - 2460	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-238	1970	1940	1200 - 2460	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-238	1450	1940	1200 - 2460	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-Total	3540	3980	2160 - 5250	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-Total	3750	3980	2160 - 5250	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Uranium-Total	4090	3980	2160 - 5250	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total	3860	3980	2160 - 5250	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total (mass)	5260	5800	3200 - 7290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total (mass)	5420	5800	3200 - 7290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total (mass)	5900	5800	3200 - 7290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	µg/kg	Uranium-Total (mass)	4440	5800	3200 - 7290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Soil	pCi/kg	Zinc-65	7020	6090	4850 - 8090	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Americium-241	1700	1860	1140 - 2470	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Cesium-134	1660	1830	1180 - 2380	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Cesium-137	2470	2500	1810 - 3480	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Cobalt-60	1350	1390	959 - 1940	Acceptable

Table D-7

2017 ERA PROGRAM (MRAD) PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Curium-244	629	734	360 - 1140	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Manganese-54	<32.2	<300	0.00 - 300	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Plutonium-238	2880	3250	1940 - 4450	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Plutonium-239	1990	2150	1320 - 2960	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Potassium-40	30900	30900	22300 - 43400	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Strontium-90	701	726	414 - 963	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-234	2720	3090	2030 - 3970	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-234	3080	3090	2030 - 3970	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-238	2820	3060	2040 - 3890	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-238	3020	3060	2040 - 3890	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-Total	5970	6290	4260 - 7830	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-Total	5690	6290	4260 - 7830	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Uranium-Total	6238	6290	4260 - 7830	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	µg/kg	Uranium-Total (mass)	8910	9250	6200 - 11700	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	µg/kg	Uranium-Total (mass)	8440	9250	6200 - 11700	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	µg/kg	Uranium-Total (mass)	9030	9250	6200 - 11700	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Vegetation	pCi/kg	Zinc-65	907	853	615 - 1200	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Americium-241	80.6	76.4	47.1 - 103	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Cesium-134	1140	1100	700 - 1360	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Cesium-137	1490	1390	1040 - 1830	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Cobalt-60	1120	1030	797 - 1290	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Iron-55	242	256	79.4 - 500	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Manganese-54	<7.53	<50.0	0.00 - 50.0	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Plutonium-238	54.1	54.3	37.2 - 71.4	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Plutonium-239	58.2	62	44.9 - 81.0	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Strontium-90	52.2	52.4	25.6 - 78.5	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-234	71.1	73.1	45.3 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-234	79	73.1	45.3 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-238	70.7	72.4	46.8 - 100	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-238	77.1	72.4	46.8 - 100	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-Total	154	149	82.5 - 227	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-Total	145	149	82.5 - 227	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Uranium-Total	159.5	149	82.5 - 227	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	µg/Filter	Uranium-Total (mass)	230	217	139 - 306	Acceptable

Table D-7

2017 ERA PROGRAM (MRAD) PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
ERA	2nd/2017	05/23/17	MRAD-26	Filter	µg/Filter	Uranium-Total (mass)	212	217	139 - 306	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	µg/Filter	Uranium-Total (mass)	231	217	139 - 306	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Zinc-65	1160	984	705 - 1360	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Gross Alpha	112	85.5	28.6 - 133	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Filter	pCi/Filter	Gross Beta	54.9	45.2	28.6 - 65.9	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Americium-241	150	140	94.3 - 188	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Cesium-134	2380	2510	1840 - 2880	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Cesium-137	1480	1400	1190 - 1680	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Cobalt-60	2570	2540	2210 - 2970	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Iron-55	923	984	587 - 1340	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Manganese-54	<6.36	<100	0.00 - 100	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Plutonium-238	108	128	94.7 - 159	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Plutonium-239	73.3	85.8	66.6 - 108	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Strontium-90	685	714	465 - 944	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-234	82.1	90.3	67.8 - 116	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-234	92	90.3	67.8 - 116	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-234	87.1	90.3	67.8 - 116	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-238	86.7	89.5	68.2 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-238	84.1	89.5	68.2 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-238	98	89.5	68.2 - 110	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-Total	181	184	135 - 238	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-Total	173	184	135 - 238	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-Total	180	184	135 - 238	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Uranium-Total	185	184	135 - 238	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	µg/L	Uranium-Total (mass)	270	268	214 - 324	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	µg/L	Uranium-Total (mass)	260	268	214 - 324	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	µg/L	Uranium-Total (mass)	252	268	214 - 324	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	µg/L	Uranium-Total (mass)	276	268	214 - 324	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Zinc-65	2160	1960	1630 - 2470	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Gross Alpha	125	89.5	31.8 - 139	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Gross Beta	59.6	61	34.9 - 90.4	Acceptable
ERA	2nd/2017	05/23/17	MRAD-26	Water	pCi/L	Tritium	18900	19400	13000 - 27700	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Actinium-228	1200	1240	795 - 1720	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Americium-241	1180	1140	667 - 1480	Acceptable

Table D-7

2017 ERA PROGRAM (MRAD) PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Bismuth-212	1600	1240	330 - 1820	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Bismuth-214	1460	1890	1140 - 2720	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Cesium-134	5770	6320	4130 - 7590	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Cesium-137	3940	3830	2930 - 4930	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Cobalt-60	4110	4130	2790 - 5690	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Lead-212	1270	1240	812 - 1730	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Lead-214	1720	1980	1160 - 2950	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Manganese-54	<29.2	<1000	<1000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Plutonium-238	508	615	370 - 849	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Plutonium-239	578	506	331 - 699	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Potassium-40	10600	10600	7740 - 14200	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Strontium-90	2530	3460	1320 - 5470	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Thorium-234	4160	3690	1170 - 6940	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-234	4310	3720	2270 - 4770	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-234	3350	3720	2270 - 4770	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-234	3400	3720	2270 - 4770	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-238	3590	3690	2280 - 4680	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-238	4380	3690	2280 - 4680	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-238	3260	3690	2280 - 4680	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-Total	7732	7580	4110 - 10000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-Total	7190	7580	4110 - 10000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-Total	7780	7580	4110 - 10000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Uranium-Total	8090	7580	4110 - 10000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	µg/kg	Uranium-Total (mass)	12100	11100	6120 - 14000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	µg/kg	Uranium-Total (mass)	10800	11100	6120 - 14000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	µg/kg	Uranium-Total (mass)	12200	11100	6120 - 14000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	µg/kg	Uranium-Total (mass)	9770	11100	6120 - 14000	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Soil	pCi/kg	Zinc-65	7380	6660	5300 - 8850	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Americium-241	681	670	410 - 891	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Cesium-134	1530	1670	1070 - 2170	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Cesium-137	1890	1840	1330 - 2560	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Cobalt-60	2320	2180	1500 - 3050	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Curium-244	2380	2790	1370 - 4350	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Manganese-54	<36.1	<300	<300	Acceptable

Table D-7

2017 ERA PROGRAM (MRAD) PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Plutonium-238	3340	4180	2490 - 5720	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Plutonium-239	950	1060	651 - 1460	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Potassium-40	34900	30900	22300 - 43400	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Strontium-90	2580	2650	1510 - 3510	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-234	985	995	654 - 1280	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-234	1100	995	654 - 1280	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-238	1040	987	659 - 1250	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-238	821	987	659 - 1250	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-Total	2320	2030	1380 - 2530	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-Total	1845	2030	1380 - 2530	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Uranium-Total	2390	2030	1380 - 2530	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	µg/kg	Uranium-Total (mass)	3200	2980	2000 - 3780	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	µg/kg	Uranium-Total (mass)	2460	2980	2000 - 3780	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	µg/kg	Uranium-Total (mass)	3460	2980	2000 - 3780	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Vegetation	pCi/kg	Zinc-65	1670	1400	1010 - 1970	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Americium-241	15.4	14.9	9.18 - 20.2	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Cesium-134	1410	1440	916 - 1790	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Cesium-137	1010	954	717 - 1250	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Cobalt-60	296	271	210 - 339	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Iron-55	1010	1080	335 - 2110	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Manganese-54	<3.18	<50.0	<50.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Plutonium-238	61.8	63.9	43.8 - 84.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Plutonium-239	40.2	44.4	32.1 - 58.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Strontium-90	115	121	59.1 - 181	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-234	42.8	41.5	25.7 - 62.6	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-234	38.5	41.5	25.7 - 62.6	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-238	41.1	41.2	26.6 - 57.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-238	37.5	41.2	26.6 - 57.0	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-Total	82	84.6	46.8 - 129	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-Total	86.7	84.6	46.8 - 129	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Uranium-Total	83	84.6	46.8 - 129	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	µg/Filter	Uranium-Total (mass)	129	123	78.7 - 173	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	µg/Filter	Uranium-Total (mass)	124	123	78.7 - 173	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	µg/Filter	Uranium-Total (mass)	113	123	78.7 - 173	Acceptable

Table D-7

2017 ERA PROGRAM (MRAD) PERFORMANCE EVALUATION RESULTS (GEL)

PT Provider	Quarter / Year	Report Received Date	Sample Number	Sample Media	Unit	Analyte / Nuclide	GEL Value	Known value	Acceptance Range/ Ratio	Evaluation
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Zinc-65	146	123	88.1 - 170	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Gross Alpha	60	50.1	16.8 - 77.8	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Filter	pCi/Filter	Gross Beta	68.3	61.8	39.1 - 90.1	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Americium-241	176	158	106 - 212	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Cesium-134	1340	1400	1030 - 1610	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Cesium-137	390	378	321 - 453	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Cobalt-60	1990	1830	1590 - 2140	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Iron-55	1550	1640	978 - 2230	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Manganese-54	<9.38	<100	<100	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Plutonium-238	136	158	117 - 197	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Plutonium-239	114	134	104 - 169	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Strontium-90	218	222	145 - 293	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-234	163	160	120 - 206	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-234	153	160	120 - 206	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-234	157	160	120 - 206	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-238	169	158	120 - 194	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-238	136	158	120 - 194	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-Total	306	325	239 - 420	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-Total	310	325	239 - 420	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Uranium-Total	343	325	239 - 420	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	µg/L	Uranium-Total (mass)	510	474	378 - 573	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	µg/L	Uranium-Total (mass)	463	474	378 - 573	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	µg/L	Uranium-Total (mass)	407	474	378 - 573	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Zinc-65	2090	1750	1460 - 2210	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Gross Alpha	109	113	40.1 - 175	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Gross Beta	127	130	74.4 - 193	Acceptable
ERA	4th/2017	11/17/17	MRAD-27	Water	pCi/L	Tritium	21100	22500	15100 - 32100	Acceptable

Enclosure 2

Revision 28 of Salem and Hope Creek Generating Stations'

Offsite Dose Calculation Manual

Supplement to the 2017 PSEG Nuclear Annual Radiological Environmental Operating Report (AREOR)

Hope Creek ODCM Revision 28

Effective Date: 09/22/2017

(Revision Summary starts on page 2 of ODCM)

Salem ODCM Revision 28

Effective Date: 09/22/2017

(Revision Summary starts on page 3 of ODCM)

OFFSITE DOSE CALCULATION MANUAL

FOR

PSEG NUCLEAR LLC

HOPE CREEK GENERATING STATION

Revision 28

Prepared by:	Rick M. Heathwaite Hope Creek ODCM Coordinator	7/24/17 Date
Accepted by:	Shelly Kugler Hope Creek Chemistry Manager	7/31/17 Date
Accepted by:	/ Steve Poorman Hope Creek PORC Chairman	9/5/17 Date
	Meeting #: H2017-06	
Approved by:	/ Casulli Edward Hope Creek Plant Manager	9/7/17 Date

Revision Summary

This revision is effective after review and acceptance by the PORC and the approval and dated signature of the Plant General Manager.

Item No.	(old) Rev. 27 page No.	(new) Rev. 28 page No.	Description of Change	Type of Change
1	10	12	Defined date range for "new" 10 CFR Part 20 and "old" 10 CFR Part 20. Justification: Provided clarity for time period when the "new" 10 CFR Part 20 and "old" 10 CFR Part 20 were effective.	Editorial
2	22	25	Included 3 asterisks (***) on item 3.b to connect to Action 112. Justification: Need to add note for Action 112 for releases when service water by-pass is in service. (70175347/020)	Technical
3	23	26	Added note with 3 asterisks (***) to define action. Justification: Defined actions to take when liquid releases are being made when cooling tower is out of service and releases are using service water by-pass for dilution. (70175347/020)	Technical
4	40	40	The heading for the column, Lower Limit of Detection, on Table 4.11.2.1.2-1 was revised to include the proper units. The column had a typographical error. Justification: the units displayed in revision 27 on Table 4.11.2.1.2-1 were □Ci/ml, the units should be µCi/ml.	Editorial
5	40	40	Table 4.11.2.1.2-1. Updated item "D". Item D was changed from "All Release types as listed in A and B above" to "All Release types as listed in B and C above". Removed Item A. Justification: Item A, the Offgas Treatment System item was removed from the table as this is not a release point and is monitored by the North Plant Vent. Item A is now listed as "Not Used". Item D was revised to indicate it's applicable to only Items B and C. Item B is the containment purge and has unique and special sampling requirements prior to release due to the potential for releases into primary containment that may need to be accounted for as a batch release. This specification only applies to effluent release points which are the North Plant Vent, South Plant Vent, and the FRVS.	Editorial

Item No.	(old) Rev. 27 page No.	(new) Rev. 28 page No.	Description of Change	Type of Change
6	50	51	Updated Table 3.12.1-1, Radiological Environmental Monitoring Program, heading to remove the asterisk (*) and remove the item referenced by the asterisk (*) at the bottom of the page. Justification: The Item referenced by the asterisk (*) is a generic statement from NUREG-1302 to aid in the initial development of site specific environmental monitoring programs. The statement is no longer needed in the ODCM since the program is already established.	Editorial
7	50	51	Updated Table 3.12.1-1, item 1, third paragraph, to reflect current conditions. The outer ring of TLDs is in the 5 to 11 km range. Justifications The dosimeters were not relocated. The dosimeter sample location range was changed in ODCM Revision 27 because (6 to 8 km) is the range in NUREG-1302. NUREG-1302 also acknowledges that sample locations vary from site to site. Due to plant location, some of the ideal locations are not accessible or are over the water so alternate locations which are accessible were selected in the (5 to 11 km) range. This is not a change to the program but restores previously specified range of Revision 26. (70175881/010)	Editorial
8	52	53	Updated Table 3.12.1-1, Item 3.a, "Sampling Collection Frequency" from "Grab sample monthly" to "Grab sample semi-monthly and composited". Justification: the frequency was increased from monthly to semi-monthly and the sample composited for gamma analysis in order to collect a more representative surface water sample. (70152838/010)	Technical

Item No.	(old) Rev. 27 page No.	(new) Rev. 28 page No.	Description of Change	Type of Change
9	58-59	57-58	Corrected typographical error on Table 3.12.1-2. Corrected column heading "Airborne Particulate or Gases (pCi/m3)" to "Airborne Particulate or Gases (pCi/m^3)". Added note 1 to bottom of Tables 3.12.1-2 and 4.12.1-1 explaining that the H-3 and I-131 LLD/reporting values were used due to no drinking water exposure pathway. Justification: Corrected the exponent in the units for the Airborne column in Tables 3.12.1-2 and 4.12.1-1 to superscript. Note 1 for Table 3.12.1-2 explains why limit value is 30,000 pCi/L instead of 20,000 pCi/L and in Table 4.12.1-1 why LLD value is 3,000 instead of 2,000 pCi/L for H-3 as listed in NUREG-1302. Also explains why limit value is 20 pCi/L instead of 2 pCi/L and why LLD value is 15 pCi/L instead of 1 pCi/L for I-131 as listed in NUREG-1302. NUREG-1302 has notes allowing these higher values if no drinking water pathway exists. (70199487/010)	Editorial
10	63	60	Inserted a note, annotated with two asterisks (**), to ensure that receptors are on land instead of over water. Justification: The use of real receptors provides an actual dose to real pathways instead of hypothetical dose to hypothetical pathways. NUREG-0133 indicates that actual pathways should be used. (80113172/0490)	Editorial
11	66	63	Inserted information from WGE explaining rationale for time used to obtain particulate and iodine samples from gaseous release points. Justification: WGE in order 70177022/050 explained the acceptability of the specified time used to establish sampling when samplers are out service. Explanation of the time used at Hope Creek was requested to be inserted in the BASES by NRC.	Editorial

Item No.	(old) Rev. 27 page No.	(new) Rev. 28 page No.	Description of Change	Type of Change
12	70	67	Inserted a note to ensure that receptors are over land instead of water. Justification: The use of real receptors provides an actual dose to real pathways instead of hypothetical dose to hypothetical pathways. NUREG-0133 indicates that actual pathways should be used. (80113172/0490)	Editorial
13	91	90	Inserted a note to explain that as an extra measure of conservatism, there is a 25 percent reduction factor applied to the default setpoints. There is also a note explaining that the EALs are based on actual monitor readings not alarm setpoints. Justification: This item provides an explanation of the existing conditions in the ODCM and why the calculated setpoint is different from the default setpoint listed in the ODCM. (70179192/020)	Editorial
14	99	98	In Section 3.3, inserted "Revision 2" with Regulatory Guide 1.21 to indicate which revision of Regulatory Guide 1.21 is referenced for doses due to C-14 releases. Justification: This is consistent with the description contained in Section 3.3.1 for the estimation of C-14 annual releases. This is an editorial change.	Editorial
15	101	102	Updated Drawing to include service water bypass and label cooling tower blowdown line. Justification: Reflects current release pathways. (70175347/020)	Editorial
16	103	104	Adjusted Table 1-1 Column widths to proper size to contain existing information. Justification: Editorial change, columns not sized properly to hold all information. Change bars were not used for marking this editorial change.	Editorial
17	110	111	Reformatted Table 2-2. Updated Ci actual value description to include appropriate reference. Included Calculated Setpoint for RMS points and updated comment for clarification. Justification: Default setpoints were not changed, updated for clarification information only.	Editorial

Item No.	(old) Rev. 27 page No.	(new) Rev. 28 page No.	Description of Change	Type of Change
18	111	112	Updated Table 2-3, Item 3.11.2.3 to correct location. Correct location is 4.6 miles SW. Previous location was described incorrectly as 4.9 miles West. Changed the case of miles to lower case. Justification: Based on Land Use Census data the existing location was previously described incorrectly.	Editorial
19	112 through 122	113 through 123	Adjusted all columns in Table 2-4 so that numbers would fit. No data was changed. Justification: The numbers did not fit properly in the existing column widths and in some cases were not being fully displayed or printed thereby giving false indication of the number to use. This was an editorial change and no data was revised. Change bars not included since data was not altered.	Editorial
20	140	140	Changed the column 3 and 4 headings in the first table in Table C-1 to reflect the actual nomenclature as the descriptions found in the formulas. No data was changed. Reformatted the data into a table format. Table C-1 columns 3 and 4 of the Noble Gases –Air table were incorrectly labeled. The column headings were updated to reflect the same nomenclature as descriptions found in the formulas. Justification: equations C.1, C.2, C.3, and C.4 in Appendix C, "Determination of Effective Dose Factors" were used to correct the incorrect table headings. Table headings were corrected to agree with formulas and calculations.	Editorial
21	146	146-147	Updated sampling location descriptions to refer to new maps since there are now three maps instead of two as in revision 27. Appendix E Sample Designation page was completely revised. Justifications: New Sampling Locations Maps were made. Third map showing sampling location beyond 10 miles was added. Due to sampling location changes, new maps are required to show locations and station codes. Third map added for ease of reading. Appendix E Sample Designation changes were made to improve clarity and correct editorial items. Revision bars not used for this change	Editorial

Item No.	(old) Rev. 27 page No.	(new) Rev. 28 page No.	Description of Change	Type of Change
22	142 through 150	148 through 153	Table E-1, REMP Sample Locations, was updated to reflect current sample locations, add latitude and longitude information and to clarify ambiguous abbreviations. Justification: All sample locations were reviewed to ensure compliance with the requirements of ODCM Table 3.12.1-1, Radiological Environmental Monitoring Program. Sample locations were updated to reflect the actual current locations in the field. Latitude and longitudes were added to each sample location to ensure ease of location identification. Some location descriptions were improved to provide clarity. This rewrite corrects editorial items identified in review of 2014 ARERR. Revision bars not used for this change so individual changes could be marked.	Editorial
23	149	152	Table E-1.F, Water Sediment Locations (ESS), changed 6S2 to 6A1. Justification: 6S2 is already defined as an IDM location. ESS locations are beyond site boundary because they are over water so the ESS location was renamed 6A1.	Technical
24	150	153	Table E-1.I, Food Product Locations (FPL, FPV), 7S2 location added. 16S2 location name corrected to 15S2. Justification: 7S2 is a new location for FPL/FPV located next to the 7S2 air sampler. Also, the FPL/FPV location identified as 16S2 in Revision 27 of the ODCM was a typing error and should have been identified as 15S2. (70166150/030)	Technical
25	153-154	155-157	New Sampling Locations Maps were made. Third map showing sampling location beyond 10 miles was added. Revision bars not used for this change. Justification: Due to sampling location changes, new maps are required to show locations and station codes. Third map added for ease of reading.	Technical
26	156	159	Updated the description used in Appendix F to describe Table F-1, Maximum Permissible Concentrations. The description was updated to reflect the revision date of 10 CFR 20. Added a clarifying statement that this revision of 10 CFR 20 is referred to as the "old" 10 CFR 20. Justification: These were editorial changes only with no changes to existing data in the data tables. (70166487/010)	Editorial

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

HOPE CREEK NUCLEAR GENERATING STATION
OFFSITE DOSE CALCULATION MANUAL

INTRODUCTION

The Hope Creek Offsite Dose Calculation Manual (ODCM) is a supporting document to the Hope Creek Technical Specifications. The previous Limiting Conditions for Operations that were contained in the Radiological Effluent Technical Specifications (RETS) are now included in the ODCM as Radiological Effluent Controls (REC). The ODCM contains two parts: Part I - Radiological Effluent Controls, and Part II – Calculational Methodologies.

Part I includes the following:

- The Radiological Effluent Controls and the Radiological Environmental Monitoring Programs required by Technical Specifications 6.8.4
- Descriptions of the information that should be included in the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Report required by Technical Specifications 6.9.1.6 and 6.9.1.7, respectively.

Part II describes the methodologies and parameters used for:

- the calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints; and
- the calculation of radioactive liquid and gaseous concentrations, dose rates, cumulative quarterly and yearly doses, and projected doses.

Part II also contains a list and graphical description of the specific sample locations for the radiological environmental monitoring program (REMP), and the liquid and gaseous waste treatment systems.

The current licensing basis applies Maximum Permissible Concentrations (MPCs) for radioactive liquid effluent concentration limits. Since the MPC values were removed from 10CFR20 effective 1/1/94, the MPC values are provided as Appendix F to the ODCM. As discussed in the Safety Evaluation by the Office Of Nuclear Reactor Regulation Related to Amendment No.121, letters between the Nuclear Management and Resources Council (NUMARC) concerning the differences between the "old" 10CFR20 and the "new" 10CFR20 allowed continued use of the instantaneous release limits (MPCs). The NUMARC letter of April 28, 1993, concluded that the RETS that reference the "old" Part 20 are generally more restrictive than the comparable requirements of the "new" Part 20, and therefore, in accordance with 10 CFR 20.1008, the existing RETS could remain in force after the licensee implements the "new" Part 20. The letter stated that the existing RETS which reference the "old" Part 20 would maintain the level of required protection of public health and safety, and would be consistent with the requirements of the "new" Part 20. The "new" 10 CFR Part 20 was effective January 1, 1994. Versions of 10 CFR Part 20 prior to January 1, 1994 are considered to be the "old" 10 CFR Part 20.

PART I - RADIOLOGICAL EFFLUENT CONTROLS

SECTION 1.0

DEFINITIONS

1.0 DEFINITIONS

The following terms are defined so that uniform interpretation of these CONTROLS may be achieved. The defined terms appear in capitalized type and are applicable throughout these CONTROLS.

1.1 ACTION

ACTION shall be that part of a CONTROL which prescribes remedial measures required under designated conditions.

1.2 CHANNEL CALIBRATION

A 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 that the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including the required sensor, alarm, display, and trip functions, and shall include the CHANNEL FUNCTIONAL TEST. Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an in place qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. Whenever an RTD or thermocouple sensing element is replaced, the next required CHANNEL CALIBRATION shall include an in place cross calibration that compares the other sensing elements with the recently installed sensing monitor. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping, or total channel steps so that the entire channel is calibrated.

1.3 CHANNEL CHECK

A 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.

1.4 CHANNEL FUNCTIONAL TEST

A CHANNEL FUNCTIONAL TEST shall be:

A. Analog channels - the injection of a simulated signal into the channel as close to the sensor as practicable to verify OPERABILITY including alarm and/or trip functions and channel failure trips.

B. Bi stable channels – the injection of a simulated signal into the sensor to verify OPERABILITY including alarm and/or trip functions.

The CHANNEL FUNCTIONAL TEST may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is tested.

1.5 CONTROL

The Limiting Conditions for Operation (LCOs) that were contained in the Radiological Effluent Technical Specifications were transferred to the OFFSITE DOSE CALCULATION MANUAL (ODCM) and were renamed CONTROLS. This is to distinguish between those LCOs that were retained in the Technical Specifications and those LCOs or CONTROLS that were transferred to the ODCM.

1.6 DOSE EQUIVALENT I-131

DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries per 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 those listed in Table III of TID-14844 "Calculation of Distance Factors for Power and Test Reactor Sites."

1.7 FREQUENCY NOTATION

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

1.8 MEMBER(S) OF THE PUBLIC

MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the licensee, its contractors, or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational or other purposes not associated with the plant

1.9 OFF-GAS RADWASTE TREATMENT SYSTEM (GASEOUS RADWASTE TREATMENT SYSTEM)

An OFF-GAS RADWASTE TREATMENT SYSTEM (GASEOUS RADWASTE TREATMENT SYSTEM) is any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the main condenser evacuation system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

1.10 OFFSITE DOSE CALCULATION MANUAL (ODCM)

The OFFSITE DOSE CALCULATION MANUAL (ODCM) shall contain the methodology and parameters used in the calculation of offsite doses due to radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring alarm/trip setpoints, and in the conduct of the radiological environmental monitoring program. The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by Technical Specification Section 6.8.4 and (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Reports required by Technical Specification Sections 6.9.1.6 and 6.9.1.7, respectively.

1.11 OPERABLE - OPERABILITY

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).

1.12 OPERATIONAL CONDITION - CONDITION

An OPERATIONAL CONDITION (i.e., CONDITION) shall be any one inclusive combination of mode switch position and average reactor coolant temperature as specified in Table 1.2.

1.13 PURGE - PURGING

PURGE or PURGING 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 required to purify the confinement.

1.14 RATED THERMAL POWER

RATED THERMAL POWER shall be a total reactor core heat transfer rate to the reactor coolant of 3840 MWT.

1.15 REPORTABLE EVENT

A REPORTABLE EVENT shall be any of those conditions specified in Section 50.73 to 10CFR Part 50 or 10CFR 72.75.

1.16 SITE BOUNDARY

The SITE BOUNDARY shall be that line beyond which the land or property is neither owned, nor leased, nor otherwise controlled by the licensee.

1.17 SOURCE CHECK

SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

1.18 THERMAL POWER

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

1.19 UNRESTRICTED AREA

An UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY, access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the SITE BOUNDARY used for residential quarters or for industrial, commercial, institutional, and/or recreational purposes.

1.20 VENTILATION EXHAUST TREATMENT SYSTEM

A VENTILATION EXHAUST TREATMENT SYSTEM shall be any system designed and installed to reduce gaseous radioiodine and radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers 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 Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

1.21 VENTING

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.

TABLE 1.1: SURVEILLANCE FREQUENCY NOTATION

NOTATION	FREQUENCY
S	At least once per 12 hours
D	At least once per 24 hours
W	At least once per 7 days
M	At least once per 31 days
Q	At least once per 92 days
SA	At least once per 184 days
A	At least once per 366 days
R	At least once per 18 months (550 days)
S/U	Prior to each reactor startup
P	Prior to each radioactive release
Z	During startup, prior to exceeding 30% of RATED THERMAL POWER, if not performed within the previous 7 days
N/A	Not Applicable

TABLE 1.2: OPERATIONAL CONDITIONS

CONDITION	MODE SWITCH POSITION	AVERAGE REACTOR COOLANT TEMPERATURE
1. Power Operation	Run	Any temperature
2. Startup	Startup/Hot Standby	Any temperature
3. Hot Shutdown	Shutdown#, ***	> 200°F
4. Cold Shutdown	Shutdown#, ##, ***	≤ 200°F+
5. Refueling*	Shutdown or Refuel **, #	≤ 140°F

The reactor mode switch may be placed in the Run, Startup/Hot Standby, or Refuel position to test the switch interlock functions and related instrumentation provided that the control rods are verified to remain fully inserted by a second licensed operator or other technically qualified member of the unit technical staff. If the reactor mode switch is placed in the Refuel position, the one-rod-out interlock shall be OPERABLE.

The reactor mode switch may be placed in the Refuel position while a single control rod drive is being removed from the reactor pressure vessel per Technical Specification 3.9.10.1.

* Fuel in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

** See Special Test Exceptions Technical Specification sections 3.10.1 and 3.10.3.

*** The reactor mode switch may be placed in the Refuel position while a single control rod is being recoupled or withdrawn provided that the one-rod-out interlock is OPERABLE.

\+ See Special Test Exception Technical Specification 3.10.8.

PART I

RADIOLOGICAL EFFLUENT CONTROLS

SECTION 3.0 AND 4.0

CONTROLS

AND

SURVEILLANCE REQUIREMENTS

3/4 CONTROLS AND SURVEILLANCE REQUIREMENTS

3/4.0 APPLICABILITY

3.0 CONTROLS

3.0.1 Compliance with the CONTROLS contained in the succeeding CONTROLS is required during the OPERATIONAL CONDITIONS or other conditions specified therein; except that upon failure to meet the CONTROLS, 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.

3.0.3 When a CONTROL is not met, except as provided in the associated ACTION requirements, within one hour action shall be initiated to place the unit in an OPERATIONAL CONDITION in which the CONTROL does not apply by placing it, as applicable, in:

1. At least STARTUP within the next 6 hours,
2. At least HOT SHUTDOWN within the following 6 hours, and
3. At least COLD SHUTDOWN within the subsequent 24 hours.

Where corrective measures are completed that permit operation under the ACTION requirements, the ACTION may be taken in accordance with the specified time limits as measured from the time of failure to meet the CONTROL. Exceptions to these requirements are stated in the individual CONTROLS.

This CONTROL is not applicable in OPERATIONAL CONDITION 4 or 5.

3.0.4 Entry into an OPERATIONAL CONDITIONS or other specified condition shall not be made when the conditions of the CONTROLS are not met and the associated ACTION requires a shutdown if they are not met within a specified time interval. Entry into an OPERATIONAL CONDITION or other specified condition may be made in accordance with ACTION requirements when conformance to them permits continued operation of the facility for an unlimited period of time. This provision shall not prevent passage through or to OPERATIONAL CONDITIONS as required to comply with ACTION requirements. Exceptions to these requirements are stated in the individual CONTROLS.

3.0.5 Equipment removed from service or declared inoperable to comply with ACTIONS may be returned to service under administrative control solely to perform testing to demonstrate its OPERABILITY or the OPERABILITY of other equipment. This is an exception to CONTROL 3.0.2 for the system returned to service under administrative control to perform the testing required to demonstrate OPERABILITY.

4.0 SURVEILLANCE REQUIREMENTS

4.0.1 Surveillance Requirements shall be met during the OPERATIONAL CONDITIONS or other 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 surveillance interval with a maximum allowable extension not to exceed 25 percent of the specified surveillance interval.

4.0.3 Failure to perform a Surveillance Requirement within the allowed surveillance interval, defined by CONTROL 4.0.2, shall constitute a failure to meet the OPERABILITY requirements for a CONTROL. The time limits of the ACTION requirements are applicable at the time it is identified that a Surveillance Requirement has not been performed. The ACTION requirements may be delayed for up to 24 hours to permit the completion of the surveillance when the allowed outage time limits of the ACTION requirements are less than 24 hours. Surveillance Requirements do not have to be performed on inoperable equipment.

4.0.4 Entry into an OPERATIONAL CONDITION or other specified applicable condition shall not be made unless the Surveillance Requirement(s) associated with the CONTROLS have been performed within the applicable surveillance interval or as otherwise specified. This provision shall not prevent passage through or to OPERATIONAL CONDITIONS as required to comply with ACTION requirements.

3/4.3 INSTRUMENTATION

3/4.3.7.10 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.7.10 In accordance with Hope Creek Technical Specifications 6.8.4.g.1, the radioactive liquid effluent monitoring instrumentation channels shown in Table 3.3.7.10-1 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: During all liquid releases via these pathways.

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 3.3.7.10-1. Exert best efforts to return the instrument to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release report why the inoperability was not corrected in a timely manner.

c. The provisions of CONTROL 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.3.7.10 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 4.3.7.10-1

TABLE 3.3.7.10-1: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1. Radioactivity Monitors Providing Alarm and Automatic Termination of Release		
a. Liquid Radwaste Discharge Line to the Cooling Tower Blowdown Line	1	110
b. Turbine Building Circulating Water Dewatering Sump Discharge Line to the Cooling Tower*	1	110
2. Radioactivity Monitors Providing Alarm but not Providing Automatic Termination of Release		
a. Cooling Tower Blowdown Effluent	1	111
3. Flow Rate Measurement Devices		
a. Liquid Radwaste Discharge Line to the Cooling Tower Blowdown Line	1	112
b. Cooling Tower Blowdown Weir***	1	112
c. Turbine Building Circulating Water Dewatering Sump Discharge Line**	N/A	N/A

TABLE 3.3.7.10-1: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION – TABLE NOTATION (Continued)

ACTION 110 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with CONTROL 4.11.1.1.2, 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 111 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that, at least once per 12 hours, grab samples are collected and analyzed for principal gamma emitters, I-131, and dissolved and entrained noble gases at the lower limits of detection required in ODCM CONTROL Table 4.11.1.1.1-1.B, and the Surveillance Requirement 4.11.1.1.2 is performed. Otherwise, suspend the release of radioactive effluents via this pathway.

ACTION 112 - With the number of channels OPERABLE 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 during actual releases. Pump performance curves generated in place may be used to estimate flow.

* See Appendix A for setpoint determination for the Turbine Building Circulating Water Dewatering Sump (TBCWDWS). Different setpoints are established for this monitor based on its use for batch release or continuous release. Automatic termination of releases from the TBCWDWS is by trip of the sump pump(s). ACTION 110 only applies to batch releases for the TBCWDWS. Continuous releases are not authorized with the TBCWDWS radiation monitor inoperable.

** There are no discharge process flow rate measurement devices for this pathway. Conservative assumptions are made for release rates. The maximum release rate from the sump is 100 gpm. This value should be used for setpoint calculations to determine compliance with CONTROL 3.11.1.1. More realistic values may be used to calculate total activity released and dose consequences. Actual values should be used if process flow measurement devices are installed.

*** During periods when releases are made using the Service Water Bypass Line for dilution, the Cooling Tower Blowdown Weir flow measurement device is bypassed. During this configuration the number of channels OPERABLE for the flow rate measurement device is 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 during actual releases. Pump performance curves generated in place may be used to estimate flow. The flow rate when releases are being made using the Service Water Bypass Line must have a minimum of 12,000 gpm to maintain the minimum dilution factor required for liquid releases to the Delaware River.

TABLE 4.3.7.10-1: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1. Radioactivity Monitors Providing Alarm and Automatic Termination of Release				
a. Liquid Radwaste Discharge Line to the Cooling Tower Blowdown Line	D	P	R(3)	Q(1)
b. Turbine Building Circulating Water Dewatering Sump Discharge Line to the Cooling Tower*	D(5)	M	R(3)	Q(1)(6)
2. Radioactivity Monitors Providing Alarm but not Providing Automatic Termination of Release				
a. Cooling Tower Blowdown Effluent	D	M	R(3)	Q(2)
3. Flow Rate Measurement Devices				
a. Liquid Radwaste Discharge Line to the Cooling Tower Blowdown Line	D(4)	N/A	R	Q
b. Cooling Tower Blowdown Weir	D(4)	N/A	R	Q

TABLE 4.3.7.10-1: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS – TABLE NOTATIONS (Continued)

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

a. Instrument indicates measured levels at or above the Alarm/Trip setpoint, or

b. Circuit failure, or

c. Instrument indicates a downscale failure.

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

a. Instrument indicates measured levels at or above the Alarm/Trip setpoint, or

b. Circuit failure, or

c. Instrument indicates a downscale failure.

(3) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Bureau of Standards (NBS)/National Institute of Standards and Testing (NIST) or using standards that have been obtained from suppliers that participate in assurance activities with NBS/NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration or are NBS/NIST traceable shall be used.

(4) 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.

(5) In addition to performing channel check on rad monitor, PERFORM:

a. CHANNEL CHECK - daily, including verification of sample flow through the radiation monitor during sump pump operation.

(6) Isolation is demonstrated by securing the discharge pump during the functional check

3/4.3 INSTRUMENTATION

3/4.3.7.11 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.7.11 In accordance with Hope Creek Technical Specifications 6.8.4.g.1, the radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.3.7.11-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of CONTROLS 3.11.2.1 are not exceeded. The alarm/trip setpoints of these channels meeting CONTROLS 3.11.2.1 shall be determined and adjusted in accordance with the methodology and parameters in the ODCM.

APPLICABILITY: As shown in Table 3.3.7.11-1

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 OPERABLE, take the ACTION shown in Table 3.3.7.11-1. Exert best efforts to return the instrument to OPERABLE status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report pursuant to CONTROL 6.9.1.7 why this inoperability was not corrected in a timely manner.

c. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.3.7.11 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.3.7.11-1.

TABLE 3.3.7.11-1: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	ACTION
1. Deleted			
2. Filtration, Recirculation and Ventilation Monitoring System			
a. Noble Gas Activity Monitor	1	*	123
b. Iodine Sampler	1	*	125
c. Particulate Sampler	1	*	125
d. Flow Rate Monitor	1	*	122
e. Sampler Flow Rate Monitor	1	*	122
3. South Plant Vent Monitoring System			
a. Noble Gas Activity Monitor	1	*	123
b. Iodine Sampler	1	*	125
c. Particulate Sampler	1	*	125
d. Flow Rate Monitor	1	*	122
e. Sampler Flow Rate Monitor	1	*	122
4. North Plant Vent Monitoring System			
a. Noble Gas Activity Monitor	1	*	123
b. Iodine Sampler	1	*	125
c. Particulate Sampler	1	*	125
d. Flow Rate Monitor	1	*	122
e. Sampler Flow Rate Monitor	1	*	122

* At all times

TABLE 3.3.7.11-1: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION – TABLE NOTATIONS (Continued)

ACTION 122 - With the number of channels OPERABLE 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. Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 123 - 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 taken at least once per 12 hours and these samples are analyzed for principal gamma emitters (noble gases) at the lower limits of detection required in ODCM CONTROL Table 4.11.2.1.2-1.A or B within 24 hours. Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 124 - DELETED

ACTION 125 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that within 8 hours samples are continuously collected with auxiliary sampling equipment as required in Table 4.11.2.1.2-1.

TABLE 4.3.7.11-1: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
1. Deleted					
2. Filtration, Recirculation and Ventilation Monitoring System					
a. Noble Gas Activity Monitor	D	M	R(2)	Q(1)	*
b. Iodine Sampler	W	N/A	N/A	N/A	*
c. Particulate Sampler	W	N/A	N/A	N/A	*
d. Flow Rate Monitor	D	N/A	R	Q	*
e. Sampler Flow Rate Monitor	D	N/A	R	Q	*
3. South Plant Vent Monitoring System					
a. Noble Gas Activity Monitor	D	M	R(2)	Q(1)	*
b. Iodine Sampler	W	N/A	N/A	N/A	*
c. Particulate Sampler	W	N/A	N/A	N/A	*
d. Flow Rate Monitor	D	N/A	R	Q	*
e. Sampler Flow Rate Monitor	D	N/A	R	Q	*
4. North Plant Vent Monitoring System					
a. Noble Gas Activity Monitor	D	M	R(2)	Q(1)	*
b. Iodine Sampler	W	N/A	N/A	N/A	*
c. Particulate Sampler	W	N/A	N/A	N/A	*
d. Flow Rate Monitor	D	N/A	R	Q	*
e. Sampler Flow Rate Monitor	D	N/A	R	Q	*

* At all times

TABLE 4.3.7.11-1: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS – TABLE NOTATIONS (Continued)

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

a. Instrument indicates measured levels above the alarm setpoint.

b. Circuit failure.

c. Instrument indicates a downscale failure.

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Bureau of Standards (NBS)/National Institute of Standards and Testing (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NBS/NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration or are NBS/NIST traceable shall be used.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1 LIQUID EFFLUENTS

3/4.11.1.1 CONCENTRATION

CONTROLS

3.11.1.1 In accordance with the Hope Creek Technical Specifications 6.8.4.g.2 and 3, the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (See Figure 5.1.1.1-1) shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table II, 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} microcuries/ml.

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.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

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.

TABLE 4.11.1.1.1-1: RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[)(a)] (uCi/ml)
A. Batch Waste 1) Release[(b)] Sample Tanks	P Each Batch	P Each Batch	Principal Gamma Emitters[(c)]	5x10^{-7}
			I-131	1x10^{-6}
2) Turbine Building Circulating Water Dewatering Sump when released in Batch Mode*	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	1x10^{-5}
	P Each Batch	M Composite[(d)]	H-3	1x10^{-5}
			Gross Alpha	1x10^{-7}
	P Each Batch	Q Composite[(d)]	Sr-89, Sr-90	5x10^{-8}
			Fe-55	1x10^{-6}
B. Continuous Releases[(e)] 1) Station Service Water System (SSWS) (If contaminated as indicated by SACS or RACS system)	N/A	M Composite	Principal Gamma Emitters[(c)]	5x10^{-7}
			I-131	1x10^{-6}
2) Turbine Building Circulating Water Dewatering Sump*	W** Grab Sample	M	Dissolved and Entrained Gases	1x10^{-5}
	NA	M Composite [(d)]	H-3	1x10^{-5}
			Gross Alpha	1x10^{-7}
	NA	Q Composite [(d)]	Sr-89, Sr-90	5x10^{-8}

TABLE 4.11.1.1.1-1: RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM – TABLE NOTATIONS (Continued)

(a) 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:

$$LLD = \frac{4.66 * S_b}{E * V * 2.22E6 * Y * \exp(-\lambda \Delta t)}$$

WHERE: LLD is the "a priori" lower limit of detection as defined above, as microcuries per unit mass or volume,

4.66 is the statistical factor from NUREG 1302

Sb is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate, as counts per minute,

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22E6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide (sec-1), and

Δt for plant effluents is the elapsed time between midpoint of sample collection and 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.

(b) 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.

(c) The principal gamma emitters for which the LLD CONTROL applies exclusively are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with an LLD of 5 x 10-6. This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with the above nuclides, shall also be analyzed and reported in the Radioactive Effluent Release Report pursuant to CONTROL 6.9.1.7.

(d) 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.

(e) 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.

* The Turbine Building Circulating Water Dewatering Sump (TBCWDS) is a normal radwaste discharge pathway and is monitored as such because of possible contamination from the Turbine Building Ventilation drains. Securing the sump pump provides discharge termination. Siphoning does not occur due to the differential height between the sump and the discharge point. Releases from the TBCWDS below the setpoint of 2X background are considered continuous releases. Sampling of continuous releases is performed using a continuous composite sampler. Samples for analyses required in Table 4.11.1.1.1-1 for continuous releases are obtained from the composite sampler. Releases from the sump at levels at or above 2x background may be performed as batch releases. Samples for analyses required in Table 4.11.1.1.1-1 for batch releases are obtained from the sump.

** The grab sample from the Turbine Building Circulating Water Dewatering Sump for dissolved and entrained noble gases is required monthly from the composite sampler.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1.2 DOSE

CONTROLS

3.11.1.2 In accordance with Hope Creek Technical Specifications 6.8.4.g.4 and 5, 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 Figure 5.1.1-1) shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrem to the total 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 total body and to less than or equal to 10 mrem 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 Technical Specification 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.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

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.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1.3 LIQUID WASTE TREATMENT SYSTEM

CONTROLS

3.11.1.3 In accordance with the Hope Creek Technical Specifications 6.8.4.g.6, the liquid radwaste treatment system shall be OPERABLE and appropriate portions of the system shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the projected doses due to the liquid effluent, from each reactor unit, to UNRESTRICTED AREAS (see Figure 5.1.1-1) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in any 31-day period.

APPLICABILITY: At all times.

ACTION:

a. With radioactive liquid waste being discharged 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 Technical Specification 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.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.3.1 Doses due to liquid releases from each reactor unit to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM.

4.11.1.3.2 The installed liquid Radwaste treatment system shall be demonstrated OPERABLE by meeting CONTROLS 3.11.1.1 and 3.11.1.2.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2 GASEOUS EFFLUENTS

3/4.11.2.1 DOSE RATE

CONTROLS

3.11.2.1 In accordance with the Hope Creek Technical Specifications 6.8.4.g.3 and 7, the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY (see Figure 5.1.1-1) shall be limited to the following:

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

b. For iodine-131, iodine-133, tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrem/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).

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.2.1.1 The dose rate due to noble gases in gaseous effluents shall be determined continuously 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 4.11.2.1.2-1.

TABLE 4.11.2.1.2-1: RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[(a)] (µCi/ml)
A. Not used				
B. Containment PURGE	P Each PURGE[(c)]	P Each PURGE[(c)]	Principal Gamma Emitters[(b)]	$1x10^{-4}$
	Grab Sample	P	H-3 (oxide)	$1x10^{-6}$
C. North Plant Vent South Plant Vent FRVS [(g)]	M[(c), (d)] Grab Sample	M[(c)]	Principal Gamma Emitters[(b)]	$1x10^{-4}$
			H-3 (oxide)	$1x10^{-6}$
D. All Release Types as listed in B and C above	Continuous[(e)]	W[(f)] Charcoal Sample	I-131	$1x10^{-12}$
	Continuous[(e)]	W[(f)] Particulate Sample	Principal Gamma Emitters[(b)]	$1x10^{-11}$
	Continuous[(e)]	M Composite Particulate Sample	Gross Alpha	$1x10^{-11}$
	Continuous[(e)]	Q Composite Particulate Sample	Sr-89, Sr-90	$1x10^{-11}$
	Continuous[(e)]	Noble Gas Monitor	Noble Gasses Gross Beta or Gamma	$1x10^{-6}$

TABLE 4.11.2.1.2-1: RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM-TABLE NOTATION (Continued)

(a) The LLD is defined in Table 4.11.1.1.1-1

(b) The principal gamma emitters for which the LLD CONTROL applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for 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 emissions. 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 Radioactive Effluent Release Report pursuant to CONTROL 6.9.1.7.

(c) Sampling and analysis shall also be performed following shutdown, startup or a THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period. This requirement does not apply if:

1. Analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of three; and
2. The noble gas monitor shows that effluent activity has not increased by more than a factor of three.

(d) Tritium grab samples shall be taken at least once per 7 days from the spent fuel pool area, whenever fuel is in the spent fuel pool.

(e) 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.

(f) Samples shall be changed at least once per 7 days 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 percent of RATED THERMAL POWER in 1 hour 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 primary 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 three.

(g) Table 4.11.2.1.2-1, Notations "c", and "f" do not apply. Monthly samples for principle gamma emitters and tritium are required only if the FRVS Vent Fan(s) is in service greater than 8 hours. For noble gas and tritium, representative samples of Reactor Building may be obtained for compliance in lieu of skid samples. FRVS continuous samples required when FRVS Vent Fan(s) is in service for greater than 2 hours.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2.2DOSE - NOBLE GASES

CONTROLS

3.11.2.2 In accordance with the Hope Creek Technical Specification 6.8.4.g.5 and 8, the air dose due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the SITE BOUNDARY (see Figure 5.1.1-1) 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.

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 Technical Specification 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 release and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

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.

3/4.11 RADIOACTIVE EFFLUENTS

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

CONTROLS

3.11.2.3 In accordance with Hope Creek Technical Specification 6.8.4.g.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 reactor unit, to areas at and beyond the SITE BOUNDARY (see Figure 5.1.1-1) 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.

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 Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit 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.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

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.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2.4GASEOUS RADWASTE TREATMENT

CONTROLS

3.11.2.4 In accordance with Hope Creek Technical Specifications 6.8.4.g.6, the GASEOUS RADWASTE TREATMENT SYSTEM shall be in operation.

APPLICABILITY: Whenever the main condenser steam jet air ejector is in operation.

ACTION:

a. With gaseous radwaste from the main condenser air ejector system being discharged without treatment for more than 7 days, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 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.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.2.4 The readings of the relevant instruments shall be checked every 12 hours when the main condenser air ejector is in use to ensure that the gaseous radwaste treatment system is functioning.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2.5VENTILATION EXHAUST TREATMENT

CONTROLS

3.11.2.5 In accordance with Hope Creek Technical Specifications 6.8.4.g.6, the VENTILATION EXHAUST TREATMENT SYSTEM for the Reactor Building and the Service and Radwaste Building shall be OPERABLE and the appropriate portions of the system shall be used to reduce release of radioactivity when the projected dose in 31 days due to gaseous effluent releases from each unit to areas at and beyond the SITE BOUNDARY (see Figure 5.1.1-1), would exceed:

a. 0.2 mrad to air for gamma radiation, or

b. 0.4 mrad to air for beta radiation, or

c. 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

APPLICABILITY: At all times.

ACTION:

a. With radioactive ventilation exhaust being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 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.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.2.5.1 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 the VENTILATION EXHAUST TREATMENT SYSTEM is not being fully utilized.

4.11.2.5.2 The installed VENTILATION EXAUST TREATMENT SYSTEM shall be considered OPERABLE by meeting CONTROLS 3.11.2.1, 3.11.2.2, and 3.11.2.3.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2.8VENTING OR PURGING

CONTROLS

3.11.2.8 VENTING or PURGING of the Mark I containment drywell shall be through either the reactor building ventilation system or the filtration, recirculation and ventilation system.*

APPLICABILITY: Whenever the containment is vented or purged.

ACTION:

a. With the requirements of the above CONTROL not satisfied, suspend all VENTING and PURGING of the drywell.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLAINCE REQUIREMENTS

4.11.2.8 The containment shall be determined to be aligned for VENTING or PURGING through either the reactor building ventilation system, the filtration, recirculation and ventilation system, or the hardened torus vent within 4 hours prior to the start of and at least once per 12 hours during VENTING or PURGING of the drywell.

* Following Type A Integrated Leakage Rate Testing, the Mark I containment drywell may be vented through the hardened torus vent.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.4 TOTAL DOSE

CONTROLS

3.11.4 In accordance with Hope Creek Technical Specification s 6.8.4.g.11, the annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem.

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 CONTROLS 3.11.1.2a, 3.11.1.2b, 3.11.2.2a, 3.11.2.2b, 3.11.2.3a, or 3.11.2.3b, calculations should be made including direct radiation contributions from the units and including outside storage tanks, etc. to determine whether the 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 Technical Specification 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 10 CFR Part 20.2203 (iv), 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 CFR Part 190 or 10 CFR 72.104 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 and 10 CFR 72.104. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

3/4.11 RADIOACTIVE EFFLUENTS (Continued)

3/4.11.4 TOTAL DOSE

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, 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 reactor units including outside storage tanks, etc. shall be determined in accordance with the methodology and parameters in the ODCM. This requirement is applicable only under conditions set forth in CONTROL 3.11.4, ACTION a.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

CONTROLS

3.12.1. In accordance with Hope Creek Technical Specifications 6.8.4.h.1, the radiological environmental monitoring program shall be conducted as specified in Table 3.12.1-1.

APPLICABILITY: At all times.

ACTION:

a. With the radiological environmental monitoring program not being conducted as specified in Table 3.12.1-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Technical Specification 6.9.1.6, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeding the reporting levels of Table 3.12.1-2 when averaged over any calendar quarter, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 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 limits of CONTROLS 3.11.1.2, 3.11.2.2, and 3.11.2.3. When more than one of the radionuclides in Table 3.12.1-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{concentration(1)}{reporting\ Level\ (1)} + \frac{concentration\ (2)}{reporting\ Level\ (2)} + \geq 1.0$$

When radionuclides other than those in Table 3.12.1-2 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 CONTROLS 3.11.1.2, 3.11.2.2, and 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 pursuant to CONTROL 6.9.1.6.

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

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING (Continued)

3/4.12.1 MONITORING PROGRAM

ACTION: (Continued)

c. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 3.12.1-1, identify specific locations for obtaining replacement samples and add them to the radiological environmental monitoring program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program. Pursuant to CONTROL 6.9.1.7, identify the cause of the unavailability of samples and the new location(s) for obtaining replacement samples in the next Radioactive Effluent Release Report pursuant to CONTROL 6.9.1.7 and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

d. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.12.1 The radiological environmental monitoring samples shall be collected pursuant to Table 3.12.1-1 from the specific locations given in the table and figure(s) in the ODCM, and shall be analyzed pursuant to the requirements of Table 3.12.1-1, and the detection capabilities required by Table 4.12.1-1.

TABLE 3.12.1-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
1. Directed Radiation(2)	Fifty eight routine monitoring stations with two or more dosimeters placed as follows: An inner ring of stations one in each land based meteorological sector in the general area of the SITE BOUNDARY; An outer ring of stations, one in each land-based meteorological sector in the 5 to 11 km range from the site; and The balance of the stations to be placed in special interest areas such as population centers, nearby residences, schools, and in one or two areas to serve as control stations.	Quarterly	Gamma dose quarterly

TABLE 3.12.1-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[(1)]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
2. Airborne Radioiodine and Particulates	Samples from 5[(3)] locations: Three samples from close to the SITE BOUNDARY location, in different sectors, of the highest calculated annual average ground level D/Q One sample from the vicinity of a community having a highest calculated annual average ground-level D/Q; and One sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction.	Continuous sampler operation with sample collection weekly or more frequently if required by dust loading.	<u>Radioiodine Canister</u> I-131 analysis weekly. <u>Particulate Sampler</u> Gross beta radioactivity analysis following filter change [(4)]; Gamma isotopic analysis[(5)] of composites (by location) quarterly.

TABLE 3.12.1-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
3. Waterborne			
a. Surface[6]	One sample upstream. One sample downstream One sample outfall One sample cross-stream	Grab sample semi-monthly.	Composite for gamma isotopic analysis [5] monthly. Composite for tritium analysis quarterly.
b. Ground	Samples from one or two sources only if likely to be affected[8].	Monthly	Gamma isotopic analysis[5] monthly and tritium analysis quarterly.
c. Drinking[11]	One sample of the nearest water supply affected by its discharge	Composite sample over two-week period[7] when I-131 analysis is performed; monthly composite otherwise.	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year[8]. Composite for gross beta and gamma isotopic analysis[5] monthly Composite for tritium analysis quarterly
d. Sediment	One sample downstream area One sample cross-stream area One sample from outfall area One sample from upstream area A control location One sample from shoreline area	Semi-annually	Gamma isotopic analysis[5] semiannually

TABLE 3.12.1-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
4. Ingestion			
a. Milk	Samples from milking animals in three locations within 5 km distance having the highest dose potential. If there are none, then, one sample from milking animals in each of three areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per yr(9). One sample from milking animals at a control location 15 to 30 km distant.	Semimonthly when animals are on pasture, monthly at other time.	Gamma isotopic (5) and I-131 analysis semi-monthly when animals are on pasture; monthly at other times.
b. Fish and Invertebrates	One sample of each commercially and recreationally important species in vicinity of plant discharge area. One sample of same species in area not influenced by plant discharge.	Sample in season, or semiannually if they are not seasonal.	Gamma isotopic analysis(5) on edible portions.
c. Food Products	One sample of each principal class of food products from any area that is irrigated by water in which liquid plant wastes have been discharged.	At time of harvest. (10)	Gamma isotopic analysis (5) on edible portion.
	Samples of three different kinds of broad leaf grown nearest each of two different offsite locations of highest predicted annual ground level D/Q if milk sampling is not performed.	Monthly during growing season.	Gamma isotopic analysis (5) on edible portion.
	One sample of each similar broadleaf vegetation grown 15 to 30 km distant in the least prevalent wind direction of milk sampling is not performed.	Monthly during growing season.	Gamma isotopic analysis (5) on edible portion.

TABLE 3.12.1-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - TABLE NOTATIONS (Continued)

(1) Specific parameters of distance and direction sector from the midpoint of a line between the center of the Salem units 1 & 2 containment domes and additional description where pertinent, shall be provided for each and every sample location in Table 3.12.1-1 in a table and figure(s) in the ODCM. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and to Reg. Guide 4.8 as amended by Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to circumstances such as hazardous conditions, seasonal unavailability and malfunction of automatic sampling equipment. If specimens are unobtainable due to sampling equipment malfunction, effort shall be made to complete corrective action 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 6.9.1.6. It is recognized that, 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 specific 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 given in the ODCM. Pursuant to CONTROL 6.9.1.7, submit in the next Radioactive Effluent Release Report documentation for a change in the ODCM including revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples for the pathway and justifying the selection of the new location(s) for obtaining samples.

(2) One or more instruments, such as pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a passive dosimeter (PD) a device meeting the criteria of ANSI N545 is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used for measuring direct radiation. The frequency of analysis or readout for dosimetry systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading. The 40 stations is not an absolute number. The number of direct radiation monitoring stations may be reduced according to geographical limitations; e.g., at an ocean site, some sectors will be over water so that the number of dosimeters may be reduced accordingly.

(3) There are four additional air sample locations – a "duplicate" air sampler at location 5S2, 5D1, 1F1 and 2F6 which are maintained for their historical data.

(4) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

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

(6) The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream" sample shall be taken in an area beyond but near the mixing zone. "Upstream" samples in an estuary must be taken far enough upstream to be beyond the plant influence. Saltwater shall be sampled only when the receiving water is utilized for recreational activities.

TABLE 3.12.1-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - TABLE NOTATIONS (Continued)

(7) A composite sample is one in which the quantity (aliquot) of liquid sampled is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow. In this program composite sample aliquots shall be collected at time intervals that are very short relative to the compositing period in order to assure obtaining a representative sample.

(8) Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

(9) The dose shall be calculated for the maximum organ and age group using the methodology and parameters in the ODCM. There are no farms that meet the 5 km requirement and it is unlikely that any releases from the site will approach the 1 mrem criteria at 5 to 8 km. Milk samples will be taken (owner obliging) within 8 km and other management audit samples within 16 km. Broad leaf vegetation (within 8 km) shall be taken to meet this pathway.

(10) If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvest occurs continuously, sampling shall be monthly. Attention shall be paid to including samples of tuberous and root food products. The Delaware River at the location of Salem and Hope Creek Nuclear Power Plants is a brackish water source. No irrigation of food products is performed using water in the vicinity from which liquid plant wastes have been discharged. However, 12 management audit food samples are collected from various locations.

(11) No groundwater samples are required as liquid effluents discharged from Salem and Hope Creek Generating Stations do not directly affect this pathway. However for management audit, one raw and one treated ground water sample from the nearest unaffected water supply is required.

TABLE 3.12.1-2: REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

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[1]				
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	20[1]	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	

Note 1: No drinking water exposure pathway exists on site. If a drinking water pathway existed, then the water reporting level would be 20,000 pCi/L for H-3 and 2 pCi/L for I-131.

TABLE 4.12.1-1: DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS(1), (2) LOWER LIMITS 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[1]					
Mn-54	15		130			
Fe-59	30		260			
Co-58, 60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	15[1]	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

Note 1: No drinking water exposure pathway exists on site. If a drinking water pathway existed, then the water LLD would be 2,000 pCi/L for H-3 and 1 pCi/L for I-131.

TABLE 4.12.1-1: DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS(1), (2) LOWER LIMITS OF DETECTION (LLD)(3) – TABLE NOTATIONS (Continued)

(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 6.9.1.6.

(2) Required detection capabilities for dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.

(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:

$$LLD = \frac{4.66 * S_b}{E * V * 2.22 * Y * \exp(-\lambda \Delta t)}$$

Where: LLD is the "a priori" lower limit of detection as defined above, as picocuries per unit mass or volume,

4.66 is the statistical factor from NUREG 1302,

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

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield, when applicable,

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

Δt for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting (sec).

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

For low count rates a value of 2.71 may be added to the numerator.

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 6.9.1.6.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.2 LAND USE CENSUS

CONTROLS

3.12.2 In accordance with the Hope Creek Technical Specifications 6.8.4.h.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 m^2 (500 ft^2) producing broad leaf vegetation. [For elevated releases as defined in Regulatory Guide 1.111, Revision 1, July 1977, the Land Use Census shall also identify within a distance of 5 km (3 miles) the locations in each of the 16 meteorological sectors of all milk animals and all gardens of greater than 50 m2 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, identify the new location(s) in the next Radioactive Effluent Release Report, pursuant to CONTROL 6.9.1.7.

b. With a land use census identifying a location(s) ** that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with CONTROL 3.12.1, add the new location(s) to the radiological environmental monitoring program within 30 days. 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 CONTROL 6.9.1.7, identify the new location(s) in the next Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

c. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

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, visual 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 6.9.1.6.

* Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Q's in lieu of the garden census. CONTROLS for broadleaf vegetation sampling in Table 3.12.1-1, Part 4.c shall be followed, including analysis of control samples.

** New receptor locations must be on land and not over water to be considered in dose calculations.

3.4/12 RADIOLOGICAL ENVIRONMENTAL MONITORING (Continued)

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

CONTROLS

3.12.3 In accordance with Hope Creek Technical Specifications 6.8.4.h.3, analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission, that correspond to samples required by Table 3.12.1-1.

APPLICABILITY: At all times.

ACTION:

a. With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.9.1.6.

b. The provisions of CONTROLS 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS

4.12.3 The Interlaboratory Comparison Program shall be described in the ODCM. 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 6.9.1.6.

BASES

FOR

SECTION 3.0 AND 4.0

CONTROLS

AND

SURVEILLANCE REQUIREMENTS

NOTE: The BASES contained in the succeeding pages summarize the reasons for the CONTROLS of Sections 3.0 and 4.0, but are not considered a part of these CONTROLS.

3/4.3 INSTRUMENTATION

BASES

3/4.3.7.10 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 effluents 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.

3/4.3.7.11 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 effluents 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. This will ensure 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.

Allowable Time for Return to Service for Loss of Particulate and Iodine Sampling

The Noble Gas monitor will be one of the first indications that an abnormal radiological condition exists in the effluent ventilation system. The Noble Gas monitor has an alarm function and the alarm setpoint is determined in accordance with the methodology contained the Hope Creek Offsite Dose Calculation Manual. Radioactive Gaseous Effluent Monitoring Instrumentation, Table 3.3.7.11-1, ACTION 123 allows compensatory noble gas sampling to be collected within 12 hours of a declaration of inoperable monitor.

There is no particulate and iodine monitor provided with the monitoring system and therefore there are no early indications that an abnormal radiological condition exists in the effluent ventilation system from particulate or iodine releases. Particulate and iodine samples are normally continuously collected and sampled on a weekly basis and analyzed in the laboratory. Doses are calculated after laboratory analyses are complete. Doses are then compared against the quarterly and yearly limits.

If the particulate and iodine monitoring sample collection devices were out of service for 8 hours out of a quarter (2190 hours), the calculated dose to the public would be affected by < 1% (8 hours/2190 hours in a quarter = 0.00365 = 0.365%). Radioactive Gaseous Effluent Monitoring Instrumentation, Table 3.3.7.11-1, ACTION 122 requires a once per four hour flow estimation to be made when sample flow for the instrument is out of service.

Because of the 4 hour flow verification/estimation for ACTION 122, it is very unlikely that the iodine and particulate monitoring would be out of service for 8 hours.

If control room indication of either process flow or sample flow is lost, then ACTION 122 allows a condition to continue as long as flow is estimated every 4 hours. A loss of sample flow indication would require Radiation Protection to visit the vent Radiation Monitoring System (RMS) skid to perform a direct read of the sample flow instrumentation in accordance with Section 5.3 of HC.RP-ST.ZZ-0004. At this time, should the loss of sample flow be due to a loss of continuous sampling (pump failure) then ACTION 125 would be invoked and the setup of alternate sampling would occur at this time and sample flow would then be obtained. The setup for alternate particulate and iodine sampling would normally be less than 4 hours due to the active 4 hour estimates required by ACTION 122.

If the particulate and iodine monitor were out of service for 8 hours there would be no impact to the safe operation of the plant and no significant impact to the health and safety of the public. The dose impact missing 8 hours of sampling would be evaluated when samples are obtained for noble gas within the 12 hour time limit of ACTION 123.

3/4.11 RADIOACTIVE EFFLUENTS

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 (pre 1994) 10 CFR Part 20, Appendix B, Table II, 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 20.106(a) to the population. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

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 the HASL Procedures Manual, HASL-300 (revised annually).

3/4.11 RADIOACTIVE EFFLUENTS (Continued)

3/4.11.1.2DOSE

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 freshwater 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. 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 Purposes of Implementing Appendix I," April 1977.

3/4.11.1.3LIQUID RADWASTE TREATMENT

The OPERABILITY of the liquid Radwaste treatment system ensures that this system will be available for use whenever liquid effluents require treatment prior to their 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 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 the Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

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 concentrations of 10 CFR Part 20, Appendix B, Table II, Column 1. 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 annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 [10 CFR Part 20.106(b)]. For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of the individual will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC with the appropriate occupancy factors shall be given in the ODCM. 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 mrem/year to the total body or to less than or equal to 3000 mrem/yr 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 mrem/year.

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 the HASL Procedures Manual, HASL-300 (revised annually).

3/4.11.2.2 DOSE – NOBLE GASES

This CONTROL is provided to implement the requirements of Section II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The CONTROL implements the guides set forth in Section II.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 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 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.

3/4.11.2.3 DOSE – IODINE-131, IODINE-133, TRITIUM, AND RADIONUCLIDES IN PARTICULATE FORM

This CONTROL is provided to implement the requirements of Section 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 UNRERSTRICTED AREAS will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in 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 ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials 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 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-life greater than 8 days are dependent on the existing radionuclide pathways to man, in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these 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.
Note: any new receptors must be located on land and not water to be considered in dose calculations.

3/4.11.2.4
and
3/4.11.2.5 GASEOUS RADWASTE TREATMENT AND VENTILATION EXHAUST TREATMENT

The OPERABILITY of the GASEOUS RADWASTE TREATMENT SYSTEM and the VENTILATION EXHAUST TREAMENT SYSTEM ensures that the system 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 General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives 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.

3/4.11.2.8 VENTING OR PURGING

This CONTROL provides reasonable assurance that releases from drywell venting or purging operations will not exceed the annual dose limits of 10 CFR Part 20 for UNRESTRICTED AREAS.

3/4.11.4 TOTAL DOSE

This CONTROL is provided to meet the dose limitations of 40 CFR Part 190 that have now been incorporated into 10 CFR Part 20 by 46 FR 18525 as well as the dose limitations specific to Independent Spent Fuel Storage Installation (ISFSI) operations in accordance with 10 CFR 72.104. Over the long term, as more storage casks are placed on the ISFSI pads, it is expected that ISFSI operations will become the prominent contributor to the dose limits in this section. ISFSI dose contribution is in the form of direct radiation as no liquid or gas releases are expected to occur. The PSEG 10 CFR 72.212 Report prepared in accordance with 10 CFR 72 requirements assumes a certain array of casks exists on the pads. The dose contribution from this array of casks in combination with historical uranium fuel cycle operations prior to ISFSI operations was analyzed to be within the 40 CFR 190 and 10 CFR 72.104 limits. The CONTROL requires the preparation and submittal of a Special Report whenever the calculated doses from plant including the ISFSI radioactive effluents exceed 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. For sites containing up to 4 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 reactor 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 or 10 CFR 72.104 limits. For 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 km must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190 or 10 CFR 72.104, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 or 10 CFR 72.104 have not already been corrected), in accordance with the provisions of 40 CFR Part 190 or 10 CFR 72.104 and 10 CFR Part 20.405c, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 or 10 CFR 72.104 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190 or 10 CFR 72.104, 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 ENVIORNMENTAL MONITORING

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 exposures of MEMBERS OF THE PUBLIC resulting from the station 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 Reg. Guide 4.8 as amended by Radiological Assessment Branch Position on Environmental Monitoring, Revision 1, and 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 4.12.1-1 are considered optimum for routine environmental measurements in industrial laboratories. 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.

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 the HASL Procedures Manual, HASL-300 (revised annually).

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 are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey, from visual survey or consulting with local agricultural authorities shall be used. 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 $50m^2$ 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 kg/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 kg/m^2.

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

The 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 material 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.

SECTION 5.0

DESIGN FEATURES

5.0 DESIGN FEATURES

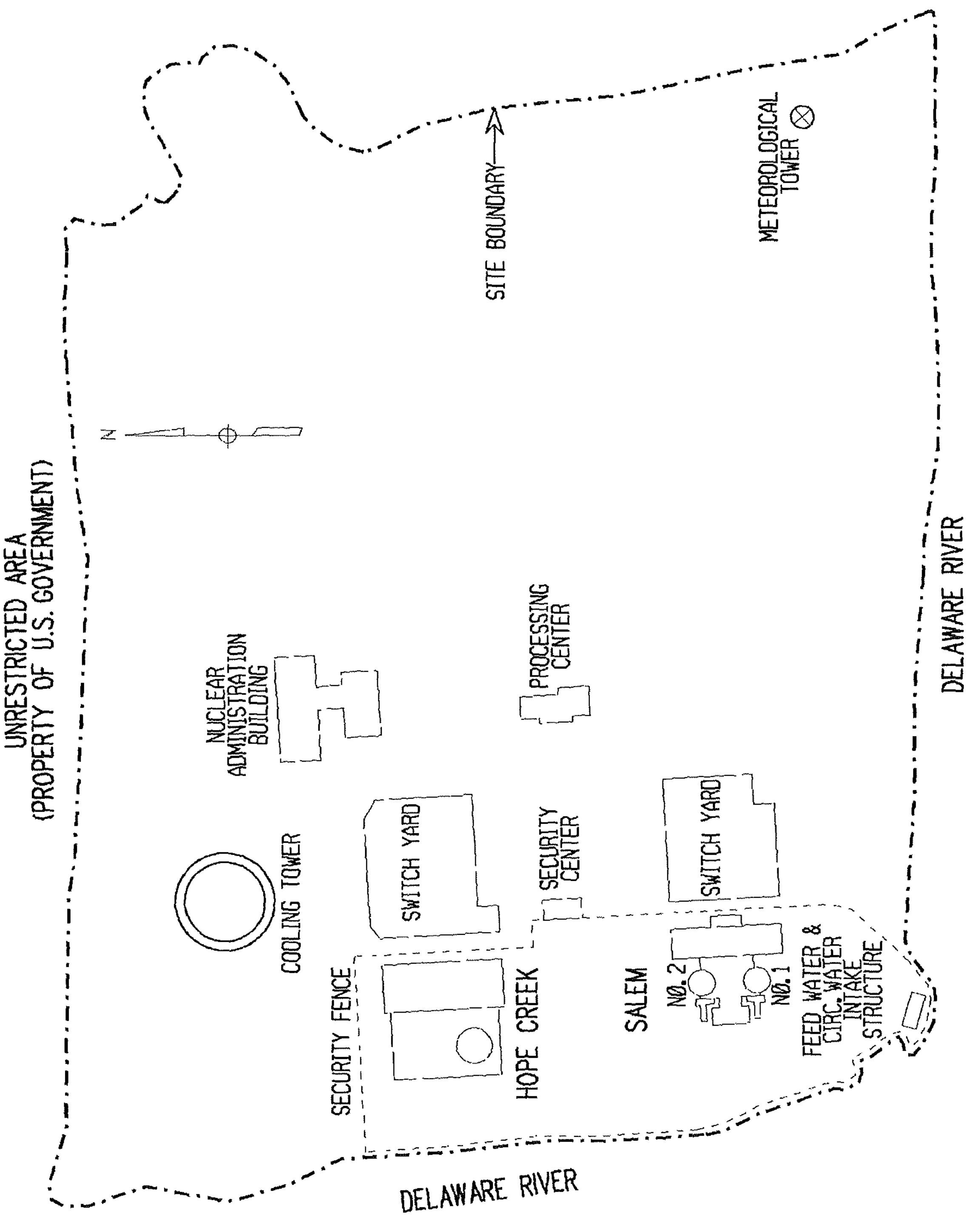
(Provided FOR INFORMATION ONLY. Technical Specifications Section 5.0 is controlling.)

5.1 SITE

MAP DEFINING UNRESTRICTED AREAS AND SITE BOUNDARY FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

5.1.1 Information regarding radioactive gaseous and liquid effluents which will allow identification of structures and release points as well as definition of UNRESTRICTED AREAS within the SITE BOUNDARY that are accessible to MEMBERS OF THE PUBLIC, shall be as shown in Figure 5.1.1-1.

FIGURE 5.1.1-1: AREA PLOT PLAN OF SITE



6.0 ADMINISTRATIVE CONTROLS

6.9.1.6 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

In accordance with Hope Creek Technical Specifications 6.9.1.6, The Annual Radiological Environmental Operating Report* covering the operation of the unit during the previous calendar year, shall be submitted prior to May 1 of each year.

The Annual Radiological Environmental Operating Reports shall include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, with operational controls (as appropriate), 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 censuses required by CONTROL 3.12.2. If harmful effects or evidence of irreversible damage are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to alleviate the problem.

The Annual Radiological Environmental Operating Reports shall include summarized and tabulated results in the format of Reg. Guide 4.8 as amended by Radiological Assessment Branch Technical Position, Revision 1, November 1979, for all of the radiological environmental samples taken during the report period pursuant to the table and figures in the environmental radiation section of the ODCM. Deviations from the sampling program identified in CONTROL 3.12.1 shall be reported. 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 reports shall also include the following: a summary description of the radiological environmental monitoring program; at least two legible maps, one covering sampling locations near the SITE BOUNDARY and a second covering the more distant locations, all keyed to a table giving distances and directions from midpoint of a line between the center of the Salem units 1& 2 containment domes; the results of licensee participation in the Interlaboratory Comparison Program, as required by CONTROL 3.12.3 and discussion of all analyses in which the LLD required by Table 4.12.1-1 was not achieved.

The report shall also include the results of specific activity analysis in which the primary coolant exceeded the limits of Technical Specification 3.4.5. The following information shall be included: (1) Reactor power history starting 48 hours prior to the first sample in which the limit was exceeded; (2) Results of the last isotopic analysis for radioiodine performed prior to exceeding the limit, results of analysis while limit was exceeded and results of one analysis after the radioiodine activity was reduced to less than the limit. Each result should include date and time of sampling and the radioiodine concentrations; (3) Clean-up system flow history starting 48 hours prior to the first sample in which the limit was exceeded; (4) Graph of the I-131 per gram as a function of time for the duration of the specific activity of the steady-state level; and (5) The time duration when the specific activity of the primary coolant exceeded the limit.

* A single submittal may be made for a multiple unit site. The submittal should combine those sections that are common to all units at the site.

6.9.1.7 RADIOACTIVE EFFLUENT RELEASE REPORT

In accordance with Hope Creek Technical Specifications 6.9.1.7, The Annual Radioactive Effluent Release Report* covering the operation of the unit, shall be submitted by May 1 of each year and in accordance with the requirements of 10CFR50.36a.

The Radioactive Effluent Release Report 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.

The Radioactive Effluent Release Report 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 of wind speed, wind direction, atmospheric stability, and precipitation (if measured) on magnetic tape, or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. The 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. The 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 (Figure 5.1.1-1) 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 historical annual average meteorology or 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. The assessment of radiation doses shall be performed in accordance with the OFFSITE DOSE CALCULATION MANUAL (ODCM).

The Radioactive Effluent Release Report shall identify those radiological environmental sample parameters and locations where it is not possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In addition, the cause of the unavailability of samples for the pathway and the new location(s) for obtaining replacement samples should be identified. The report should also include a revised figure(s) and table(s) for the ODCM reflecting the new location(s).

The Radioactive Effluent Release Report shall also include an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous calendar year to show conformance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation and 10 CFR 72.104 Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI. Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev. 1, October 1977.

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:

a. Container volume,

b. Total curie quantity (specify whether determined by measurement or estimate),

c. Principal radionuclides (specify whether determined by measurement or estimate),

d. Type of waste (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms),

e. Type of container (e.g., LSA, Type A, Type B, Large Quantity), and

f. Solidification agent or absorbent (e.g., cement, urea formaldehyde).

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

The Radioactive Effluent Release Report shall include any changes made during the reporting period to the PROCESS CONTROL PROGRAM (PCP), the OFFSITE DOSE CALCULATION MANUAL (ODCM), or radioactive waste systems. Also list new locations identified by the land use census pursuant to CONTROL 3.12.2. for dose calculations or environmental monitoring.

* 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.

6.15 MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS AND SOLID WASTE TREATMENT SYSTEMS

6.15.1 LICENSEE INITIATED MAJOR CHANGES TO THE RADIOACTIVE WASTE SYSTEM (LIQUID, GASEOUS AND SOLID)

1. Shall be reported to the Commission in the UFSAR for the period in which the evaluation was reviewed by the Plant Operations Review Committee (PORC). The discussion of each change shall contain:

    a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10CFR50.59;

    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 exposures to individual 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 prior to 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 PORC.

2. Shall become effective upon review and acceptance by the PORC and signed by the Plant Manager.

PART II – CALCULATIONAL METHODOLOGIES

1.0 LIQUID EFFLUENTS

1.1 Radiation Monitoring Instrumentation and Controls

The liquid effluent monitoring instrumentation and controls at Hope Creek for controlling and monitoring normal radioactive material releases in accordance with the Hope Creek Radiological Effluent Technical Specifications are summarized as follows:

1. Alarm (and Automatic Termination) - Liquid Radwaste Discharge Line Monitor provides the alarm and automatic termination of liquid (RE4861) radioactive material releases from the liquid waste management system as required by CONTROL 3.3.7.10.

   Circulating Water Dewatering Sump Discharge Monitor (RE4557) provides alarm and automatic termination of liquid radioactive releases from the circulating dewatering sump as required by CONTROL 3.3.7.10. Condensation drains from certain supply ventilation units and liquids from the fill and venting of the circulating water side of the condenser waterboxes are directed to this sump. Automatic termination is performed by trip of the sump pumps on high gamma radiation signal.

2. Alarm (Only) - The Cooling-Tower Blowdown Effluent Monitor (RE8817) provides an Alarm function only for releases into the environment as required by CONTROL 3.3.7.10.

   Liquid radioactive waste flow diagrams with the applicable, associated radiation monitoring instrumentation and controls are presented in Figure 1-1.

1.2 Liquid Effluent Monitor Setpoint Determination

Per the requirements of CONTROL 3.3.7.10, alarm setpoints shall be established for the liquid monitoring instrumentation to ensure that the release concentration limits of CONTROL 3.11.1.1 are met (i.e., the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentrations specified in 10 CFR 20 Appendix B. Table II, Column 2, (Appendix F) for radionuclides and 2.0E-04 μCi/ml for dissolved or entrained noble gases). The following equation (adopted from NUREG-0133) must be satisfied to meet the liquid effluent restrictions:

$$c \leq \frac{C\,(F+f)}{f} \tag{1.1}$$

Where:

C = The effluent concentration limit of CONTROL 3.11.1.1 implementing the 10 CFR 20 MPC (Appendix F) for the site, in μCi/ml.

c = The setpoint, in μCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint, represents a value which, if exceeded, would result in concentrations exceeding the limits of 10 CFR 20 in the UNRESTRICTED AREA.

f = The flow rate at the radiation monitor location, in volume per unit time, but the same units as F, below.

F = The dilution water flow rate as measured prior to the release point, in volume per unit time.

[Note that if no dilution is provided, $c \leq C$. Also, note that when (F) is large compared to (f), then (F + f) = F.]

1.2.1 Liquid Effluent Monitors

*The setpoints for the liquid effluent monitors at the Hope Creek Generating Station are determined by the following equation:

$$SP \leq \frac{MCP_e * CTBD * [1 - CF]}{RR} + bkg \tag{1.2}$$

with:

$$MPC_e = \sum_i C_i \ (gamma) \ / \ \sum_i \frac{C_i}{MPC_i} \ (gamma) \tag{1.3}$$

Where:

	SP	=	Alarm setpoint corresponding to the maximum allowable release rate (μCi/ml).
	MPC_e	=	An effective MPC value for the mixture of radionuclides in the effluent stream, (μCi/ml).
	C_i	=	The concentration of radionuclide in the liquid effluent (μCi/ml).
	MPC_i	=	The MPC value corresponding to radionuclide i from (Appendix F) 10 CFR 20, Appendix B, Table II, Column 2 (μCi/ml).
	CTBD	=	The Cooling-Tower Blowdown Discharge rate at the time of release (gal/min).
	RR	=	The liquid effluent release rate (gal/min) at the monitor location (i.e., at the liquid radwaste monitor, at the TBCW monitor, or at the CTBD monitor).
	bkg	=	The background of the monitor (μCi/ml).
	CF	=	Correction factor to account for non-gamma emitting nuclides and radiation monitor inaccuracies.

The radioactivity monitor setpoint equation (1.2) remains valid during outages when the Cooling-Tower Blowdown discharge is potentially at its lowest value. Reduction of the waste stream flow (RR) may be necessary during these periods to meet the discharge criteria. Procedural restrictions prevent simultaneous batch liquid releases. The setpoints should be reduced to allow for potential or actual concurrent continuous releases such that the limits of ODCM CONTROL 3.11.1.1 are not exceeded.

1.2.2 Conservative Default Values

Conservative alarm setpoints for liquid radwaste radiation monitors may be determined through the use of default parameters. Table 1-1 summarizes all current default values in use for Hope Creek. They are based upon the following:

a. Substitution of the effective MPC value with a default value of 4.09E-05 μCi/ml for radwaste releases (Refer to Appendix A for justification);

b. Substitutions of the Cooling-Tower Blowdown discharge rate with the minimum average flow, in gal/min; and,

c. Substitutions of the effluent release rate with the highest allowed rate, in gal/min.

d. Substitution of a 0.8 correction factor (CF) to account for monitor inaccuracies and non-gamma emitting radionuclides.

The use of the conservative alarm setpoint, or a setpoint below the conservative value, is acceptable provided that the value used is at least as conservative as the release specific setpoint calculated in accordance with Equation 1.2 above. Procedural controls exist to verify the setpoint utilized is at or below what is required.

1.3 Liquid Effluent Concentration Limits - 10 CFR 20

CONTROL 3.11.1.1 limits the concentration of radioactive material in liquid effluents (after dilution in the Cooling-Tower Blowdown Discharge System) to less than the concentrations as specified in 10 CFR 20, Appendix B, Table II, Column 2 (Appendix F) for radionuclides other than noble gases.

Noble gases are limited to a diluted concentration of 2.0E-04 μCi/ml. Release rates are controlled and radiation monitor alarm setpoints are established as addressed above to ensure that these concentration limits are not exceeded. However, in the event any liquid release results in an alarm setpoint being exceeded, an evaluation of compliance with the concentration limits of CONTROL 3.11.1.1 may be performed using the following equation:

$$\frac{C_i}{MPC_i} * \frac{RR}{CTBD + RR} \leq 1 \qquad \textbf{(1.4)}$$

Where:

C_i = Actual concentration of radionuclide i as measured in the undiluted liquid effluent (μCi/ml).

MPC_i = The MPC value corresponding to radionuclide i from 10 CFR 20, Appendix B, Table II, Column 2 (Appendix F) (μCi/ml).

= 2E-04 μCi/ml for dissolved or entrained noble gases.

RR = The actual liquid effluent release rate (gal/min)

CTBD = The actual Cooling-Tower Blowdown discharge at the time *of release (gal/min).*

1.4 Liquid Effluent Dose Calculation - 10 CFR 50

1.4.1 Member of the Public Dose - Liquid Effluents

CONTROL 3.11.1.2 limits the dose or dose commitment to MEMBERS OF THE PUBLIC from radioactive materials in liquid effluents from Hope Creek Generating Station to:

- during any calendar quarter:
  - ≤ 1.5 mrem to total body
  - ≤ 5.0 mrem to any organ
- during any calendar year:
  - ≤ 3.0 mrem to total body
  - ≤ 10.0 mrem to any organ

Per the surveillance requirements to CONTROL 4.11.1.2, the following calculation methods shall be used for determining the dose or dose commitment due to the liquid radioactive effluents from Hope Creek.

$$D_o = \frac{8.35E-04 * VOL}{CTBD} * \sum_i C_i * A_{io}$$

(1.5)

Where:

	D_o	=	Dose or dose commitment to organ o, including total body (mrem).
	A_{io}	=	Site-related ingestion dose commitment factor to the total body or any organ o for radionuclide i (mrem/hr per μCi/ml).
	C_i	=	Average concentration of radionuclide i, in undiluted liquid effluent representative of volume VOL (μCi/ml).
	VOL	=	Volume of liquid effluent released (gal).
	CTBD	=	Average Cooling-Tower Blowdown discharge rate during release period (gal/min).
	8.35E-04	=	Conversion factor (1.67E-2 hr/min) and a near field dilution factor of 0.05 (refer to Appendix B for definition).

The site-related ingestion dose/dose commitment factors (A_{io}) are presented in Table 1-2 and have been derived in accordance with NUREG-0133 by the equation:

$$A_{io} = 1.14E+05\ [(UI * BI_i) + (UF * BF_i)]\ Df_{io}$$

(1.6)

Where:

	A_{io}	=	Composite dose parameter for the total body or critical organ o of an adult for radionuclide i, for the fish and invertebrate ingestion pathways (mrem/hr per μCi/ml).
	1.14E+05	=	Conversion factor (pCi/μCi * ml/kg per hr/yr).
	UI	=	Adult invertebrate consumption (5 kg/yr).
	Bi_i	=	Bioaccumulation factor for radionuclide i in invertebrates from Table 1-3 (pCi/kg per pCi/1).
	UF	=	Adult fish consumption (21 kg/yr).
	Bf_i	=	Bioaccumulation factor for nuclide i in fish from Table 1-3 (pCi/kg per pCi/l).
	Df_{io}	=	Dose conversion factor for nuclide i for adults in preselected organ, o, from Table E-11 of Regulatory Guide 1.109 (mrem/pCi).

The radionuclides included in the periodic dose assessment per the requirements of CONTROL 3/4.11.1.2 are those as identified by gamma spectral analysis of the liquid waste samples collected and analyzed per the requirements of CONTROL 3/4.11.1.1, Table 4.11.1.1.1-1.

Radionuclides requiring radiochemical analysis (e.g., Sr-89 and Sr-90) will be added to the dose analysis at a frequency consistent with the required minimum analysis frequency of CONTROL Table 4.11.1.1.1-1.

1.4.2 Simplified Liquid Effluent Dose Calculation

In lieu of the individual radionuclide dose assessment as presented in Section 1.4.1, the following simplified dose calculation equation may be used for demonstrating compliance with the dose limits of CONTROL 3.11.1.2. (Refer to Appendix B for the derivation and justification for this simplified method.)

Total Body

$$D_{tb} = \frac{1.94E+02 * VOL}{CTBD} * \sum_i C_i \tag{1.7}$$

Maximum Organ

$$D_{max\,o} = \frac{5.28E+02 * VOL}{CTBD} * \sum_i C_i \tag{1.8}$$

Where:

	D_{tb}	=	Conservatively evaluated total body dose (mrem).
	$D_{max\,o}$	=	Evaluated maximum organ dose (mrem).
	C_i	=	Average concentration of radionuclide i, in undiluted liquid effluent representative of the volume VOL (μCi/ml).
	VOL	=	Volume of liquid effluent released (gal).
	CTBD	=	Average Cooling-Tower Blowdown discharge rate during release period (gal/min).
	1.94E+02	=	Conversion factor (1.67E-2 hr/min), the conservative total body ingestion dose commitment factor (Zn-65 = 2.32E+5 mrem/hr per μCi/ml), and the near field dilution factor of 0.05. (See Appendix B)
	5.28E+02	=	Conversion factor (1.67E-2 hr/min), the conservative maximum organ ingestion dose commitment factor (Fe-59, GI-LLI – 6.32E+5 mrem/hr per μCi/ml), and the near field dilution factor of 0.05 (See Appendix B).

1.5 Liquid Effluent Dose Projections

CONTROL 3.11.1.3 requires that the liquid radioactive waste processing system be used to reduce the radioactive material levels in the liquid waste prior to release when the 31-day projected doses exceed:

- 0.06 mrem to the total body, or
- 0.2 mrem to any organ.

The applicable liquid waste processing system for maintaining radioactive material releases ALARA are the drain filters and demineralizers as delineated in Figure 1-1.

Dose projections are made at least once per 31-days by the following equations:

$$D_{tbp} = (D_{tb} / d) * 31d \tag{1.9}$$

$$D_{maxp} = (D_{max} / d) * 31d \tag{1.10}$$

Where:

	D_{tbp}	=	The total body dose projection for current 31-day period (mrem).
	D_{tb}	=	The total body dose to date for current calendar quarter as determined by equation (1.5) or (1.7).
	D_{maxp}	=	The maximum organ dose to date for current calendar quarter as determined by equation (1.5 or (1.8)) (mrem).
	d	=	The number of days in current calendar quarter at the end of the release.
	31d	=	The number of days of concern.

1.6 Representative Samples

A sample should be representative of the bulk stream or volume of effluent from which it is taken. Prior to sampling, large volumes of liquid waste should be mixed in as short a time interval as practicable to assure that any sediments or particulate solids are distributed uniformly in the waste mixture. Recirculation pumps for liquid waste tanks (collection or sample test tanks) should be capable of recirculating at a rate of not less than two tank volumes in eight hours. Minimum recirculation times and methods of recirculation are controlled by specific plant procedures.

2.0 GASEOUS EFFLUENTS

2.1 Radiation Monitoring Instrumentation and Controls

The gaseous effluent monitoring instrumentation and controls at Hope Creek for controlling and monitoring normal radioactive material releases in accordance with the Radiological Effluent CONTROLS are summarized as follows:

1. Filtration, Recirculation, and Ventilation System

   The FRVS is maintained in a standby condition. Upon reactor building isolation, the FRVS recirculation system recirculates the reactor building air through HEPA and charcoal filters. Releases are made to the atmosphere via a reactor building vent or the South Plant Vent depending on mode of operation. Noble gas monitoring is provided by RE-4811A.

2. South Plant Vent

   The SPV receives discharge from the radwaste evaporator, reactor building purge, auxiliary building radwaste area, condensate demineralizer, pipe chase, feedwater heater, and untreated ventilation sources. Effluents are monitored (for noble gas) by the RE-4875B monitor.

3. North Plant Vent

   The NPV receives discharge from the gaseous radwaste treatment system (Offgas system) and untreated ventilation air sources. Effluents are monitored (for noble gases) by the RE-4573B monitor.

   Gaseous radioactive waste flow diagrams with the applicable, associated radiation monitoring instrumentation controls are presented in Figures 2-1 and 2-2.

2.2 Gaseous Effluent Monitor Setpoint Determination

2.2.1 Plant Vent, FRVS

Per the requirements of CONTROL 3.3.7.11, alarm setpoints shall be established for the gaseous effluent monitoring instrumentation to ensure that the release rate of noble gases does not exceed the limits of CONTROL 3.11.2.1, which corresponds to a dose rate at the SITE BOUNDARY of 500 mrem/year to the total body or 3000 mrem/year to the skin. Based on a grab sample analysis of the applicable release (i.e., of FRVS, pipe chase, gaseous radwaste treatment system air, etc.), the radiation monitoring alarm setpoints may be established by the following calculation method. The measured radionuclide concentrations and release rate are used to calculate the fraction of the allowable release rate, as limited by CONTROL 3.11.2.1, by the equation:

$$FRAC = [\,4.72E+02 * {}^{X}/_{Q} * VF * \sum_{i}(C_i * K_i)\,] / 500 \tag{2.1}$$

$$FRAC = [\,4.72E+02 * {}^{X}/_{Q} * VF * \sum_{i}(C_i * (L_i + 1.1M_i))\,] / 3000 \tag{2.2}$$

Where:

FRAC	=	Fraction of the allowable release rate based on the identified radionuclide concentrations and the release flow rate.
X/Q	=	Annual average meteorological dispersion to the controlling site boundary location (sec/m^3).
VF	=	Ventilation system flow rate for the applicable release point and monitor (ft^3/min).
C_i	=	Concentration of noble gas radionuclide i as determined by radioanalysis of grab sample (uCi/cm^3)
K_i	=	Total body dose conversion factor for noble gas radionuclide i (mrem/yr per μCi/m^3), from Table 2-1
L_i	=	Beta skin dose conversion factor for noble gas radionuclide i (mrem/yr per μCi/m^3), from Table 2-1
M_i	=	Gamma air dose conversion factor for noble gas radionuclide i (mrad/yr per μCi/m^3), from Table 2-1
1.1	=	mrem skin dose per mrad gamma air dose (mrem/mrad)
4.72E+02	=	Conversion factor (cm^3/ft^3 * min/sec)
500	=	Total body dose rate limit (mrem/yr)
3000	=	Skin dose rate limit (mrem/yr)

Based on the more limiting FRAC (i.e., higher value) as determined above, the alarm setpoints for the applicable monitors may be calculated by the equation:

$$SP \leq [AF * \sum_i C_i / FRAC] + bkg$$

(2.3)

Where:

Where:	SP	=	Alarm setpoint corresponding to the maximum allowable release rate (μCi/cc).
	FRAC	=	Highest fraction of the allowable release rate as determined in equation (2.2).
	bkg	=	Background of the monitor (μCi/cc).
	AF	=	Administrative allocation factor for the specific monitor (0.2 NPV, 0.2 SPV, 0.1 FRVS).

The allocation factor (AF) is an administrative control imposed to ensure that combined releases from Salem Units 1 and 2 and Hope Creek will not exceed the regulatory limits on release rate from the site (i.e., the release rate limits of CONTROL 3.11.2.1). Normally, the combined AF value for Salem Units 1 and 2 is 0.5 (0.25 per unit), with the remainder 0.5 allocated to Hope Creek. Any increase in AF above 0.5 for the Hope Creek Generating Station will be coordinated with the Salem Generating Station to ensure that the combined allocation factors for all units do not exceed 1.0.

2.2.2 Conservative Default Values

A conservative alarm setpoint can be established, in lieu of the individual radionuclide evaluation based on the grab sample analysis, to eliminate the potential of periodically having to adjust the setpoint to reflect minor changes in radionuclide distribution and variations in release flow rate. The alarm setpoint may be conservatively determined by the default values presented in Table 2-2.

These values are based upon:

- The maximum ventilation (or purge) flow rate;
- A radionuclide distribution adopted from ANSI N237- 1976/ANS 18.1 "Source Term Specifications", Table 5 and;
- An administrative allocation factor of 0.5 to conservatively ensure that any releases from Hope Creek do not exceed the maximum allowable release rate.

For the noble gas radionuclide distribution from ANSI N237-1976/ANS 18.1 (Note Table C-1), the alarm setpoint based on the total body dose rate is more restrictive than the corresponding setpoint based on the skin dose rate. As an additional measure of conservatism, the default setpoints are set approximately 25% lower than the calculated setpoints. The resulting conservative, default setpoints are presented in Table 2-2. Note: Emergency Action Levels (EALs) are based on actual monitor readings not on alarm set points.

2.3 Gaseous Effluent Instantaneous Dose Rate Calculations - 10 CFR 20

2.3.1 Site Boundary Dose Rate - Noble Gases

CONTROL 3.11.2.la limits the dose rate at the SITE BOUNDARY due to noble gas releases to ≤ 500 mrem/yr, total body and ≤ 3000 mrem/yr, skin. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event any gaseous releases from the station results in an alarm setpoint (as determined in Section 2.2.1) being exceeded, an evaluation of the SITE BOUNDARY dose rate resulting from the release shall be performed using the following equations:

$$D_{tb} = {}^{X}/_{Q} * \sum_{i} (K_i * Q_i) \tag{2.4}$$

$$D_s = {}^{X}/_{Q} * \sum_{i} ((L_i + 1.1M_i) * Q_i) \tag{2.5}$$

Where:

	D_{tb}	=	Total body dose rate (mrem/yr).
	D_s	=	Skin dose rate (mrem/yr).
	X/Q	=	Atmospheric dispersion to the controlling SITE BOUNDARY location (sec/m^3).
	Q_i	=	Average release rate of radionuclide i over the release period under evaluation (μCi/sec).
	K_i	=	Total body dose conversion factor for noble gas radionuclide i (mrem/yr per μCi/m^3), from Table 2-1.
	L_i	=	Beta skin dose conversion factor for noble gas radionuclide i (mrad/yr per μCi/m^3), from Table 2-1.
	M_i	=	Gamma air dose conversion factor for noble gas radionuclide i (mrad/yr per μCi/m^3, from Table 2-1.
	1.1	=	mrem skin dose per mrad gamma air dose (mrem/mrad)

As appropriate, simultaneous releases from Salem Units 1 and 2 and Hope Creek will be considered in evaluating compliance with the release rate limits of CONTROL 3.11.2.1a, following any releases exceeding the above prescribed alarm setpoints. Monitor indications (readings) may be averaged over a time period not to exceed 15 minutes when determining noble gas release rate based on correlation of the monitor reading and monitor sensitivity. The 15-minute averaging is needed to allow for reasonable monitor response to potentially changing radioactive material concentrations and to exclude potential electronic spikes in monitor readings that may be unrelated to radioactive material releases. As identified, any electronic spiking monitor responses may be excluded from the analysis.

NOTE: For administrative purposes, more conservative alarm setpoints than those as prescribed above may be imposed. However, conditions exceeding these more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding the dose limits of CONTROL 3.11.2.1a. Provided actual releases do not result in radiation monitor indications exceeding alarm setpoint values based on the above criteria, no further analyses are required for demonstrating compliance with the limits of CONTROL 3.11.2.1a.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2-3 may be used for evaluating the gaseous effluent dose rate.

2.3.2 Site Boundary Dose Rate - Radioiodine and Particulates

CONTROL 3.11.2.1b limits the dose rate to $\leq$ 1500 mrem/yr to any organ for I-131, I-133, tritium and particulates with half-lives greater than 8 days. To demonstrate compliance with this limit, an evaluation is performed at a frequency no greater than that corresponding to the sampling and analysis time period (e.g., nominally once per 7 days). The following equation shall be used for the dose rate evaluation:

$$D_o = X/Q * \sum_i (R_{io} * Q_i) \tag{2.6}$$

Where:

D_o = Average organ dose rate over the sampling time period (mrem/yr).

X/Q = Atmospheric dispersion to the controlling SITE BOUNDARY location for the inhalation pathway (sec/m^3).

R_{io} = Dose parameter for radionuclide i (mrem/yr per μCi/m^3) and organ o for the child inhalation pathway from Table 2-4.

Q_i = Average release rate over the appropriate sampling period and analysis frequency for radionuclide I, I-131, I-133, tritium or other radionuclide in particulate form with half- life greater than 8 days (μCi/sec).

By substituting 1500 mrem/yr for D_o and solving for Q, an allowable release rate for I-131 can be determined. Based on the annual average meteorological dispersion (See Table 2-3) and the most limiting potential pathway, age group and organ (inhalation, child, thyroid -- Ri = 1.62E+07 mrem/yr per μCi/m^3), the allowable release rate for I-131 is 34.7 μCi/sec. Reducing this release rate by a factor of 2 to account for potential dose contributions from other radioactive particulate material and other release points (e.g., Salem), the corresponding release rate allocated to Hope Creek is 17.4 μCi/sec. For a 7-day period, which is the nominal sampling and analysis frequency for I-131, the cumulative release is 10.5 Ci.

Therefore, as long as the I-131 release in any 7-day period do not exceed 10.5 Ci, no additional analyses are needed for verifying compliance with the CONTROL 3.11.2.1.b limits on allowable release rate.

2.4 Noble Gas Effluent Dose Calculations - 10 CFR 50

2.4.1 Unrestricted Area Dose - Noble Gases

CONTROL 3.11.2.2 requires a periodic assessment of releases of noble gases to evaluate compliance with the quarterly dose limits of ≤ 5 mrad, gamma-air and ≤ 10 mrad, beta-air and the calendar year limits ≤ 10 mrad, gamma-air and ≤ 20 mrad, beta-air.

The limits are applicable separately to each generating station and are not combined site limits. The following equations shall be used to calculate the gamma-air and beta-air doses:

$$D_\gamma = 3.17E-08 * {}^{X}/_{Q} * \sum_i (M_i * Q_i) \tag{2.7}$$

$$D_\beta = 3.17E-08 * {}^{X}/_{Q} * \sum_i (N_i * Q_i) \tag{2.8}$$

Where:

D_γ	=	Air dose due to gamma emissions for noble gas radionuclides (mrad).
D_β	=	Air dose due to beta emissions for noble gas radionuclides (mrad).
X/Q	=	Atmospheric dispersion to the controlling SITE BOUNDARY location (sec/m^3).
Q_i	=	Cumulative release of noble gas radionuclide i over the period of interest (μCi).
M_i	=	Air dose factor due to gamma emission from noble gas radionuclide i (mrad/yr per μCi/m^3, from Table 2-1.
N_i	=	Air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per μCi/m^3, Table 2-1).
3.17E-08	=	Conversion factor (yr/sec).

2.4.2 Simplified Dose Calculation for Noble Gases

In lieu of the individual noble gas radionuclide dose assessment as presented above, the following simplified dose calculation equations may be used for verifying compliance with the dose limits of CONTROL 3.11.2.2 (Refer to Appendix C for the derivation and justification of this simplified method).

$$D_\gamma = \frac{3.17E-8}{0.50} * {}^{\chi}/_{Q} * M_{eff} * \sum_i Q_i \tag{2.9}$$

$$D_\beta = \frac{3.17E-8}{0.50} * {}^{\chi}/_{Q} * N_{eff} * \sum_i Q_i \tag{2.10}$$

Where:

M_{eff}	=	8.1E+03, effective gamma-air dose factor (mrad/yr per µCi/m3).
N_{eff}	=	8.5E+03, effective beta-air dose factor (mrad/yr per µCi/m3).
Q_i	=	Cumulative release for all noble gas radionuclides (µCi).
0.50	=	Conservatism factor to account for potential variability in the radionuclide distribution.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2-3, may be used for the evaluation of the gamma-air and beta-air doses.

2.5 Radioiodine and Particulate Dose Calculations - 10 CFR 50

2.5.1 Unrestricted Area Dose - Radioiodine and Particulates

In accordance with the requirements of CONTROL 3.11.2.3, a periodic assessment shall be performed to evaluate compliance with the quarterly dose limit of ≤7.5 mrem and calendar year limit of ≤ 15 mrem to any organ. The following equation shall be used to evaluate the maximum organ dose due to release of I-131, I-133, tritium and particulates with half-lives greater than 8 days:

$$D_{aop} = 3.17E-08 * W * SF_p * \sum_i (R_{iaop} * Q_i) \quad \textbf{(2.11)}$$

Where:

- D_{aop} = Dose or dose commitment via all pathways p and age group a (as identified in Table 2-3) to organ o, including the total body (mrem).
- W = Atmospheric dispersion parameter to the controlling location(s) as identified in Table 2-3.
- X/Q = Atmospheric dispersion for inhalation pathway and H-3 dose contribution via other pathways (sec/m^3).
- D/Q = Atmospheric deposition for vegetation, milk and ground plane exposure pathways (1/m^2).
- R_{iaop} = Dose factor for radionuclide i (mrem/yr per µCi/m^3 or m^2 - mrem/yr per µCi/sec) and organ o from Table 2-4 for each age group a and the applicable pathway p as identified in Table 2-3. Values for R_{iaop} were derived in accordance with the methods described in NUREG-0133.
- Q_i = Cumulative release over the period of interest for radionuclide i - I-131, I-133, H-3 or radioactive material in particulate form with half-life greater than 8 days (µCi).
- SF_p = Annual seasonal correction factor to account for fraction of the year that the applicable exposure pathway does not exist.

1. For milk and vegetation exposure pathways: A six month fresh vegetation and grazing season (May through Oct) = 0.5

2. For inhalation and ground plane exposure pathways: = 1.0

For evaluating the maximum exposed individual, the infant age group is controlling for the milk pathway. Only the controlling age group as identified in Table 2-3 need be evaluated for compliance with Control 3.11.2.3

2.5.2 Simplified Dose Calculation for Radioiodines and Particulates

In lieu of the individual radionuclide (I-131, I-133 and particulates) dose assessment for the resident/dairy location as presented above, the following simplified dose calculation equation may be used for verifying compliance with the dose limits of CONTROL 3.11.2.3 (Refer to Appendix D for the derivation and justification of this simplified method):

$$D_{\max o} = 3.17E-08 * W * SF_p * R_{I-131} * \sum_i Q_i$$

(2.12)

Where:

	$D_{\max o}$	=	Maximum organ dose (mrem).
	R_{I-131}	=	I-131 dose parameter for the thyroid for the identifie controlling pathway.
		=	1.05E+12, infant thyroid dose parameter with the cow-milk pathway controlling (m^2 - mrem/yr per μCi/sec).
	W	=	D/Q for radioiodine, 2.87E-10 1/m^2.
	Q_i	=	Cumulative release over the period of interest for radionuclide I, I-131 or radioactive material in particulate form with half-life greater than 8 days (μCi).
	SF_p	=	Annual seasonal correction factor to account for fraction of the year that the applicable exposure pathway does not exist.

The location of exposure pathways and the maximum organ dose calculation may be based on the available pathways in the surrounding environment of Hope Creek as identified by the annual land-use census (CONTROL 3.12.2). Otherwise, the dose will be evaluated based on the predetermined controlling pathways as identified in Table 2-3.

2.6 Gaseous Effluent Dose Projection

CONTROL 3.11.2.4 requires that the VENTILATION EXHAUST TREATMENT SYSTEM be used to reduce radioactive material levels prior to discharge when projected doses in 31-days exceed:

- 0.2 mrad to air from gamma radiation, or
- 0.4 mrad to air from beta radiation, or
- 0.3 mrad to any organ of a Member of the Public.

The applicable gaseous processing systems for maintaining radioactive material releases ALARA are the *Gaseous Radwaste Treatment System and* Exhaust Treatment System as delineated in Figures 2-1 and 2-2.

Dose projection are performed at least once per 31-days by the following equations:

$$D_{gp} = (D_g/d) * 31d \tag{2.13}$$

$$D_{dp} = (D_d/d) * 31d \tag{2.14}$$

$$D_{maxp} = (D_{max}/d) * 31d \tag{2.15}$$

Where:	D_{gp}	=	Gamma air dose projection for current 31-day period (mrad).
	D_g	=	Gamma air dose to date for current calendar quarter as determined by equation (2.7) or (2.9) (mrad).
	D_{bp}	=	Beta air dose projection for current 31-day period (mrad).
	D_b	=	Beta air dose to date for current calendar quarter as determined by equation (2.8) or (2.10) (mrad).
	D_{maxp}	=	Maximum organ dose projection for current 31-day period (mrem).
	D_{max}	=	Maximum organ dose to date for current calendar quarter as determined by equation (2.11) or (2.12) (mrem).
	d	=	Number of days in current calendar quarter at the end of the release.
	31d	=	The number of days of concern.

3.0 SPECIAL DOSE ANALYSIS

3.1 Doses Due to Activities Inside the Site Boundary

In accordance with Technical Specification 6.9.1.7, the Radioactive Effluent Release Report (RERR) submitted by May 1st of each year shall include an assessment of radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY.

The calculation methods as presented in Sections 2.4 and 2.5 may be used for determining the maximum potential dose to a MEMBER OF THE PUBLIC located inside the site boundary. For the purpose of this calculation, a MEMBER OF THE PUBLIC is an adult individual who is not subject to occupational exposure (i.e., an un-monitored site worker) performing duties within the site boundary, and who is exposed to radioactive material in gaseous effluent for 2,000 hours per year via the inhalation and ground plane exposure pathways. The values for the atmospheric dispersion coefficients at the point of interest inside the site boundary (e.g., 0.25 mile) shall be developed from the current year meteorological data.

3.2 Total Dose to MEMBERS OF THE PUBLIC - 40 CFR 190 and 10 CFR 72.104

The Radioactive Effluent Release Report (RERR) submitted by May 1st of each year shall also include an assessment of the radiation dose to the likely most exposed MEMBER OF THE PUBLIC for reactor releases and other nearby uranium fuel cycle courses (including dose contributions from effluents and direct radiation from on-site sources). For the likely most exposed MEMBER OF THE PUBLIC in the vicinity of Artificial Island, the sources of exposure need only consider the Salem Generating station and the Hope Creek Generating Station which includes the Independent Spent Fuel Storage Installation (ISFSI): No other fuel cycle facilities contribute to the MEMBER OF THE PUBLIC dose for the Artificial Island vicinity.

The dose contribution from the operation of Salem Generating Stations will be estimated based on the methods as presented in the Salem Offsite Dose Calculation Manual (SGS ODCM).

As appropriate for demonstrating/evaluating compliance with the limits of CONTROL 3.11.4 (40 CFR 190) the results of the environmental monitoring program may be used for providing data on actual measured levels of radioactive material in the actual pathways of exposure.

3.2.1 Effluent Dose Calculations

For purposes of implementing the surveillance requirements of CONTROL 3/4.11.4 and the reporting requirements of 6.9.1.7 (RERR) dose calculations for the Hope Creek Generating Station may be performed using the calculation methods contained within the ODCM; the conservation controlling pathways and locations of Table 2-4 or the actual pathways and locations as identified by the land use census (CONTROL 3/4.12.1) may be used. Average annual meteorological dispersion parameters or meteorological conditions concurrent with the release period under evaluation may be used.

3.2.2 Direct Exposure Dose Determination

Any potentially significant direct exposure contribution to off-site individual doses may be evaluated based on the results of the environmental measurements (e.g., dosimetry, ion chamber measurements) and/or by the use of a radiation transport and shielding calculation method. Only during a non-typical condition will there exist any potential for significant on-site sources at Hope Creek that would yield potentially significant off-site doses (i.e., in excess of 1 mrem per year to a MEMBER OF THE PUBLIC), that would require detailed evaluation for demonstrating compliance with 40 CFR 190 or 10 CFR 72.104. However, should a situation exist whereby the direct exposure contribution is potentially significant, on-site measurements, off-site measurements and/or calculational techniques will be used for determination of dose for assessing 40 CFR 190 or 10 CFR 72.104 compliance.

3.3 Doses due to Carbon 14 in Gaseous Effluent

Because gaseous effluent releases from a boiling water reactor (BWR), such as the Hope Creek Generating Station, can contain significant quantities of C-14 (i.e., approximately 8 to 9.5 curies annually according to Revision 2 of Regulatory Guide 1.21), the NRC has recommended that licensees evaluate C-14 as a potential principal radionuclide for gaseous releases from their facility. The results in an evaluation conducted in response to SAP Order 70096339 identified C-14 as a principal radionuclide in gaseous effluent releases from the Hope Creek Generating Station.

3.3.1 Estimation of Carbon 14 Annual Release

The methodology for estimating the quantity C-14 released annually from the Hope Creek Generating Station incorporates the use of a normalized C-14 source term and a scaling factor based on power generation. NCRP Report No. 81, *Carbon-14 in the Environment*, has been identified by the NRC as a source for scaling factors (refer to section 1.9 in Revision 2 of Regulatory Guide 1.21). This approach is one of three NRC-recommended methods for estimating the quantity of C-14 discharged in gaseous effluent (refer to Regulatory position 1.9 in Revision 2 of Regulatory Guide 1.21). Electrical energy output value for the reporting period should be used to estimate the quantity of C-14 released.

3.3.2 Carbon 14 dose Determinations

The methodology for determining doses from C-14 in gaseous releases incorporates dose models described in Regulatory Guide 1.109. Estimated C-14 releases and average meteorological data for the reporting period should be used as input to the dose calculations. The doses due to C-14 in gaseous releases are calculated for receptors located at and beyond the site boundary. For doses at locations beyond the site boundaries, receptors shall be real individuals via active pathways as identified in the Annual Land Use Census. Doses due to C-14 in gaseous effluent and the assumptions used in the dose calculations shall be included in the annual Radioactive Effluent Release Report.

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

4.1 Sampling Program

The operational phase of the Radiological Environmental Monitoring Program (REMP) is conducted in accordance with the requirements of CONTROL 3.12. The objectives of the program are:

- To determine whether any significant increases occur in the concentration of radionuclides in the critical pathways of exposure in the vicinity of Artificial Island;
- To determine if the operation of the Hope Creek Generating Station has resulted in any increase in the inventory of long lived radionuclides in the environment;
- To detect any changes in the ambient gamma radiation levels; and
- To verify that HCGS operations have no detrimental effects on the health and safety of the public or on the environment.

The sampling requirements (type of samples, collection frequency and analysis) and sample locations are presented in Appendix E.

NOTE: No public drinking water samples or irrigation water samples are taken as these pathways are not directly affected by liquid effluents discharged from Hope Creek Generating Station.

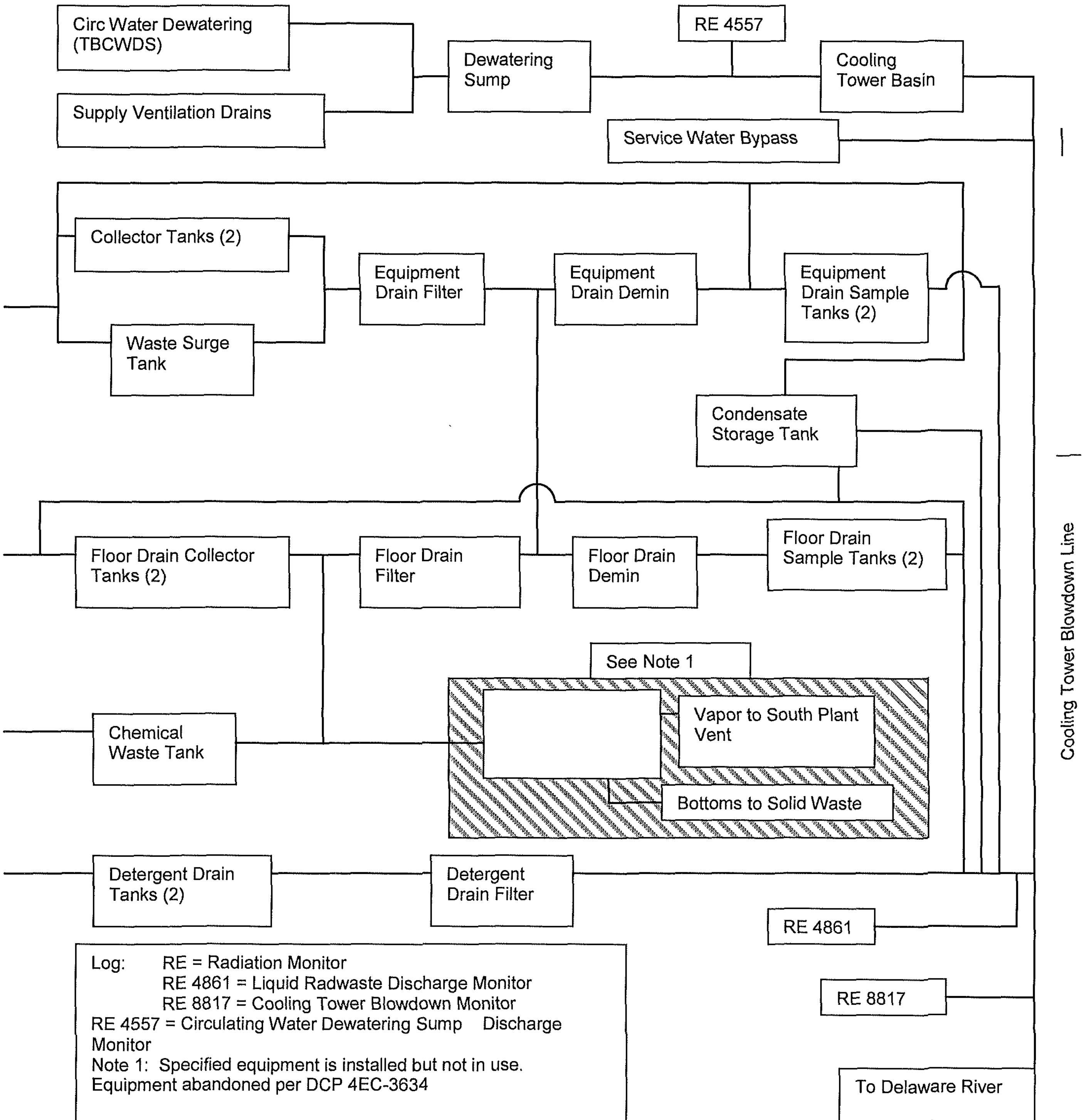
4.2 Interlaboratory Comparison Program

CONTROL 3.12.3 requires analyses be performed on radioactive material supplied as part of an Interlaboratory Comparison. Participation in an approved Interlaboratory Comparison Program provides a check on the preciseness of measurements of radioactive materials in environmental samples. A summary of the Interlaboratory Comparison Program results will be provided in the Annual Radiological Environmental Operating Report pursuant to CONTROLS 6.9.1.7.

5.0 HCGS EXPLOSIVE GAS MONITORING PROGRAM

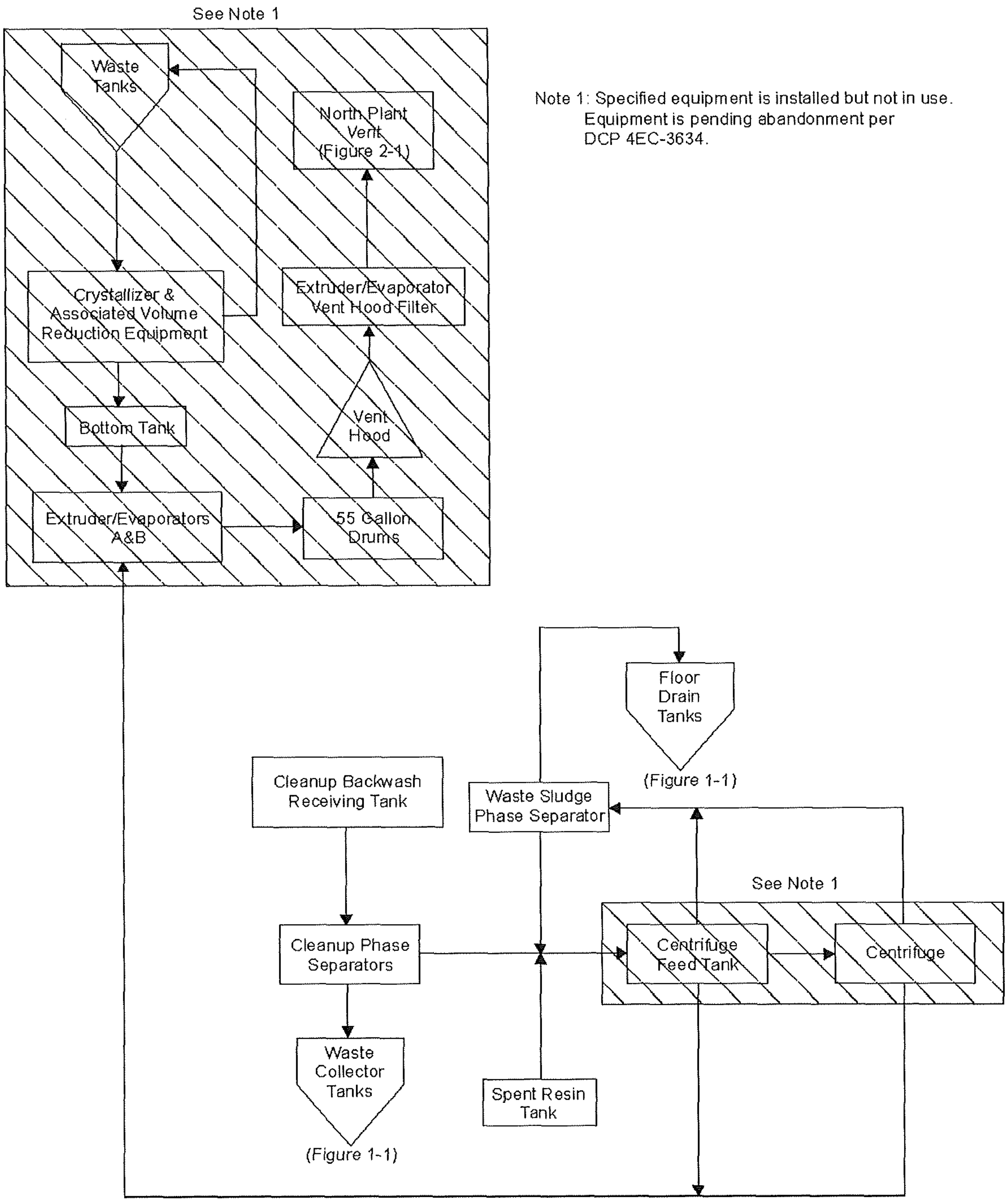
The Hope Creek Explosive Gas Monitoring program was moved within the Hope Creek Technical Specifications to section 6.8.4.d. This was performed in Technical Specification Amendment 91. Details of the Hope Creek Explosive Gas Monitoring program are maintained in station implementing procedures and are controlled by the 50.59 safety evaluation and procedure processes.

FIGURE 1-1: LIQUID RADWASTE TREATMENT AND MONITORING SYSTEM



Log: RE = Radiation Monitor
RE 4861 = Liquid Radwaste Discharge Monitor
RE 8817 = Cooling Tower Blowdown Monitor
RE 4557 = Circulating Water Dewatering Sump Discharge Monitor
Note 1: Specified equipment is installed but not in use. Equipment abandoned per DCP 4EC-3634

FIGURE 1-2: SOLID RADWASTE PROCESSING SYSTEM



Note 1: Specified equipment is installed but not in use. Equipment is pending abandonment per DCP 4EC-3634.

TABLE 1-1: PARAMETERS FOR LIQUID ALARM SETPOINT DETERMINATION

Parameter	Actual Value	Default Value	Units	Comments
MPCe	Calc	4.09E-05*	µCi/ml	Calculated for each batch to be released
MPC I-131	3.0E-07	N/A	µCi/ml	Taken from 10 CFR 20, Appendix B, Table II, Column 2 (Appendix F)
C_i	Measured	N/A	µCi/ml	Taken from gamma spectral analysis of liquid effluent
MPC_i	Measured	N/A	µCi/ml	Taken from 10CFR20, Appendix B, Table II, Column 2 (Appendix F)
CTBD	Measured	12000	gpm	Cooling tower blowdown discharge
RR	Measured	176 1300	gpm or gpm (CST)	Determined prior to release, release rate can be adjusted for CONTROL compliance
	Estimated	100	gpm (TBCW)	Maximum flow rate with both pumps running (50 gpm each)
SP (Setpoints)				
A) RE4861	Calc	5.58E-04	µCi/ml	Default alarm setpoints; more conservative values may be used as appropriate and desirable for ensuring regulatory compliance and for maintaining releases ALARA
RE8817	Calc	8.18E-06	µCi/ml	
RE4557	Calc	2.40E-06	µCi/ml	Maximum alarm setpoint continuous release; more conservative value may be established by plant procedure
B) RE4861	Calc	7.55E-05	µCi/ml	These setpoints are for condensate storage tank releases
RE8817	Calc	8.18E-06	µCi/ml	

* See Appendix A for basis

TABLE 1-2: SITE RELATED INGESTION DOSE COMMITMENT FACTOR, A_{io} (FISH AND INVERTEBRATE CONSUMPTION)

(mrem/hr per μCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	-	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1
C-14	1.45E+4	2.90E+3	2.90E+3	2.90E+3	2.90E+3	2.90E+3	2.90E+3
Na-24	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1
P-32	4.69E+6	2.91E+5	1.81E+5	-	-	-	5.27E+5
Cr-51	-	-	5.58E+0	3.34E+0	1.23E+0	7.40E+0	1.40E+3
Mn-54	-	7.06E+3	1.35E+3	-	2.10E+3	-	2.16E+4
Mn-56	-	1.78E+2	3.15E+1	-	2.26E+2	-	5.67E+3
Fe-55	5.11E+4	3.53E+4	8.23E+3	-	-	1.97E+4	2.03E+4
Fe-59	8.06E+4	1.90E+5	7.27E+4	-	-	5.30E+4	6.32E+5
Co-57	-	1.42E+2	2.36E+2	-	-	-	3.59E+3
Co-58	-	6.03E+2	1.35E+3	-	-	-	1.22E+4
Co-60	-	1.73E+3	3.82E+3	-	-	-	3.25E+4
Ni-63	4.96E+4	3.44E+3	1.67E+3	-	-	-	7.18E+2
Ni-65	2.02E+2	2.62E+1	1.20E+1	-	-	-	6.65E+2
Cu-64	-	2.14E+2	1.01E+2	-	5.40E+2	-	1.83E+4
Zn-65	1.61E+5	5.13E+5	2.32E+5	-	3.43E+5	-	3.23E+5
Zn-69m	5.66E+3	1.36E+4	1.24E+3	-	8.22E+3	-	8.29E+5
As-76	4.38E+2	1.16E+3	5.14E+3	3.42E+2	1.39E+3	3.58E+2	4.30E+4
Br-82	-	-	4.07E+0	-	-	-	4.67E+0
Br-83	-	-	7.25E-2	-	-	-	1.04E-1
Br-84	-	-	9.39E-2	-	-	-	7.37E-7
Br-85	-	-	3.86E-3	-	-	-	-
Rb-86	-	6.24E+2	2.91E+2	-	-	-	1.23E+2
Rb-88	-	1.79E+0	9.49E-1	-	-	-	2.47E-11
Rb-89	-	1.19E+0	8.34E-1	-	-	-	6.89E-14
Sr-89	4.99E+3	-	1.43E+2	-	-	-	8.00E+2
Sr-90	1.23E+5	-	3.01E+4	-	-	-	3.55E+3
Sr-91	9.18E+1	-	3.71E+0	-	-	-	4.37E+2
Sr-92	3.48E+1	-	1.51E+0	-	-	-	6.90E+2
Y-90	6.06E+0	-	1.63E-1	-	-	-	6.42E+4
Y-91m	5.73E-2	-	2.22E-3	-	-	-	1.68E-1
Y-91	8.88E+1	-	2.37E+0	-	-	-	4.89E+4
Y-92	5.32E-1	-	1.56E-2	-	-	-	9.32E+3
Y-93	1.69E+0	-	4.66E-2	-	-	-	5.35E+4
Zr-95	1.59E+1	5.11E+0	3.46E+0	-	8.02E+0	-	1.62E+4
Zr-97	8.81E-1	1.78E-1	8.13E-2	-	2.68E-1	-	5.51E+4
Nb-95	4.47E+2	2.49E+2	1.34E+2	-	2.46E+2	-	1.51E+6
Nb-97	3.75E+0	9.49E-1	3.46E-1	-	1.11E+0	-	3.50E+3
Mo-99	-	1.28E+2	2.43E+1	-	2.89E+2	-	2.96E+2
Tc-99m	1.30E-2	3.66E-2	4.66E-1	-	5.56E-1	1.79E-2	2.17E+1
Tc-101	1.33E-2	1.92E-2	1.88E-1	-	3.46E-1	9.81E-3	5.77E-14

TABLE 1-2: SITE RELATED INGESTION DOSE COMMITMENT FACTOR, A_{io} (FISH AND INVERTEBRATE CONSUMPTION) (Continued)

(mrem/hr per µCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
Ru-103	1.07E+2	-	4.60E+1	-	4.07E+2	-	1.25E+4
Ru-105	8.89E+0	-	3.51E+0	-	1.15E+2	-	5.44E+3
Ru-106	1.59E+3	-	2.01E+2	-	3.06E+3	-	1.03E+5
Ag-110m	1.56E+3	1.45E+3	8.60E+2	-	2.85E+3	-	5.91E+5
Sb-122	1.98E+1	4.55E-1	6.82E+0	3.06E-1	-	1.19E+1	7.51E+3
Sb-124	2.77E+2	5.23E+0	1.10E+2	6.71E-1	-	2.15E+2	7.86E+3
Sb-125	1.77E+2	1.98E+0	4.21E+1	1.80E-1	-	1.36E+2	1.95E+3
Sb-126	1.14E+2	2.31E+0	4.10E+1	6.96E-1	-	6.97E+1	9.29E+3
Te-125m	2.17E+2	7.86E+1	2.91E+1	6.52E+1	8.82E+2	-	8.66E+2
Te-127m	5.48E+2	1.96E+2	6.68E+1	1.40E+2	2.23E+3	-	1.84E+3
Te-127	8.90E+0	3.20E+0	1.93E+0	6.60E+0	3.63E+1	-	7.03E+2
Te-129m	9.31E+2	3.47E+2	1.47E+2	3.20E+2	3.89E+3	-	4.69E+3
Te-129	2.54E+0	9.55E-1	6.19E-1	1.95E+0	1.07E+1	-	1.92E+0
Te-131m	1.40E+2	6.85E+1	5.71E+1	1.08E+2	6.94E+2	-	6.80E+3
Te-131	1.59E+0	6.66E-1	5.03E-1	1.31E+0	6.99E+0	-	2.26E-1
Te-132	2.04E+2	1.32E+2	1.24E+2	1.46E+2	1.27E+3	-	6.24E+3
I-130	3.96E+1	1.17E+2	4.61E+1	9.91E+3	1.82E+2	-	1.01E+2
I-131	2.18E+2	3.12E+2	1.79E+2	1.02E+5	5.35E+2	-	8.23E+1
I-132	1.06E+1	2.85E+1	9.96E+0	9.96E+2	4.54E+1	-	5.35E+0
I-133	7.45E+1	1.30E+2	3.95E+1	1.90E+4	2.26E+2	-	1.16E+2
I-134	5.56E+0	1.51E+1	5.40E+0	2.62E+2	2.40E+1	-	1.32E-2
I-135	2.32E+1	6.08E+1	2.24E+1	4.01E+3	9.75E+1	-	6.87E+1
Cs-134	6.84E+3	1.63E+4	1.33E+4	-	5.27E+3	1.75E+3	2.85E+2
Cs-136	7.16E+2	2.83E+3	2.04E+3	-	1.57E+3	2.16E+2	3.21E+2
Cs-137	8.77E+3	1.20E+4	7.85E+3	-	4.07E+3	1.35E+3	2.32E+2
Cs-138	6.07E+0	1.20E+1	5.94E+0	-	8.81E+0	8.70E-1	5.12E-5
Ba-139	7.85E+0	5.59E-3	2.30E-1	-	5.23E-3	3.17E-3	1.39E+1
Ba-140	1.64E+3	2.06E+0	1.08E+2	-	7.02E-1	1.18E+0	3.38E+3
Ba-141	3.81E+0	2.88E-3	1.29E-1	-	2.68E-3	1.63E-3	1.80E-9
Ba-142	1.72E+0	1.77E-3	1.08E-1	-	1.50E-3	1.00E-3	2.43E-18
La-140	1.57E+0	7.94E-1	2.10E-1	-	-	-	5.83E+4
La-142	8.06E-2	3.67E-2	9.13E-3	-	-	-	2.68E+2
Ce-141	3.43E+0	2.32E+0	2.63E-1	-	1.08E+0	-	8.86E+3
Ce-143	6.04E-1	4.46E+2	4.94E-2	-	1.97E-1	-	1.67E+4
Ce-144	1.79E+2	7.47E+1	9.59E+0	-	4.43E+1	-	6.04E+4
Pr-143	5.79E+0	2.32E+0	2.87E-1	-	1.34E+0	-	2.54E+4
Pr-144	1.90E-2	7.87E-3	9.64E-4	-	4.44E-3	-	2.73E-9
Nd-147	3.96E+0	4.58E+0	2.74E-1	-	2.68E+0	-	2.20E+4
W-187	9.16E+0	7.66E+0	2.68E+0	-	-	-	2.51E+3
Np-239	3.53E-2	3.47E-3	1.91E-3	-	1.08E-2	-	7.11E+2

TABLE 1-3: BIOACCUMULATION FACTORS

(pCi/kg per pCi/liter)*

ELEMENT	SALTWATER FISH	SALTWATER INVERTEBRATES
H	9.0E-01	9.3E-01
C	1.8E+03	1.4E+03
Na	6.7E-02	1.9E-01
P	3.0E+03	3.0E+04
Cr	4.0E+02	2.0E+03
Mn	5.5E+02	4.0E+02
Fe	3.0E+03	2.0E+04
Co	1.0E+02	1.0E+03
Ni	1.0E+02	2.5E+02
Cu	6.7E+02	1.7E+03
Zn	2.0E+03	5.0E+04
Br	1.5E-02	3.1E+00
Rb	8.3E+00	1.7E+01
Sr	2.0E+00	2.0E+01
Y	2.5E+01	1.0E+03
Zr	2.0E+02	8.0E+01
Nb	3.0E+04	1.0E+02
Mo	1.0E+01	1.0E+01
Tc	1.0E+01	5.0E+01
Ru	3.0E+00	1.0E+03
Rh	1.0E+01	2.0E+03
Ag	3.3E+03	3.3E+03
Sb	4.0E+01	5.4E+00
Te	1.0E+01	1.0E+02
I	1.0E+01	5.0E+01
Cs	4.0E+01	2.5E+01
Ba	1.0E+01	1.0E+02
La	2.5E+01	1.0E+03
Ce	1.0E+01	6.0E+02
Pr	2.5E+01	1.0E+03
Nd	2.5E+01	1.0E+03
W	3.0E+01	3.0E+01
Np	1.0E+01	1.0E+01
As	3.3E+02	3.3E+02

* Values in this table are taken from Regulatory Guide 1.109 except for phosphorus (fish) which is adapted from NUREG/CR-1336 and silver, arsenic and antimony which are taken from UCRL 50564, Rev. 1, October 1972.

FIGURE 2-1: GASEOUS RADWASTE TREATMENT SYSTEM

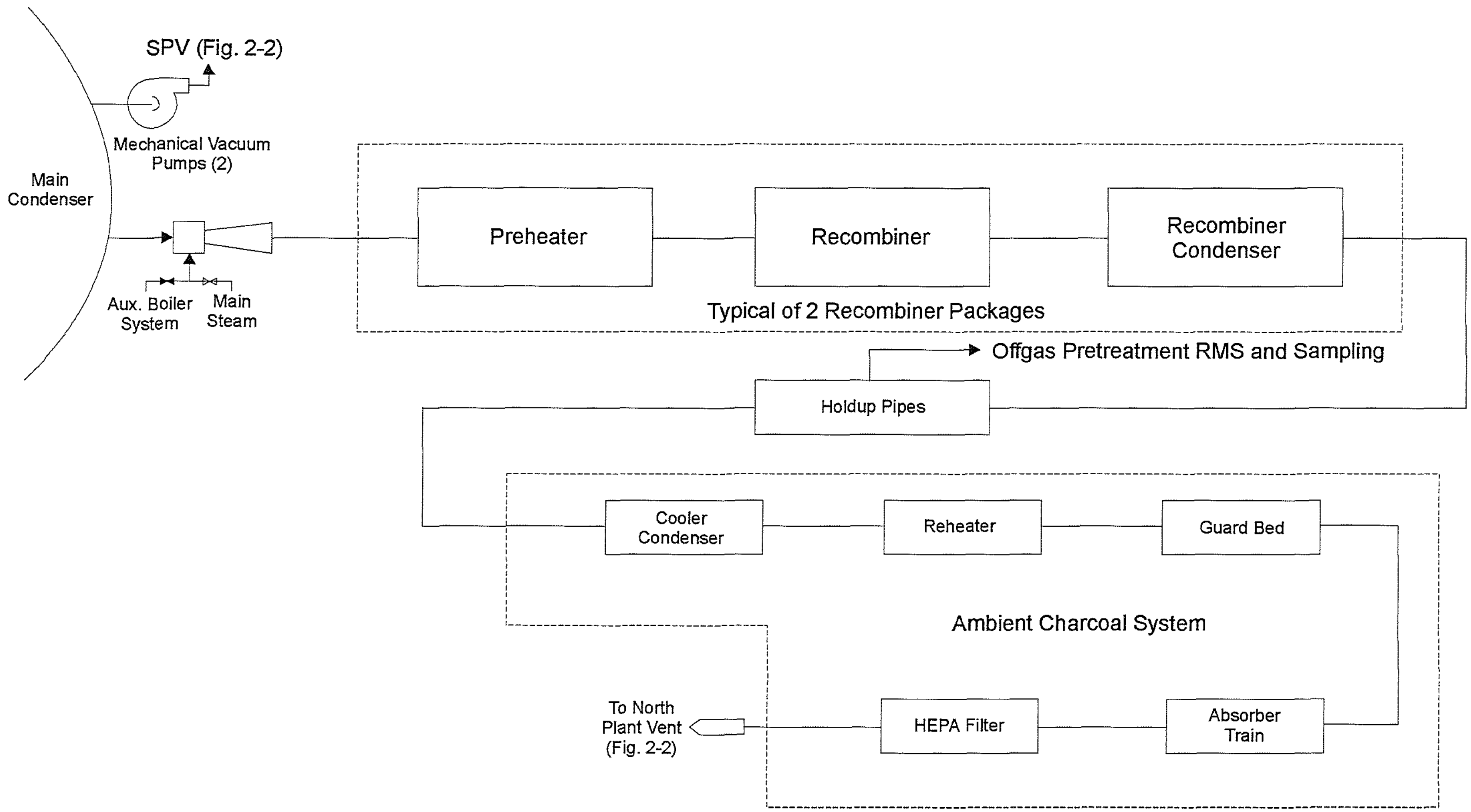
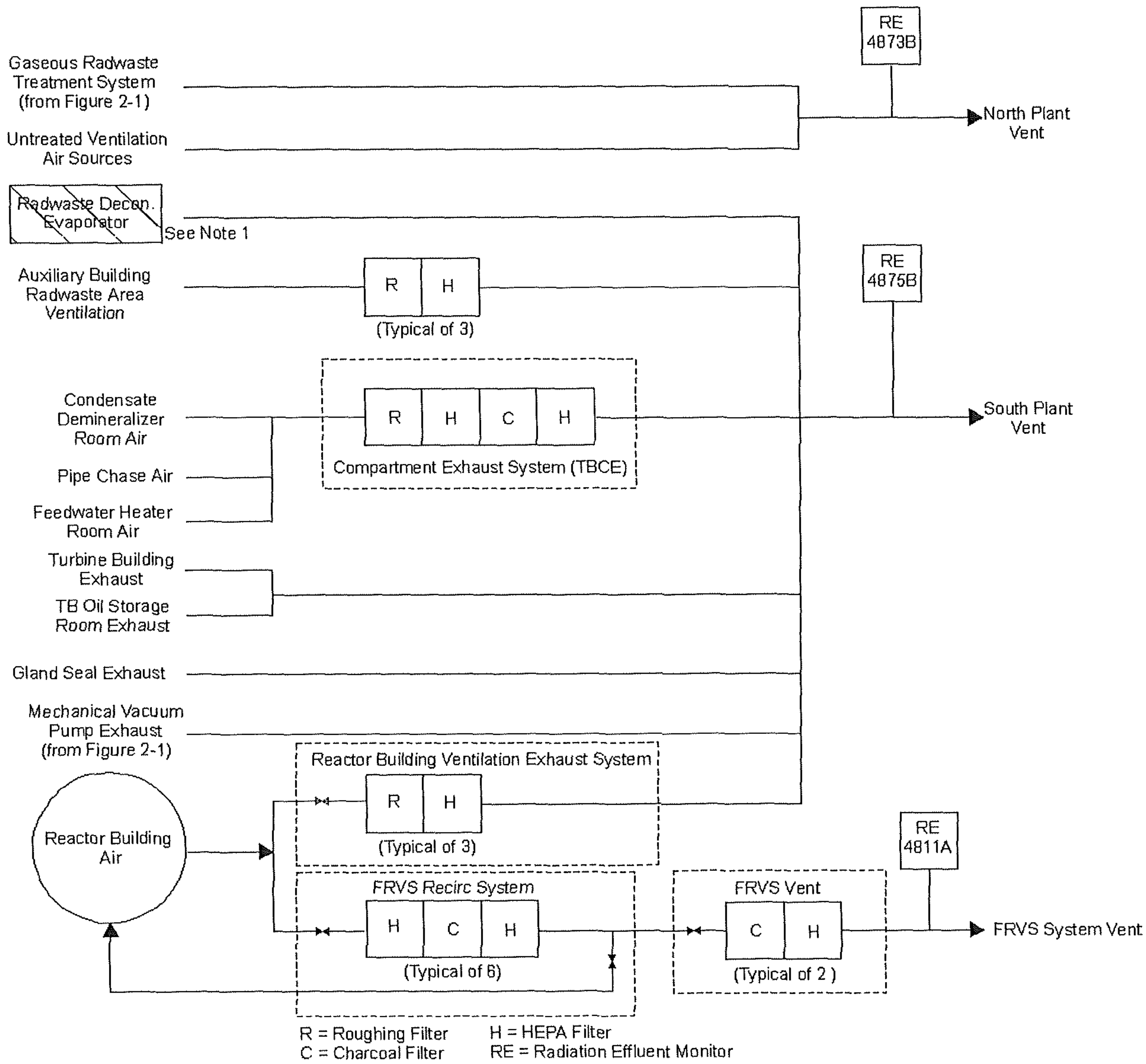


FIGURE 2-2: VENTILATION EXHAUST TREATMENT SYSTEM



Note 1: **Specified equipment is installed but not in use.**
Equipment pending abandonment per DCP 4EC-3634.

TABLE 2-1: DOSE FACTORS FOR NOBLE GASES

Radionuclide	Total Body Dose Factor Ki (mrem/yr per µCi/m3)	Skin Dose Factor Li (mrem/yr per µCi/m3)	Gamma Air Dose Factor Mi (mrad/yr per µCi/m3)	Beta Air Dose Factor Ni (mrad/yr per µCi/m3
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

TABLE 2-2: PARAMETERS FOR GASEOUS ALARM SETPOINT DETERMINATION

Parameter	Actual Value	Default Value	Units	Comments
X/Q	Calculated	2.14E-6	sec/m^3	From FSAR Table 2.3-31, 0.5 mile, N
VF (NPV)	Measured	41,900	ft^3/min	Maximum Operation
VF (SPV)	Measured	440,180	ft^3/min	Maximum Operation
VF (FRVS)	Measured	9,000	ft^3/min	Maximum Operation
AF (NPV)	Coordinated with SGS	0.2	Unitless	Administrative allocation factor to ensure releases do not exceed release rate limit
AF (SPV)	Coordinated with SGS	0.2	Unitless	Administrative allocation factor to ensure releases do not exceed release rate limit
AF (FRVS)	Coordinated with SGS	0.1	Unitless	Administrative allocation factor to ensure releases do not exceed release rate limit
C_i	Measured or Distribution from ANSI N237-1976[1]	N/A	μCi/cm^3	Normally derived from ANSI N237-1976
K_i	Nuclide Specific	N/A Specific	mrem/yr per μCi/m^3	Table 2-1
L_i	Nuclide Specific	N/A	mrem/yr per μCi/m^3	Table 2-1
M_i	Nuclide Specific	N/A	mrad/yr per μCi/m^3	Table 2-1
Setpoints	**Calculated Setpoint**	**Default Setpoint**		
NPV (RE 4873B)	3.03E-4	2.43E-4	μCi/cc	As an additional measure of conservatism, the default setpoints are set approximately 25% lower than the calculated setpoints.
SPV (RE 4875B)	2.89E-5	2.31E-5	μCi/cc	
FRVS (RE 4811A)	7.06E-4	5.65E-4	μCi/cc	

[1] See Section 2.2.2

TABLE 2-3: CONTROLLING LOCATIONS, PATHWAYS AND ATMOSPHERIC DISPERSION FOR DOSE CALCULATIONS*

ODCM Control	Location	Pathway(s)	Age Group	(sec/m3)	(1/m2)
3.11.2.1a	Site Boundary 0.5 miles, N*	Noble Gases direct exposure	N/A	2.14 E-06	N/A
3.11.2.1b	Site Boundary 0.5 miles, N*	Inhalation and ground plane	Child	2.14 E-06	N/A
3.11.2.2	Site Boundary 0.5 miles, N*	Gamma-Air Beta-Air	N/A	2.14 E-06	N/A
3.11.2.3	Residence/Dairy - 4.9 miles, W**	Milk, ground plane and inhalation	Infant	7.2 E-08	2.87 E-10
3.11.2.3	Residence/Garden/Beef 4.6 miles SW**	Ground Plane, inhalation, garden produce, meat ingestion	Child	8.0E-08	2.4E-10

* The identified controlling locations, pathways and atmospheric dispersion are from the Artificial Island Radiological Monitoring Program and the Hope Creek FSAR.

** Location and distance are determined from the performance of the annual land use census as required by ODCM CONTROL 3.12.2.

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, INHALATION PATHWAY DOSE FACTORS

ADULT (mrem/yr per μCi/m^3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3
C-14	1.82E+4	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3
P-32	1.32E+6	7.71E+4	-	-	-	8.64E+4	5.01E+4
Cr-51	-	-	5.95E+1	2.28E+1	1.44E+4	3.32E+3	1.00E+2
Mn-54	-	3.96E+4	-	9.84E+3	1.40E+6	7.74E+4	6.30E+3
Fe-55	2.46E+4	1.70E+4	-	-	7.21E+4	6.03E+3	3.94E+3
Fe-59	1.18E+4	2.78E+4	-	-	1.02E+6	1.88E+5	1.06E+4
Co-57	-	6.92E+2	-	-	3.70E+5	3.14E+4	6.71E+2
Co-58	-	1.58E+3	-	-	9.28E+5	1.06E+5	2.07E+3
Co-60	-	1.15E+4	-	-	5.97E+6	2.85E+5	1.48E+4
Ni-63	4.32E+5	3.14E+4	-	-	1.78E+5	1.34E+4	1.45E+4
Zn-65	3.24E+4	1.03E+5	-	6.90E+4	8.64E+5	5.34E+4	4.66E+4
Rb-86	-	1.35E+5	-	-	-	1.66E+4	5.90E+4
Sr-89	3.04E+5	-	-	-	1.40E+6	3.50E+5	8.72E+3
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+6
Y-91	4.62E+5	-	-	-	1.70E+6	3.85E+5	1.24E+4
Zr-95	1.07E+5	3.44E+4	-	5.42E+4	1.77E+6	1.50E+5	2.33E+4
Nb-95	1.41E+4	7.82E+3	-	7.74E+3	5.05E+5	1.04E+5	4.21E+3
Ru-103	1.53E+3	-	-	5.83E+3	5.05E+5	1.10E+5	6.58E+2
Ru-106	6.91E+4	-	-	1.34E+5	9.36E+6	9.12E+5	8.72E+3
Ag-110m	1.08E+4	1.00E+4	-	1.97E+4	4.63E+6	3.02E+5	5.94E+3
Sb-124	3.12E+4	5.89E+2	7.55E+1	-	2.48E+6	4.06E+5	1.24E+4
Sb-125	5.34E+4	5.95E+2	5.40E+1	-	1.74E+6	1.01E+5	1.26E+4
Te-125m	3.42E+3	1.58E+3	1.05E+3	1.24E+4	3.14E+5	7.06E+4	4.67E+2
Te-127m	1.26E+4	5.77E+3	3.29E+3	4.58E+4	9.60E+5	1.50E+5	1.57E+3
Te-129m	9.76E+3	4.67E+3	3.44E+3	3.66E+4	1.16E+6	3.83E+5	1.58E+3
I-131	2.52E+4	3.58E+4	1.19E+7	6.13E+4	-	6.28E+3	2.05E+4
I-132	1.16E+3	3.26E+3	1.14E+5	5.18E+3	-	4.06E+2	1.16E+3
I-133	8.64E+3	1.48E+4	2.15E+6	2.58E+4	-	8.88E+3	4.52E+3
I-134	6.44E+2	1.73E+3	2.98E+4	2.75E+3	-	1.01E+0	6.15E+2
I-135	2.68E+3	6.98E+3	4.48E+5	1.11E+4	-	5.25E+3	2.57E+3
Cs-134	3.73E+5	8.48E+5	-	2.87E+5	9.76E+4	1.04E+4	7.28E+5
Cs-136	3.90E+4	1.46E+5	-	8.56E+4	1.20E+4	1.17E+4	1.10E+5
Cs-137	4.78E+5	6.21E+5	-	2.22E+5	7.52E+4	8.40E+3	4.28E+5
Ba-140	3.90E+4	4.90E+1	-	1.67E+1	1.27E+6	2.18E+5	2.57E+3
Ce-141	1.99E+4	1.35E+4	-	6.26E+3	3.62E+5	1.20E+5	1.53E+3
Ce-144	3.43E+6	1.43E+6	-	8.48E+5	7.78E+6	8.16E+5	1.84E+5
Pr-143	9.36E+3	3.75E+3	-	2.16E+3	2.81E+5	2.00E+5	4.64E+2
Nd-147	5.27E+3	6.10E+3	-	3.56E+3	2.21E+5	1.73E+5	3.65E+2

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, INHALATION PATHWAY DOSE FACTORS (Continued)

TEENAGER (mrem/yr per $\mu Ci/m^3$)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3
C-14	2.60E+4	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3
P-32	1.89E+6	1.10E+5	-	-	-	9.28E+4	7.16E+4
Cr-51	-	-	7.50E+1	3.07E+1	2.10E+4	3.00E+3	1.35E+2
Mn-54	-	5.11E+4	-	1.27E+4	1.98E+6	6.68E+4	8.40E+3
Fe-55	3.34E+4	2.38E+4	-	-	1.24E+5	6.39E+3	5.54E+3
Fe-59	1.59E+4	3.70E+4	-	-	1.53E+6	1.78E+5	1.43E+4
Co-57	-	6.92E+2	-	-	5.86E+5	3.14E+4	9.20E+2
Co-58	-	2.07E+3	-	-	1.34E+6	9.52E+4	2.78E+3
Co-60	-	1.51E+4	-	-	8.72E+6	2.59E+5	1.98E+4
Ni-63	5.80E+5	4.34E+4	-	-	3.07E+5	1.42E+4	1.98E+4
Zn-65	3.86E+4	1.34E+5	-	8.64E+4	1.24E+6	4.66E+4	6.24E+4
Rb-86	-	1.90E+5	-	-	-	1.77E+4	8.40E+4
Sr-89	4.34E+5	-	-	-	2.42E+6	3.71E+5	1.25E+4
Sr-90	1.08E+8	-	-	-	1.65E+7	7.65E+5	6.68E+6
Y-91	6.61E+5	-	-	-	2.94E+6	4.09E+5	1.77E+4
Zr-95	1.46E+5	4.58E+4	-	6.74E+4	2.69E+6	1.49E+5	3.15E+4
Nb-95	1.86E+4	1.03E+4	-	1.00E+4	7.51E+5	9.68E+4	5.66E+3
Ru-103	2.10E+3	-	-	7.43E+3	7.83E+5	1.09E+5	8.96E+2
Ru-106	9.84E+4	-	-	1.90E+5	1.61E+7	9.60E+5	1.24E+4
Ag-110m	1.38E+4	1.31E+4	-	2.50E+4	6.75E+6	2.73E+5	7.99E+3
Sb-124	4.30E+4	7.94E+2	9.76E+1	-	3.85E+6	3.98E+5	1.68E+4
Sb-125	7.38E+4	8.08E+2	7.04E+1	-	2.74E+6	9.92E+4	1.72E+4
Te-125m	4.88E+3	2.24E+3	1.40E+3	-	5.36E+5	7.50E+4	6.67E+2
Te-127m	1.80E+4	8.16E+3	4.38E+3	6.54E+4	1.66E+6	1.59E+5	2.18E+3
Te-129m	1.39E+4	6.58E+3	4.58E+3	5.19E+4	1.98E+6	4.05E+5	2.25E+3
I-131	3.54E+4	4.91E+4	1.46E+7	8.40E+4	-	6.49E+3	2.64E+4
I-132	1.59E+3	4.38E+3	1.51E+5	6.92E+3	-	1.27E+3	1.58E+3
I-133	1.22E+4	2.05E+4	2.92E+6	3.59E+4	-	1.03E+4	6.22E+3
I-134	8.88E+2	2.32E+3	3.95E+4	3.66E+3	-	2.04E+1	8.40E+2
I-135	3.70E+3	9.44E+3	6.21E+5	1.49E+4	-	6.95E+3	3.49E+3
Cs-134	5.02E+5	1.13E+6	-	3.75E+5	1.46E+5	9.76E+3	5.49E+5
Cs-136	5.15E+4	1.94E+5	-	1.10E+5	1.78E+4	1.09E+4	1.37E+5
Cs-137	6.70E+5	8.48E+5	-	3.04E+5	1.21E+5	8.48E+3	3.11E+5
Ba-140	5.47E+4	6.70E+1	-	2.28E+1	2.03E+6	2.29E+5	3.52E+3
Ce-141	2.84E+4	1.90E+4	-	8.88E+3	6.14E+5	1.26E+5	2.17E+3
Ce-144	4.89E+6	2.02E+6	-	1.21E+6	1.34E+7	8.64E+5	2.62E+5
Pr-143	1.34E+4	5.31E+3	-	3.09E+3	4.83E+5	2.14E+5	6.62E+2
Nd-147	7.86E+3	8.56E+3	-	5.02E+3	3.72E+5	1.82E+5	5.13E+2

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, INHALATION PATHWAY DOSE FACTORS (Continued)

CHILD (mrem/yr per μCi/m^3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3
C-14	3.59E+4	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3
P-32	2.60E+6	1.14E+5	-	-	-	4.22E+4	9.88E+4
Cr-51	-	-	8.55E+1	2.43E+1	1.70E+4	1.08E+3	1.54E+2
Mn-54	-	4.29E+4	-	1.00E+4	1.58E+6	2.29E+4	9.51E+3
Fe-55	4.74E+4	2.52E+4	-	-	1.11E+5	2.87E+3	7.77E+3
Fe-59	2.07E+4	3.34E+4	-	-	1.27E+6	7.07E+4	1.67E+4
Co-57	-	9.03E+2	-	-	5.07E+5	1.32E+4	1.07E+3
Co-58	-	1.77E+3	-	-	1.11E+6	3.44E+4	3.16E+3
Co-60	-	1.31E+4	-	-	7.07E+6	9.62E+4	2.26E+4
Ni-63	8.21E+5	4.63E+4	-	-	2.75E+5	6.33E+3	2.80E+4
Zn-65	4.26E+4	1.13E+5	-	7.14E+4	9.95E+5	1.63E+4	7.03E+4
Rb-86	-	1.98E+5	-	-		7.99E+3	1.14E+5
Sr-89	5.99E+5	-	-	-	2.16E+6	1.67E+5	1.72E+4
Sr-90	1.01E+8	-	-	-	1.48E+7	3.43E+5	6.44E+6
Y-91	9.14E+5	-	-	-	2.63E+6	1.84E+5	2.44E+4
Zr-95	1.90E+5	4.18E+4	-	5.96E+4	2.23E+6	6.11E+4	3.70E+4
Nb-95	2.35E+4	9.18E+3	-	8.62E+3	6.14E+5	3.70E+4	6.55E+3
Ru-103	2.79E+3	-	-	7.03E+3	6.62E+5	4.48E+4	1.07E+3
Ru-106	1.36E+5	-	-	1.84E+5	1.43E+7	4.29E+5	1.69E+4
Ag-110m	1.69E+4	1.14E+4	-	2.12E+4	5.48E+6	1.00E+5	9.14E+3
Sb-124	5.74E+4	7.40E+2	1.26E+2	-	3.24E+6	1.64E+5	2.00E+4
Sb-125	9.84E+4	7.59E+2	9.10E+1	-	2.32E+6	4.03E+4	2.07E+4
Te-125m	6.73E+3	2.33E+3	1.92E+3	-	4.77E+5	3.38E+4	9.14E+2
Te-127m	2.49E+4	8.55E+3	6.07E+3	6.36E+4	1.48E+6	7.14E+4	3.02E+3
Te-129m	1.92E+4	6.85E+3	6.33E+3	5.03E+4	1.76E+6	1.82E+5	3.04E+3
I-131	4.81E+4	4.81E+4	1.62E+7	7.88E+4	-	2.84E+3	2.73E+4
I-132	2.12E+3	4.07E+3	1.94E+5	6.25E+3	-	3.22E+3	1.88E+3
I-133	1.66E+4	2.03E+4	3.85E+6	3.38E+4	-	5.48E+3	7.70E+3
I-134	1.17E+3	2.16E+3	5.07E+4	3.30E+3	-	9.55E+2	9.95E+2
I-135	4.92E+3	8.73E+3	7.92E+5	1.34E+4	-	4.44E+3	4.14E+3
Cs-134	6.51E+5	1.01E+6	-	3.30E+5	1.21E+5	3.85E+3	2.25E+5
Cs-136	6.51E+4	1.71E+5	-	9.55E+4	1.45E+4	4.18E+3	1.16E+5
Cs-137	9.07E+5	8.25E+5	-	2.82E+5	1.04E+5	3.62E+3	1.28E+5
Ba-140	7.40E+4	6.48E+1	-	2.11E+1	1.74E+6	1.02E+5	4.33E+3
Ce-141	3.92E+4	1.95E+4	-	8.55E+3	5.44E+5	5.66E+4	2.90E+3
Ce-144	6.77E+6	2.12E+6	-	1.17E+6	1.20E+7	3.89E+5	3.61E+5
Pr-143	1.85E+4	5.55E+3	-	3.00E+3	4.33E+5	9.73E+4	9.14E+2
Nd-147	1.08E+4	8.73E+3	-	4.81E+3	3.28E+5	8.21E+4	6.81E+2

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, INHALATION PATHWAY DOSE FACTORS (Continued)

INFANT (mrem/yr per $\mu Ci/m^3$)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2
C-14	2.65E+4	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3
P-32	2.03E+6	1.12E+5	-	-	-	1.61E+4	7.74E+4
Cr-51	-	-	5.75E+1	1.32E+1	1.28E+4	3.57E+2	8.95E+1
Mn-54	-	2.53E+4	-	4.98E+3	1.00E+6	7.06E+3	4.98E+3
Fe-55	1.97E+4	1.17E+4	-	-	8.69E+4	1.09E+3	3.33E+3
Fe-59	1.36E+4	2.35E+4	-	-	1.02E+6	2.48E+4	9.48E+3
Co-57	-	6.51E+2	-	-	3.79E+5	4.86E+3	6.41E+2
Co-58	-	1.22E+3	-	-	7.77E+5	1.11E+4	1.82E+3
Co-60	-	8.02E+3	-	-	4.51E+6	3.19E+4	1.18E+4
Ni-63	3.39E+5	2.04E+4	-	-	2.09E+5	2.42E+3	1.16E+4
Zn-65	1.93E+4	6.26E+4	-	3.25E+4	6.47E+5	5.14E+4	3.11E+4
Rb-86	-	1.90E+5	-	-	-	3.04E+3	8.82E+4
Sr-89	3.98E+5	-	-	-	2.03E+6	6.40E+4	1.14E+4
Sr-90	4.09E+7	-	-	-	1.12E+7	1.31E+5	2.59E+6
Y-91	5.88E+5	-	-	-	2.45E+6	7.03E+4	1.57E+4
Zr-95	1.15E+5	2.79E+4	-	3.11E+4	1.75E+6	2.17E+4	2.03E+4
Nb-95	1.57E+4	6.43E+3	-	4.72E+3	4.79E+5	1.27E+4	3.78E+3
Ru-103	2.02E+3	-	-	4.24E+3	5.52E+5	1.61E+4	6.79E+2
Ru-106	8.68E+4	-	-	1.07E+5	1.16E+7	1.64E+5	1.09E+4
Ag-110m	9.98E+3	7.22E+3	-	1.09E+4	3.67E+6	3.30E+4	5.00E+3
Sb-124	3.79E+4	5.56E+2	1.01E+2	-	2.65E+6	5.91E+4	1.20E+4
Sb-125	5.17E+4	4.77E+2	6.23E+1	-	1.64E+6	1.47E+4	1.09E+4
Te-125m	4.76E+3	1.99E+3	1.62E+3	-	4.47E+5	1.29E+4	6.58E+2
Te-127m	1.67E+4	6.90E+3	4.87E+3	3.75E+4	1.31E+6	2.73E+4	2.07E+3
Te-129m	1.41E+4	6.09E+3	5.47E+3	3.18E+4	1.68E+6	6.90E+4	2.23E+3
I-131	3.79E+4	4.44E+4	1.48E+7	5.18E+4	-	1.06E+3	1.96E+4
I-132	1.69E+3	3.54E+3	1.69E+5	3.95E+5	-	1.90E+3	1.26E+3
I-133	1.32E+4	1.92E+4	3.56E+6	2.24E+4	-	2.61E+3	5.60E+3
I-134	9.21E+2	1.88E+3	4.45E+4	2.09E+3	-	1.29E+3	6.65E+2
I-135	3.86E+3	7.60E+3	6.96E+5	8.47E+3	-	1.83E+3	2.77E+3
Cs-134	3.96E+5	7.03E+5	-	1.90E+5	7.97E+4	1.33E+3	7.45E+4
Cs-136	4.83E+4	1.35E+5	-	5.64E+4	1.18E+4	1.43E+3	5.29E+4
Cs-137	5.49E+5	6.12E+5	-	1.72E+5	7.13E+4	1.33E+3	4.55E+4
Ba-140	5.60E+4	5.60E+1	-	1.34E+1	1.60E+6	3.84E+4	2.90E+3
Ce-141	2.77E+4	1.67E+4	-	5.25E+3	5.17E+5	2.16E+4	1.99E+3
Ce-144	3.19E+6	1.21E+6	-	5.38E+5	9.84E+6	1.48E+5	1.76E+5
Pr-143	1.40E+4	5.24E+3	-	1.97E+3	4.33E+5	3.72E+4	6.99E+2
Nd-147	7.94E+3	8.13E+3	-	3.15E+3	3.22E+5	3.12E+4	5.00E+2

TABLE 2-4: **PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, GRASS-COW-MILK PATHWAY DOSE FACTORS** (Continued)

ADULT (mrem/yr per μCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per μCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2
C-14	3.63E+5	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4
P-32	1.71E+10	1.06E+9	-	-	-	1.92E+9	6.60E+8
Cr-51	-	-	1.71E+4	6.30E+3	3.80E+4	7.20E+6	2.86E+4
Mn-54	-	8.40E+6	-	2.50E+6	-	2.57E+7	1.60E+6
Fe-55	2.51E+7	1.73E+7	-	-	9.67E+6	9.95E+6	4.04E+6
Fe-59	2.98E+7	7.00E+7	-	-	1.95E+7	2.33E+8	2.68E+7
Co-57	-	1.28E+6	-	-	-	3.25E+7	2.13E+6
Co-58	-	4.72E+6	-	-	-	9.57E+7	1.06E+7
Co-60	-	1.64E+7	-	-	-	3.08E+8	3.62E+7
Ni-63	6.73E+9	4.66E+8	-	-	-	9.73E+7	2.26E+8
Zn-65	1.37E+9	4.36E+9	-	2.92E+9	-	2.75E+9	1.97E+9
Rb-86	-	2.59E+9	-	-	-	5.11E+8	1.21E+9
Sr-89	1.45E+9	-	-	-	-	2.33E+8	4.16E+7
Sr-90	4.68E+10	-	-	-	-	1.35E+9	1.15E+10
Y-91	8.60E+3	-	-	-	-	4.73E+6	2.30E+2
Zr-95	9.46E+2	3.03E+2	-	4.76E+2	-	9.62E+5	2.05E+2
Nb-95	8.25E+4	4.59E+4	-	4.54E+4	-	2.79E+8	2.47E+4
Ru-103	1.02E+3	-	-	3.89E+3	-	1.19E+5	4.39E+2
Ru-106	2.04E+4	-	-	3.94E+4	-	1.32E+6	2.58E+3
Ag-110m	5.83E+7	5.39E+7	-	1.06E+8	-	2.20E+10	3.20E+7
Sb-124	2.57E+7	4.86E+5	6.24E+4	-	2.00E+7	7.31E+8	1.02E+7
Sb-125	2.04E+7	2.28E+5	2.08E+4	-	1.58E+7	2.25E+8	4.86E+6
Te-125m	1.63E+7	5.90E+6	4.90E+6	6.63E+7	-	6.50E+7	2.18E+6
Te-127m	4.58E+7	1.64E+7	1.17E+7	1.86E+8	-	1.54E+8	5.58E+6
Te-129m	6.04E+7	2.25E+7	2.08E+7	2.52E+8	-	3.04E+8	9.57E+6
I-131	2.96E+8	4.24E+8	1.39E+11	7.27E+8	-	1.12E+8	2.43E+8
I-132	1.64E-1	4.37E-1	1.53E+1	6.97E-1	-	8.22E-2	1.53E-1
I-133	3.97E+6	6.90E+6	1.01E+9	1.20E+7	-	6.20E+6	2.10E+6
I-134	-	-	-	-	-	-	-
I-135	1.39E+4	3.63E+4	2.40E+6	5.83E+4	-	4.10E+4	1.34E+4
Cs-134	5.65E+9	1.34E+10	-	4.35E+9	1.44E+9	2.35E+8	1.10E+10
Cs-136	2.61E+8	1.03E+9	-	5.74E+8	7.87E+7	1.17E+8	7.42E+8
Cs-137	7.38E+9	1.01E+10	-	3.43E+9	1.14E+9	1.95E+8	6.61E+9
Ba-140	2.69E+7	3.38E+4	-	1.15E+4	1.93E+4	5.54E+7	1.76E+6
Ce-141	4.84E+3	3.27E+3	-	1.52E+3	-	1.25E+7	3.71E+2
Ce-144	3.58E+5	1.50E+5	-	8.87E+4	-	1.21E+8	1.92E+4
Pr-143	1.59E+2	6.37E+1	-	3.68E+1	-	6.96E+5	7.88E+0
Nd-147	9.42E+1	1.09E+2	-	6.37E+1	-	5.23E+5	6.52E+0

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, GRASS-COW-MILK PATHWAY DOSE FACTORS (Continued)

TEENAGER (mrem/yr per µCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per µCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2
C-14	6.70E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5
P-32	3.15E+10	1.95E+9	-	-	-	2.65E+9	1.22E+9
Cr-51	-	-	2.78E+4	1.10E+4	7.13E+4	8.40E+6	5.00E+4
Mn-54	-	1.40E+7	-	4.17E+6	-	2.87E+7	2.78E+6
Fe-55	4.45E+7	3.16E+7	-	-	2.00E+7	1.37E+7	7.36E+6
Fe-59	5.20E+7	1.21E+8	-	-	3.82E+7	2.87E+8	4.68E+7
Co-57	-	2.25E+6	-	-	-	4.19E+7	3.76E+6
Co-58	-	7.95E+6	-	-	-	1.10E+8	1.83E+7
Co-60	-	2.78E+7	-	-	-	3.62E+8	6.26E+7
Ni-63	1.18E+10	8.35E+8	-	-	-	1.33E+8	4.01E+8
Zn-65	2.11E+9	7.31E+9	-	4.68E+9	-	3.10E+9	3.41E+9
Rb-86	-	4.73E+9	-	-	-	7.00E+8	2.22E+9
Sr-89	2.67E+9	-	-	-	-	3.18E+8	7.66E+7
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+6
Y-91	1.58E+4	-	-	-	-	6.48E+6	4.24E+2
Zr-95	1.65E+3	5.22E+2	-	7.67E+2	-	1.20E+6	3.59E+2
Nb-95	1.41E+5	7.80E+4	-	7.57E+4	-	3.34E+8	4.30E+4
Ru-103	1.81E+3	-	-	6.40E+3	-	1.52E+5	7.75E+2
Ru-106	3.75E+4	-	-	7.23E+4	-	1.80E+6	4.73E+3
Ag-110m	9.63E+7	9.11E+7	-	1.74E+8	-	2.56E+10	5.54E+7
Sb-124	4.59E+7	8.46E+5	1.04E+5	-	4.01E+7	9.25E+8	1.79E+7
Sb-125	3.65E+7	3.99E+5	3.49E+4	-	3.21E+7	2.84E+8	8.54E+6
Te-125m	3.00E+7	1.08E+7	8.39E+6	-	-	8.86E+7	4.02E+6
Te-127m	8.44E+7	2.99E+7	2.01E+7	3.42E+8	-	2.10E+8	1.00E+7
Te-129m	1.11E+8	4.10E+7	3.57E+7	4.62E+8	-	4.15E+8	1.75E+7
I-131	5.38E+8	7.53E+8	2.20E+11	1.30E+9	-	1.49E+8	4.04E+8
I-132	2.90E-1	7.59E-1	2.56E+1	1.20E+0	-	3.31E-1	2.72E-1
I-133	7.24E+6	1.23E+7	1.72E+9	2.15E+7	-	9.30E+6	3.75E+6
I-134	-	-	-	-	-	-	-
I-135	2.47E+4	6.35E+4	4.08E+6	1.00E+5	-	7.03E+4	2.35E+4
Cs-134	9.81E+9	2.31E+10	-	7.34E+9	2.80E+9	2.87E+8	1.07E+10
Cs-136	4.45E+8	1.75E+9	-	9.53E+8	1.50E+8	1.41E+8	1.18E+9
Cs-137	1.34E+10	1.78E+10	-	6.06E+9	2.35E+9	2.53E+8	6.20E+9
Ba-140	4.85E+7	5.95E+4	-	2.02E+4	4.00E+4	7.49E+7	3.13E+6
Ce-141	8.87E+3	1.35E+4	-	2.79E+3	-	1.69E+7	6.81E+2
Ce-144	6.58E+5	2.72E+5	-	1.63E+5	-	1.66E+8	3.54E+4
Pr-143	2.92E+2	1.17E+2	-	6.77E+1	-	9.61E+5	1.45E+1
Nd-147	1.81E+2	1.97E+2	-	1.16E+2	-	7.11E+5	1.18E+1

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, GRASS-COW-MILK PATHWAY DOSE FACTORS (Continued)

CHILD (mrem/yr per µCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per µCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3
C-14	1.65E+6	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5
P-32	7.77E+10	3.64E+9	-	-	-	2.15E+9	3.00E+9
Cr-51	-	-	5.66E+4	1.55E+4	1.03E+5	5.41E+6	1.02E+5
Mn-54	-	2.09E+7	-	5.87E+6	-	1.76E+7	5.58E+6
Fe-55	1.12E+8	5.93E+7	-	-	3.35E+7	1.10E+7	1.84E+7
Fe-59	1.20E+8	1.95E+8	-	-	5.65E+7	2.03E+8	9.71E+7
Co-57	-	3.84E+6	-	-	-	3.14E+7	7.77E+6
Co-58	-	1.21E+7	-	-	-	7.08E+7	3.72E+7
Co-60	-	4.32E+7	-	-	-	2.39E+8	1.27E+8
Ni-63	2.96E+10	1.59E+9	-	-	-	1.07E+8	1.01E+9
Zn-65	4.13E+9	1.10E+10	-	6.94E+9	-	1.93E+9	6.85E+9
Rb-86	-	8.77E+9	-	-	-	5.64E+8	5.39E+9
Sr-89	6.62E+9	-	-	-	-	2.56E+8	1.89E+8
Sr-90	1.12E+11	-	-	-	-	1.51E+9	2.83E+10
Y-91	3.91E+4	-	-	-	-	5.21E+6	1.04E+3
Zr-95	3.84E+3	8.45E+2	-	1.21E+3	-	8.81E+5	7.52E+2
Nb-95	3.18E+5	1.24E+5	-	1.16E+5	-	2.29E+8	8.84E+4
Ru-103	4.29E+3	-	-	1.08E+4	-	1.11E+5	1.65E+3
Ru-106	9.24E+4	-	-	1.25E+5	-	1.44E+6	1.15E+4
Ag-110m	2.09E+8	1.41E+8	-	2.63E+8	-	1.68E+10	1.13E+8
Sb-124	1.09E+8	1.41E+8	2.40E+5	-	6.03E+7	6.79E+8	3.81E+7
Sb-125	8.70E+7	1.41E+6	8.06E+4	-	4.85E+7	2.08E+8	1.82E+7
Te-125m	7.38E+7	2.00E+7	2.07E+7	-	-	7.12E+7	9.84E+6
Te-127m	2.08E+8	5.60E+7	4.97E+7	5.93E+8	-	1.68E+8	2.47E+7
Te-129m	2.72E+8	7.61E+7	8.78E+7	8.00E+8	-	3.32E+8	4.23E+7
I-131	1.30E+9	1.31E+9	4.34E+11	2.15E+9	-	1.17E+8	7.46E+8
I-132	6.86E-1	1.26E+0	5.85E+1	1.93E+0	-	1.48E+0	5.80E-1
I-133	1.76E+7	2.18E+7	4.04E+9	3.63E+7	-	8.77E+6	8.23E+6
I-134	-	-	-	-	-	-	-
I-135	5.84E+4	1.05E+5	9.30E+6	1.61E+5	-	8.00E+4	4.97E+4
Cs-134	2.26E+10	3.71E+10	-	1.15E+10	4.13E+9	2.00E+8	7.83E+9
Cs-136	1.00E+9	2.76E+9	-	1.47E+9	2.19E+8	9.70E+7	1.79E+9
Cs-137	3.22E+10	3.09E+10	-	1.01E+10	3.62E+9	1.93E+8	4.55E+9
Ba-140	1.17E+8	1.03E+5	-	3.34E+4	6.12E+4	5.94E+7	6.84E+6
Ce-141	2.19E+4	1.09E+4	-	4.78E+3	-	1.36E+7	1.62E+3
Ce-144	1.62E+6	5.09E+5	-	2.82E+5	-	1.33E+8	8.66E+4
Pr-143	7.23E+2	2.17E+2	-	1.17E+2	-	7.80E+5	3.59E+1
Nd-147	4.45E+2	3.60E+2	-	1.98E+2	-	5.71E+5	2.79E+1

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, GRASS-COW-MILK PATHWAY DOSE FACTORS (Continued)

INFANT (mrem/yr per µCi/m³) FOR H-3 AND C-14
(m² * mrem/yr per µCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3
C-14	3.23E+6	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5
P-32	1.60E+11	9.42E+9	-	-	-	2.17E+9	6.21E+9
Cr-51	-	-	1.05E+5	2.30E+4	2.05E+5	4.71E+6	1.61E+5
Mn-54	-	3.89E+7	-	8.63E+6	-	1.43E+7	8.83E+6
Fe-55	1.35E+8	8.72E+7	-	-	4.27E+7	1.11E+7	2.33E+7
Fe-59	2.25E+8	3.93E+8	-	-	1.16E+8	1.88E+8	1.55E+8
Co-57	-	8.95E+6	-	-	-	3.05E+7	1.46E+7
Co-58	-	2.43E+7	-	-	-	6.05E+7	6.06E+7
Co-60	-	8.81E+7	-	-	-	2.10E+8	2.08E+8
Ni-63	3.49E+10	2.16E+9	-	-	-	1.07E+8	1.21E+9
Zn-65	5.55E+9	1.90E+10	-	9.23E+9	-	1.61E+10	8.78E+9
Rb-86	-	2.22E+10	-	-	-	5.69E+8	1.10E+10
Sr-89	1.26E+10	-	-	-	-	2.59E+8	3.61E+8
Sr-90	1.22E+11	-	-	-	-	1.52E+9	3.10E+10
Y-91	7.33E+4	-	-	-	-	5.26E+6	1.95E+3
Zr-95	6.83E+3	1.66E+3	-	1.79E+3	-	8.28E+5	1.18E+3
Nb-95	5.93E+5	2.44E+5	-	1.75E+5	-	2.06E+8	1.41E+5
Ru-103	8.69E+3	-	-	1.81E+4	-	1.06E+5	2.91E+3
Ru-106	1.90E+5	-	-	2.25E+5	-	1.44E+6	2.38E+4
Ag-110m	3.86E+8	2.82E+8	-	4.03E+8	-	1.46E+10	1.86E+8
Sb-124	2.09E+8	3.08E+6	5.56E+5	-	1.31E+8	6.46E+8	6.49E+7
Sb-125	1.49E+8	1.45E+6	1.87E+5	-	9.38E+7	1.99E+8	3.07E+7
Te-125m	1.51E+8	5.04E+7	5.07E+7	-	-	7.18E+7	2.04E+7
Te-127m	4.21E+8	1.40E+8	1.22E+8	1.04E+9	-	1.70E+8	5.10E+7
Te-129m	5.59E+8	1.92E+8	2.15E+8	1.40E+9	-	3.34E+8	8.62E+7
I-131	2.72E+9	3.21E+9	1.05E+12	3.75E+9	-	1.15E+8	1.41E+9
I-132	1.42E+0	2.89E+0	1.35E+2	3.22E+0	-	2.34E+0	1.03E+0
I-133	3.72E+7	5.41E+7	9.84E+9	6.36E+7	-	9.16E+6	1.58E+7
I-134	-	-	1.01E-9	-	-	-	-
I-135	1.21E+5	2.41E+5	2.16E+7	2.69E+5	-	8.74E+4	8.80E+4
Cs-134	3.65E+10	6.80E+10	-	1.75E+10	7.18E+9	1.85E+8	6.87E+9
Cs-136	1.96E+9	5.77E+9	-	2.30E+9	4.70E+8	8.76E+7	2.15E+9
Cs-137	5.15E+10	6.02E+10	-	1.62E+10	6.55E+9	1.88E+8	4.27E+9
Ba-140	2.41E+8	2.41E+5	-	5.73E+4	1.48E+5	5.92E+7	1.24E+7
Ce-141	4.33E+4	2.64E+4	-	8.15E+3	-	1.37E+7	3.11E+3
Ce-144	2.33E+6	9.52E+5	-	3.85E+5	-	1.33E+8	1.30E+5
Pr-143	1.49E+3	5.59E+2	-	2.08E+2	-	7.89E+5	7.41E+1
Nd-147	8.82E+2	9.06E+2	-	3.49E+2	-	5.74E+5	5.55E+1

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, VEGETATION PATHWAY DOSE FACTORS (Continued)

ADULT (mrem/yr per μCi/m³) FOR H-3 AND C-14
(m² * mrem/yr per μCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3
C-14	8.97E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5
P-32	1.40E+9	8.73E+7	-	-	-	1.58E+8	5.42E+7
Cr-51	-	-	2.79E+4	1.03E+4	6.19E+4	1.17E+7	4.66E+4
Mn-54	-	3.11E+8	-	9.27E+7	-	9.54E+8	5.94E+7
Fe-55	2.09E+8	1.45E+8	-	-	8.06E+7	8.29E+7	3.37E+7
Fe-59	1.27E+8	2.99E+8	-	-	8.35E+7	9.96E+8	1.14E+8
Co-57	-	1.17E+7	-	-	-	2.97E+8	1.95E+7
Co-58	-	3.09E+7	-	-	-	6.26E+8	6.92E+7
Co-60	-	1.67E+8	-	-	-	3.14E+9	3.69E+8
Ni-63	1.04E+10	7.21E+8	-	-	-	1.50E+8	3.49E+8
Zn-65	3.17E+8	1.01E+9	-	6.75E+8	-	6.36E+8	4.56E+8
Rb-86	-	2.19E+8	-	-	-	4.32E+7	1.02E+8
Sr-89	9.96E+9	-	-	-	-	1.60E+9	2.86E+8
Sr-90	6.05E+11	-	-	-	-	1.75E+10	1.48E+10
Y-91	5.13E+6	-	-	-	-	2.82E+9	1.37E+5
Zr-95	1.19E+6	3.81E+5	-	5.97E+5	-	1.21E+9	2.58E+5
Nb-95	1.42E+5	7.91E+4	-	7.81E+4	-	4.80E+8	4.25E+4
Ru-103	4.80E+6	-	-	1.83E+7	-	5.61E+8	2.07E+6
Ru-106	1.93E+8	-	-	3.72E+8	-	1.25E+10	2.44E+7
Ag-110m	1.06E+7	9.76E+6	-	1.92E+7	-	3.98E+9	5.80E+6
Sb-124	1.04E+8	1.96E+6	2.52E+5	-	8.08E+7	2.95E+9	4.11E+7
Sb-125	1.36E+8	1.52E+6	1.39E+5	-	1.05E+8	1.50E+9	3.25E+7
Te-125m	9.66E+7	3.50E+7	2.90E+7	3.93E+8	-	3.86E+8	1.29E+7
Te-127m	3.49E+8	1.25E+8	8.92E+7	1.42E+9	-	1.17E+9	4.26E+7
Te-129m	2.55E+8	9.50E+7	8.75E+7	1.06E+9	-	1.28E+9	4.03E+7
I-131	8.09E+7	1.16E+8	3.79E+10	1.98E+8	-	3.05E+7	6.63E+7
I-132	5.74E+1	1.54E+2	5.38E+3	2.45E+2	-	2.89E+1	5.38E+1
I-133	2.12E+6	3.69E+6	5.42E+8	6.44E+6	-	3.31E+6	1.12E+6
I-134	1.06E-4	2.88E-4	5.00E-3	4.59E-4	-	2.51E-7	1.03E-4
I-135	4.08E+4	1.07E+5	7.04E+6	1.71E+5	-	1.21E+5	3.94E+4
Cs-134	4.66E+9	1.11E+10	-	3.59E+9	1.19E+9	1.94E+8	9.07E+9
Cs-136	4.20E+7	1.66E+8	-	9.24E+7	1.27E+7	1.89E+7	1.19E+8
Cs-137	6.36E+9	8.70E+9	-	2.95E+9	9.81E+8	1.68E+8	5.70E+9
Ba-140	1.29E+8	1.62E+5	-	5.49E+4	9.25E+4	2.65E+8	8.43E+6
Ce-141	1.96E+5	1.33E+5	-	6.17E+4	-	5.08E+8	1.51E+4
Ce-144	3.29E+7	1.38E+7	-	8.16E+6	-	1.11E+10	1.77E+6
Pr-143	6.34E+4	2.54E+4	-	1.47E+4	-	2.78E+8	3.14E+3
Nd-147	3.34E+4	3.86E+4	-	2.25E+4	-	1.85E+8	2.31E+3

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, VEGETATION PATHWAY DOSE FACTORS (Continued)

TEENAGER (mrem/yr per µCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per µCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3
C-14	1.45E+6	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5
P-32	1.61E+9	9.96E+7	-	-	-	1.35E+8	6.23E+7
Cr-51	-	-	3.44E+4	1.36E+4	8.85E+4	1.04E+7	6.20E+4
Mn-54	-	4.52E+8	-	1.35E+8	-	9.27E+8	8.97E+7
Fe-55	3.25E+8	2.31E+8	-	-	1.46E+8	9.98E+7	5.38E+7
Fe-59	1.81E+8	4.22E+8	-	-	1.33E+8	9.98E+8	1.63E+8
Co-57	-	1.79E+7	-	-	-	3.34E+8	3.00E+7
Co-58	-	4.38E+7	-	-	-	6.04E+8	1.01E+8
Co-60	-	2.49E+8	-	-	-	3.24E+9	5.60E+8
Ni-63	1.61E+10	1.13E+9	-	-	-	1.81E+8	5.45E+8
Zn-65	4.24E+8	1.47E+9	-	9.41E+8	-	6.23E+8	6.86E+8
Rb-86	-	2.73E+8	-	-	-	4.O5E+7	1.28E+8
Sr-89	1.51E+10	-	-	-	-	1.80E+9	4.33E+8
Sr-90	7.51E+11	-	-	-	-	2.11E+10	1.85E+11
Y-91	7.87E+6	-	-	-	-	3.23E+9	2.11E+5
Zr-95	1.74E+6	5.49E+5	-	8.07E+5	-	1.27E+9	3.78E+5
Nb-95	1.92E+5	1.06E+5	-	1.03E+5	-	4.55E+8	5.86E+4
Ru-103	6.87E+6	-	-	2.42E+7	-	5.74E+8	2.94E+6
Ru-106	3.09E+8	-	-	5.97E+8	-	1.48E+10	3.90E+7
Ag-110m	1.52E+7	1.44E+7	-	2.74E+7	-	4.04E+9	8.74E+6
Sb-124	1.55E+8	2.85E+6	3.51E+5	-	1.35E+8	3.11E+9	6.03E+7
Sb-125	2.14E+8	2.34E+6	2.04E+5	-	1.88E+8	1.66E+9	5.00E+7
Te-125m	1.48E+8	5.34E+7	4.14E+7	-	-	4.37E+8	1.98E+7
Te-127m	5.51E+8	1.96E+8	1.31E+8	2.24E+9	-	1.37E+9	6.56E+7
Te-129m	3.67E+8	1.36E+8	1.18E+8	1.54E+9	-	1.38E+9	5.81E+7
I-131	7.70E+7	1.08E+8	3.14E+10	1.85E+8	-	2.13E+7	5.79E+7
I-132	5.18E+1	1.36E+2	4.57E+3	2.14E+2	-	5.91E+1	4.87E+1
I-133	1.97E+6	3.34E+6	4.66E+8	5.86E+6	-	2.53E+6	1.02E+6
I-134	9.59E-5	2.54E-4	4.24E-3	4.01E-4	-	3.35E-6	9.13E-5
I-135	3.68E+4	9.48E+4	6.10E+6	1.50E+5	-	1.05E+5	3.52E+4
Cs-134	7.09E+9	1.67E+10	-	5.30E+9	2.02E+9	2.08E+8	7.74E+9
Cs-136	4.29E+7	1.69E+8	-	9.19E+7	1.45E+7	1.36E+7	1.13E+8
Cs-137	1.01E+10	1.35E+10	-	4.59E+9	1.78E+9	1.92E+8	4.69E+9
Ba-140	1.38E+8	1.69E+5	-	5.75E+4	1.14E+5	2.13E+8	8.91E+6
Ce-141	2.82E+5	1.88E+5	-	8.86E+4	-	5.38E+8	2.16E+4
Ce-144	5.27E+7	2.18E+7	-	1.30E+7	-	1.33E+10	2.83E+6
Pr-143	7.12E+4	2.84E+4	-	1.65E+4	-	2.34E+8	3.55E+3
Nd-147	3.63E+4	3.94E+4	-	2.32E+4	-	1.42E+8	2.36E+3

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, VEGETATION PATHWAY DOSE FACTORS (Continued)

CHILD (mrem/yr per μCi/m³) FOR H-3 AND C-14
(m² * mrem/yr per μCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3
C-14	3.50E+6	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5
P-32	3.37E+9	1.58E+8	-	-	-	9.30E+7	1.30E+8
Cr-51	-	-	6.54E+4	1.79E+4	1.19E+5	6.25E+6	1.18E+5
Mn-54	-	6.61E+8	-	1.85E+8	-	5.55E+8	1.76E+8
Fe-55	8.00E+8	4.24E+8	-	-	2.40E+8	7.86E+7	1.31E+8
Fe-59	4.01E+8	6.49E+8	-	-	1.88E+8	6.76E+8	3.23E+8
Co-57	-	2.99E+7	-	-	-	2.45E+8	6.04E+7
Co-58	-	6.47E+7	-	-	-	3.77E+8	1.98E+8
Co-60	-	3.78E+8	-	-	-	2.10E+9	1.12E+9
Ni-63	3.95E+10	2.11E+9	-	-	-	1.42E+8	1.34E+9
Zn-65	8.12E+8	2.16E+9	-	1.36E+9	-	3.80E+8	1.35E+9
Rb-86	-	4.52E+8	-	-	-	2.91E+7	2.78E+8
Sr-89	3.59E+10	-	-	-	-	1.39E+9	1.03E+9
Sr-90	1.24E+12	-	-	-	-	1.67E+10	3.15E+11
Y-91	1.87E+7	-	-	-	-	2.49E+9	5.01E+5
Zr-95	3.90E+6	8.58E+5	-	1.23E+6	-	8.95E+8	7.64E+5
Nb-95	4.10E+5	1.59E+5	-	1.50E+5	-	2.95E+8	1.14E+5
Ru-103	1.55E+7	-	-	3.89E+7	-	3.99E+8	5.94E+6
Ru-106	7.45E+8	-	-	1.01E+9	-	1.16E+10	9.30E+7
Ag-110m	3.22E+7	2.17E+7	-	4.05E+7	-	2.58E+9	1.74E+7
Sb-124	3.52E+8	4.57E+6	7.78E+5	-	1.96E+8	2.20E+9	1.23E+8
Sb-125	4.99E+8	3.85E+6	4.62E+5	-	2.78E+8	1.19E+9	1.05E+8
Te-125m	3.51E+8	9.50E+7	9.84E+7	-	-	3.38E+8	4.67E+7
Te-127m	1.32E+9	3.56E+8	3.16E+8	3.77E+9	-	1.07E+9	1.57E+8
Te-129m	8.54E+8	2.39E+8	2.75E+8	2.51E+9	-	1.04E+9	1.33E+8
I-131	1.43E+8	1.44E+8	4.76E+10	2.36E+8	-	1.28E+7	8.18E+7
I-132	9.20E+1	1.69E+2	7.84E+3	2.59E+2	-	1.99E+2	7.77E+1
I-133	3.59E+6	4.44E+6	8.25E+8	7.40E+6	-	1.79E+6	1.68E+6
I-134	1.70E-4	3.16E-4	7.28E-3	4.84E-4	-	2.10E-4	1.46E-4
I-135	6.54E+4	1.18E+5	1.04E+7	1.81E+5	-	8.98E+4	5.57E+4
Cs-134	1.60E+10	2.63E+10	-	8.14E+9	2.92E+9	1.42E+8	5.54E+9
Cs-136	8.06E+7	2.22E+8	-	1.18E+8	1.76E+7	7.79E+6	1.43E+8
Cs-137	2.39E+10	2.29E+10	-	7.46E+9	2.68E+9	1.43E+8	3.38E+9
Ba-140	2.77E+8	2.43E+5	-	7.90E+4	1.45E+5	1.40E+8	1.62E+7
Ce-141	6.35E+5	3.26E+5	-	1.43E+5	-	4.07E+8	4.84E+4
Ce-144	1.27E+8	3.98E+7	-	2.21E+7	-	1.04E+10	6.78E+6
Pr-143	1.48E+5	4.46E+4	-	2.41E+4	-	1.60E+8	7.37E+3
Nd-147	7.16E+4	5.80E+4	-	3.18E+4	-	9.18E+7	4.49E+3

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, GROUND PLANE PATHWAY DOSE FACTORS (Continued)

(m^2 * mrem/yr per μCi/sec)

Nuclide	Any Organ
H-3	-
C-14	-
P-32	-
Cr-51	4.68E+6
Mn-54	1.34E+9
Fe-55	-
Fe-59	2.75E+8
Co-58	3.82E+8
Co-60	2.16E+10
Ni-63	-
Zn-65	7.45E+8
Rb-86	8.98E+6
Sr-89	2.16E+4
Sr-90	-
Y-91	1.08E+6
Zr-95	2.48E+8
Nb-95	1.36E+8
Ru-103	1.09E+8
Ru-106	4.21E+8
Ag-110m	3.47E+9
Te-125m	1.55E+6
Te-127m	9.17E+4
Te-129m	2.00E+7
I-131	1.72E+7
I-132	1.24E+6
I-133	2.47E+6
I-134	4.49E+5
I-135	2.56E+6
Cs-134	6.75E+9
Cs-136	1.49E+8
Cs-137	1.04E+10
Ba-140	2.05E+7
Ce-141	1.36E+7
Ce-144	6.95E+7
Pr-143	-
Nd-147	8.40E+6

APPENDIX A

EVALUATION OF DEFAULT MPC VALUES

FOR LIQUID EFFLUENTS

APPENDIX A: EVALUATION OF DEFAULT MPC VALUE FOR LIQUID EFFLUENTS

In accordance with the requirements of CONTROL 3.3.7.10 the radioactive effluent monitors shall be operable with alarm setpoints established to ensure that the concentration of radioactive material at the discharge point does not exceed the MPC value of 10 CFR 20, Appendix B, Table II, Column 2 (Appendix F). The determination of allowable radionuclide concentration and corresponding alarm setpoint is a function of the individual monitor.

In order to limit the need for routinely having to re-establish the alarm setpoints as a function of changing radionuclide distributions, a default alarm setpoint can be established. This default setpoint can be based on an evaluation of the radionuclide distribution from the 1997 to 1999 release data of the liquid effluents from Hope Creek and the effective MPC value for this distribution.

The effective MPC value for a radionuclide distribution is calculated by the equation:

$$MPC_e = \sum_i C_i \ (gamma) \ / \ \sum_i \frac{C_i}{MPC_i} \ (gamma) \tag{A.1}$$

Where:

	MPC_e	=	An effective MPC value for a mixture of radionuclides (μCi/ml)
	C_i	=	Concentration of radionuclide i in the mixture
	MPC_i	=	The 10 CFR 20, Appendix B, Table II, Column II MPC value for radionuclide i (μCi/ml) Appendix F

Considering the average effective MPC values from 1997 thru 1999 releases it is reasonable to select an MPC value of 4.09E-5 μCi/ml as typical of liquid radwaste discharges. This value will be reviewed and adjusted as necessary based on the distribution history of effluents from Hope Creek. Using the value of 4.09E-5 μCi/ml to calculate the default alarm setpoint, results in a setpoint that:

1. Will not require frequent re-adjustment due to minor variations in the nuclide distribution which are typical of routine plant operations, and;

2. Will provide for a liquid radwaste discharge rate (as evaluated for each batch release) that is compatible with plant operations (Refer to Table 1-1).

1.0 DEFAULT SETPOINT DETERMINATION

Conservative alarm setpoints can be determined through the use of default parameters. Table 1-1 summarizes all current default values in use for Hope Creek.

A. Liquid Radwaste Monitor (RE4861)

$$SP \leq \frac{MPC_e * CTBD * [1 - CF]}{RR} + bkg \tag{1.2}$$

Default values from Table 1-1:

Where:
- MPC_e = 4.09E-5 μCi/ml
- CTBD = 12000 gpm
- RR = 176 gpm (LRW)
- Bkg = 0 μCi/ml
- CF = 0.8

$$SP \leq \frac{4.09E\text{-}5 * 12000 * 0.2}{176} + 0$$

$$\underline{SP \leq 5.58E\text{-}4\ \mu Ci/ml}$$

Correction Factor:

A correction factor must be applied to the default setpoint calculation in order to account for radiation monitor uncertainties and the contribution of non-gamma emitting radionuclides such as H-3, Sr, and Fe.

a. Radiation Monitor Inaccuracies

Hope Creek PSBP 311649 lists a total loop accuracy of 30% for the liquid radwaste radiation monitors. A factor of 0.30 is applied to the default setpoint to ensure the trip setpoint is reached before the analytical limit is obtained.

b. Non-Gamma Emitting Radionuclides

Non-gamma emitting radionuclides are analyzed on a monthly and quarterly basis from composite samples of liquid radwaste releases.

Nuclide	MPC (μCi/ml)	Activity (μCi/ml)	Activity / MPC
H-3	3E-3	1.0E-1	33.3
Fe-55	8E-4	4.7E-4	0.59
Sr-89	3E-6	1.6E-6	0.53
Sr-90	3E-7	2.0E-8	0.07
Total			34.5

The values in the table above represent the historical maximum reactor coolant values for non-gamma emitting nuclides (H3 is an assumed maximum). Reactor coolant values were chosen to represent the maximum concentration of non-gamma emitting radionuclides that could be released from Hope Creek station in liquid effluent. The activity values in the table are further diluted by a minimum factor of 68 prior to release to the Delaware River. The minimum dilution factor is obtained by using the minimum cooling tower blowdown flowrate of 12,000 gpm and the maximum release rate of 176 gpm.

A conservative correction factor for non-gamma emitting radionuclides can be obtained by using the highest Activity / MPC fraction and the minimum dilution factor as follows:

Correction Factor (non-gamma) = 34.5 / 68 = 0.5

An overall correction factor can be obtained by adding the correction factor for radiation monitor inaccuracies and non-gamma emitting radionuclides as follows:

Overall Correction Factor = 0.3 + 0.5 = 0.8

B. Cooling Tower Blowdown Radiation Monitor (RE8817)

The cooling tower blowdown radiation monitor provides an Alarm only function for releases into the environment. The cooling tower blowdown is the final release point for liquid effluents from Hope Creek station to the Delaware River.

$$SP \leq MPC_g * 0.2$$

$$SP \leq 4.09E{-5}\ \mu Ci/ml * 0.2$$

$$\underline{\mathbf{SP \leq 8.18E{-6}\ \mu Ci/ml (RE8817)}}$$

C. Turbine Building Circulating Water Dewatering Sump Radiation Monitor (RE4557)

The Turbine Building Circulating Water Dewatering Sump Radiation Monitor (RE4557) provides automatic termination of liquid radioactive releases from the Circulating Water Dewatering Sump. The sump pumps discharge to the circulating water system to the cooling tower. Plant design and procedures maintain the setpoint at <2 times background radiation levels. Releases from the sump at gamma activity concentrations less than the monitor setpoint are considered continuous releases since inputs to the sump would occur during discharge. Releases of activity above the established continuous release setpoint may be performed on a batch basis following sampling and analysis of the sump contents. Hope Creek calculation SP-0004 established a setpoint for the monitor at 1.4E-02 μCi/ml based on a postulated release of reactor steam into the sump. Using the MPCe determined for Liquid Radwaste and Cooling Tower Blowdown monitors, a more conservative maximum default value for batch releases can be determined:

$$SP \leq \frac{MPC_e * CTBD * [1 - CF]}{RR} + bkg \quad \textbf{(1.2)}$$

Default values from Table 1-1:

Where:	MPC_e	=	4.09E-5 μCi/ml
	CTBD	=	12000 gpm
	RR	=	100 gpm
	Bkg	=	0 μCi/ml
	CF	=	0.8

$$SP \leq \frac{4.09E{-}5 * 12000 * 0.2}{100} + 0$$

$$\underline{SP \leq 9.82E{-}4\ \mu Ci/ml\ (batch\ releases\ only)}$$

For continuous releases, the maximum setpoint should be less than 2.4E-6 μCi/ml above background to limit dose consequences from this pathway. (4HE-0241, CVF-98-0002)

D. Releases from the Condensate Storage Tank

If the Condensate Storage Tank (CST) requires release to the Delaware River, the discharge path would be through installed piping connected to the liquid Radwaste discharge path such that both the Liquid Radwaste Discharge Monitor and the Cooling Tower Blowdown monitor could detect and isolate/alarm on unexpected activity. Default setpoints are determined for potential releases of the CST.

a. Liquid Radwaste Monitor (RE4861)

$$SP \leq \frac{MPC_e * CTBD * [1 - CF]}{RR} + bkg \qquad (1.2)$$

Default values from Table 1-1:

Where:

MPC_e	=	4.09E-5 μCi/ml
CTBD	=	12000 gpm
RR	=	1300 gpm
Bkg	=	0 μCi/ml
CF	=	0.8

$$SP \leq \frac{4.09E\text{-}5 * 12000 * 0.2}{1300} + 0$$

$$\underline{\boldsymbol{SP \leq 7.55E\text{-}5\ \mu Ci/ml (RE4861)}}$$

b. Cooling Tower Blowdown Radiation Monitor (RE8817)

The cooling tower blowdown radiation monitor provides an Alarm only function for releases into the environment. The cooling tower blowdown is the final release point for liquid effluents from Hope Creek station to the Delaware River.

$$SP \leq MPC_e * 0.2$$

$$SP \leq 4.09E\text{-}5\ \mu Ci/ml * 0.2$$

$$\underline{\boldsymbol{SP \leq 8.18E\text{-}6\ \mu Ci/ml (RE8817)}}$$

TABLE A-1: CALCULATION OF EFFECTIVE MPC - HOPE CREEK

NUCLIDE	MPC	1997 ACTIVITY RELEASED (Ci)	1998 ACTIVITY RELEASED (Ci)	1999 ACTIVITY RELEASED (Ci)
Cr-51	2.00E-03	7.44E-03	2.37E-02	1.66E-02
Mn-54	1.00E-04	1.74E-02	7.48E-03	6.87E-02
Mn-56	1.00E-04	N/D	N/D	9.36E-06
Co-58	9.00E-05	5.68E-04	7.67E-04	3.30E-03
Co-60	3.00E-05	7.05E-03	6.78E-03	2.05E-02
Na-24	3.00E-05	N/D	7.02E-02	1.01E-03
Cs-137	2.00E-05	2.84E-06	1.03E-06	2.23E-04
Zn-65	1.00E-04	1.29E-03	1.39E-03	3.37E-03
Zn-69m	6.00E-05	1.58E-05	N/D	2.64E-04
Fe-59	5.00E-05	2.65E-03	1.62E-04	1.72E-02
As-76	2.00E-05	7.70E-05	N/D	9.94E-05
Nb-95	1.00E-04	N/D	N/D	1.69E-04
Mo-99	4.00E-05	9.56E-05	N/D	N/D
Zr-95	6.00E-05	N/D	N/D	4.08E-05
Tc-99m	3.00E-03	1.29E-04	2.05E-04	3.35E-04
Ru-105	1.00E-04	N/D	N/D	4.45E-05
Ag-110m	3.00E-05	4.85E-05	1.36E-05	3.88E-04
Sb-124	2.00E-05	N/D	N/D	4.63E-05
Cs-134	9.00E-06	N/D	N/D	7.13E-05
I-133	1.00E-06	N/D	3.11E-05	N/D
La-140	2.00E-05	N/D	N/D	4.82E-06
H-3	3.00E-03	1.24E+01	2.76E+01	2.95E+01
Fe-55	8.00E-04	2.28E-01	6.40E-03	2.83E-02
Sr-89	3.00E-06	8.56E-03	1.34E-05	3.29E-05
Total Curies (Gamma)		3.68E-02	1.11E-01	1.32E-01
SUM (Ci/MPCi) (Gamma)		4.93E+02	2.71E+03	1.87E+03
SUM (Ci/MPCi) (Non-Gamma)		7.27E+03	9.21E+03	9.88E+03
MPCe (μCi/ml)		7.45E-05	4.09E-05	7.03E-05

N/D Not detected

APPENDIX B

TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS

LIQUID RADIOACTIVE EFFLUENTS

APPENDIX B: TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS – LIQUID RADIOACTIVE EFFLUENTS

The radioactive liquid effluents from Hope Creek from 1997 through 1999 were evaluated to determine the dose contribution of the radionuclide distribution. This analysis was performed to evaluate the use of a limited dose analysis for determining environmental doses, providing a simplified method of determining compliance with the dose limits of CONTROL 3.11.1.2. For the expected radionuclide distribution of effluent from Hope Creek during 1997 to 1999, the controlling organ is the GI-LLI (Bone dose was controlling in 1997 due to relatively high percentage of Fe-55). The calculated GI-LLI dose is predominately a function of the Zn-65, Fe-55, and Fe-59 releases. These radionuclides also contribute the large majority of the calculated total body dose. The results of this evaluation are presented in Table B-1.

For purposes of simplifying the details of the dose calculation process, it is conservative to identify a controlling, dose significant radionuclide and limit the calculation process to the use of the dose conversion factor for this nuclide. Multiplication of the total release (i.e., cumulative activity for all radionuclides) by this dose conversion factor provides for a dose calculation method that is simplified while also being conservative.

For the evaluation of the maximum organ dose, it is conservative to use the Fe-59 dose conversion factor (6.32E5 mrem/hr per μCi/ml). By this approach, the maximum organ dose will be overestimated since this nuclide has the highest organ dose fraction of all the radionuclides evaluated. For the total body calculation, the Zn-65 dose factor (2.32E5 mrem/hr per μCi/ml, total body) is the highest among the identified dominant nuclides.

For evaluating compliance with the dose limits of CONTROL 3.11.1.2, the following simplified equations may be used:

<u>Total Body</u>

$$D_{tb} = \frac{8.35E-04 * VOL * A_{io} * C_i}{CTBD} \tag{B.1}$$

Where:

D_{tb}	=	Dose to the total body (mrem)
$A_{i,tb}$	=	2.32E5, total body ingestion dose conversion factor for Zn-65 where A is dose conversion factor, i is isotope which is Zn-65, and TB is the total body (mrem/hr per μCi/ml)
VOL	=	Volume of liquid effluent released (gal)
C_i	=	Total concentration of all radionuclides (μCi/ml)
CTBD	=	Average cooling tower blowdown discharge rate during release period (gal/min)
8.35E-04	=	conversion factor (1.67E-2 hr/min) and the near field dilution factor 0.05

Substituting the value for the Zn-65 total body dose conversion factor, the equation simplified to:

$$D_{tb} = \frac{1.94E + 02 * VOL * C_i}{CTBD}$$

(B.2)

<u>Maximum Organ</u>

$$D_{\max} = 8.35\mathrm{E} - 4 * \mathrm{VOL} * A_{i\,GI-LLI} * \sum_i C_i \; / \; CTBD$$

(B.3)

Where:

Where:	D_{max}	=	Maximum organ dose (mrem)
	$A_{i,GI-LLI}$	=	6.32E5, GI-LLI ingestion dose conversion factor for Fe-59 where A is dose conversion factor, i is isotope which is Fe-59 and o is maximum organ which is the GI-LLI (mrem/hr per μCi/ml).

Substituting the value for $A_{i,GI-LLI}$ the equation simplifies to:

$$D_{\max} = 5.28\mathrm{E} + 2 * \mathrm{VOL} * \sum_i C_i \; / \; CTBD$$

(B.4)

Tritium is not included in the limited analysis dose assessment for liquid releases, because the potential dose resulting from normal reactor releases is relatively negligible.

<u>Near Field Dilution Factor</u>

The near field dilution factor stems from NUREG-0133, Section 4.3. For plants with cooling towers, such as Hope Creek, a dilution factor is allowed so that the product of the average blowdown flow (in CFS) and the dilution factor is 1000 cfs or less. UFSAR Section 2.2.12 states that the dilution by river flow ranges from 14- to 40-fold in the mixing zone of effluent discharges and that existing cross currents tend to improve this overall dilution. The average minimum cooling tower blowdown for Hope Creek is 1.90E4 GPM (from FSAR 11.2). This converts to 42 CFS. Selecting a dilution factor of 20 (between 14 and 40 from the UFSAR) yields a product of 880 CFS, which is less than the 1000 cfs allowed by NUREG-0133. This near field dilution factor of 20 is inverted to a multiple of 0.05, which is used in the liquid effluent dose calculations.

TABLE B-1: ADULT DOSE CONTRIBUTIONS FISH AND INVERTEBRATE PATHWAYS - HOPE CREEK

Nuclide	Release (Ci)	TB Dose Fraction	GI-LLI Dose Fraction	Bone Dose Fraction	Liver Dose Fraction	Year
Fe-55	2.28E-01	0.77	0.63	0.96	0.86	1997
Fe-55	6.40E-03	0.12	0.12	0.58	0.22	1998
Fe-55	2.83E-02	0.1	0.04	0.43	0.15	1999
Mn-54	1.74E-02	*	0.05	0	0.01	1997
Mn-54	7.48E-03	0.02	0.14	0	0.05	1998
Mn-54	6.87E-02	0.04	0.1	0	0.07	1999
Co-58	5.68E-04	*	*	0	*	1997
Co-58	7.67E-04	*	*	0	*	1998
Co-58	3.30E-03	*	*	0	*	1999
Fe-59	2.65E-03	0.08	0.23	0.02	0.05	1997
Fe-59	1.62E-04	0.03	0.09	0.02	0.03	1998
Fe-59	1.72E-02	0.51	0.7	0.4	0.5	1999
Co-60	7.05E-03	0.01	0.03	0	*	1997
Co-60	6.78E-03	0.06	0.2	0	0.01	1998
Co-60	2.05E-02	0.03	0.04	0	*	1999
Zn-65	1.29E-03	0.12	0.06	0.02	0.07	1997
Zn-65	1.39E-03	0.75	0.4	0.4	0.68	1998
Zn-65	3.37E-03	0.32	0.07	0.16	0.27	1999

* = Less than 0.01

APPENDIX C

TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS

GASEOUS RADIOACTIVE EFFLUENTS

APPENDIX C: TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS – GASEOUS RADIOACTIVE EFFLUENTS

Overview

The evaluation of doses due to releases of radioactive material to the atmosphere can be simplified by the use of effective dose transfer factors instead of using dose factors which are radionuclide specific. These effective factors, which are based on typical radionuclide distributions of releases, can be applied to the total radioactivity releases to approximate the dose in the environment. Instead of having to perform individual radionuclide dose analysis only a single multiplication (i.e., Keff, Meff, or Neff times the total quantity of radioactive material releases) would be needed. The approach provides a reasonable estimate of the actual dose while eliminating the need for a detailed calculation technique.

Determination of Effective Dose Factors

Effective dose transfer factors are calculated by the following equations:

$$K_{eff} = \sum_i (K_i * f_i) \quad \textbf{(C.1)}$$

Where: K_{eff} = The effective total body factor due to gamma emissions from all noble gases released.

K_i = The total body dose factor due to gamma emissions from each noble gas radionuclide i released.

f_i = The fractional abundance of noble gas radionuclide i relative to the total noble gas activity.

$$(L + 1.1M_{eff}) = \sum_i ((L_i + 1.1M_i) * f_i) \quad \textbf{(C.2)}$$

Where: $(L + 1.1M_{eff})$ = The effective skin dose factor due to beta and gamma emissions from all noble gases released.

$(L_i + 1.1\,M_i)$ = The skin dose factor due to beta and gamma emissions from each noble gas radionuclide i released.

$$M_{eff} = \sum_i (M_i * f_i) \quad \textbf{(C.3)}$$

Where: M_{eff} = The effective air dose factor due to gamma emissions from all noble gases released.

M_i = The air dose factor due to gamma emissions from each noble gas radionuclide i released.

$$N_{eff} = \sum_i (N_i * f_i)$$

(C.4)

Where:

N_{eff}	=	The effective air dose factor due to beta emissions from all noble gases released.
N_i	=	The air dose factor due to beta emissions from each noble gas radionuclide i released.

Normally, it would be expected that past radioactive effluent data would be used for the determination of the effective dose factors. However, the noble gas releases from Hope Creek have a short history and with continued excellent fuel performance, has hampered efforts in collecting and detecting appreciable noble gas mixes of radionuclides. So, to provide a reasonable basis for the derivation of the effective noble gas dose factors, the source terms from ANSI N237-1976/ANS-18.1, "Source Term Specifications", Table 5 has been used as representing a typical distribution. The effective dose factors as derived are presented in Table C-1.

Application

To provide an additional degree of conservatism, a factor of 0.50 is introduced into the dose calculation process when the effective dose transfer factor is used. This conservatism provides additional assurance that the evaluation of doses by the use of a single effective factor will not significantly underestimate any actual doses in the environment.

For evaluating compliance with the dose limits of CONTROL 3.11.2.2, the following simplified equations may be used:

$$D_\gamma = \frac{3.17E-08}{0.50} * \chi/_Q * M_{ef}f * \sum_i Q_i$$

(C.5)

$$D_\beta = \frac{3.17E-08}{0.50} * \chi/_Q * N_{ef}f * \sum_i Q_i$$

(C.6)

Where:

D_γ	=	Air dose due to gamma emissions for the cumulative release of all noble gases (mrad)
D_β	=	Air dose due to beta emissions for the cumulative release of all noble gases (mrad)
X/Q	=	Atmospheric dispersion to the controlling site boundary (sec/m^3)
M_{eff}	=	8.1E3, effective gamma-air dose factor (mrad/yr per μCi/m^3)
N_{eff}	=	8.5E3, effective beta-air dose factor (mrad/yr per μCi/m^3)
Q_i	=	Cumulative release for all noble gas radionuclides (μCi)
3.17E-08	=	Conversion factor (yr/sec)
0.50	=	Conservatism factor to account for the variability in the effluent data

Combining the constants, the dose calculation equations simplify to:

$$D_\gamma = 5.14E - 4 * {}^{\chi}/_{Q} * \sum_i Q_i$$

(C.7)

$$D_\beta = 5.39E - 4 * {}^{\chi}/_{Q} * \sum_i Q_i$$

(C.8)

The effective dose factors are to be used on a limited basis for the purpose of facilitating the timely assessment of radioactive effluent releases, particularly during periods of computer malfunction where a detailed dose assessment may be unavailable.

TABLE C-1: EFFECTIVE DOSE FACTORS NOBLE GASES
TOTAL BODY AND SKIN DOSE

Radionuclide	f_i	Total Body Dose Factor (K_{eff}) (mrem/yr per µCi/m^3)	Total Skin Dose Factor (L + 1.1 M_{eff}) (mrem/yr per µCi/m^3)
Kr-83m	0.01	N/A	N/A
Kr-85m	0.01	1.0E1	2.8E1
Kr-87	0.04	2.4E2	6.6E2
Kr-88	0.04	5.9E2	7.6E2
Kr-89	0.27	4.5E3	7.9E3
Xe-133	0.02	5.9E0	1.4E1
Xe-135	0.05	9.0E1	2.0E2
Xe-135m	0.06	1.9E2	2.6E2
Xe-137	0.31	4.4E2	4.3E3
Xe-138	0.19	1.7E3	2.7E3
Total		7.8E3	1.7E4

Noble Gases - Air

Radionuclide	f_i	Gamma Air Dose Factor (M_{eff}) (mrad/yr per µCi/m^3)	Beta Air Dose Factor (N_{eff}) (mrad/yr per µCi/m^3)
Kr-83m	0.01	N/A	3.0E0
Kr-85m	0.01	1.2E1	2.0E1
Kr-87	0.04	2.5E2	4.1E2
Kr-88	0.04	6.1E2	1.2E2
Kr-89	0.27	4.7E3	2.9E3
Xe-133	0.02	7.0E0	2.1E1
Xe-135	0.05	9.6E1	1.2E2
Xe-135m	0.06	2.0E2	4.4E1
Xe-137	0.31	4.7E2	3.9E3
Xe-138	0.19	1.8E3	9.0E2
Total		8.1E3	8.4E3

* Based on noble gas distribution from ANSI N237-1976/ANS-18.1,"Source Term Specification".

APPENDIX D

TECHNICAL BASIS FOR EFFECTIVE DOSE PARAMETERS

GASEOUS RADIOACTIVE EFFLUENTS

APPENDIX D: TECHNICAL BASIS FOR EFFECTIVE DOSE PARAMETERS – GASEOUS RADIOACTIVE EFFLUENTS

The pathway dose factors for the controlling infant age group were evaluated to determine the controlling pathway, organ and radionuclide. This analysis was performed to provide a simplified method for determining compliance with CONTROL 3.11.2.3. For the infant age group, the controlling pathway is the grass - cow - milk (g/c/m) pathway. An infant receives a greater radiation dose from the g/c/m pathway than any other pathway. Of this g/c/m pathway, the maximum exposed organ including the total body, is the thyroid, and the highest dose contributor is radionuclide I-131. The results of this evaluation are presented in Table D-1.

For purposes of simplifying the details of the dose calculation process, it is conservative to identify a controlling, dose significant organ and radionuclide and limit the calculation process to the use of the dose conversion factor for the organ and radionuclide. Multiplication of the total release (i.e., cumulative activity for all radionuclides) by this dose conversion factor provides for a dose calculation method that is simplified while also being conservative.

For the evaluation of the dose commitment via a controlling pathway and age group, it is conservative to use the infant, g/c/m, thyroid, I-131 pathway dose factor (1.67E12 m^2*mrem/yr per μCi/sec). By this approach, the maximum dose commitment will be overestimated since I-131 has the highest pathway dose factor of all radionuclides evaluated.

For evaluating compliance with the dose limits of CONTROL 3.11.2.3, the following simplified equation may be used:

$$D_{max} = 3.17E - 8 * W * R_{I-131} * \sum_i Q_i \tag{D.1}$$

Where:

D_{max}	=	Maximum organ dose (mrem)
W	=	Atmospheric dispersion parameter to the controlling location (s) as identified in Table 2-3.
X/Q	=	Atmospheric dispersion for inhalation pathway (sec/m^3)
D/Q	=	Atmospheric disposition for vegetation, milk and ground plane exposure pathways (m^{-2})
Q_i	=	Cumulative release over the period of interest for radioiodines and particulates (μCi).
3.17E-8	=	Conversion factor (yr/sec)
R_{I-131}	=	I-131 dose parameter for the thyroid for the identified controlling pathway.
	=	1.05E12, infant thyroid dose parameter with the grass - cow - milk pathway controlling (m^2mrem/yr per μCi/sec)

The ground plane exposure and inhalation pathways need not be considered when the above simplified calculational method is used because of the overall negligible contribution of these pathways to the total thyroid dose. It is recognized that for some particulate radionuclides (e.g., Co-60 and Cs-137), the ground exposure pathway may represent a higher dose contribution than either the vegetation or milk pathway. However, use of the I-131 thyroid dose parameter for all radionuclides will maximize the organ dose calculation, especially considering that no other radionuclides has a higher dose parameter for any organ via any pathway than I-131 for the thyroid via the milk pathway.

The location of exposure pathways and the maximum organ dose calculation may be based on the available pathways in the surrounding environment of Hope Creek as identified by the annual land-use census (CONTROL 3.12.2). Otherwise, the dose will be evaluated based on the predetermined controlling pathways as identified in Table 2-3.

TABLE D-1: INFANT DOSE CONTRIBUTIONS – FRACTION OF TOTAL ORGAN AND BODY DOSE

Target Organs	Grass – Cow – Milk	Ground Plan
Total Body	0.02	0.15
Bone	0.23	0.14
Liver	0.09	0.15
Thyroid	0.59	0.15
Kidney	0.02	0.15
Lung	0.01	0.14
GI-LLI	0.02	0.15

TABLE D-2: INFANT DOSE CONTRIBUTIONS – FRACTION OF DOSE CONTRIBUTION BY PATHWAY

Pathway	Frac
Grass – Cow – Milk	0.92
Ground Plane	0.08
Inhalation	N/A

APPENDIX E

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM -

SAMPLE TYPE, LOCATION AND ANALYSIS

APPENDIX E: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE TYPE, LOCATION, AND ANALYSIS

Samples are identified by a three part code. 1) The first two letters are the program identification code. Because of the proximity of the Salem and Hope Creek Stations, a common environmental surveillance program is conducted. The identification code "SA," has been applied to Salem and Hope Creek Stations. 2) The next three letters are the media sampled.

- AIO = Air Iodine
- APT = Air Particulates
- ECH = Hard Shell Blue Crab
- ESF = Edible Fish
- ESS = Sediment
- FPL = Green Leaf Vegetables
- FPV = Vegetables (Various)
- GAM = Game (Muskrat)
- IDM = Immersion Dose (TLD)
- MLK = Milk
- PWR – Potable Water (Raw)
- PWT = Potable Water (Treated)
- SOL - Soil
- SWA = Surface Water
- VGT = Fodder Crops (Various)
- WWA = Well Water

3) The last three or four symbols are a location code based on direction and distance from a standard reference point. The reference point is located at midpoint between the center of the Salem Unit 1 and Salem Unit 2 containments. Of these, the first one or two represent each of the sixteen angular sectors of 22.5 degrees centered about the reactor site. Sector one is divided evenly by the north axis and other sectors are numbered in a clockwise direction as follows:

- 1 = N
- 2 = NNE
- 3 = NE
- 4 = ENE
- 5 = E
- 6 = ESE
- 7 = SE
- 8 = SSE
- 9 = S
- 10 = SSW
- 11 = SW
- 12 = WSW
- 13 = W
- 14 = WNW
- 15 = NW
- 16 = NNW

The next digit is a letter which represents the radial distance from the plant:

- S = On-site location
- A = 0-1 miles off-site
- B = 1-2 miles off-site
- C = 2-3 miles off-site
- D = 3-4 miles off-site
- E = 4-5 miles off-site
- F = 5-10 miles off-site
- G = 10-20 miles off-site
- H = > 20 miles off-site

The last number is the station numerical designation within each sector and zone; e.g., 1,2,3, etc. For example, the designation SA-WWA-3E1 would indicate a sample in the Salem and Hope Creek program (SA), consisting of well water (WWA), which had been collected in sector number 3, centered at 45 degrees (north east) with respect to the midpoijntmidpoint between Salem 1 and 2 containments at a radial distance of 4 to 5 miles off-site, (therefore, radial distance E). The number 1 indicates that this is sampling station number 1 in that particular sector.

SAMPLING LOCATIONS

All sampling locations and specific information about the individual locations are given here in Table E-1. Maps E-1, E-2 and E-3 show the locations of sampling stations with respect to the site. Not all stations in Table E-1 are required sample locations. Some of the stations identified in Table E-1 are used for management audit samples. Minimum sampling requirements are specified in Table 3.12-1.

TABLE E-1: REMP SAMPLE LOCATIONS

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
A. Direct Radiation Monitoring Locations (IDM)			
1S1	0.56 mi. N	39.47103333	-75.53698333
2S2	0.42 mi. NNE	39.4685	-75.53318333
2S4	0.61 mi. NNE; in the equipment laydown area	39.47071667	-75.53075
3S1	0.61 mi. NE	39.46901667	-75.52796667
4S1	0.63 mi ENE; access road near intersection to TB-02	39.46705	-75.52573333
5S1	0.89 mi. E; site access road	39.46113333	-75.51978333
6S2	0.24 mi. ESE; area around helicopter pad	39.46198333	-75.53186667
7S1	0.14 mi. SE	39.46168333	-75.53411667
8S1	0.15mi. SSE; fuel oil storage	39.46138333	-75.53428333
9S1	0.18mi. S; fuel oil storage	39.4606	-75.53485
10S1	0.09 mi. SSW; circulating water building.	39.46166667	-75.536
11S1	0.08 mi. SW; service water building.	39.46198333	-75.53708333
12S1	0.06 mi. WSW; outside security fence	39.4626	-75.53726667
13S1	0.09 mi. W; outside security fence	39.46335	-75.53778333
14S1	0.16 mi. NNW; outside security fence	39.46476667	-75.53796667
15S1	0.54 mi. NW; near river and barge slip	39.46935	-75.54208333
15S2	0.57 mi NW, near Hope Creek barge slip	39.46988333	-75.54216667
16S1	0.56 mi. NNW; on road near fuel oil storage tank	39.47033333	-75.54046667
16S2	0.58 mi. NNW; near security firing range	39.47125	-75.5381
16S3	0.87 mi NNW, Consolidated Spoils Facility	39.47451667	-75.54283333
4D2	3.97 mi. ENE; Alloway Creek Neck Road	39.4882	-75.46958333
5D1	3.50 mi. E; local farm	39.47326667	-75.47223333
10D1	3.89 mi. SSW; Taylor's Bridge Spur	39.41021667	-75.56221667
14D1	3.43 mi. WNW; Bay View, Delaware	39.48766667	-75.59201667

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
A. Direct Radiation Monitoring Locations (IDM) (Continued)			
15D1	3.87 mi. NW; Rt 9, Augustine Beach, Delaware	39.50208333	-75.588
2E1	4.43 mi. NNE; local farm	39.523	-75.50713333
3E1	4.13 mi. NE; local farm	39.50163333	-75.47743333
11E2	4.97 mi. SW; Route 9	39.40546667	-75.59243333
12E1	4.40 mi. WSW; Thomas Landing	39.4477	-75.61613333
13E1	4.07 mi. W; Diehl House Lab	39.46648333	-75.61225
16E1	4.05 mi. NNW; Port Penn	39.5127	-75.57633333
1F1	5.73 mi. N; Fort Elfsborg	39.54488333	-75.51873333
2F2	8.51 mi. NNE; Salem Substation	39.5748	-75.46938333
2F5	7.29 mi. NNE; Salem High School	39.55746667	-75.47523333
2F6	7.45 mi. NNE; PSEG EERC Salem New Jersey	39.56188333	-75.48031667
3F2	5.10 mi. NE; Hancocks Bridge, New Jersey Municipal Building	39.50683333	-75.45963333
3F3	8.66 mi. NE; Quinton Township Elementary School New Jersey	39.5436	-75.41225
4F2	5.98 mi. ENE; Mays Lane, Harmersville, New Jersey	39.49921667	-75.4346
5F1	6.40 mi. E; Canton, New Jersey	39.47266667	-75.41718333
6F1	6.46 mi. ESE; Stow Neck Road	39.43993333	-75.41913333
7F2	8.96 mi. SE; Bayside, New Jersey	39.38285	-75.40435
8F1	9.61 mi. SE; Woodland Beach, Delaware	39.33221667	-75.47438333
9F1	5.49 mi. S; off Route 9, Delaware	39.38403333	-75.54916667
10F2	5.73 mi. SSW; Route 9, Delaware	39.3839	-75.5692
11F1	5.97 mi. SW; Taylors Bridge, Delaware	39.41276667	-75.6272
12F2	9.35 mi. WSW; Townsend Elementary School, Delaware	39.3963	-75.68851667

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
A. Direct Radiation Monitoring Locations (IDM) (Continued)			
13F2	6.44 mi. W; Odessa, Delaware	39.45495	-75.6562
13F3	9.26 mi. W; Redding Middle School, Middletown, Delaware	39.45358333	-75.70905
13F4	9.80 mi. W; Middletown, Delaware	39.44761667	-75.71851667
14F2	6.62 mi. WNW; Route 13 and Boyds Corner Road	39.49965	-75.6507
15F3	5.39 mi. NW	39.51645	-75.60976667
16F2	8.06 mi. NNW; Delaware City Public School	39.5719	-75.59048333
1G3	18.99 mi. N; N. Church Street Wilmington, Delaware	39.73811667	-75.54186667
3G1	16.58 mi. NE; local farm	39.59855	-75.28006667
10G1	11.53 mi. SSW; Smyrna, Delaware	39.30371667	-75.60158333
14G1	13.38 mi. WNW; Route 286, Bethel Church Road., Delaware	39.5215	-75.77491667
16G1	15.09 mi. NNW; Wilmington Airport	39.67728333	-75.59283333
3H1	32.76 mi. NE; National Park, New Jersey	39.85998333	-75.19933333
B. Air Sampling Locations (AIO,APT)			
5S1	0.89 mi. E; site access road	39.46113333	-75.51978333
5S2	0.90 mi. E; site access road (duplicate sample)	39.46086667	-75.51968333
7S2	0.20 mi. SE; old Salem parking lot	39.46171667	-75.53255
15S2	0.57 mi. NW, near Hope Creek barge slip	39.46988333	-75.54216667
5D1	3.50 mi. E; local farm	39.47326667	-75.47223333
16E1	4.05 mi. NNW; Port Penn	39.5127	-75.57633333
1F1	5.73 mi. N; Fort Elfsborg	39.54488333	-75.51873333
2F6	7.45 mi. NNE; PSEG EERC Salem New Jersey	39.56188333	-75.48031667
14G1	13.38 mi. WNW; Route 286, Bethel Church Road, Delaware	39.5215	-75.77491667

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
C. Surface Water Locations (SWA) - Delaware River			
11A1	0.19 mi. SW; Salem outfall area	39.46051135	-75.53809583
11A1a	Alternate 0.15 SE; barge slip area	39.461667	-75.53375
12C1	1.81 mi. WSW; West bank of Delaware River	39.45366667	-75.568
12C1a	Alternate 3.71 mi. WSW at the tip of Augustine Beach Boat Ramp	39.50472222	-75.58
7E1	4.42 mi. SE; 1.0 mi. west of Mad Horse Creek	39.418	-75.47733333
7E1a	Alternate 9.27 mi SE end of Bayside Road	39.37616667	-75.404
1F2	7.28 mi. N; midpoint of Delaware River	39.56783333	-75.55166667
16F1	6.89 mi. NNW; C&D Canal	39.55916667	-75.57083333
16F1a	Alternate 6.52 mi. NNW; tip of C&D Canal	39.55566667	-75.55933333
D. Ground Water Locations (WWA)			
3E1	4.13 mi. NE; local farm	39.50163333	-75.47743333
No groundwater samples are required as liquid effluents discharged from Hope Creek and Salem Generating Stations do not directly affect this pathway. However, this location (3E1) is being monitored as a management audit sample			
E. Drinking Water Locations (PWR, PWT)			
2F3	7.85 mi NNE, City of Salem Water and Sewage Dept.	39.55666667	-75.453
No public drinking water samples or irrigation water samples are required as these pathways are not directly affected by liquid effluents discharged from Hope Creek and Salem Generating Stations. However, this location (2F3) is being monitored as a management audit sample			

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
F. Water Sediment Locations (ESS)			
11A1	0.19 mi. SW; Salem outfall area	39.46051135	-75.53809583
15A1	0.65 mi. NW; Hope Creek outfall area	39.4709	-75.5434
16A1	0.64 mi. NNW; south storm drain outfall	39.47066667	-75.543
12C1	1.81 mi. WSW; West bank of Delaware River	39.45366667	-75.568
7E1	4.42 mi. SE; 1.0 mi. west of Mad Horse Creek	39.418	-75.47733333
16F1	6.89 mi. NNW; C&D Canal	39.55916667	-75.57083333
6A1	0.27 mi. ESE; near shoreline	39.461135	-75.531853
G. Milk Sampling Locations (MLK)			
2G3	11.85 mi. NNE, local farm	39.6035	-75.40883333
3G1	16.58 mi. NE; local farm	39.59855	-75.28006667
13E3	4.62 mi W, local farm	39.45283333	-75.62166667
14F4	8.04 mi. WNW; local farm	39.50733333	-75.67533333
H. Fish and Invertebrate Locations (ESF, ECH)			
11A1	0.19 mi. SW; Salem outfall area	39.46051135	-75.53809583
12C1	1.81 mi. WSW; West bank of Delaware River	39.45366667	-75.568
7E1	4.42 mi. SE; 1.0 mi. west of Mad Horse Creek	39.418	-75.47733333

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
I. Food Product Locations (FPL, FPV)			
1S1	0.56 mi. N	39.47103333	-75.53698333
7S2	0.20 mi. SE; old Salem parking lot	39.46171667	-75.53255
15S2	0.57 mi. NW, near Hope Creek barge slip	39.46988333	-75.54216667
16S1	0.56 mi. NNW; on road near fuel oil storage tank	39.47033333	-75.54046667
10D1	3.89 mi. SSW; Taylor's Bridge Spur	39.41021667	-75.56221667
The Delaware River at the location of Salem and Hope Creek Nuclear Power Plants is a brackish water source. No irrigation of food products is performed using water in the vicinity from which liquid plant wastes have been discharged. However, 12 management audit food samples are collected from various locations			
*All distances and directions for the Station Locations are referenced to the midpoint between the two Salem units' containments. The WGS 84 coordinates for this site center point location are: Latitude N 39° - 27' – 46.5" and Longitude W 75° - 32' – 10.6".			

SAMPLES COLLECTION AND ANALYSIS

SAMPLE	COLLECTION METHOD	ANALYSIS
Air Particulate	Continuous low volume air sampler. Sample collected every week along with the filter change.	Gross Beta analysis on each weekly sample. Gamma spectrometry shall be performed if gross beta exceeds10 times the yearly mean of the control station value. Samples shall be analyzed 24 hrs or more after collection to allow for radon and thorium daughter decay. Gamma isotopic analysis on quarterly composites.
Air Iodine	A TEDA impregnated charcoal cartridge is connected to air particulate air sampler and is collected weekly at filter change.	Iodine 131 analysis are performed on each weekly sample.
Crab and Fish	Two batch samples are sealed in a plastic bag or jar and frozen semi-annually or when in season.	Gamma isotopic analysis of edible port ion on collection.
Sediment	A sediment sample is taken semi-annually.	Gamma isotopic analysis semi-annually.
Direct	2 PD's will be collected from each location quarterly.	Gamma dose quarterly.
Milk	Sample of fresh milk is collected for each farm semi-monthly when cows are in pasture, monthly at other times.	Gamma isotopic analysis and I-131analysis on each sample on collection.
Water (Potable, Surface)	monthly providing winter icing Sample to be collected conditions allow.	Gamma isotopic monthly H-3 on quarterly surface sample, monthly on ground water sample.

FIGURE E-1: ON-SITE SAMPLING LOCATIONS – LOCATIONS 0 TO 1 MILE

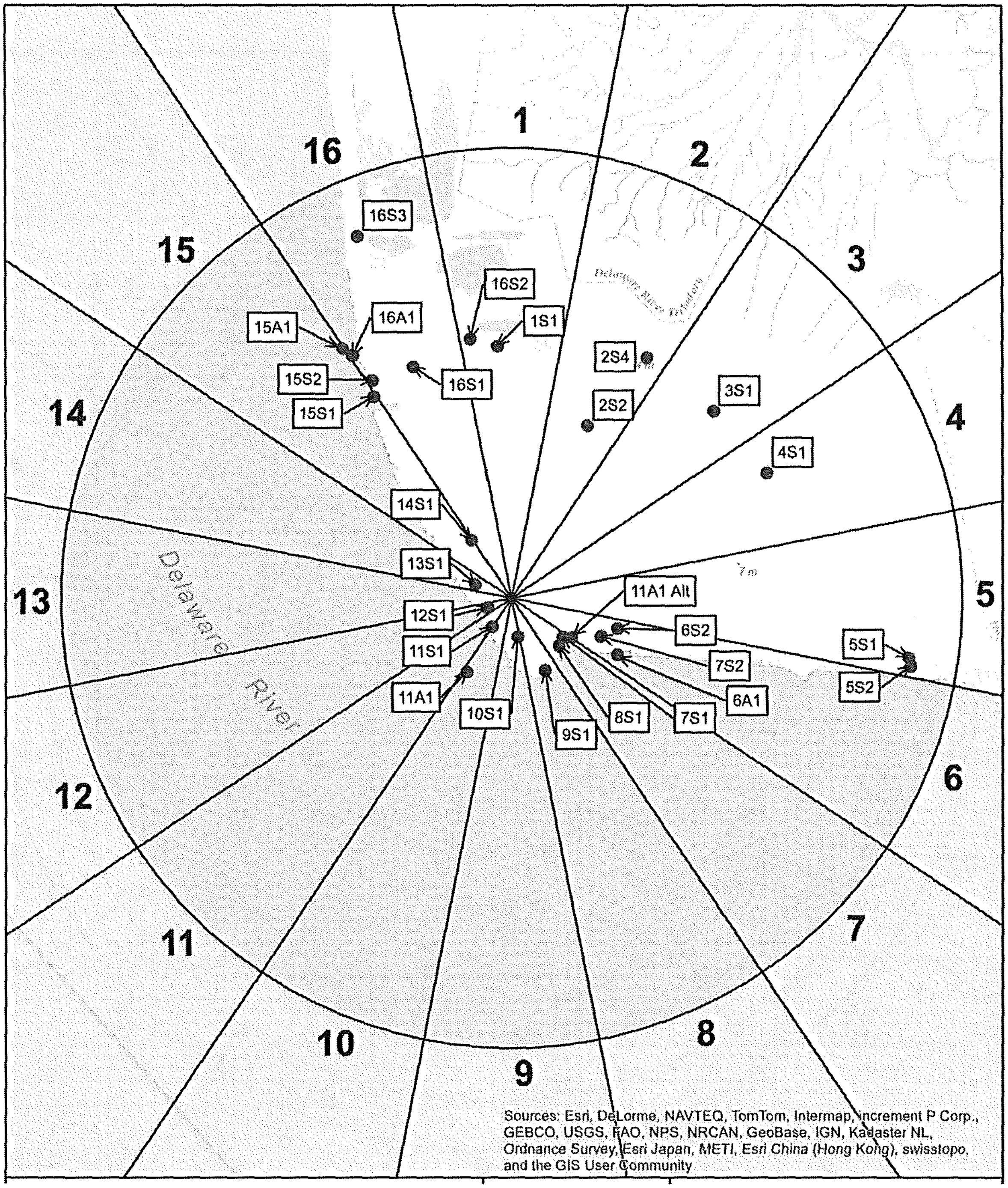


FIGURE E-2: OFF-SITE SAMPLING LOCATIONS – LOCATIONS 1 TO 10 MILES

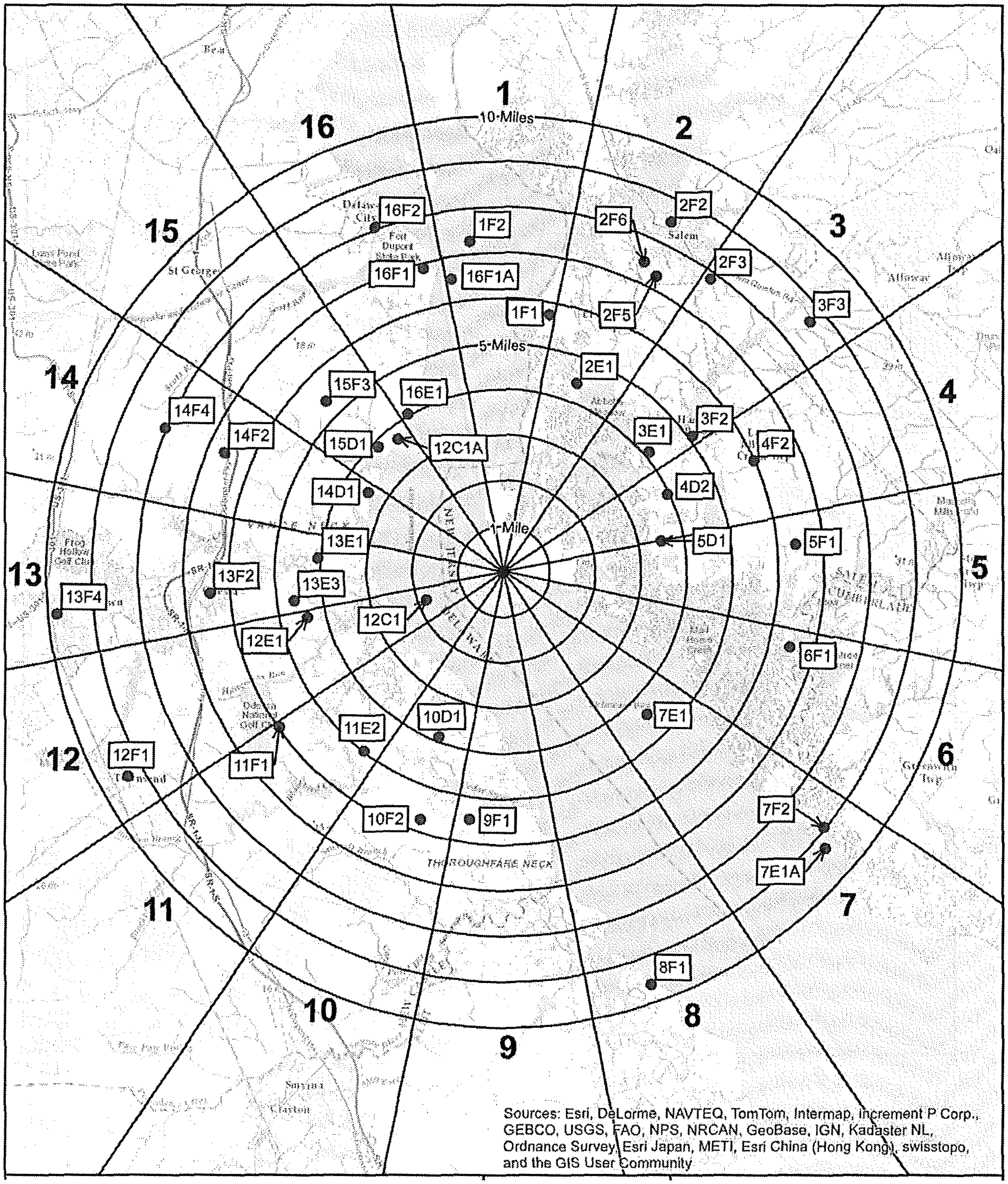
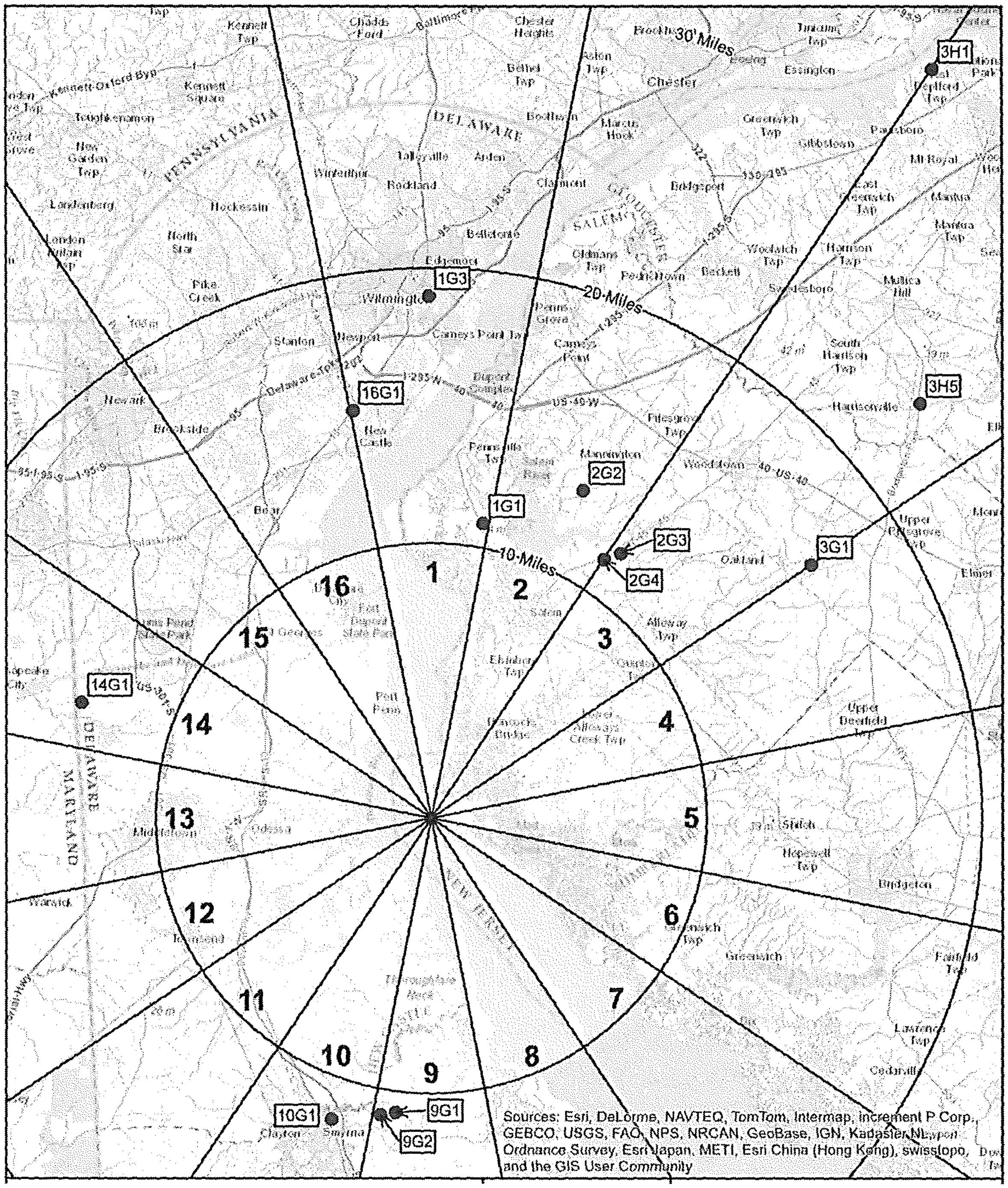


FIGURE E-3: OFF-SITE SAMPLING LOCATIONS



APPENDIX F

MAXIMUM PERMISSIBLE CONCENTRATIONS

LIQUID EFFLUENTS

APPENDIX F: MAXIMUM PERMISSIBLE CONCENTRATION (MPC) VALUES FOR LIQUID EFFLUENTS

The following radionuclide concentrations were obtained from 10 CFR 20 Appendix B, Table II, Column 2 revised January 1, 1998 and referred to as the "old" 10 CFR 20.

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS

Element	Isotope	Soluble Conc (μCi/ml)	Insoluble Conc. (μCi/ml)
Actinium (89)	Ac-227	2E-6	3E-4
	Ac-228	9E-5	9E-5
Americium (95)	Am-241	4E-6	3E-5
	Am-242m	4E-6	9E-5
	Am-242	1E-4	1E-4
	Am-243	4E-6	3E-5
	Am-244	5E-3	5E-3
Antimony (51)	Sb-122	3E-5	3E-5
	Sb-124	2E-5	2E-5
	Sb-125	1E-4	1E-4
	Sb-126	3E-6	3E-6
Arsenic (33)	As-73	5E-4	5E-4
	As-74	5E-5	5E-5
	As-76	2E-5	2E-5
	As-77	8E-5	8E-5
Astatine (85)	At-211	2E-6	7E-5
Barium (56)	Ba-131	2E-4	2E-4
	Ba-140	3E-5	2E-5
Berkelium (97)	Bk-249	6E-4	6E-4
	Bk-250	2E-4	2E-4
Beryllium (4)	Be-7	2E-3	2E-3
Bismuth (83)	Bi-206	4E-5	4E-5
	Bi-207	6E-5	6E-5
	Bi-210	4E-5	4E-5
	Bi-212	4E-4	4E-4
Bromine (35)	Br-82	3E-4	4E-5
Cadmium (48)	Cd-109	2E-4	2E-4
	Cd-115m	3E-5	3E-5
	Cd-115	3E-5	4E-5
Calcium (20)	Ca-45	9E-6	2E-4
	Ca-47	5E-5	3E-5
Californium (98)	Cf-249	4E-6	2E-5
	Cf-250	1E-5	3E-5
	Cf-251	4E-6	3E-5
	Cf-252	7E-6	7E-6
	Cf-253	1E-4	1E-4
	Cf-254	1E-7	1E-7

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (Continued)

Element	Isotope	Soluble Conc. (μCi/ml)	Insoluble Conc. (μCi/ml)
Carbon (6)	C-14	8E-4	-------
Cerium (58)	Ce-141	9E-5	9E-5
	Ce-143	4E-5	4E-5
	Ce-144	1E-5	1E-5
Cesium (55)	Cs-131	2E-3	9E-4
	Cs-134m	6E-3	1E-3
	Cs-134	9E-6	4E-5
	Cs-135	1E-4	2E-4
	Cs-136	9E-5	6E-5
	Cs-137	2E-5	4E-5
Chlorine (17)	Cl-36	8E-5	6E-5
	Cl-38	4E-4	4E-4
Chromium (24)	Cr-51	2E-3	2E-3
Cobalt (27)	Co-57	5E-4	4E-4
	Co-58m	3E-3	2E-3
	Co-58	1E-4	9E-5
	Co-60	5E-5	3E-5
Copper (29)	Cu-64	3E-4	2E-4
Curium (96)	Cm-242	2E-5	2E-5
	Cm-243	5E-6	2E-5
	Cm-244	7E-6	3E-5
	Cm-245	4E-6	3E-5
	Cm-246	4E-6	3E-5
	Cm-247	4E-6	2E-5
	Cm-248	4E-7	1E-6
	Cm-249	2E-3	2E-3
Dysprosium (66)	Dy-165	4E-4	4E-4
	Dy-166	4E-5	4E-5
Einsteinium (99)	Es-253	2E-5	2E-5
	Es-254m	2E-5	2E-5
	Es-254	1E-5	1E-5
	Es-255	3E-5	3E-5
Erbium (68)	Er-169	9E-5	9E-5
	Er-171	1E-4	1E-4
Europium (63)	Eu-152 (9.2 hrs)	6E-5	6E-5
	Eu-152 (13 yrs)	8E-5	8E-5
	Eu-154	2E-5	2E-5
	Eu-155	2E-4	2E-4
Fermium (100)	Fm-254	1E-4	1E-4
	Fm-255	3E-5	3E-5
	Fm-256	9E-7	9E-7

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (Continued)

Element	Isotope	Soluble Conc. (μCi/ml)	Insoluble Conc. (μCi/ml)
Fluorine (9)	F-18	8E-4	5E-4
Gadolinium (64)	Gd-153	2E-4	2E-4
	Gd-159	8E-5	8E-5
Gallium (31)	Ga-72	4E-5	4E-5
Germanium (32)	Ge-71	2E-3	2E-3
Gold (79)	Au-196	2E-4	1E-4
	Au-198	5E-5	5E-5
	Au-199	2E-4	2E-4
Hafnium (72)	Hf-181	7E-5	7E-5
Holmium (67)	Ho-166	3E-5	3E-5
Hydrogen (3)	H-3	3E-3	3E-3
Indium (49)	In-113m	1E-3	1E-3
	In-114m	2E-5	2E-5
	In-115m	4E-4	4E-4
	In-115	9E-5	9E-5
Iodine (53)	I-125	2E-7	2E-4
	I-126	3E-7	9E-5
	I-129	6E-8	2E-4
	I-131	3E-7	6E-5
	I-132	8E-6	2E-4
	I-133	1E-6	4E-5
	I-134	2E-5	6E-4
	I-135	4E-6	7E-5
Iridium (77)	Ir-190	2E-4	2E-4
	Ir-192	4E-5	4E-5
	Ir-194	3E-5	3E-5
Iron (26)	Fe-55	8E-4	2E-3
	Fe-59	6E-5	5E-5
Lanthanum (57)	La-140	2E-5	2E-5
	La-141	3E-6	3E-6
Lead (82)	Pb-203	4E-4	4E-4
	Pb-210	1E-7	2E-4
	Pb-212	2E-5	2E-5
Lutetium (71)	Lu-177	1E-4	1E-4
Manganese (25)	Mn-52	3E-5	3E-5
	Mn-54	1E-4	1E-4
	Mn-56	1E-4	1E-4
Mercury (80)	Hg-197m	2E-4	2E-4
	Hg-197	3E-4	5E-4
	Hg-203	2E-5	1E-4
Molybdenum (42)	Mo-99	2E-4	4E-5

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (Continued)

Element	Isotope	Soluble Conc. (μCi/ml)	Insoluble Conc. (μCi/ml)
Neodymium (60)	Nd-144	7E-5	8E-5
	Nd-147	6E-5	6E-5
	Nd-149	3E-4	3E-4
Neptunium (93)	Np-237	3E-6	3E-5
	Np-239	1E-4	1E-4
Nickel (28)	Ni-59	2E-4	2E-3
	Ni-63	3E-5	7E-4
	Ni-65	1E-4	1E-4
Niobium (41)	Nb-93m	4E-4	4E-4
	Nb-95	1E-4	1E-4
	Nb-97	9E-4	9E-4
Osmium (76)	Os-185	7E-5	7E-5
	Os-191m	3E-3	2E-3
	Os-191	2E-4	2E-4
	Os-193	6E-5	5E-5
Palladium (46)	Pd-103	3E-4	3E-4
	Pd-109	9E-5	7E-5
Phosphorus (15)	P-32	2E-5	2E-5
Platinum (78)	Pt-191	1E-4	1E-4
	Pt-193m	1E-3	1E-3
	Pt-193	9E-4	2E-3
	Pt-197m	1E-3	9E-4
	Pt-197	1E-4	1E-4
Plutonium (94)	Pu-238	5E-6	3E-5
	Pu-239	5E-6	3E-5
	Pu-240	5E-6	3E-5
	Pu-241	2E-4	1E-3
	Pu-242	5E-6	3E-5
	Pu-243	3E-4	3E-4
Polonium (84)	Po-210	7E-7	3E-5
Potassium (19)	K-42	3E-4	2E-5
Praseodymium(59)	Pr-142	3E-5	3E-5
	Pr-143	5E-5	5E-5
Promethium (61)	Pm-147	2E-4	2E-4
	Pm-149	4E-5	4E-5
Protactinium(91)	Pa-230	2E-4	2E-4
	Pa-231	9E-7	2E-5
	Pa-233	1E-4	1E-4

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (Continued)

Element	Isotope	Soluble Conc. (μCi/ml)	Insoluble Conc. (μCi/ml)
Radium (88)	Ra-223	7E-7	4E-6
	Ra-224	2E-6	5E-6
	Ra-226	3E-8	3E-5
	Ra-228	3E-8	3E-5
Rhenium (75)	Re-183	6E-4	3E-4
	Re-186	9E-5	5E-5
	Re-187	3E-3	2E-3
	Re-188	6E-5	3E-5
Rhodium (45)	Rh-103m	1E-2	1E-2
	Rh-105	1E-4	1E-4
Rubidium (37)	Rb-86	7E-5	2E-5
	Rb-87	1E-4	2E-4
Ruthenium (44)	Ru-97	4E-4	3E-4
	Ru-103	8E-5	8E-5
	Ru-105	1E-4	1E-4
	Ru-106	1E-5	1E-5
Samarium (62)	Sm-147	6E-5	7E-5
	Sm-151	4E-4	4E-4
	Sm-153	8E-5	8E-5
Scandium (21)	Sc-46	4E-5	4E-5
	Sc-47	9E-5	9E-5
	Sc-48	3E-5	3E-5
Selenium (34)	Se-75	3E-4	3E-4
Silicon (14)	Si-31	9E-4	2E-4
Silver (47)	Ag-105	1E-4	1E-4
	Ag-110m	3E-5	3E-5
	Ag-111	4E-5	4E-5
Sodium (11)	Na-22	4E-5	3E-5
	Na-24	2E-4	3E-5
Strontium (38)	Sr-85m	7E-3	7E-3
	Sr-85	1E-4	2E-4
	Sr-89	3E-6	3E-5
	Sr-90	3E-7	4E-5
	Sr-91	7E-5	5E-5
	Sr-92	7E-5	6E-5
Sulfur (16)	S-35	6E-5	3E-4
Tantalum (73)	Ta-182	4E-5	4E-5

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (Continued)

Element	Isotope	Soluble Conc. (μCi/ml)	Insoluble Conc. (μCi/ml)
Technetium (43)	Tc-96m	1E-2	1E-2
	Tc-96	1E-4	5E-5
	Tc-97m	4E-4	2E-4
	Tc-97	2E-3	8E-4
	Tc-99m	6E-3	3E-3
	Tc-99	3E-4	2E-4
Tellurium (52)	Te-125m	2E-4	1E-4
	Tc-127m	6E-5	5E-5
	Te-127	3E-4	2E-4
	Te-129m	3E-5	2E-5
	Te-129	8E-4	8E-4
	Te-131m	6E-5	4E-5
	Te-132	3E-5	2E-5
Terbium (65)	Tb-160	4E-5	4E-5
Thallium (81)	Tl-200	4E-4	2E-4
	Tl-201	3E-4	2E-4
	Tl-202	1E-4	7E-5
	Tl-204	1E-4	6E-5
Thorium (90)	Th-227	2E-5	2E-5
	Th-228	7E-6	1E-5
	Th-230	2E-6	3E-5
	Th-231	2E-4	2E-4
	Th-232	2E-6	4E-5
	Th-natural	2E-6	2E-5
	Th-234	2E-5	2E-5
Thulium (69)	Tm-170	5E-5	5E-5
	Tm-171	5E-4	5E-4
Tin (50)	Sn-113	9E-5	8E-5
	Sn-124	2E-5	2E-5
Tungsten (74)	W-181	4E-4	3E-4
	W-185	1E-4	1E-4
	W-187	7E-5	6E-5
Uranium (92)	U-230	5E-6	5E-6
	U-232	3E-5	3E-5
	U-233	3E-5	3E-5
	U-234	3E-5	3E-5
	U-235	3E-5	3E-5
	U-236	3E-5	3E-5
	U-238	4E-5	4E-5
	U-240	3E-5	3E-5
	U-natural	3E-5	3E-5

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (Continued)

Element	Isotope	Soluble Conc. (μCi/ml)	Insoluble Conc. (μCi/ml)
Vanadium (23)	V-48	3E-5	3E-5
Ytterbium (70)	Yb-175	1E-4	1E-4
Yttrium	Y-90	2E-5	2E-5
	Y-91m	3E-3	3E-3
	Y-91	3E-5	3E-5
	Y-92	6E-5	6E-5
	Y-93	3E-5	3E-5
Zinc (30)	Zn-65	1E-4	2E-4
	Zn-69m	7E-5	6E-5
	Zn-69	2E-3	2E-3
Zirconium (40)	Zr-93	8E-4	8E-4
	Zr-95	6E-5	6E-5
	Zr-97	2E-5	2E-5
Any single radio-nuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radio - active half-life greater than 2 hours		3E-6	3E-6
Any single radio-nuclide not listed above, which decays by alpha emission or spontaneous fission.		3E-8	3E-8

Notes:
1. If the identity of any radionuclide is not known, the limiting values for purposes of this table shall be: 3E-8 μCi/ml.
2. If the identity and concentration of each radionuclide are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e. "unity").

OFFSITE DOSE CALCULATION MANUAL

FOR

PSEG NUCLEAR LLC

SALEM GENERATING STATION

Revision 28

Prepared By:	Richard H. Cary ODCM Coordinator	12/13/2016 Date
Reviewed by:	Mark Pyle Salem Chemistry Manager	1/19/17 Date
SQR	Ryan Gallagher Reviewed by	12/28/17 Date
Accepted by:	Patrick Martino PORC Chairman	1/25/17 Date
	Meeting #: S2017-002	
Approved by:	C.V. Plant Manager	9/18/17 Date

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Revision Summary:

All of the items indicated below are considered implemented on the date the Plant Manager signs the cover page indicating approval of revision 28 to the Salem ODCM.

Item No.	Rev. 27 Page No.	Rev. 28 Page No.	Description of Change	Type of Change
1	20 26	26 32	In 3/4.3.3.8 and 4/3.3.9 Action d was deleted. **Justification:** Action d was added in Revision 27 although the reporting requirements are already in Action b so has caused confusion. Restoring to NUREG 1301 wording is for clarification only and is an editorial change.	Editorial
2	27	33	Edited monitor numbers in Table 3.3-13: Radioactive Gaseous Effluent Monitoring Instrumentation per markup in DCP #80057583. **Justification:** DCP #80057583 removed some Unit 1 and Unit 2 R45 skids components. (80057583/450).	Technical
3	27 28	35	TABLE 3.3-13: Moved note ## so it is after note # in the Table Notations. **Justification:** Editorial to place note ## after note #.	Editorial
4	31	38	Added note to Control 3.11.1.1, "Since the MPC values were removed from 10 CFR 20 effective 1/1/94, the MPC values are provided as Appendix F to the ODCM". **Justification:** This addition did not change the intent or technical content. It was performed to add clarity and consistency within this document. (70166487/10)	Editorial
5	32	39 41	In Table 4.11-1.1 added Groundwater Remediation as a new Batch Liquid Release Type and added note "f" to Table 4.11-1 Table Notations. **Justification:** Groundwater onsite contains small amounts of tritium due to a historical leak from the Salem Unit 1 Spent Fuel Pool. During the remediation process, some groundwater is pumped to a tank and then batch released using similar methodology to other batch releases and is treated as a Radioactive Liquid Release. This change customizes the Liquid Release Type to be plant specific as per NUREG-1301. (70162733/010)	Technical

6	32	39 41	In TABLE 4.11-1/.B added note "g" to Steam Generator Blowdown. Note "g" also added to TABLE 4.11-1 Table Notations to reference Section 1.5 of the ODCM for better explanation of blowdown flow path since Steam Generator Blowdown is normally routed to the condenser and not directly to the environment. **Justification:** This only attempts to clarify and does not change technical information. Steam Generator Blowdown may be sampled directly or after processing but before release to the environment. See section 1.5 in Part II – Calculational Methodologies for further clarification (70162733/010)	Editorial
7	32	39 41	In Table 4.11-1.1 added Groundwater Remediation as a new Continuous Liquid Release Type and added note "h" to Table 4.11-1 Table Notations. **Justification:** Groundwater onsite contains small amounts of tritium due to a historical leak from the Salem Unit 1 Spent Fuel Pool. During the remediation process, some groundwater is continuously pumped to the Non-Rad Waste Basin where it is sampled by a compositor and is treated as a Radioactive Liquid Release. This change customizes the Liquid Release Type to be plant specific as per NUREG-1301. (70162733/010)	Technical
8	33	40	Corrected LLD delta time definition in Table 4.11-1: Radioactive Liquid Waste Sampling and Analysis Program to reflect REC program LLD. **Justification:** Table 4.11-1 incorrectly defined delta time using definition for REMP counting. Corrected to agree with NUREG-1301. (70166487/010)	Editorial
9	34	40	Moved note from bottom of Table 4.11-1 about Ce-144 LLD to notation c. **Justification:** Note moved into notation "c" is editorial.	Editorial
10	36	43	Clarified Controls 3.11.1.3 to state the 92-day dose projection required by the Technical Specifications (TS) 6.8.4.g.6 is being satisfied by performing 31-day dose projections. **Justification:** 92-day dose projection was previously removed from ODCM and replaced with 31-day dose projection. 92-day remains in TS. This change only adds a note saying the 31-day performance is more conservative than the 92-days allowed by TS. (70166444/010)	Editorial

11	38 39	45 46	Table 4.11-2: Added Containment Equipment Hatch as a Gaseous Release Type. Added notes "h" and "i" to Table 4.11-2 Table Notations to clarify when monitoring is needed and when analysis for hard-to-detects is required. **Justification:** Containment Equipment Hatch is opened during outages and may have outward flow of gases. Addition to this table acknowledges this and gives direction to perform monitoring when hatch is open. (70171791/030)	Technical
12	41	48	In Control 3.11.2.3, I-133 is being added. **Justification:** I-133 is currently included in the dose calculations performed by effluents software but was left out of previous ODCM revision. I-133 being added will also agree with NUREG-1301, Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactor.	Editorial
13	42	49	Clarified Controls 3.11.2.4 to state the 92-day dose projection required by the Technical Specifications, TS, 6.8.4.g.6 is being satisfied by performing 31-day dose projections. **Justification:** 92-day dose projection was previously removed from ODCM and replaced with 31-day dose projection. 92-day remains in TS. This change only adds a note saying the 31-day performance is more conservative than the 92-days allowed by TS. (70166444/010)	Editorial
14	46	53	Changed distance for outer ring dosimeter sample locations in Table 3.12-1.1 from (6 to 8 km) to (5 to 11 km) to reflect plant specific information. **Justification:** The dosimeters were not relocated. The dosimeter sample location range was changed in ODCM Revision 27 because (6 to 8 km) is the range in NUREG-1301. NUREG-1301 also acknowledges that sample locations vary from site to site. Due to plant location, some of the ideal locations are not accessible or are over the water so alternate locations which are accessible were selected in the (5 to 11 km) range. This is not a change to the program but restores previously specified range of Revision 26. (70175881/010)	Editorial
15	46	53	Note below Table 3.12-1 deleted. **Justification:** Note came from NUREG 1301 and concerned customizing table to the local site. This was performed when program was setup.	Editorial

16	47	54	Clarify gamma isotopic analysis is performed on particulate sample composite in Type and Frequency of Analysis column of Table 3.12-1.2. **Justification:** It was not clear during review of document which analyses were for iodine sample and which were for particulate sample. This revision complies with NUREG-1301. This is not a change in practice, this is an editorial change.	Editorial
17	48	55	Changed sampling and collection frequency and type of analysis for Surface Waterborne samples in Table 3.12-1.3.a. **Justification:** Sampling frequency was increased from monthly to semi-monthly. Specified the analysis will be performed on a composited sample; the frequency of sample analysis was not changed. This aligns program more closely agree with NUREG-1301. (70152838/010)	Technical
18	51	58	Edited Table Notation (3) in Table 3.12-1 to identify sample location 5S2 as a duplicate sample location. **Justification:** The purpose of sample location 5S2 was unclear. This is an editorial change. (70169329/020)	Editorial
19	53 54	60 61 62	Added note (1) to bottom of Table 3.12-2 and of Table 4.12-1 explaining these H-3 and I-131 LLD values were used due to no drinking water exposure pathway. **Justification:** Explains why limit value is 30,000 pCi/L instead of 20,000 pCi/L and why LLD value is 3,000 pCi/L instead of 2,000 pCi/L for H-3 as listed in NUREG-1301. Also explains why limit value is 20 pCi/L instead of 2 pCi/L and why LLD value is 15 pCi/L instead of 1 pCi/L for I-131 as listed in NUREG-1301. NUREG-1301 has notes allowing these higher values if no drinking water pathway exists. (70199487/010)	Editorial
20	54	61	In Table 4.12-1 changed LLD for I-131 from 10 to 15. **Justification:** Changed to agree with NUREG-1301 guidance which says "If no drinking water pathway exists, a value of 15 pCi/L may be used.	Technical
21	57	64	Removed reference to elevated release from Control 3.12.2. **Justification:** No elevated release exists at Salem and reference clutters text and adds to confusion. This is an editorial change.	Editorial

22	57	64	Inserted note ** in actions a. and b. for Control 3.12.2 to specify that receptor locations must be on land and not over water. **Justification:** The use of a real receptor provides an actual dose to real pathways instead of hypothetical dose to hypothetical pathways. NUREG-0133 indicates that actual pathways should be used. (80113172/490)	Editorial
23	62 63	68 69	Edited monitor numbers in Bases Section 4/3.3.9 on Unit 1 and Unit 2 Instrument Description Tables per markup in DCP #80057583. **Justification:** DCP #80057583 removed some Unit 1 and Unit 2 R45 skids components. (80057583/450)	Technical
24	66	74	Inserted a note in Bases Section 3/4.11.2.3 to specify that receptor locations must be on land and not over water. **Justification:** The use of real receptors provides an actual dose to real pathways instead of hypothetical dose to hypothetical pathways. NUREG-0133 indicates that actual pathways should be used. (80113172/490)	Editorial
25	72	81	Inserted header page for section 6.0 **Justification:** Editorial	Editorial
26	82	96	Section 1.6: Added equations and supporting definitions for liquid 31 day dose projection. **Justification:** Dose projection equations were left out of ODCM revision 27 when 92-day dose projection was replaced by 31-day dose projection. (70166444/010)	Technical
27	92	108	Section 2.7: Added equations and supporting definitions for gaseous 31 day dose projection. **Justification:** Dose projection equations left out of ODCM revision 27 when 92-day dose projection was replaced by 31-day dose projection. (70166444/010)	Technical
28	96 97 98	113 114 115	Figures 1-1, 1-2, and 1-3 edited line connections so they reached tanks and repositioned some lines and verbiage for clarity. No technical changes. Revision bars not used on these charts. **Justification:** Editorial change.	Editorial
29	99	116	Comments in Table 1-1.1 for 1-R18, 1-R19(A,B,C,D) and 1-R13(A,B) Sensitivities and Setpoints were edited to correct references. **Justification:** Engineering Calculations which replaced the previous document were performed for DCP 80019351.	Editorial
30	100	117	Comments in Table 1-1.2 for 2-R18, 2-R19(A,B,C,D), 2-R13(A,B) and R37 Sensitivities and Setpoints were edited to	Editorial

			correct references. **Justification:** Engineering Calculations which replaced the previous document were performed due to component upgrades. Those references were updated in this revision.	
31	107	124	Comments in Table 2-2.1 for 1-R-12A and 1-R-41 Sensitivities and Setpoints were changed to reference the correct calculations which control the setpoints. **Justification:** Calculations were performed as Engineering Documents SC-RM004 in 2005 and SC-RM002 in 2007. These setpoints are conservative and setpoints were not specified in revision 27 of the ODCM.	Editorial
32	108	125	Comments in Table 2-2.2 for 2-R-12A and 2-R-41 Sensitivities and Setpoints were changed to reference the correct calculations which control the setpoints. **Justification:** Calculations were performed as Engineering Documents SC-RM004 in 2005 and SC-RM002 in 2007. These setpoints are conservative and setpoints were not specified in revision 27 of the ODCM.	Editorial
33	142	159 160	Appendix E Sample Designation page was completely revised. **Justification:** The rewrite is editorial for clarity. This rewrite corrects editorial items identified in review of 2014 ARERR.	Editorial
34	143 to 146	161 to 166	Appendix E Table E-1 was reformatted, Latitude and Longitude values were added, and station locations were corrected for accuracy and for clarification as needed. Revision bars not used for this change so other individual changes could be marked. **Justification:** GPS coordinates and distances can now be determined more accurately. Latitude and Longitude values are not required for this table but enhance the ability to locate sample stations. Some Station Locations descriptions were outdated.	Technical
35	144	163	Table E-1.B, Air Sample Locations, changed 7S1 to 7S2. **Justification:** This is a new air sampler location and 7S1 is a previously defined Direct Radiation Monitoring Location (IDM). (70166150/030)	Technical
36	145	165	Table E-1.F, Water Sediment Locations (ESS), changed 6S2 to 6A1. **Justification:** 6S2 is already defined as an IDM location. ESS locations are beyond site boundary because they are over water so the ESS location was renamed 6A1.	Technical
37	146	166	Table E-1.I, Food Product Locations (FPL, FPV), 7S2 location added. 16S2 location name corrected to 15S2.	Technical

			Justification: 7S2 is a new location for FPL/FPV located next to the 7S2 air sampler. Also, the FPL/FPV location identified as 16S2 in Revision 27 of the ODCM was a typing error and should have been identified as 15S2. (70166150/030)	
38	148	167	On Sample Collection and Analysis table the "Water (potable, surface) sample was divided into two entries. **Justification:** The separation was made to add clarity to this line item. This is an editorial change.	Editorial
39	149 150	168 169 170	New Sampling Locations Maps were made. Third map showing sampling location beyond 10 miles was added. Revision bars not used for this change. **Justification:** Due to sampling location changes, new maps are required to show locations and station codes. Third map added for ease of reading.	Technical
40	152	172	In Appendix F title, corrected effective date of 10 CFR 20 revision used for MPC values from 10 CFR 20 Appendix B, Table II, Column 2. Added a clarifying statement that this revision of 10 CFR 20 is referred to as the "old" 10 CFR 20. **Justification:** The date was not correct for the revision of 10 CFR 20. This was an editorial change only. (70166487/10)	Editorial
41	ALL	ALL	Corrections were made throughout on capitalization, formatting, spelling, and other clerical items. Font changed to Arial 12 except where larger or smaller type was appropriate or needed. **Justification:** These did not change the intent or technical content. They were performed to add clarity and consistency and to correct typos.	Editorial
42	ALL	ALL	Added "old" and "new" in front of 10 CFR 20 references to specify whether referring to pre-1994 revision or post-1994 revision. Standardized spaces in 10 CFR xx. **Justification:** These did not change the intent or technical content. They were performed to specify whether referring to pre-1994 revision or post-1994 revision. This adds clarity and consistency and is an editorial change. (70166487/10)	Editorial

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

SALEM NUCLEAR GENERATING STATION
OFFSITE DOSE CALCULATION MANUAL

INTRODUCTION

The Salem Offsite Dose Calculation Manual (ODCM) is a supporting document to the Salem Units 1 and 2 Technical Specifications. The previous Limiting Conditions for Operations that were contained in the Radiological Effluent Technical Specifications (RETS) are now included in the ODCM as Radiological Effluent Controls (REC). The ODCM contains two parts: Part I - Radiological Effluent Controls, and Part II – Calculational Methodologies.

Part I includes the following:

- The Radiological Effluent Controls and the Radiological Environmental Monitoring Programs required by Technical Specifications 6.8.4
- Descriptions of the information that should be included in the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Report required by Technical Specifications 6.9.1.7 and 6.9.1.8, respectively.

Part II describes methodologies and parameters used for:

- The calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints; and
- The calculation of radioactive liquid and gaseous concentrations, dose rates, cumulative quarterly and yearly doses, and projected doses.

Part II also contains a list and graphical description of the specific sample locations for the radiological environmental monitoring program (REMP), and the liquid and gaseous waste treatment systems.

Revisions to the ODCM shall be made in accordance with the Technical Specifications Section 6.14.

The current licensing basis applies Maximum Permissible Concentrations (MPCs) for radioactive liquid effluent concentration limits. Since the MPC values were removed from 10 CFR 20 effective 1/1/94, the MPC values are provided as Appendix F to the ODCM. As discussed in the Safety Evaluation by the Office of Nuclear Reactor Regulation related to Amendment Nos. 234 and 215, letters between the Nuclear Management and Resources Council (NUMARC) concerning the differences between the "old" 10 CFR 20 and the "new" 10 CFR 20 allowed continued use of the instantaneous release limits (MPCs). The NUMARC letter of April 28, 1993, concluded that the RETS referencing the "old" Part 20 are generally more restrictive than the comparable requirements of the "new" Part 20, and therefore, in accordance with 10 CFR 20.1008, the existing RETS could remain in force after the licensee implements the "new" Part 20. The letter stated that the existing RETS which reference the "old" Part 20 would maintain the level of required protection of public health and safety, and would be consistent with the requirements of the "new" Part 20. The "new" 10 CFR 20 was effective January 1, 1994. Versions of 10 CFR 20 prior to January 1, 1994 are considered the "old" 10 CFR Part 20.

PART I - RADIOLOGICAL EFFLUENT CONTROLS

SECTION 1.0

DEFINITIONS

1.0 DEFINED TERMS

The DEFINED TERMS of this section appear in capitalized type and are applicable throughout these CONTROLS.

1.1 ACTION

ACTION shall be that part of a CONTROL which prescribes remedial measures required under designated conditions.

1.2 CHANNEL CALIBRATION

A 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 that the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including the required sensor, alarm, display, and trip functions, and shall include the CHANNEL FUNCTIONAL TEST. Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an in-place qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. Whenever an RTD or thermocouple sensing element is replaced, the next required CHANNEL CALIBRATION shall include an in-place cross calibration that compares the other sensing elements with the recently installed sensing monitor. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping, or total channel steps so that the entire channel is calibrated.

1.3 CHANNEL CHECK

A 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.

1.4 CHANNEL FUNCTIONAL TEST

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.

1.5 CONTROL

The Limiting Conditions for Operation (LCOs) that were contained in the Radiological Effluent Technical Specifications were transferred to the OFFSITE DOSE CALCULATION MANUAL (ODCM) and were renamed CONTROLS. This is to distinguish between those LCOs that were retained in the Technical Specifications and those LCOs or CONTROLS that were transferred to the ODCM.

1.6 DOSE EQUIVALENT I-131

DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries per 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 those listed in Federal Guidance Report No. 11 (FGR 11), "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion and Ingestion".

1.7 FREQUENCY NOTATION

The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the intervals defined in Table 1.2.

1.8 GASEOUS RADWASTE TREATMENT SYSTEM

A GASEOUS RADWASTE TREATMENT SYSTEM is any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

1.9 MEMBER(S) OF THE PUBLIC

MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the licensee, its contractors, or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational or other purposes not associated with the plant.

1.10 OFFSITE DOSE CALCULATION MANUAL (ODCM)

The OFFSITE DOSE CALCULATION MANUAL (ODCM) shall contain the methodology and parameters used in the calculation of offsite doses due to 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 Technical Specification Section 6.8.4 and (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and the Radioactive Effluent Release Reports required by Technical Specification Sections 6.9.1.7 and 6.9.1.8, respectively.

1.11 OPERABLE - OPERABILITY

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, normal or emergency electrical power source, cooling and seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component or device to perform its specified safety function(s) are also capable of performing their related support function(s).

1.12 OPERATIONAL MODE - MODE

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 1.1.

1.13 PURGE - PURGING

PURGE or PURGING 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 required to purify the confinement.

1.14 RATED THERMAL POWER

RATED THERMAL POWER shall be a total reactor core heat transfer rate to the reactor coolant of 3459 MWt.

1.15 REPORTABLE EVENT

A REPORTABLE EVENT shall be any of those conditions specified in Section 50.73 to Part 50 or 72.75.

1.16 SITE BOUNDARY

The SITE BOUNDARY shall be that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee, as shown in Figure 5.1-3.

1.17 SOURCE CHECK

SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to either (a) an external source of increased radioactivity, or (b) an internal source of radioactivity (keep-alive source), or (c) an equivalent electronic source check.

1.18 THERMAL POWER

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

1.19 UNRESTRICTED AREA

An UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY, access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the SITE BOUNDARY used for residential quarters or industrial, commercial, institutional, and/or recreational purposes.

1.20 VENTILATION EXHAUST TREATMENT SYSTEM

A VENTILATION EXHAUST TREATMENT SYSTEM shall be any system designed and installed to reduce gaseous radioiodine and radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers 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 Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

1.21 VENTING

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.

1.22 WASTE GAS HOLDUP SYSTEM

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: OPERATIONAL MODES

MODE	REACTIVITY CONDITION, K_{eff}	THERMAL POWER*	AVERAGE COOLANT TEMPERATURE
1. Power Operation	> 0.99	> 5%	> 350°F
2. Startup	> 0.99	≤ 5%	≥ 350°F
3. Hot Standby	< 0.99	0	≥ 350°F
4. Hot Shutdown	< 0.99	0	350°F > T_{avg} > 200°F
5. Cold Shutdown	< 0.99	0	≤ 200°F
6. Refueling**	≤ 0.95	0	≤ 140°F

* Excluding decay heat.

** Fuel in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

TABLE 1.2: FREQUENCY NOTATION

NOTATION	FREQUENCY
S	At least once per 12 hours
D	At least once per 24 hours
W	At least once per 7 days
M	At least once per 31 days
Q	At least once per 92 days
SA	At least once per 6 months
R	At least once per 18 months
S/U	Prior to each reactor startup
P	Prior to each release
N.A.	Not Applicable

SECTIONS 3.0 AND 4.0

CONTROLS

AND

SURVEILLANCE REQUIREMENTS

3/4 CONTROLS AND SURVEILLANCE REQUIREMENTS

3/4.0 APPLICABILITY

3.0 CONTROLS

3.0.1 Compliance with the CONTROLS contained in the succeeding CONTROLS is required during the OPERATIONAL MODES or other 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 CONTROLS 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.

3.0.3 When a CONTROL is not met except as provided in the associated ACTION requirements, within one hour action shall be initiated to place the unit in a MODE in which the CONTROL does not apply by placing it, as applicable, in:

1. At least HOT STANDBY within the next 6 hours,
2. At least HOT SHUTDOWN within the following 6 hours, and
3. At least COLD SHUTDOWN within the subsequent 24 hours.

Where corrective measures are completed that permit operation under the ACTION requirements, the ACTION may be taken in accordance with the specified time limits as measured from the time of failure to meet the CONTROL. Exceptions to these requirements are stated in the individual CONTROLS.

This CONTROL is not applicable in MODE 5 or 6.

3.0.4 Entry into an OPERATIONAL MODE or other specified condition:

a. Shall not be made when the conditions of the CONTROL are not met and the associated ACTION requires a shutdown if they are not met within a specified time interval.

b. May be made in accordance with ACTION requirements when conformance to them permits continued operation of the facility for an unlimited period of time.

This provision shall not prevent passage through or to OPERATIONAL MODES as required to comply with ACTION requirements. Exceptions to these requirements are stated in the individual CONTROLS.

4.0 SURVEILLANCE REQUIREMENTS

4.0.1 Surveillance Requirements shall be met during the OPERATIONAL MODES or other 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 surveillance interval with a maximum allowable extension not to exceed 25 percent of the specified surveillance interval.

4.0.3 Failure to perform a Surveillance Requirement within the allowed surveillance interval, defined by specification 4.0.2, shall constitute a failure to meet the OPERABILITY requirements for a CONTROL. The time limits of the ACTION requirements are applicable at the time it is identified that a Surveillance Requirement has not been performed. The ACTION requirements may be delayed for up to 24 hours to permit the completion of the surveillance when the allowed outage time limits of the ACTION requirements are less than 24 hours. Surveillance Requirements do not have to be performed on inoperable equipment.

4.0.4 Entry into an OPERATIONAL MODE or other specified condition shall not be made unless the Surveillance Requirement(s) associated with the CONTROL has been performed within the stated surveillance interval or as otherwise specified. This provision shall not prevent passage through or to OPERATIONAL MODES as required to comply with ACTION requirements.

3/4.3 INSTRUMENTATION

3/4.3.3.8 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.3.8 In accordance with Salem Units 1 and 2 Technical Specifications 6.8.4.g.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 in accordance with the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY: During all liquid releases via these pathways.

ACTION:

a. With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above CONTROL, without delay 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. Exert best efforts to return the instrument to OPERABLE status within 30 days and, if unsuccessful, explain in the next radioactive effluent release report why the inoperability was not corrected in a timely manner.

c. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.3.3.8 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 operations at the frequencies shown in Table 4.3-12.

TABLE 3.3-12: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1. Gross Radioactivity Monitors Providing Automatic Termination of Release		
a. Liquid Radwaste Effluent Line	1 **(1R18, 2R18)**	26
b. Steam Generator Blowdown Line	4 **(1R19A-D, 2R19A-D)**	27
2. Gross Radioactivity Monitors not Providing Automatic Termination of Release		
a. Containment Fan Coolers – Service Water Line Discharge	2 (Unit 1) **(1R13A, B)** 2 (Unit 2) **(2R13A, B)**	28
b. Chemical Waste Basin	1 **(R37)**	31
3. Flow Rate Measurement Devices		
a. Liquid Radwaste Effluent Line	1 **(1FR1064, 2FR1064)**	29
b. Steam Generator Blowdown Line	4 **(1FA-3178, -3180, -3182, -3184, 2FA-3178, -3180, -3182, -3184)**	29

TABLE 3.3-12: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION – TABLE NOTATION (Continued)

ACTION 26 - 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 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 27 - 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 principal gamma emitters, I-131, and dissolved and entrained gases at the lower limits of detection required in ODCM CONTROL Table 4.11-1.B, and the ODCM Surveillance Requirement 4.11.1.1.2 is performed:

a. At least once per 8 hours when the specific activity of the secondary coolant is greater than 0.01 microcuries/gram DOSE EQUIVALENT I-131, or
b. At least once per 24 hours when the specific activity of the secondary coolant is less than or equal to 0.01 microcuries/gram DOSE EQUIVALENT I-131.

ACTION 28 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that:

a. At least once per 8 hours, local monitor readouts for the affected channels are verified to be below their alarm setpoints, or
b. With a Service Water System leak (inside containment) on the Containment Fan Coil Unit associated with the inoperable monitor either:
    1. At least once per 8 hours, grab samples are to be collected and analyzed for principal gamma emitters, I-131, and dissolved and entrained gases at the lower limits of detection specified in ODCM CONTROL Table 4.11-1.B, and the ODCM Surveillance Requirement 4.11.1.1.2 is performed, or
    2. Isolate the release pathway.
c. With no identified service water leakage (inside containment) on the Containment Fan Coil Unit associated with the inoperable monitor, at least once per 24 hours, collect grab samples and analyze for principal gamma emitters, I-131, and dissolved and entrained gases at the lower limits of detection specified in ODCM CONTROL Table 4.11-1.B, and the ODCM Surveillance Requirement 4.11.1.1.2 is performed.

TABLE 3.3-12: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION – TABLE NOTATION (Continued)

ACTION 29 - With the number of channels OPERABLE 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 during actual releases. Pump performance curves may be used to estimate flow.

ACTION 31 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that grab sampling is conducted in accordance with the following table:

FREQUENCY	CONDITION
1 per week	During normal operation (all MODES)
1 per day	During operation with an identified primary to secondary leak on either Salem Unit

The grab samples shall be analyzed for principal gamma emitters, I-131, and dissolved and entrained gases at the lower limits of detection specified in ODCM CONTROL Table 4.11-1.B, and the ODCM Surveillance Requirement 4.11.1.1.2 shall be performed.

TABLE 4.3-12: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1. Gross Radioactive Monitors Providing Alarm and Automatic Termination of Release				
a. Liquid Radwaste Effluent Line	D	P#	R(3)	Q(1)
b. Steam Generator Blowdown Line	D	M	R(3)	Q(1)
2. Gross Radioactivity Monitors Providing Alarm but not Providing Automatic Termination of Release				
a. Containment Fan Coolers – Service Water Line Discharge	D	M	R(3)	Q(2)
b. Chemical Waste Basin Line	D	M	R(3)	Q(5)
3. Flow Rate Measurement Devices				
a. Liquid Radwaste Effluent Line	D(4)	N.A.	R	N.A.
b. Steam Generator Blowdown Line	D(4)	N.A.	R	N.A.

TABLE 4.3-12: RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS – TABLE NOTATIONS (Continued)

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

a. Instrument indicates measured levels at or above the alarm/trip setpoint.

b. Circuit failure. (Loss of Power)

c. Control Room Instrument indicates a downscale failure.

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

a. Instrument indicates measured levels at or above the alarm/trip setpoint.

b. Circuit failure. (Loss of Power)

c. Control Room Instrument indicates a downscale failure.

d. Instrument controls not set in operate mode. (On instruments equipped with operate mode switches only **{Unit 1}**).

(3) The initial CHANNEL CALIBRATION was performed using appropriate liquid or gaseous calibration sources obtained from reputable suppliers. The activity of the calibration sources were reconfirmed using a multi-channel analyzer which was calibrated using one or more NBS (now NIST) standards.

(4) 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.

(5) The CHANNEL FUNCTIONAL TEST shall also demonstrate that Control Room alarm annunciation occurs if any of the following conditions exist:

a. Instrument indicates measured levels at or above the alarm/trip setpoint.

b. Circuit failure. (Loss of Power)

The R18's channels off-line channels which requires periodic decontamination. Any count rate indication above 10,000 cpm constitutes a SOURCE CHECK for compliance purposes.

3/4.3 INSTRUMENTATION

3/4.3.3.9 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

3.3.3.9 In accordance with Salem Units 1 and 2 Technical Specifications 6.8.4.g.1, the radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.3-13 shall be OPERABLE 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 in accordance with 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, without delay 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 OPERABLE, take the ACTION shown in Table 3.3-13. Exert best efforts to return the instrument to OPERABLE status within 30 days and, if unsuccessful, explain in the next radioactive effluent release report why the inoperability was not corrected in a timely manner.

c. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.3.3.9 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.3-13.

TABLE 3.3-13: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	ACTION
1. Waste Gas Holdup System			
a. Noble Gas Activity Monitor – Providing Alarm and Automatic Termination of Release	1 (1R41A&D, 2R41A&D)	*	31
2. Containment Purge			
a. Noble Gas Activity Monitor	1 (1R12A or 1R41A&D, 2R12A or 2R41A&D) #	**	34
3. Containment Pressure – Vacuum Relief			
a. Noble Gas Activity Monitor	1 (1R12A or 1R41A&D 2R12A or 2R41A & D) #	**	37
4. Plant Vent Header System ##			
a. Noble Gas Activity Monitor	1 (1R41A&D, 2R41A&D)	*	33
b. Iodine Sampler	1 (1RME4, 5 or 1RME50, 51, 2RME4, 5 or 2RME50, 51)	*	36
c. Particulate Sampler	1 (1RME4, 5 or 1RME50, 51, 2RME4, 5 or 2RME50, 51)	*	36
d. Process Flow Rate Monitor (stack)	1 (1RM-1FA8603, 2RM-2FA8603)	*	32
e. Sampler Flow Rate Monitor	1 (1RM-1FA17079 or S1RM-1YD20697, 2RM-2FA17079 or S2RM-2YD20697)	*	32

TABLE 3.3-13: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION – TABLE NOTATION (Continued)

ACTION 31 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, the contents of the tank(s) may be released to the environment provided that prior to initiating the 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 valving lineup;

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 32 - With the number of channels OPERABLE 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 33 - 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 taken at least once per 8 hours and these samples are analyzed for gaseous principal gamma emitters at the lower limits of detection required in ODCM CONTROL TABLE 4.11-2.A, B, or C within 24 hours. Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 34 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, immediately suspend PURGING 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 that within 4 hours samples are continuously collected with auxiliary sampling equipment as required in Table 4.11-2.

TABLE 3.3-13: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION – TABLE NOTATION (Continued)

ACTION 37 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, Containment Pressure Reliefs may be performed provided that prior to initiating the release:

a. At least two independent samples of containment are analyzed, and

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

Otherwise, suspend release of radioactive effluents via this pathway.

* At all times, other than when the line is valved out and locked.

** During Containment Purges or Containment Pressure - Vacuum Relief

APPLICABILITY:

– Modes 1-6, R41A/D Monitors providing Alarm and Automatic Termination of Release, or
– Modes 1-5, R12A Monitor providing Alarm and Automatic Termination of Release, or
– Mode 6, R12A Monitor providing Alarm only (Automatic Termination of Release is not required).
– During Mode Undefined (Defueled) operation, containment purge is reclassified as a building ventilation process stream monitored by the PLANT VENT HEADER SYSTEM.

During movement of irradiated fuel within containment with the Containment Equipment Hatch OPEN, only R41A/D can be credited for MINIMUM CHANNEL OPERABLE.

During movement of irradiated fuel within containment with the Containment Equipment Hatch CLOSED, R41A/D or R12A may be credited for MINIMUM CHANNEL OPERABLE.

The following process streams are routed to the plant vent where they are effectively monitored by the instruments described:

a. Condenser Air Removal System

b. Auxiliary Building Ventilation System

c. Fuel Handling Building Ventilation System

d. Radwaste Area Ventilation System

e. Containment Purges & Pressure-Vacuum Relief

TABLE 4.3-13: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

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. Containment Purge and Pressure – Vacuum Relief					
a. Noble Gas Activity Monitor	P	P	R(3)	Q(1)	*
3. Plant Vent Header 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.	*
d. Process Flow Rate Monitor (stack)	D	N.A.	R	N.A.	*
e. Sampler Flow Rate Monitor	W	N.A.	R	N.A.	*

The following process streams are routed to the plant vent where they are effectively monitored by the instruments described:

a. Condenser Air Removal System
b. Auxiliary Building Ventilation System
c. Fuel Handling Building Ventilation System
d. Radwaste Area Ventilation System
e. Containment Purges & Pressure-Vacuum Relief

TABLE 4.3-13: RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS – TABLE NOTATIONS (Continued)

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

a. Instrument indicates measured levels above the alarm/trip setpoint.

b. Circuit failure. (Loss of Power)

c. Control Room Instrument indicates a downscale failure. (Alarm Only)

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

a. Instrument indicates measured levels at or above the alarm/trip setpoint.

b. Circuit failure. (Loss of Power)

c. Control Room Instrument indicates a downscale failure.

(3) The initial CHANNEL CALIBRATION was performed using appropriate liquid or gaseous calibration sources obtained from reputable suppliers. The activity of the calibration sources were reconfirmed using a multi-channel analyzer which was calibrated using one or more NBS (now NIST) standards.

* At all times.

** During Containment Purges or Containment Pressure - Vacuum Relief

SURVEILLANCE REQUIREMENT

- Modes 1-6, R41A/D Monitors providing Alarm and Automatic Termination of Release
- Modes 1-5, R12A Monitors providing Alarm and Automatic Termination of Release
- Mode 6, R12A Monitors providing Alarm only (Automatic Termination of Release is not required).
- During Mode Undefined (Defueled) operation, containment purge is reclassified as a building ventilation process stream monitored by the PLANT VENT HEADER SYSTEM.

During movement of irradiated fuel within containment with the Containment Equipment Hatch OPEN, only R41A/D can be credited for MINIMUM CHANNEL OPERABLE.

During movement of irradiated fuel within containment with the Containment Equipment Hatch CLOSED, R41A/D or R12A may be credited for MINIMUM CHANNEL OPERABLE.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1 LIQUID EFFLUENTS

3/4.11.1.1 CONCENTRATION

CONTROLS

3.11.1.1 In accordance with the Salem Units 1 and 2 Technical Specifications 6.8.4.g. 2 and 3, the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (See Figure 5.1-3) shall be limited to the concentrations specified in the "old" 10 CFR Part 20, Appendix B, Table II, Column 2* for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-4 uCi/ml.

APPLICABILITY: At all times.

ACTION:

With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, without delay 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 analyses program in Table 4.11-1.

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

| * Since the MPC values were removed from 10 CFR 20 effective 1/1/94, the MPC values are provided as Appendix F to the ODCM.

TABLE 4.11-1: RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[(a)] (uCi/ml)
A. Batch Waste Release 1. Tanks[b] 2. Groundwater Remediation Batch [f]	P Each Batch	P Each Batch	Principal Gamma Emitters[c]	$5x10^{-7}$
			I-131	$1x10^{-6}$
	P One Batch/M	M	Dissolve and Entrained Gases (Gamma Emitters)	$1x10^{-5}$
	P Each Batch	M Composite[d]	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
	P Each Batch	Q Composite[d]	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$
B Continuous Releases[e] 1. Steam Generator Blowdown[g] 2. Ground Water Remediation Continuous [h]	W Grab Sample	W	Principal Gamma Emitters[c]	$5x10^{-7}$
			I-131	$1x10^{-6}$
	M Grab Sample	M	Dissolved and Entrained Gases	$1x10^{-5}$
	W Grab Sample	M Composite[d]	H-3	$1x10^{-5}$
			Gross Alpha	$1x10^{-7}$
	W Grab Sample	Q Composite[d]	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$

TABLE 4.11-1: RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM – TABLE NOTATION (Continued)

a. 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):

$$LLD = \frac{4.66 \bullet S_b}{E \bullet V \bullet 2.22E6 \bullet Y \bullet \exp(-\lambda \Delta t)}$$

WHERE: LLD is the "a priori" lower limit of detection as defined above (as microcuries per unit mass or volume)

4.66 is the statistical factor from NUREG 1301

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

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22E6 is the number of disintegrations per minute per microcurie

Y is the fractional radiochemical yield (when applicable)

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

Δt is the elapsed time between the midpoint of sample collection and 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

b. 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 to assure representative sampling.

c. The principal gamma emitters for which the LLD CONTROL applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 is also included, but with an LLD of 2 x 10^{-6}. This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

TABLE 4.11-1: RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM – TABLE NOTATION (Continued)

d. 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.

e. A continuous release is the discharge of liquid wastes of a non-discrete volume, e.g., from a volume of a system that has an input flow during the continuous release.

f. Groundwater Remediation Batch refers to pumping groundwater to a tank, isolating the tank, then processing as a batch release.

g. Steam Generator Blowdown may be sampled directly or after processing but before release to the environment. See section 1.5 in PART II – CALCULATIONAL METHODOLOGIES for further clarification.

h. Groundwater Remediation Continuous refers to pumping of groundwater to Non-rad Waste Basin and releasing in a continuous mode.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1.2 DOSE

CONTROLS

3.11.1.2 In accordance with Salem Units 1 and 2 Technical Specifications 6.8.4.g.4 and 5, 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 Figure 5.1-3) shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrem to the total 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 total body and to less than or equal to 10 mrem 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 Technical Specification 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.

b. The provisions of CONTROL 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.2 Cumulative dose contributions from liquid effluents shall be determined in accordance with the ODCM at least once per 31 days.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1.3 LIQUID RADWASTE TREATMENT

CONTROLS

3.11.1.3 In accordance with the Salem Units 1 and 2 Technical Specifications 6.8.4.g.6, the Liquid Radwaste Treatment System shall be OPERABLE and appropriate portions of the system used to reduce releases of radioactivity when the projected doses due to the liquid effluent, from each unit, to UNRESTRICTED AREAS (see Figure 5.1-3) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31 day period. *

* Values of 0.06 mrem and 0.2 mrem in 31 day period come from NUREG-1301 and are more conservative than the 92-day requirement of Technical Specifications 6.8.4.g.6.

APPLICABILITY: At all times.

ACTION:

a. With the radioactive liquid waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 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.

b. The provisions of CONTROL 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.1.3 Doses due to liquid releases shall be projected at least once per 31 days in accordance with the ODCM.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2 GASEOUS EFFLUENTS

3/4.11.2.1 DOSE RATE

CONTROLS

3.11.2.1 In accordance with the Salem Units 1 and 2 Technical Specifications 6.8.4.g.3 and 7, the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY (see Figure 5.1-3) shall be limited to the following:

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

APPLICABILITY: At all times.

ACTION:

With the dose rate(s) exceeding the above limits, without delay 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 continuously to be within the above limits in accordance with 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 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

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (uCi/mL)
A. Waste Gas Storage Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters[b]	$1x10^{-4}$
B. Containment PURGE	P Each PURGE Grab Sample	P Each PURGE	Principal Gamma Emitters[b]	$1x10^{-4}$
			H-3	$1x10^{-6}$
C. Plant Vent	M[c,d,e] Grab Sample	M[c]	Principal Gamma Emitters[b]	$1x10^{-4}$
			H-3	$1x10^{-6}$
D. All Release Types as Listed in A, B, and C Above	Continuous[f]	W[g] Charcoal Sample	I-131	$1x10^{-12}$
	Continuous[f]	W[g] Particulate Sample	Principal Gamma Emitters[b] (I-131, Others)	$1x10^{-11}$
	Continuous[f]	M Composite Particulate Sample	Gross Alpha	$1x10^{-11}$
	Continuous[f]	Q Composite Particulate Sample	Sr-89, Sr-90	$1x10^{-11}$
	Continuous[f]	Noble Gas Monitor	Noble Gasses Gross Beta or Gamma	$1x10^{-6}$
E. Containment Hatch when open during outages[h]	Continuous	D Charcoal Sample	I-131	$1x10^{-11}$
	Continuous	D Particulate Sample[i]	Principal Gamma Emitters[b]	$1x10^{-10}$
	D Grab Sample	D	Principal Gamma Emitters[b]	$1x10^{-4}$
			H-3	$1x10^{-6}$
	Continuous	Once per release period or Q	Gross Alpha Sr-89, Sr-90	$1x10^{-10}$

TABLE 4.11-2: RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM – TABLE NOTATION (Continued)

a. The LLD is defined in Table 4.11.1

b. The principal gamma emitters for which the LLD CONTROL applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

c. Sampling and analysis shall also be performed following shutdown, startup or a THERMAL POWER change that, within one hour, exceeds 15 percent of RATED THERMAL POWER unless:

   1. Analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of three; and

   2. The noble gas activity monitor shows that effluent activity has not increased by more than a factor of three.

d. Tritium grab samples shall be taken at least once per 24 hours when the refueling canal is flooded.

e. Tritium grab samples shall be taken at least once per 7 days from the ventilation exhaust from the spent fuel pool area whenever spent fuel is in the spent fuel pool.

f. 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.

g. Samples shall be changed at least once per 7 days 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 that, within one hour, exceeds 15 percent of RATED THERMAL POWER 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 primary 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 three.

h. With the Containment Equipment Hatch OPEN, the air near the opening is monitored to estimate dose to public from any potential release.

i. The composite of all particulate filters collected when releases were being made through the Containment Hatch are to be analyzed for gross alpha, strontium-89, and strontium-90 at a LLD of no more than $1x10^{-10}$ uCi/mL at the end of the outage or Quarterly (92 day interval) from date of first opening until date of last closing.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2.2 DOSE - NOBLE GASES

CONTROLS

3.11.2.2 In accordance with the Salem Units 1 and 2 Technical Specification 6.8.4.g.5 and 8, the air dose due to noble gases released in gaseous effluents, from each reactor unit, from the site areas and beyond the SITE BOUNDARY (see Figure 5.1-3) 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.

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 Technical Specification 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 release and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

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

3/4.11 RADIOACTIVE EFFLUENTS

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

CONTROLS

3.11.2.3 In accordance with the Salem Units 1 and 2 Technical Specification 6.8.4.g.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 reactor unit, from the site to areas at and beyond the SITE BOUNDARY (see Figure 5.1-3) 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.

APPLICABILITY: At all times.

ACTION:

a. With the calculated air 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 Technical Specification 6.9.2, a Special Report that identifies the cause(s) for exceeding the limit and defines the corrective actions that have been taken to reduce the release and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

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 ODCM at least once per 31 days.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2.4 GASEOUS RADWASTE TREATMENT

CONTROLS

3.11.2.4 In accordance with the Salem Units 1 and 2 Technical Specifications 6.8.4.g.6, the GASEOUS RADWASTE TREATMENT SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM shall be OPERABLE and appropriate portions of these systems shall be used to reduce releases of radioactivity when the projected doses due to gaseous effluent releases, from each unit, to areas at and beyond the SITE BOUNDARY (see Figure 5.1-3), in a 92-day period would exceed a suitable fraction of allowable dose. This 92-day requirement is satisfied by performing dose projections every 31 days and determining if they would exceed the limits listed below from NUREG-1301:

- 0.2 mrad in air from gamma radiation, or
- 0.4 mrad in air from beta radiation, or
- 0.3 mrad to any organ to a MEMBER OF THE PUBLIC

APPLICABILITY: At all times.

ACTION:

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

   1. Explanation of why gaseous 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.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.2.4 Doses due to gaseous releases from the site shall be projected at least once per 31 days in accordance with the ODCM.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.4 TOTAL DOSE

CONTROLS

3.11.4 In accordance with Salem Units 1 and 2 Technical Specifications 6.8.4.g.11, the annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC, due to releases of radioactivity and radiation, from uranium fuel cycle sources shall be limited to less than or equal to 25 mrem to the total body or any organ (except the thyroid, which shall be limited to less than or equal to 75 mrem).

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 3.11.1.2a, 3.11.1.2b, 3.11.2.2a, 3.11.2.2b, 3.11.2.3a, or 3.11.2.3b, calculations should be made including direct radiation contributions from the reactor units and from outside storage tanks to determine whether the limits of this CONTROL have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 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 10 CFR Part 20.405c, 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 CFR Part 190 or 10 CFR 72.104 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 and 10 CFR 72.104. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

b. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

4.11.4.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with CONTROLS 3.11.1.2, 3.11.2.2, 3.11.2.3, and in accordance with the ODCM.

4.11.4.2 Cumulative dose contributions from direct radiation from the reactor units and from radwaste storage shall be determined in accordance with the ODCM.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

CONTROLS

3.12.1. In accordance with Salem Units 1 and 2 Technical Specifications 6.8.4.h.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 Technical Specification 6.9.1.7, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location 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 Technical Specification 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 limits of CONTROLS 3.11.1.2, 3.11.2.2, and 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:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \ldots \geq 1.0$$

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 CONTROLS 3.11.1.2, 3.11.2.2, and 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 pursuant to CONTROL 6.9.1.7.

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

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.1 MONITORING PROGRAM

CONTROLS

ACTION: (Continued)

c. With milk or fresh leafy vegetable 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 to the radiological environmental monitoring program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program.

   Pursuant to Technical Specification 6.9.1.8, identify the cause of the unavailability of samples and the new location(s) for obtaining replacement samples in the next Radioactive Effluent Release Report. Include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

d. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

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

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
1. Direct Radiation(2)	Fifty eight routine monitoring stations with two or more dosimeters placed as follows: An inner ring of stations one in each land based meteorological sector in the general area of the SITE BOUNDARY; An outer ring of stations, one in each land-based meteorological sector in the 5 to 11 km range from the site; and The balance of the stations to be placed in special interest areas such as population centers, nearby residences, schools, and in one or two areas to serve as control stations.	Quarterly	Gamma dose quarterly

TABLE 3.12-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[(1)]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
2. AIRBORNE Radioiodine and Particulates	Samples from 5[(3)] locations: Three samples from close to the SITE BOUNDARY location, in different sectors, of the highest calculated annual average ground level D/Q. One sample from the vicinity of a community having a highest calculated annual average ground-level D/Q; and One sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction.	Continuous sampler operation with sample collection weekly or more frequently if required by dust loading	Radioiodine Canister I-131 analysis weekly. Particulate Sampler Gross beta radioactivity analysis following filter change[(4)]. AND Gamma isotopic analysis[(5)] of particulate composites (by location) quarterly.

TABLE 3.12-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
3. WATERBORNE			
a. Surface[6]	One sample upstream One sample downstream One sample outfall One sample cross-stream	Grab sample semi-monthly	Composite for gamma isotopic analysis[5] monthly. Composite for tritium analysis quarterly.
b. Ground	Samples from one or two sources only if likely to be affected[8].	Monthly	Gamma isotopic analysis[5] monthly and tritium analysis quarterly.
c. Drinking[11]	One sample of the nearest water supply affected by its discharge	Composite sample over two-week period[7] when I-131 analysis is performed; monthly composite otherwise	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year[9]. Composite for gross beta and gamma isotopic analysis[5] monthly Composite for tritium analysis quarterly
d. Sediment	One sample from downstream area One sample from cross-stream area One sample from outfall area One sample from upstream area One sample from a control location One sample from shoreline location	Semiannually	Gamma isotopic analysis[5] semiannually

TABLE 3.12-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS(1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
4. INGESTION			
a. Milk	Samples from milking animals in three locations within 5 km distance having the highest dose potential. If there are none, then one sample from milking animals in each of three areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per yr(9). One sample from milking animals at a control location 15 to 30 km distant.	Semi-monthly when animals are on pasture, monthly at other time	Gamma isotopic(5) and I-131 analysis semi-monthly when animals are on pasture; monthly at other times.
b. Fish and Invertebrates	One sample of each commercially and recreationally important species in vicinity of plant discharge area. One sample of same species in area not influenced by plant discharge.	Sample in season, or semiannually if they are not seasonal	Gamma isotopic analysis(5) on edible portions.

TABLE 3.12-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS (1)	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
c. Food Products	One sample of each principal class of food products from any area that is irrigated by water in which liquid plant wastes have been discharged	At time of harvest(10)	Gamma isotopic analysis (5) on edible portion.
	Samples of three different kinds of broad leaf grown nearest each of two different offsite locations of highest predicted annual ground level D/Q if milk sampling is not performed.	Monthly during growing season	Gamma isotopic analysis(5) on edible portion.
	One sample of each similar broadleaf vegetation grown 15 to 30 km distant in the least prevalent wind direction if milk sampling is not performed.	Monthly during growing season	Gamma isotopic analysis (5) on edible portion.

TABLE 3.12-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM – TABLE NOTATION (Continued)

(1) Specific parameters of distance and direction sector from the midpoint of a line between the center of the Salem Units 1 & 2 containment domes, and additional description where pertinent, shall be provided for each and every sample location in Table 3.12-1 in a table and figure(s) in the ODCM. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and to Reg. Guide 4.8 as amended by Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to circumstances such as hazardous conditions, seasonal unavailability and malfunction of automatic sampling equipment. If specimens are unobtainable due to sampling equipment malfunction, effort shall be made to complete corrective action 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 6.9.1.7. It is recognized that, 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 specific 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 given in the ODCM. Pursuant to CONTROL 6.9.1.8, submit in the next Radioactive Effluent Release Report documentation for a change in the ODCM including revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples for the pathway and justifying the selection of the new location(s) for obtaining samples.

(2) One or more instruments, such as pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a Passive Dosimeter (PD), a device meeting the criteria of ANSI N545 is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used for measuring direct radiation. The frequency of analysis or readout will depend upon the characteristics of the specific dosimetry system used and should be selected to obtain optimum dose information with minimal fading. The number of direct radiation monitoring stations may be reduced according to geographical limitations; e.g., at an ocean site, some sectors will be over water so that the number of dosimeters may be reduced accordingly.

(3) There are four additional air sample locations – one "duplicate" air sampler at location 5S2 plus locations 5D1, 1F1 and 2F6 which are maintained for their historical data.

(4) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

TABLE 3.12-1: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM – TABLE NOTATION (Continued)

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

(6) The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream" sample shall be taken in an area beyond but near the mixing zone. "Upstream" samples in an estuary must be taken far enough upstream to be beyond the plant influence. Saltwater shall be sampled only when the receiving water is utilized for recreational activities.

(7) A composite sample is one which the quantity (aliquot) of liquid sampled is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow. In this program composite sample aliquots shall be collected at time intervals that are very short relative to the compositing period in order to assure obtaining a representative sample.

(8) Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

(9) The dose shall be calculated for the maximum organ and age group using the methodology and parameters in the ODCM. There are no farms that meet the 5 km requirement and it is unlikely that any releases from the site will approach the 1 mrem criteria at 5 to 8 km. Milk samples will be taken (owner obliging) within 8 km and other management audit samples within 16 km. Broad leaf vegetation (within 8 km) shall be taken to meet this pathway.

(10) If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvest occurs continuously, sampling shall be monthly. Attention shall be paid to including samples of tuberous and root food products. The Delaware River at the location of Salem and Hope Creek Nuclear Power Plants is a brackish water source. No irrigation of food products is performed using water in the vicinity from which liquid plant wastes have been discharged. However, 12 management audit food samples are collected from various locations.

(11) No groundwater samples are required as liquid effluents discharged from Salem and Hope Creek Generating Stations do not directly affect this pathway. However for management audit, one raw and one treated ground water sample from the nearest unaffected water supply is required.

TABLE 3.12-2: REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

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	3×10^4 (1)				
Mn-54	1×10^3		3×10^4		
Fe-59	4×10^2		1×10^4		
Co-58	1×10^3		3×10^4		
Co-60	3×10^2		1×10^4		
Zn-65	3×10^2		2×10^4		
Zr-Nb-95	4×10^2				
I-131	20 (1)	0.9		3	1×10^2
Cs-134	30	10	1×10^3	60	1×10^3
Cs-137	50	20	2×10^3	70	2×10^3
Ba-La-140	2×10^2			3×10^2	

1. No drinking water exposure path exists on site. If a drinking water pathway existed, then the water reporting level would be 20,000 pCi/L for H-3 and 2 pCi/L for I-131.

TABLE 4.12-1: DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[(1), (2)]

LOWER LIMITS OF DETECTION (LLD) [(4)]

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	1×10^{-2}				
H-3	3000 [(3)]					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	15 [(3)]	7×10^{-2}		1	60	
Cs-134	15	5×10^{-2}	130	15	60	150
Cs-137	18	6×10^{-2}	150	18	80	180
Ba-La-140	15			15		

TABLE 4.12-1: DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS – 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 6.9.1.7.

(2) Required detection capabilities for dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.

(3) No drinking water exposure pathway exists on site. If drinking water pathway existed, then the water LLD would be 2,000 pCi/L for H-3 and 1 pCi/L for I-131.

TABLE 4.12-1: DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS – TABLE NOTATIONS

(4) 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:

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

WHERE: LLD is the "a priori" lower limit of detection as defined above (as picocuries per unit mass or volume)

4.66 is the statistical factor from NUREG 1301

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

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22 is the number of disintegrations per minute per picocurie

Y is the fractional radiochemical yield (when applicable)

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

Δt for environmental samples is the elapsed time between sample collection (or end of the sample collection period) and time of counting

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

For low count rates a value of 2.71 may be added to the numerator

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 6.9.1.7.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.2 LAND USE CENSUS

CONTROLS

3.12.2 In accordance with the Salem Units 1 and 2 Technical Specifications 6.8.4.h.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 m^2 (500 ft^2) 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, identify the new location(s) in the next Radioactive Effluent Release Report, pursuant to CONTROL 6.9.1.8.

b. With a land use census identifying a location(s)** that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with CONTROL 3.12.1, add the new location(s) to the radiological environmental monitoring program within 30 days. 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 CONTROL 6.9.1.8, identify the new location(s) in the next Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

c. The provisions of CONTROLS 3.0.3 and 3.0.4 are not applicable.

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, visual 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 6.9.1.7.

* Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Q in lieu of the garden census. CONTROLS for broadleaf vegetation sampling in Table 3.12-1.4c shall be followed, including analysis of control samples.

** New receptor locations must be on land and not over water to be considered in dose calculations.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

CONTROLS

3.12.3 In accordance with Salem Units 1 and 2 Technical Specifications 6.8.4.h.3, analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission, 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 actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to CONTROL 6.9.1.7.

b. The provisions of CONTROLS 3.0.3 and 3.0.4. are not applicable.

SURVEILLANCE REQUIREMENTS

4.12.3 The Interlaboratory Comparison Program shall be described in the ODCM. 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 6.9.1.7.

BASES

FOR

SECTIONS 3.0 AND 4.0

CONTROLS

AND

SURVEILLANCE REQUIREMENTS

NOTE: The BASES contained in the succeeding pages summarize the reasons for the CONTROLS of Sections 3.0 and 4.0, but are not considered a part of these CONTROLS.

3/4.3 INSTRUMENTATION

3/4.3.3.8 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

BASES

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the procedures in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of the "old" 10 CFR Part 20 (ODCM Appendix F). 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.

CROSS REFERENCE - TABLES 3.3-12 and 4.3-12

Unit 1 T/S Table Item No.	Instrument Description	Acceptable RMS Channels
1a	Liquid Radwaste Effluent Line Gross Activity	1R18
1b	Steam Generator Blowdown Line Gross Activity	1R19A, B, C, and D(1)
2a	Containment Fan Coolers Service Water Line Discharge Gross Activity	1R13A and B(1)

Unit 2 T/S Table Item No.	Instrument Description	Acceptable RMS Channels
1a	Liquid Radwaste Effluent Line Gross Activity	2R18
1b	Steam Generator Blowdown Line Gross Activity	2R19A,B,C, and D(1)
2a	Containment Fan Coolers - Service Water Line Discharge Gross Activity	2R13A and B(1)
2b	Chemical Waste Basin Line Gross Activity	R37

(1) The channels listed are required to be operable to meet a single operable channel for the ODCM's "Minimum Channels Operable" requirement.

3/4.3 INSTRUMENTATION

3/4.3.3.9 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

BASES

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the procedures in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of the "old" 10 CFR Part 20 (ODCM Appendix F). 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.

CROSS REFERENCE - TABLES 3.3-13 and 4.3-13

Unit 1 T/S Table Item No.	Instrument Description	Acceptable RMS Channels
1a	Waste Gas Holdup System Noble Gas Activity	1R41A and D(1)(2)
2a	Containment Purge and Pressure - Vacuum Relief Noble Gas Activity	1R12A or 1R41A and D(1)(2)
3a	Plant Vent Header System Noble Gas Activity	1R41A and D(1)(2)
3b	Plant Vent Header System Iodine Sampler (3)	1RME 4, 5 (1R41) or 1RME50, 51 (1R45)
3c	Plant Vent Header System Particulate Sampler (3)	1RME 4, 5 (1R41) or 1 RME50, 51 (1R45)

(1) The channels listed are required to be operable to meet a single operable channel for the ODCM's Minimum Channels Operable" requirement.

(2) 1R41D is the setpoint channel. 1R41A is the measurement channel.

(3) Laboratory analysis of the sampler filters ensures that the limits of ODCM CONTROL 3.11.2.1 are not exceeded. Alarm/trip setpoints do not apply to these passive components.

3/ 4.3 INSTRUMENTATION

3/4.3.3.9 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION (Continued)

BASES

Unit 2 T/S Table Item No.	Instrument Description	Acceptable RMS Channels
1a	Waste Gas Holdup System Noble Gas Activity	2R41A and D(1)(2)
2a	Containment Purge and Pressure - Vacuum Relief Noble Gas Activity	2R12A or 2R41A and D(1)(2)
3a	Plant Vent Header System Noble Gas Activity	2R41A and D(1)(2)
3b	Plant Vent Header System Iodine Sampler (3)	RME 4, 5 (2R41) or 2RME50, 51 (2R45)
3c	Plant Vent Header System Particulate Sampler (3)	2RME 4, 5 (2R41) or 2RME50, 51 (2R45)

(1) The channels listed are required to be operable to meet a single operable channel for the ODCM's "Minimum Channels Operable" requirement.

(2) 2R41D is the setpoint channel. 2R41A is the measurement channel.

(3) Laboratory analysis of the sampler filters ensures that the limits of ODCM CONTROL 3.11.2.1 are not exceeded. Alarm/trip setpoints do not apply to these passive components.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1 LIQUID EFFLUENTS

BASES

3/4.11.1.1 CONCENTRATION

The CONTROL is provided to ensure that the concentration of radioactive materials released in liquid waste effluents will be less than the concentration levels specified in the "old" 10 CFR Part 20, Appendix B Table II, Column 2 (ODCM Appendix F). 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 20.106(a) to the population. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs).

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 will be kept "as low as is reasonably achievable." Also, for freshwater 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 calculations 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. 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 Purposes of Implementing Appendix I," April 1977.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.1 LIQUID EFFLUENTS (Continued)

BASES

3/4.11.1.2 DOSE (Continued)

The CONTROL applies to the release of liquid effluents from each reactor at the site. For units with shared radwaste treatment systems, the liquid effluents from the shared system are proportioned among the units sharing that system.

3/4.11.1.3 LIQUID RADWASTE TREATMENT

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 Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.0 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 the Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2 GASEOUS EFFLUENTS

BASES

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. The annual dose limits are the doses associated with the concentrations of the "old" 10 CFR Part 20, Appendix B, Table II, Column 1 (ODCM Appendix F). These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in the "old" Appendix B, Table II of 10 CFR Part 20 [10 CFR Part 20.106(b)]. For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of the individual will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC with the appropriate occupancy factors shall be given in the ODCM. 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 mrem/year to the whole body and 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 mrem/year.

This CONTROL applies to the release of gaseous effluents from all reactors at the site.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2 GASEOUS EFFLUENTS (Continued)

3/4.11.2.2 DOSE - NOBLE GASES

This CONTROL is provided to implement the requirements of Section II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The CONTROL implements the guides set forth in Section II.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 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 calculations 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 50, Appendix I," Revision I, 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.

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

This CONTROL is provided to implement the requirements of Section II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The CONTROL 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 will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in 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 ODCM calculational methods for calculating the doses due to the actual release rates of the subject materials 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 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 dose based upon the historical average atmospheric conditions. The release rate controls for iodine-131, iodine 133, tritium, and radionuclides in particulate form with half-life greater than 8 days are dependent on the existing radionuclide pathways to man in the areas at and beyond the SITE BOUNDARY.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.2 GASEOUS EFFLUENTS (Continued)

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

The pathways that were examined in the development of these 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. Note that any new receptor locations must be on land and not over water to be considered in dose calculations.

3/4.11.2.4 GASEOUS RADWASTE TREATMENT SYSTEM

The requirement that the appropriate portions of this system 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 Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objectives given in Section II.0 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.

3/4.11 RADIOACTIVE EFFLUENTS

3/4.11.4 TOTAL DOSE

BASES

This CONTROL is provided to meet the dose limitations of 40 CFR Part 190 that have now been incorporated into 10 CFR Part 20 by 46 FR 18525 as well as the dose limitations specific to Independent Spent Fuel Storage Installation (ISFSI) operations in accordance with 10 CFR 72.104. Over the long term, as more storage casks are placed on the ISFSI pads, it is expected that ISFSI operations will become the prominent contributor to the dose limits in this section. ISFSI dose contribution is in the form of direct radiation as no liquid or gas releases are expected to occur. The PSEG 10 CFR 72.212 Report prepared in accordance with 10 CFR 72 requirements assumes a certain array of casks exists on the pads. The dose contribution from this array of casks in combination with historical uranium fuel cycle operations prior to ISFSI operations was analyzed to be within the 40 CFR 190 and 10 CFR 72.104 limits. The CONTROL requires the preparation and submittal of a Special Report whenever the calculated doses from plant including the ISFSI radioactive effluents exceed 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. For sites containing up to 4 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 reactor 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 or 10 CFR 72.104 limits. For 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 km must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190 or 10 CFR 72.104, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 or 10 CFR 72.104 have not already been corrected), in accordance with the provisions of 40 CFR Part 190 or 10 CFR 72.104 and 10 CFR Part 20.405c, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 or 10 CFR 72.104 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190 or 10 CFR 72.104, 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 and 3.11.2. 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 measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the station 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. The initial 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 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 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.

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 the HASL procedures Manual, HASL-300.

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 are made if required by the results of this census. The best information from the door-to-door survey, aerial survey or consulting with local agricultural authorities shall be used. 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 $50m^2$ 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 Kg/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) yield of 2 kg/m2.

3/4.12 RADIOLOGICAL ENVIRONMENTAL MONITORING (Continued)

3/4.12.3 INTERLABORATORY COMPARISON PROGRAM

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

SECTION 5.0

DESIGN FEATURES

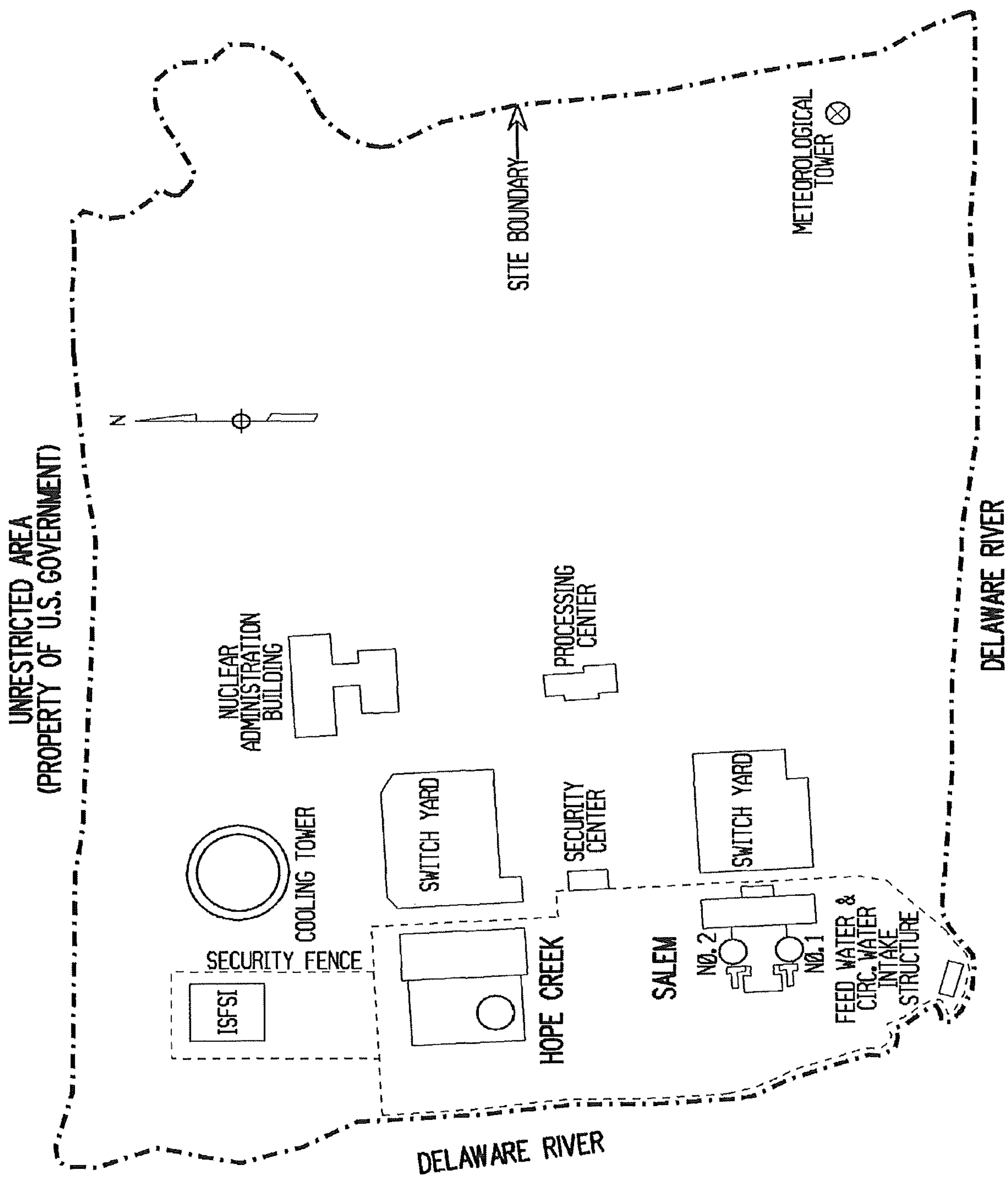
5.0 DESIGN FEATURES

5.1 SITE

5.1.3 UNRESTRICTED AREAS FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

UNRESTRICTED AREAS within the SITE BOUNDARY that are accessible to MEMBERS OF THE PUBLIC, shall be as shown in Figure 5.1-3. (Provided FOR INFORMATION ONLY. Technical Specifications Section 5.0 is controlling.)

FIGURE 5.1-3: AREA PLOT PLAN OF SITE



SECTION 6.0

ADMINISTRATIVE CONTROLS

6.0 ADMINISTRATIVE CONTROLS

6.9.1.7 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

6.9.1.7 In accordance with Salem Units 1 and 2 Technical Specifications 6.9.1.7, The Annual Radiological Environmental Operating Report* covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year.

The Annual Radiological Environmental Operating Reports shall include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies with operational controls (as appropriate), 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 censuses 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 measurements taken during the period pursuant to the Table and Figures in the environmental radiation section of the ODCM; as well as summarized and tabulated results of locations specified in these analyses and measurements in the format of the table in Reg. Guide 4.8 as amended by 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 reports shall also include the following: a summary description of the radiological environmental monitoring program; at least two legible maps, one covering sampling locations near the SITE BOUNDARY and a second covering the more distant locations, all keyed to a table giving distances and directions from the midpoint of a line between the centers of Salem Units 1 & 2 containment domes; the results of licensee participation in the Interlaboratory Comparison Program, required by CONTROL 3.12.1; and discussion of all analyses in which the LLD required by Table 4.12-1 was not achievable.

6.9.1.8 RADIOACTIVE EFFLUENT RELEASE REPORT

6.9.1.8 In accordance with Salem Units 1 and 2 Technical Specifications 6.9.1.8, The Annual Radiological Effluent Release Report* covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year and in accordance with the requirements of 10 CFR 50.36a.

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* 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.

6.9.1.8 RADIOACTIVE EFFLUENT RELEASE REPORT (Continued)

The Radioactive Effluent Release Report 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.

The Radioactive Effluent Release Report 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. The 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. The 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 (Figure 5.1-3) 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 historical annual average meteorology or 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. The assessment of radiation doses shall be performed in accordance with the OFFSITE DOSE CALCULATION MANUAL.

The Radioactive Effluent Release Report shall identify those radiological environmental sample parameters and locations where it is not possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In addition, the cause of the unavailability of samples for the pathway and the new location(s) for obtaining replacement samples should be identified. The report should also include a revised figure(s) and table(s) for the ODCM reflecting the new location(s).

The Radioactive Effluent Release Report shall also include an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous calendar year to show conformance with 40 CFR Part 190, Environmental Radiation Protection Standards for Nuclear Power Operation and 10 CFR 72.104, Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI or MRS. Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev. 1, October 1977.

6.9.1.8 RADIOACTIVE EFFLUENT RELEASE REPORT (Continued)

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:

a. Container volume,

b. Total curie quantity (specify whether determined by measurement or estimate),

c. Principal radionuclides (specify whether determined by measurement or estimate),

d. Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms),

e. Type of container (e.g., LSA, Type A, Type B, Large Quantity), and

f. Solidification agent or absorbent (e.g., cement, urea formaldehyde).

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

The Radioactive Effluent Release Report shall include any changes made during the reporting period to the PROCESS CONTROL PROGRAM (PCP), the OFFSITE DOSE CALCULATION MANUAL (ODCM), or radioactive waste systems. Also list new locations identified by the land use census pursuant to CONTROL 3.12.2. for dose calculations or environmental monitoring.

6.15 MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS AND SOLID WASTE TREATMENT SYSTEMS

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

1. Shall be reported to the Commission in the UFSAR for the period in which the evaluation was reviewed by the Plant Operations Review Committee (PORC). The discussion of each change shall contain:

   a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR50.59;

   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;

6.15 MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS AND SOLID WASTE TREATMENT SYSTEMS (Continued)

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 exposures to individual 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 prior to 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 PORC.

2. Shall become effective upon review and acceptance by the PORC.

PART II – CALCULATIONAL METHODOLOGIES

1.0 LIQUID EFFLUENTS

1.1 Radiation Monitoring Instrumentation and Controls

The liquid effluent monitoring instrumentation and controls at Salem for controlling and monitoring normal radioactive material releases in accordance with the Salem Technical Specifications 6.8.4.g and ODCM CONTROLS are summarized as follows:

1. Alarm (and Automatic Termination) - 1R18 (Unit 1) and 2R18 (Unit 2) provide the alarm and automatic termination of liquid radioactive material releases as required by ODCM CONTROL 3.3.3.8.

   1R19A, B, C, and D provide the alarm and isolation function for the Unit 1 steam generator blowdown lines. 2R19A, B, C, and D provide this function for Unit 2.

2. Alarm (only) - The alarm functions for the Service Water System are provided by the radiation monitors on the Containment Fan Cooler discharges (1R13A and B for Unit 1 and 2R13A and B for Unit 2).

   Releases from the secondary system are routed through the Chemical Waste Basin where the effluent is monitored (with an alarm function) by R37 prior to release to the environment.

Liquid radioactive release flow diagrams with the applicable, associated radiation monitoring instrumentation and controls are presented as Figures 1-1 and 1-2 for Units 1 and 2, respectively. The Liquid Radioactive Waste System is presented in Figure 1-3.

1.2 Liquid Effluent Monitor Setpoint Determination

Per the requirements of ODCM CONTROL 3.3.3.8, alarm setpoints shall be established for the liquid effluent monitoring instrumentation to ensure that the release concentration limits of ODCM CONTROL 3.11.1.1 are met (i.e., the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentrations specified in the "old" 10 CFR 20, Appendix B, Table II, Column 2, (ODCM Appendix F) for radionuclides and 2×10^{-4} uCi/ml for dissolved or entrained noble gases).

The following equation* must be satisfied to meet the liquid effluent restrictions:

$$c \leq \frac{C(F+f)}{f} \tag{1.1}$$

WHERE: C = The effluent concentration limit of ODCM CONTROL 3.11.1.1 (ODCM Appendix F) for the site, in uCi/ml. This implements the "old" 10 CFR 20 MPC values.

c = The setpoint, in uCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint, represents a value which, if exceeded, would result in concentrations exceeding the limits of the "old" 10 CFR 20 (ODCM Appendix F) in the UNRESTRICTED AREA.

f = The flow rate at the radiation monitor location, in volume per unit time, but in the same units as F, below.

F = The dilution water flow rate as measured prior to the release point, in volume per unit time

[Note that if no dilution is provided, c < C. Also, note that when (F) is large compared to (f), then (F + f) = F.]

* Adapted from NUREG-0133

1.2.1 Liquid Effluent Monitors (Radwaste, Steam Generator Blowdown, Chemical Waste Basin and Service Water

The setpoints for the liquid effluent monitors at the Salem Nuclear Generating Station are determined by the following equations:

$$SP \leq \left[\frac{MPCe * SEN * CW * CF * AF}{RR} \right] + bkg \qquad \textbf{(1.2)}$$

with:

$$MPCe = \frac{\sum_i C_i \ (gamma\ only)}{\sum_i \frac{C_i}{MPC_i} \ (gamma\ only)} \qquad \textbf{(1.3)}$$

WHERE:

	SP	=	Alarm setpoint corresponding to the maximum allowable release rate (cpm).
	MPCe	=	An effective MPC value for the mixture of gamma emitting radionuclides in the effluent stream (uCi/ml).
	C_i	=	The concentration of radionuclide i in the undiluted liquid effluents (uCi/ml).
	MPC_i	=	The MPC value corresponding to radionuclide i from the "old" 10 CFR 20, Appendix B, Table II, Column 2, (ODCM Appendix F) (uCi/ml).
	SEN	=	The sensitivity value to which the monitor is calibrated (cpm per uCi/ml).
	CW	=	The circulating water flow rate (dilution water flow) at the time of release (gal/min).
	RR	=	The liquid effluent release rate (gal/min).
	bkg	=	The background of the monitor (cpm).
	CF	=	Correction factor to account for non-gamma emitting nuclides in setpoint calculations.
	AF	=	An allocation factor applicable for steam generator blowdown.

The radioactivity monitor setpoint equation (1.2) remains valid during outages when the circulating water dilution is potentially at its lowest value. Reduction of the waste stream flow (RR) may be necessary during these periods to meet the discharge criteria. However, in order to maximize the available plant discharge dilution and thereby minimize the potential offsite doses, batch releases from either Unit 1 or Unit 2 may be routed to either the Unit 1 or Unit 2 Circulating Water System discharge. Procedural restrictions prevent simultaneous batch releases from either a single unit or both units into a single Circulating Water System discharge.

1.2.2 Conservative Default Values

Conservative alarm setpoints may be determined through the use of default parameters. Tables 1-1.1 and 1-1.2 summarize all current default values in use for Salem Unit 1 and Unit 2, respectively. They are based upon the following:

a. Substitution of the effective MPC value with a default value of 6.05-6 uCi/ml (Unit 1) and 4.81E-6 uCi/ml (Unit 2). (Refer to Appendix A for justification);

b. For additional conservatism*, substitution of the I-131 MPC value of 3-7 uCi/ml for the R19 Steam Generator Blowdown monitors, the R37 Chemical Waste Basin monitor and the R13 Service Water monitors;

c. For conservatism, use of an allocation factor of 0.5 for the Steam Generator Blowdown monitors to limit consequences of potential simultaneous primary-to-secondary leaks in two steam generators.** The allocation factor equals 1.0 for all liquid effluent setpoints;

d. Substitutions of the operational circulating water flow with the lowest flow, in gal/min;***

e. Substitutions of the effluent release rate with the highest allowed rate, in gal/min; and,

f. Substitution of a Correction factor of 0.75 to account for non-gamma emitting nuclides.

For batch liquid releases a fixed alarm setpoint is established for the 1R18 and 2R18 monitors and the release rate is controlled to ensure the inequality of equation 1.1 is maintained. With this approach, values selected for the parameters in the setpoint calculation (e.g., Table 1-1.1 and Table 1-1.2) should be any set of reasonable values that provide a setpoint value reasonably above anticipated monitor response, plus background, so as not to yield spurious alarms. The release rate is controlled to ensure compliance with the requirements of ODCM CONTROL 3.3.3.8.

* Based upon the potential for I-131 to be present in the secondary and service water systems, the use of the default effective MPC (MPCe) value as derived in Appendix A may be non-conservative for the 1R19 and 2R19 SGBD monitors, the R37 Chemical Waste Basin monitor and the R13 Service Water monitors.

** Setpoints using the Allocation Factor of 0.5 become invalid if primary-to-secondary leaks are identified in more than two steam generators simultaneously.

*** The Containment Fan Coil Unit Discharge to Service Water Line is routed to the opposite Unit's Circulating Water System discharge. Therefore, during periods when circulating water pumps are out of service, such as during refueling outages, the default setpoints of the other Unit's R13 radiation monitors are not valid.

Calculations, as performed by Engineering, to establish the actual fixed setpoints for use in the plant, incorporate uncertainties and instrument drift. These factors will cause the actual installed instrument setpoint to be at a lower (conservative) value. However, for batch releases, when the rate is controlled, these uncertainties and drift should not be included in the evaluation of acceptable release rate, since this could cause a non-conservative correction, i.e., a higher allowable release rate. Therefore, for 1R18 and 2R18 monitors, the setpoint value used for calculating the allowable release rate should be that value prior to correction for uncertainty and drift.

1.3 Liquid Effluent Concentration Limits - 10 CFR 20

ODCM CONTROL 3.11.1.1 limits the concentration of radioactive material in liquid effluents (after dilution in the Circulating Water System) to less than the concentrations as specified in the "old" 10 CFR 20, Appendix B, Table II, Column 2, (ODCM Appendix F) for radionuclides other than noble gases. Noble gases are limited to a diluted concentration of 2E-4 uCi/ml.

Release rates are controlled and radiation monitor alarm setpoints are established as addressed above to ensure that these concentration limits are not exceeded. However, in the event any liquid release results in an alarm setpoint being exceeded, an evaluation of compliance with the concentration limits of ODCM CONTROL 3.11.1.1 may be performed using the following equation:

$$\sum_i \left(\frac{C_i}{MPC_i} * \frac{RR}{CW + RR} \right) \leq 1 \qquad \textbf{(1.4)}$$

WHERE:

C_i = Actual concentration of radionuclide i as measured in the undiluted liquid effluent (uCi/ml).

MPC = The MPC value corresponding to radionuclide i from the "old" 10 CFR 20, Appendix B, Table II, Column 2 (uCi/ml) [ODCM Appendix F].

= 2E-4 uCi/ml for dissolved or entrained noble gases.

RR = The actual liquid effluent release rate (gal/min).

CW = The actual circulating water flow rate (dilution water flow) at the time of the release (gal/min).

1.4 Liquid Effluent Dose Calculation - 10 CFR 50

1.4.1 MEMBER OF THE PUBLIC Dose - Liquid Effluents

ODCM CONTROL 3.11.1.2 limits the dose or dose commitment to MEMBERS OF THE PUBLIC from radioactive materials in liquid effluents from each unit of the Salem Nuclear Generating Station to:

- during any calendar quarter;
  $\leq$ 1.5 mrem to total body per unit
  $\leq$ 5.0 mrem to any organ per unit
- during any calendar year;
  $\leq$ 3.0 mrem to total body per unit
  $\leq$ 10.0 mrem to any organ per unit.

Per the surveillance requirements of ODCM CONTROL 4.11.1.2, the following calculational methods shall be used for determining the dose or dose commitment due to the liquid radioactive effluents from Salem:

$$D_o = \frac{1.67\text{E}-02 * VOL}{CW} * \sum_i \left(C_i * A_{io}\right) \quad \textbf{(1.5)}$$

WHERE:

D_o	=	Dose or dose commitment to organ o (mrem). Total body dose can also be calculated using site-related total body dose commitment factor.
A_{io}	=	Site-related ingestion dose commitment factor to the total body or any organ o for radionuclide i (mrem/hr per uCi/ml).
C_i	=	Average concentration of radionuclide i, in undiluted liquid effluent representative of the volume VOL (uCi/ml).
VOL	=	Volume of liquid effluent released (gal)
CW	=	Average circulating water discharge rate during release period (gal/min)
1.672	=	Conversion factor (hr/min)

The site-related ingestion dose/dose commitment factors (A_{io}) are presented in Table 1-2 and have been derived in accordance with the requirements of NUREG-0133 by the equation:

$$A_{io} = 1.14\text{E} + 05 * [(UI * BI_i) + (UF * BF_i)] * DF \quad \textbf{(1.6)}$$

WHERE:

A_{io}	=	Composite dose parameter for the total body or critical organ o of an adult for radionuclide i, for the fish and invertebrate ingestion pathways (mrem/hr per uCi/ml).
UI	=	Adult invertebrate consumption (5 kg/yr).
BI_i	=	Bioaccumulation factor for radionuclide i in invertebrates from Table 1-3 (uCi/g per uCi/L).
UF	=	Adult fish consumption (21 Kg/yr).
BF_i	=	Bioaccumulation factor for radionuclide i in fish from Table 1-3 (uCi/g per uCi/l).
DF_{io}	=	Dose conversion factor for nuclide i for adults in pre-selected organ, o, from Table E-11 of Regulatory Guide 1.109 (mrem/uCi).
1.14E+05	=	Conversion factor (pCi/uCi * ml/kg per hr/yr).

The radionuclides included in the periodic dose assessment per the requirements of ODCM CONTROL 3/4.11.1.2 are those as identified by gamma spectral analysis of the liquid waste samples collected and analyzed per the requirements of ODCM CONTROL 3/4.11.1.1, Table 4.11-1.

Radionuclides requiring radiochemical analysis (e.g., Sr-89 and Sr-90) will be added to the dose analysis at a frequency consistent with the required minimum analysis frequency of ODCM CONTROL Table 4.11-1.

1.4.2 Simplified Liquid Effluent Dose Calculation

In lieu of the individual radionuclide dose assessment as presented in Section 1.4.1, the following simplified dose calculation equation may be used for demonstrating compliance with the dose limits of ODCM CONTROL 3.11.1.2. (Refer to Appendix B for the derivation and justification for this simplified method.)

Total Body

$$D_{tb} = \frac{1.21\text{E}+03 * VOL}{CW} * \sum_i C_i \qquad \textbf{(1.7)}$$

Maximum Organ

$$D_{\max} = \frac{2.52\text{E}+04 * VOL}{CW} * \sum_i C_i \qquad \textbf{(1.8)}$$

WHERE:

C_i	=	Average concentration of radionuclide i, in undiluted liquid effluent representative of the volume VOL (uCi/ml).
VOL	=	Volume of liquid effluent released (gal).
CW	=	Average circulating water discharge rate during release period (gal/min).
D_{tb}	=	Conservatively evaluated total body dose (mrem).
D_{max}	=	Conservatively evaluated maximum organ dose (mrem).
1.21E+03	=	Conversion factor (hr/min) and the total body dose conversion factor for Fe-59 = 7.27E+04 mrem/hr per uCi/ml.
2.52E+04	=	Conversion factor (hr/min) and the conservative maximum organ dose conversion factor for Nb-95 = 1.51E+06 mrem/hr per uCi/ml for GI-LLI.

1.5 Secondary Side Radioactive Liquid Effluents and Dose Calculations During Primary to Secondary Leakage

During periods of primary-to-secondary leakage (i.e., steam generator tube leaks), radioactive material will be transmitted from the primary system to the secondary system. The potential exists for the release of radioactive material to the off-site environment (Delaware River) via secondary system discharges. Potential releases are controlled/monitored by the Steam Generator Blowdown monitors (R19) and the Chemical Waste Basin monitor (R37).

However to ensure compliance with the regulatory limits on radioactive material releases, it may be desirable to account for potential releases from the secondary system during periods of primary-to-secondary leakage. Any potentially significant releases will be via the Chemical Waste Basin with the major source of activity being the Steam Generator Blowdown.

With identified radioactive material levels in the secondary system, appropriate samples should be collected and analyzed for the principal gamma emitting radionuclides. Based on the identified radioactive material levels and the volume of water discharged, the resulting environmental doses may be calculated based on equation (1.5).

Because the release rate from the secondary system is indirect (e.g., SG blowdown is normally routed to condenser where the condensate clean-up system will remove much of the radioactive material), samples should be collected from the release point (i.e., Chemical Waste Basin) for quantifying the radioactive material releases. However, for conservatism and ease of controlling and quantifying all potential release paths, it is prudent to sample the SG blowdown and to assume all radioactive material is released directly to the environment via the Chemical Waste Basin. This approach while not exact is conservative and ensures timely analysis for regulatory compliance. Accounting for radioactive material retention of the condensate clean-up system ion exchange resins may be needed to more accurately account for actual releases.

In addition to the secondary releases described in this section, the Salem Ground Water Remediation System also can potentially discharge radioactive material to the Chemical Waste Basin. To ensure regulatory compliance, the releases are monitored by Radiation Monitor R37. Samples are also collected, and analyzed for radionuclides. Based on the identified radioactive material levels and the volume of water discharged, the resulting environmental doses may be calculated based on equation (1.5).

1.6 Liquid Effluent Dose Projections

ODCM CONTROL 3.11.1.3 requires that the liquid radioactive waste processing system be used to reduce the radioactive material levels in the liquid waste prior to release when the monthly projected doses exceed:

- 0.06 mrem to the total body, or
- 0.2 mrem to any organ.

The applicable liquid waste processing system for maintaining radioactive material releases ALARA is the ion exchange system as delineated in Figure 1-3. Alternately, the waste evaporator as presented in the Salem FSAR has processing capabilities meeting the NRC ALARA design requirements and may be used in conjunction or in lieu of the ion exchange system for waste processing requirements in accordance with ODCM CONTROL 3.11.1.3. These processing requirements are applicable to each unit individually. Exceeding the projected dose requiring processing prior to release for one unit does not in itself dictate processing requirements for the other unit.

Dose projections are made at least once per 31 days by the following equations:

$$D_{tbp} = (D_{tb}/d) \ * 31\,\text{days} \tag{1.9}$$

$$D_{maxp} = (D_{max}/d) \ * 31\,\text{days} \tag{1.10}$$

WHERE:

D_{tbp}	=	The total body dose projection for current calendar quarter (mrem).
D_{tb}	=	The total body dose to date for current calendar quarter as determined by Equation 1.5 or 1.7 (mrem).
D_{maxp}	=	The maximum organ dose projection for current calendar quarter (mrem).
D_{max}	=	The maximum organ dose to date for current calendar quarter as determined by Equation 1.5 or 1.8 (mrem).
d	=	The number of days to date for current calendar quarter.
31d	=	The number of days for the projection.

2.0 GASEOUS EFFLUENTS

2.1 Radiation Monitoring Instrumentation and Controls

The gaseous effluent monitoring instrumentation and controls at Salem for controlling and monitoring normal radioactive material releases in accordance with the Technical Specifications 6.8.4.g and ODCM CONTROLS are summarized as follows:

1. Waste Gas Holdup System

   The vent header gases are collected by the waste gas holdup system. Gases may be recycled to provide cover gas for the CVCS hold-up tank or held in the waste gas tanks for decay prior to release. Waste gas decay tanks are batch released after sampling and analysis. The tanks are discharged via the Plant Vent. 1-R41D provides noble gas monitoring and automatic isolation of waste gas decay tank releases for Unit 1. This function is provided by 2-R41D for Unit 2.

2. Containment Purge and Pressure/Vacuum Relief

   Containment purges and pressure/vacuum reliefs are released to the atmosphere via the respective unit Plant Vent. Noble gas monitoring and auto isolation function are provided by 1-R41D for Unit 1 and 2-R41D for Unit 2. Additionally, in accordance with ODCM CONTROL 3.3.3.9, Table 3.3-13, 1-R12A and 2-R12A may be used to provide the containment monitoring and automatic isolation function during purge and pressure/vacuum reliefs (*).

3. Plant Vent

   The Plant Vent for each respective unit receives discharges from the waste gas hold-up system, condenser evacuation system, containment purge and pressure/vacuum reliefs, and the Auxiliary Building ventilation. Effluents are monitored by R41D, a flow through gross activity monitor (for noble gas monitoring). Radioiodine and particulate sampling capabilities are provided by charcoal cartridge and filter medium samplers. Additionally, back-up sampling capability for radioiodine and particulates is provided at the 1-R45 and 2-R45 sampling skids. Plant Vent flow rate is measured and as a back-up may be determined empirically as a function of fan operation (fan curves). Sampler flow rates are determined by flow rate instrumentation (e.g., venturi rotameter).

* The R12A monitor in Mode 6 provides containment monitoring and alarm functions without automatic isolation

Gaseous radioactive effluent flow diagrams with the applicable, associated radiation monitoring instrumentation and controls are presented in Figures 2-1. A simplified diagram of the Gaseous radioactive waste disposal system is provided in Figure 2-2.

2.2 Gaseous Effluent Monitor Setpoint Determination

2.2.1 Containment and Plant Vent Monitor

Per the requirements of ODCM CONTROL 3.3.3.9, alarm setpoints shall be established for the gaseous effluent monitoring instrumentation to ensure that the release rate of noble gases does not exceed the limits of ODCM CONTROL 3.11.2.1, which corresponds to a dose rate at the SITE BOUNDARY of 500 mrem/year to the total body or 3000 mrem/year to the skin.

Based on a grab sample analysis of the applicable release (i.e., grab sample of the Containment atmosphere, waste gas decay tank, or Plant Vent), the radiation monitoring alarm setpoints may be established by the following calculation method. The measured radionuclide concentrations and release rate are used to calculate the fraction of the allowable release rate, as limited by Specification 3.11.2.1, by the equation:

$$FRAC = \left[4.72\text{E}+02 * \chi/Q * VF * \sum_i (C_i * K_i) \right] / 500 \qquad \textbf{(2.1)}$$

$$FRAC = \left[4.72\text{E}+02 * \chi/Q * VF * \sum_i (C_i * (L_i + 1.1 M_i)) \right] / 3000 \qquad \textbf{(2.2)}$$

WHERE:

FRAC = Fraction of the allowable release rate based on the identified radionuclide concentrations and the release flow rate.

χ/Q = Annual average meteorological dispersion to the controlling. site boundary location (sec/m^3)

VF = Ventilation system flow rate for the applicable release point and monitor (ft^3/min).

C_i = Concentration of noble gas radionuclide i as determined by radioanalysis of grab sample (uCi/cm^3).

K_i = Total body dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m^3 from Table 2-1).

L_i = Beta skin dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m^3 from Table 2-1).

M_i = Gamma air dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m^3 from Table 2-1).

1.1 = mrem skin dose per mrad gamma air dose (mrem/mrad).

500 = Total body dose rate limit (mrem/yr).

3000 = Skin dose rate limit (mrem/yr).

4.72 E+02 = Conversion factor (cm^3/ft^3 * min/sec).

Based on the more limiting FRAC (i.e., higher value) as determined above, the alarm setpoints for the applicable monitors (R41D and/or R12A) may be calculated by the equation:

$$SP = \left[AF * \frac{\sum_i C_i * SEN}{FRAC} \right] + bkg \qquad \textbf{(2.3)}$$

WHERE: SP = Alarm setpoint corresponding to the maximum allowable release rate (cpm).

SEN = Monitor sensitivity (cpm per uCi/cm^3).

bkg = Background of the monitor (cpm).

AF = Administrative allocation factor for the specific monitor and type release, which corresponds to the fraction of the total allowable release rate that is administratively allocated to the release.

The allocation factor (AF) is an administrative control imposed to ensure that combined releases from Salem Units 1 and 2 and Hope Creek will not exceed the regulatory limits on release rate from the site (i.e., the release rate limits of ODCM CONTROL 3.11.2.1). Normally, the combined AF value for Salem Units 1 and 2 is equal to 0.5 (0.25 per unit), with the remainder 0.5 allocated to Hope Creek. Any increase in AF above 0.5 for the Salem Nuclear Generating Station will be coordinated with the Hope Creek Generating Station to ensure that the combined allocation factors for all units do not exceed 1.0.

2.2.2 Conservative Default Values

A conservative alarm setpoint can be established, in lieu of the individual radionuclide evaluation based on the grab sample analysis, to eliminate the potential of periodically having to adjust the setpoint to reflect minor changes in radionuclide distribution and variations in release flow rate. The alarm setpoint may be conservatively determined by the default values presented in Table 2-2.1 and 2-2.2 for Units 1 and 2, respectively. These values are based upon:

- the maximum ventilation (or purge) flow rate;
- a radionuclide distribution comprised of 95% Xe-133, 2% Xe-135, 1% Xe-133m, 1% Kr-88 and 1% Kr-85; and
- an administrative allocation factor of 0.25 to conservatively ensure that any simultaneous releases from Salem Units 1 and 2 do not exceed the maximum allowable release rate. For this radionuclide distribution, the alarm setpoint based on the total body dose rate is more restrictive than the corresponding setpoint based on the skin dose rate.

a. Adopted from ANSI N237-1976/ANS-18.1, Source Term Specifications, Table 6.

2.3 Gaseous Effluent Instantaneous Dose Rate Calculations - 10 CFR 20

2.3.1 Boundary Dose Rate - Noble Gases

ODCM CONTROL 3.11.2.1.a limits the dose rate at the SITE BOUNDARY due to noble gas releases to ≤500 mrem/yr, total body and ≤3000 mrem/yr, skin. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event any gaseous releases from the station results in an alarm setpoint being exceeded, an evaluation of the SITE BOUNDARY dose rate resulting from the release shall be performed using the following equations:

$$D_{tb} = \chi/Q * \sum_i (K_i * Q_i) \quad \textbf{(2.4)}$$

and

$$D_s = \chi/Q * \sum_i ((L_i + 1.1M_i) * Q_i) \quad \textbf{(2.5)}$$

WHERE:

D_{tb} = Total body dose rate (mrem/yr).

D_s = Skin dose rate (mrem/yr).

χ/Q = Atmospheric dispersion to the controlling SITE BOUNDARY location (sec/m^3).

Q_i = Average release rate of radionuclide i over the release period under evaluation (uCi/sec).

K_i = Total body dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m^3, from Table 2-1).

L_i = Beta skin dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m^3, from Table 2-1).

M_i = Gamma air dose conversion factor for noble gas radionuclide i (mrad/yr per uCi/m^3, from Table 2-1).

1.1 = mrem skin dose per mrad gamma air dose (mrem/mrad).

As appropriate, simultaneous releases from Salem Units 1 and 2 and Hope Creek will be considered in evaluating compliance with the release rate limits of ODCM CONTROL 3.11.2.1a, following any release exceeding the above prescribed alarm setpoints.

Monitor indications (readings) may be averaged over a time period not to exceed 15 minutes when determining noble gas release rate based on correlation of the monitor reading and monitor sensitivity. The 15-minute averaging is needed to allow for reasonable monitor response to potentially changing radioactive material concentrations and to exclude potential electronic spikes in monitor readings that may be unrelated to radioactive material releases. As identified, any electronic spiking monitor responses may be excluded from the analysis.

NOTE: For administrative purposes, more conservative alarm setpoints than those as prescribed above may be imposed. However, conditions exceeding these more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding the limits of ODCM CONTROL 3.11.2.1.a. Provided actual releases do not result in radiation monitor indications exceeding alarm setpoint values based on the above criteria, no further analyses are required for demonstrating compliance with the limits of ODCM CONTROL 3.11.2.1.a.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2-3 may be used for evaluating the gaseous effluent dose rate.

2.3.2 Site Boundary Dose Rate - Radioiodine and Particulates

ODCM CONTROL 3.11.2.1.b limits the dose rate to ≤1500 mrem/yr to any organ for I-131, I-133, tritium, and particulates with half-lives greater than 8 days. To demonstrate compliance with this limit, an evaluation is performed at a frequency no greater than that corresponding to the sampling and analysis time period (e.g., nominally once per 7 days). The following equation shall be used for the dose rate evaluation:

$$D_o = \chi/Q * \sum_i \left(R_{io} * Q_i\right) \qquad \textbf{(2.6)}$$

WHERE: D_o = Average organ dose rate over the sampling time period (mrem/yr).

χ/Q = Atmospheric dispersion to the controlling SITE BOUNDARY location for the inhalation pathway (sec/m^3).

R_{io} = Dose parameter for radionuclide i (mrem/yr per uCi/m^3) and organ o for the child inhalation pathway from Table 2-4.

Q_i = Average release rate over the appropriate sampling period and analysis frequency for radionuclide i -- I-13I, I-133, tritium or other radionuclide in particulate form with half-life greater than 8 days (uCi/sec).

By substituting 1500 mrem/yr for D_o and solving for Q, an allowable release rate for I-131 can be determined. Based on the annual average meteorological dispersion (see Table 2-3) and the most limiting potential pathway, age group and organ (inhalation, child, thyroid -- R_{io} = 1.62E+07 mrem/yr per uCi/m^3), the allowable release rate for I-131 is 42 uCi/sec. Reducing this release rate by a factor of 4 to account for potential dose contributions from other radioactive particulate material and other release points (e.g., Hope Creek), the corresponding release rate allocated to each of the Salem units is 10.5 uCi/sec.

For a 7 day period, which is the nominal sampling and analysis frequency for I-131, the cumulative release is 6.3 Ci. Therefore, as long as the I-131 releases in any 7 day period do not exceed 6.3 Ci, no additional analyses are needed for verifying compliance with the ODCM CONTROL 3.11.2.1.b limits on allowable release rate.

2.4 Noble Gas Effluent Dose Calculations - 10 CFR 50

2.4.1 UNRESTRICTED AREA Dose - Noble Gases

ODCM CONTROL 3.11.2.2 requires a periodic assessment of releases of noble gases to evaluate compliance with the quarterly dose limits of ≤5 mrad, gamma-air and ≤10 mrad, beta-air and the calendar year limits ≤10 mrad, gamma-air and ≤20 mrad, beta-air. The limits are applicable separately to each unit and are not combined site limits. The following equations shall be used to calculate the gamma-air and beta-air doses:

$$D\gamma = 3.17\text{E-}08 * {}^{\chi}\!/_{Q} * \sum_i (M_i * Q_i) \tag{2.7}$$

and

$$D\beta = 3.17\text{E-}08 * {}^{\chi}\!/_{Q} * \sum_i (N_i * Q_i) \tag{2.8}$$

WHERE:

D_γ	=	Air dose due to gamma emissions for noble gas radionuclides (mrad).
D_β	=	air dose due to beta emissions for noble gas radionuclides (mrad).
${}^{\chi}\!/_{Q}$	=	Atmospheric dispersion to the controlling SITE BOUNDARY location (sec/m^3).
Q_i	=	Cumulative release of noble gas radionuclide i over the period of interest (uCi) where uCi = (uCi/cc)*(cc released) or (uCi/sec)*(sec released).
M_i	=	Air dose factor due to gamma emissions from noble gas radionuclide i (mrad/yr per uCi/m^3, from Table 2-1).
N_i	=	Air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per uCi/m^3, Table 2-1).
3.17E-8	=	Conversion factor (yr/sec).

2.4.2 Simplified Dose Calculation for Noble Gases

In lieu of the individual noble gas radionuclide dose assessment as presented above, the following simplified dose calculation equations may be used for verifying compliance with the dose limits of ODCM CONTROL 3.11.2.2. (Refer to Appendix C for the derivation and justification for this simplified method and for values of M_{eff}, and N_{eff}.)

$$D\gamma = \frac{3.17E-08}{0.50} * \chi/Q * M_{eff} * \sum_i Q_i \qquad \textbf{(2.9)}$$

and

$$D\beta = \frac{3.17E-08}{0.50} * \chi/Q * N_{eff} * \sum_i Q_i \qquad \textbf{(2.10)}$$

WHERE:

M_{eff}	=	5.3E+02, effective gamma-air dose factor (mrad/yr per uCi/m^3).
N_{eff}	=	1.1E+03, effective beta-air dose factor (mrad/yr per uCi/m^3).
Q_i	=	Cumulative release for all noble gas radionuclides (uCi), where uCi = (uCi/cc) * (cc released) or (uCi/sec) * (sec released).
0.50	=	Conservatism factor to account for potential variability in the radionuclide distribution.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2-3, may be used for the evaluation of the gamma-air and beta-air doses.

2.5 Radioiodine and Particulate Dose Calculations - 10 CFR 50

2.5.1 UNRESTRICTED AREA Dose - Radioiodine and Particulates

In accordance with requirements of ODCM CONTROL 3.11.2.3, a periodic assessment shall be performed to evaluate compliance with the quarterly dose limit of <7.5 mrem and calendar year limit <15 mrem to any organ. The following equation shall be used to evaluate the maximum organ dose due to releases of I-131, I-133, tritium and particulates with half-lives greater than 8 days:

$$D_{aop} = 3.17\text{E-}08 * W * SF_p * \sum_i \left(R_{iop} * Q_i\right) \quad \textbf{(2.11)}$$

WHERE:

- D_{aop} = Dose or dose commitment via all pathways p and controlling age group a (as identified in Table 2-3) to organ o, including the total body (mrem).
- W = Atmospheric dispersion parameter to the controlling location(s) as identified in Table 2-3.
- χ/Q = Atmospheric dispersion for inhalation pathway, C-14, and H-3 dose contribution via other pathways (sec/m^3).
- D/Q = Atmospheric deposition for vegetation, milk and ground plane exposure pathways (m^{-2}).
- R_{iop} = Dose factor for radionuclide i (mrem/yr per uCi/m^3) or (m^2 - mrem/yr per uCi/sec) and organ o from Table 2-4 for each age group and the applicable pathway p as identified in Table 2-3. Values for R_{iop} were derived in accordance with the methods described in NUREG-0133.
- Q_i = Cumulative release over the period of interest for radionuclide i -- I-131, I-133, tritium, or radioactive material in particulate form with half-life greater than 8 days (uCi).
- SF_p = Annual seasonal correction factor to account for the fraction of the year that the applicable exposure pathway does not exist.
  1. For milk and vegetation exposure pathways: A six month fresh vegetation and grazing season (May through October) = 0.5
  2. For inhalation and ground plane exposure pathways: = 1.0

For evaluating the maximum exposed individual, only the controlling pathways and age group as identified in Table 2-3 need be evaluated for compliance with ODCM CONTROL 3.11.2.3.

2.5.2 Simplified Dose Calculation for Radioiodines and Particulates.

In lieu of the individual radionuclide (I-131, I-133, tritium, and particulates) dose assessment for the resident/dairy location as presented above, the following simplified dose calculation equation may be used for verifying compliance with the dose limits of ODCM CONTROL 3.11.2.3 (refer to Appendix D for the derivation and justification of this simplified method).

$$D_{\max} = 3.17\mathrm{E}-08 * W * SF_p * R_{I-131} * \sum_i Q_i \qquad \textbf{(2.12)}$$

WHERE: D_{max} = Maximum organ dose (mrem).

R_{I-131} = I-131 dose parameter for the thyroid for the identified controlling pathway.

= 1.05E+12, infant thyroid dose parameter with the grass-cow-milk pathway controlling (m^2 - mrem/yr per uCi/sec).

W = D/Q for radioiodine, 2.1-10 1/m^2.

Q_i = Cumulative release over the period of interest for radionuclide i - I-131, tritium, or radioactive material in particulate from with half-life greater than 8 days (uCi).

The dose should be evaluated based on the predetermined controlling pathways as identified in Table 2-3. If more limiting exposure pathways are determined to exist in the surrounding environment of Salem by the annual land-use census, Table 2-3 will be revised as specified in ODCM CONTROL 3.12.2.

2.6 Secondary Side Radioactive Gaseous Effluents and Dose Calculations

During periods of primary to secondary leakage, minor levels of radioactive material may be released via the secondary system to the atmosphere. Non-condensables (e.g., noble gases) will be predominately released via the condenser evacuation system and will be monitored and quantified by the routine plant vent monitoring and sampling system and procedures (e.g., R15 on condenser evacuation, R41D on plant vent, and the plant vent particulate and charcoal samplers).

However, if the Steam Generator blowdown is routed directly to the Chemical Waste Basin (via the SG blowdown flash tank) instead of being recycled through the condenser, it may be desirable to account for the potential atmospheric releases of radioiodines and particulates from the flash tank vent (i.e., releases due to moisture carry over). Since this pathway is not sampled or monitored, it is necessary to calculate potential releases.

Based on the guidance in NRC NUREG-0133, the releases of the radioiodines and particulates shall be calculated by the equation:

$$Q_i = C_i * R_{sgb} * F_{ft} * (1 - SQ_{ftv}) \quad \textbf{(2.13)}$$

WHERE: Q_i = The release rate of radionuclide, i, from the steam generator flash tank vent (uCi/sec).

C_i = The concentration of radionuclide, i, in the secondary coolant water averaged over not more than one week (uCi/ml).

R_{sgb} = The steam generator blowdown rate to the flash tank (ml/sec).

F_{ft} = The fraction of blowdown flashed in the tank determined from a heat balance taken around the flash tank at the applicable reactor power level.

SQ_{ftv} = The measured steam quality in the flash tank vent; or an assumed value of 0.85, based on NUREG-0017.

Tritium releases via the steam flashing may also be quantified using the above equation with the assumption of a steam quality (SQ_{ftv}) equal to 0. Since the H-3 will be associated with the water molecules, it is not necessary to account for the moisture carry-over which is the transport media for the radioiodines and particulates.

Based on the design and operating conditions at Salem, the fraction of blowdown converted to steam (F_{ft}) is approximately 0.48. The equation simplifies to the following:

$$Q_i = 0.072 * C_i * R_{sgb} \quad \textbf{(2.14)}$$

For H-3, the simplified equation is:

$$Q_i = 0.48 * C_i * R_{sgb} \quad \textbf{(2.15)}$$

Also during reactor shutdown operations with a radioactively contaminated secondary system, radioactive material may be released to the atmosphere via the atmospheric reliefs (PORV) and the safety reliefs on the main steam lines and via the steam driven auxiliary feed pump exhaust. The evaluation of the radioactive material concentration in the steam relative to that in the steam generator water is based on the guidance of NUREG-0017, Revision 1. The partitioning factors for the radioiodines is 0.01 and is 0.005 for all other particulate radioactive material. The resulting equation for quantifying releases via the atmospheric steam releases is:

$$Q_{ij} = 0.13 * (C_{ij} * SF_j) * PF_i \quad \textbf{(2.16)}$$

WHERE: Q_{ij} = Release rate of radionuclide i via pathway j, (uCi/sec).

C_{ij} = Concentration of radionuclide i, in pathway j, (uCi/ml).

SF_j = Steam flow for release pathway j.
= 400,000 lb/hr per PORV.
= 850,000 lb/hr per safety relief valve.
= 62,500 lb/hr for auxiliary feed pump exhaust.

PF_i = Partitioning factor, ratio of concentration in steam to that in the water in the steam generator.
= 0.01 for radioiodines.
= 0.005 for all other particulates.
= 1.0 for H-3.

0.13 = Conversion factor - [(hr*ml) / (sec*lb)].

Any significant releases of noble gases via the atmospheric steam releases can be quantified in accordance with the calculation methods of the Salem Emergency Plan Implementation Procedure.

Alternately, the quantification of the release rate and cumulative releases may be based on secondary samples. The measured radionuclide concentration in the secondary system may be used for quantifying the noble gases, radioiodine and particulate releases.

NOTE: The expected mode of operation would be to isolate the effected steam generator, thereby reducing the potential releases during the shutdown/cooldown process. Use of the above calculation methods should consider actual operating conditions and release mechanisms.

The calculated quantities of radioactive materials may be used as inputs to the equation (2.11) or (2.12) to calculate offsite doses for demonstrating compliance with the Technical Specifications 6.8.4.g and the ODCM CONTROLS.

2.7 Gaseous Effluent Dose Projection

ODCM CONTROL 3.11.2.4 requires that the GASEOUS RADWASTE TREATMENT SYSTEM and VENTILATION EXHAUST TREATMENT SYSTEM be used to reduce radioactive material levels prior to discharge when projected doses exceed one-half the annual design objective rate in any calendar month, i.e., exceeding:

- 0.2 mrad in air from gamma radiation, or
- 0.4 mrad in air from beta radiation or,
- 0.3 mrad to any organ to a MEMBER OF THE PUBLIC.

The applicable gaseous processing systems for maintaining radioactive material releases ALARA are the Auxiliary Building normal ventilation system (filtration systems # 1, 2 and 3) and the Waste Gas Decay Tanks as delineated in Figures 2-1 and 2-2. Dose projections are performed at least once per 31 days by the following equations:

$$D_{gp} = (D_g/d) * 31d \quad \textbf{(2.17)}$$

$$D_{dp} = (D_d/d) * 31d \quad \textbf{(2.18)}$$

$$D_{maxp} = (D_{max}/d) * 31d \quad \textbf{(2.14)}$$

WHERE:

D_{gp} = Gamma air dose projection for current 31-day period (mrad).

D_g = Max gamma air dose to date for current calendar quarter as determined by equation (2.7) or (2.9) (mrad).

D_{bp} = Beta air dose projection for current 31-day period (mrad).

D_b = Beta air dose to date for current calendar quarter as determined by equation (2.8) or (2.10) (mrad).

D_{maxp} = Maximum organ dose projection for current 31-day period (mrem).

D_{max} = Maximum organ dose to date for current calendar quarter as determined by equation (2.11) or (2.12) (mrem).

d = Number of days in current calendar quarter at the end of the release.

31d = The number of days for the projection.

3.0 SPECIAL DOSE ANALYSES

3.1 Doses Due To Activities Inside the SITE BOUNDARY

In accordance with ODCM CONTROL 6.9.1.8, the Radioactive Effluent Release Report (RERR) shall include an assessment of radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY.

The calculation methods as presented in Sections 2.4 and 2.5 may be used for determining the maximum potential dose to a MEMBER OF THE PUBLIC located inside the site boundary. For the purpose of this calculation, a MEMBER OF THE PUBLIC is an adult individual who is not subject to occupational exposure (i.e., an un-monitored site worker) performing duties within the site boundary, and who is exposed to radioactive material in gaseous effluent for 2,000 hours per year via the inhalation and ground plane exposure pathways. The values for the atmospheric dispersion coefficients at the point of interest inside the site boundary (e.g., 0.25 mile) shall be developed from the current year meteorological data.

3.2 Total dose to MEMBERS OF THE PUBLIC - 40 CFR 190 and 10 CFR 72.104

The Radioactive Effluent Release Report (RERR) shall also include an assessment of the radiation dose to the likely most exposed MEMBER OF THE PUBLIC for reactor releases and other nearby uranium fuel cycle sources (including dose contributions from effluents and direct radiation from on-site sources). For the likely most exposed MEMBER OF THE PUBLIC in the vicinity of Artificial Island, the sources of exposure need only consider the Salem Nuclear Generating Station and the Hope Creek Nuclear Generating Station which includes the Independent Spent Fuel Storage Installation (ISFSI). No other fuel cycle facilities contribute to the MEMBER OF THE PUBLIC dose for the Artificial Island vicinity.

The dose contribution from the operation of Hope Creek Nuclear Generating Station will be estimated based on the methods as presented in the Hope Creek Offsite Dose Calculation Manual (HCGS ODCM).

As appropriate for demonstrating/evaluating compliance with the limits of ODCM CONTROL 3.11.4 (40 CFR 190), the results of the environmental monitoring program may be used for providing data on actual measured levels of radioactive material in the actual pathways of exposure.

3.2.1 Effluent Dose Calculations

For purposes of implementing the surveillance requirements of ODCM CONTROL 3/4.11.4 and the reporting requirements of 6.9.1.8 (RERR), dose calculations for the Salem Nuclear Generating Station should be performed using the controlling pathways and locations of Table 2-3 and the calculation methods contained within this ODCM. If more limiting exposure pathways are determined to exist in the surrounding environment of Salem by the annual land-use census, Table 2-3 will be revised as specified in ODCM CONTROL 3.12.2.

Average annual meteorological dispersion parameters or meteorological conditions concurrent with the release period under evaluation may be used.

3.2.2 Direct Exposure Dose Determination.

Any potentially significant direct exposure contribution to off-site individual doses may be evaluated based on the results of the environmental measurements (e.g., PD, ion chamber measurements) and/or by the use of a radiation transport and shielding calculation method.

Only during a non-typical condition will there exist any potential for significant on-site sources at Salem that would yield potentially significant off-site doses (i.e., in excess of 1 mrem per year to a MEMBER OF THE PUBLIC), that would require detailed evaluation for demonstrating compliance with 40 CFR 190 or 10 CFR 72.104.

However, should a situation exist where the direct exposure contribution is potentially significant, on-site measurements, off-site measurements and/or calculation techniques will be used for determination of dose for assessing 40 CFR 190 or 10 CFR 72.104 compliance.

3.3 Doses Due to Carbon 14 in Gaseous Effluents

Because gaseous effluent releases from a pressurized water reactor (PWR), such as the Salem Generating Station, can contain significant quantities of C-14 (i.e., approximately 5 to 7.3 curies annually – Regulatory Guide 1.21 rev 2), the NRC has recommended that licensees evaluate C-14 as a potential principal radionuclide for gaseous releases from their facility. The results in an evaluation conducted in response to SAP Order 70096339 identified C-14 as a principal radionuclide in gaseous effluent releases from the Salem Generating Station.

3.3.1 Estimation of Carbon 14 in Annual Releases

The methodology for estimating the quantity C-14 released annually from the Salem Generating Station incorporates the use of a normalized C-14 source term and a scaling factor based on power generation. NCRP Report No. 81, *Carbon-14 in the Environment*, has been identified by the NRC as a source for scaling factors (refer to section 1.9 in Revision 2 of Regulatory Guide 1.21). This approach is one of three NRC-recommended methods for estimating the quantity of C-14 discharged in gaseous effluent (refer to Regulatory position 1.9 in Revision 2 of Regulatory Guide 1.21). Electrical energy output value for the reporting period should be used to estimate the quantity of C-14 released.

3.3.2 Carbon 14 dose Determinations

The methodology for determining doses from C-14 in gaseous releases incorporates dose models described in Regulatory Guide 1.109. Estimated C-14 releases and average meteorological data for the reporting period should be used as input to the dose calculations. The doses due to C-14 in gaseous releases are calculated for receptors located at and beyond the site boundary. For doses at locations beyond the site boundaries, receptors shall be real individuals via active pathways as identified in the Annual Land Use Census. Doses due to C-14 in gaseous effluent and the assumptions used in the dose calculations shall be included in the annual Radioactive Effluent Release Report.

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

4.1 Sampling Program

The operational phase of the Radiological Environmental Monitoring Program (REMP) is conducted in accordance with the requirements of ODCM CONTROL 3.12. The objectives of the program are:

- To determine whether any significant increases occur in the concentration of radionuclides in the critical pathways of exposure in the vicinity of Artificial Island;
- To determine if the operation of the Salem Nuclear Generating Stations has resulted in any increase in the inventory of long lived radionuclides in the environment;
- To detect any changes in the ambient gamma radiation levels; and
- To verify that SNGS operations have no detrimental effects on the health and safety of the public or on the environment.

The sampling requirements (type of samples*, collection frequency and analysis) and sample locations are presented in Appendix E.

*NOTE: No public drinking water samples or irrigation water samples are required as these pathways are not directly affected by liquid effluents discharged from Salem Generating Station.

4.2 Interlaboratory Comparison Program

ODCM CONTROL 3.12.3 requires analyses be performed on radioactive material supplied as part of an Interlaboratory Comparison Program. Participation in an approved Interlaboratory Comparison Program provides a check on the precision and accuracy of measurements of radioactive materials in environmental samples.

A summary of the Interlaboratory Comparison Program results will be provided in the Annual Radiological Environmental Operating Report pursuant to ODCM CONTROL 6.9.1.7.

FIGURE 1-1: LIQUID RELEASE FLOWPATH UNIT 1

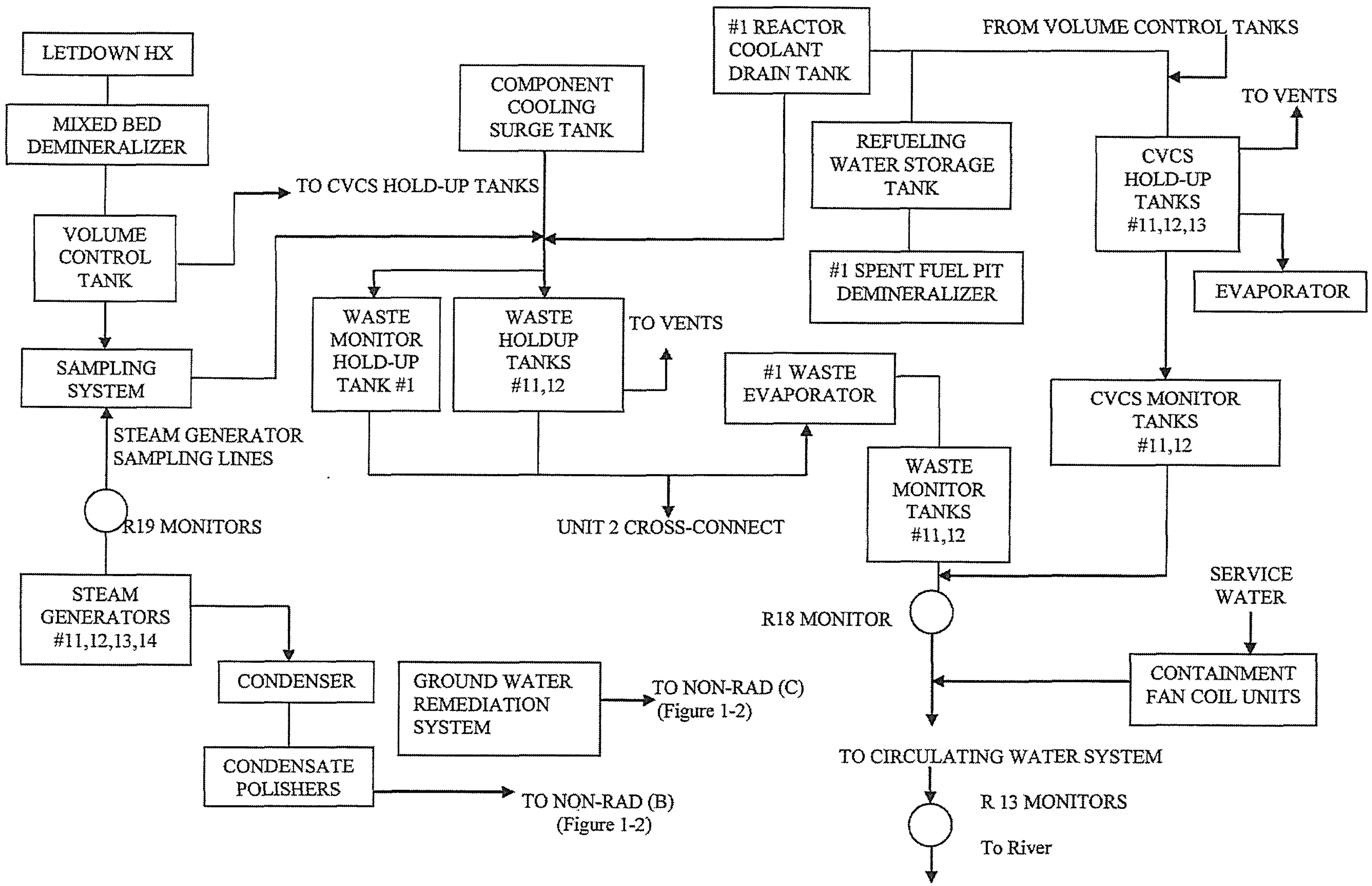


FIGURE 1-2: **LIQUID RELEASE FLOWPATH UNIT 2**

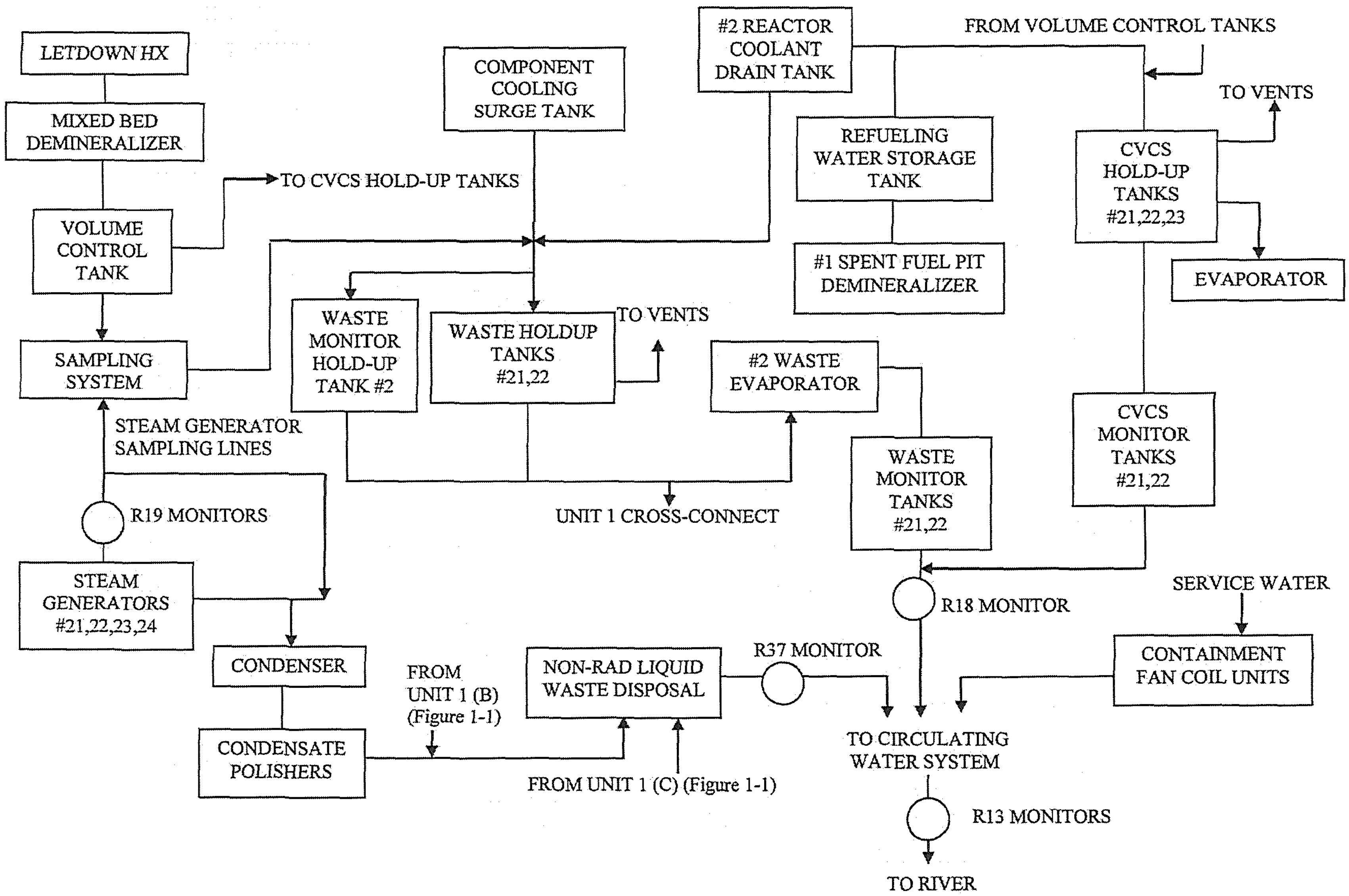


FIGURE 1-3: LIQUID RADIOACTIVE WASTE SYSTE

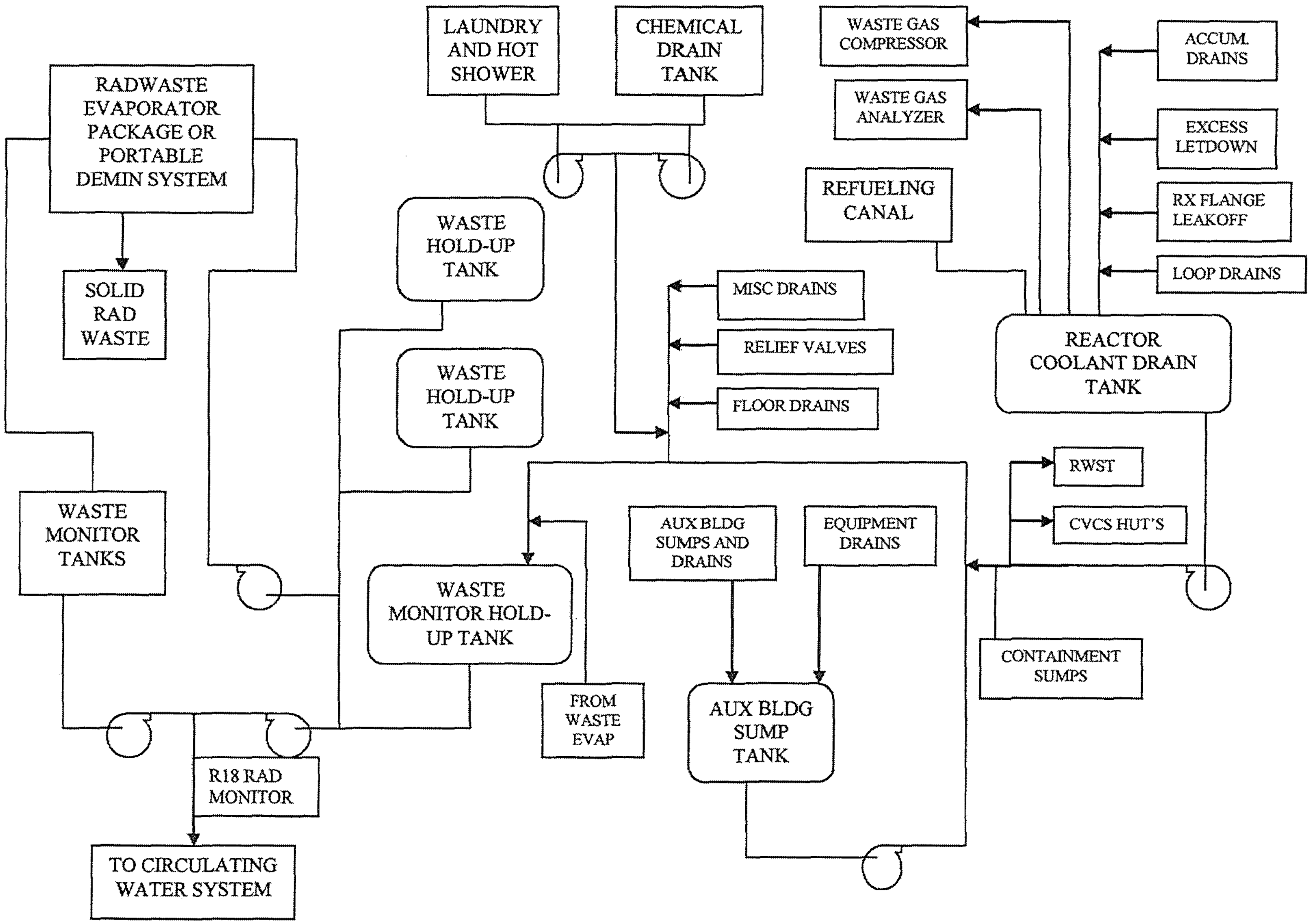


TABLE 1-1.1: PARAMETERS FOR LIQUID ALARM SETPOINT DETERMINATIONS - UNIT 1

Parameter	Actual Value	Default Value	Units	Comments
MPC_e	Calculated	6.05E-06*	uCi/ml	Calculated for each batch to be released.
MPC I-131	3.0E-07	N.A.	uCi/ml	I-131 MPC conservatively used for SG blowdown and Service Water monitor setpoints.
C_i	Measured	N.A.	uCi/ml	Taken from gamma spectral analysis of liquid effluent.
MPC_i	as determined	N.A.	uCi/ml	Taken from old 10 CFR 20, Appendix B, Table II, Col 2 (ODCM Appendix F).
Sensitivity 1-R18 1-R19 (A,B,C,D) 1-R13 (A and B)	as determined	N.A.	cpm per uCi/ml	Monitor sensitivities are controlled under the following calculations: S-1-RM-SC-4335 S-1-RM-SC-1626 SC-RM021-01
CW	as determined	1.00E+05	gpm	Circulating water system – single CW pump ***
RR 1-R18 1-R19 1-R13	as determined	 120 250 1.00 E +05	gpm	Determined prior to release; release rate can be adjusted for ODCM CONTROL compliance Steam Generator blowdown rate per Generator Circulating Water System, single CW pump ***
Setpoint 1-R18 1-R19 (A,B,C,D)** 1-R13 (A and B)**	Calculated	N.A.	cpm	Monitor setpoints are controlled under the following calculations: S-1-RM-SC-4335 S-1-RM-SC-1626 SC-RM021-01
Correction Factor (Non-Gamma)	as determined	0.75	Unitless	Default parameter to account for non-gamma emitting nuclides.
Allocation Factor 1-R19	0.5	0.5	Unitless	Conservatism factor to preclude exceeding MPC limit in the case of simultaneous primary-to-secondary leaks at both Salem Units,

* Refer to Appendix A for derivation.

** The MPC value of I-131 (3E-07 uCi/ml) has been used for derivation of R19 Steam Generator Blowdown and R13 Service Water monitor setpoints as discussed in Section 1.2.2.

*** During periods when Unit 2 Circulators are out of service, the CW flow for 1-R13 monitors is zero. See Section 1.2.2.

TABLE 1-1.2: PARAMETERS FOR LIQUID ALARM SETPOINT DETERMINATIONS - UNIT 2

Parameter	Actual Value	Default Value	Units	Comments
MPC_e	Calculated	4.81E-06*	uCi/ml	Calculated for each batch to be released.
MPC I-131	3.0E-07	N.A.	uCi/ml	I-131 MPC conservatively used for SG blowdown, Service Water and Chemical Waste Basin monitor setpoints.
C_i	Measured	N.A.	uCi/ml	Taken from gamma spectral analysis of liquid effluent.
MPC_i	as determined	N.A.	uCi/ml	Taken from old 10 CFR 20, Appendix B, Table II, Col. 2 (ODCM Appendix F)
Sensitivity 2-R18 2R19(A,B,C,D) 2-R13(A and B) R37	as determined	N.A.	cpm per uCi/ml	Monitor sensitivities are controlled under the following calculations: S-2-RM-SC-4335 SC-RM002-08 SC-RM021-02 S-2-RM-SC-9864
CW	as determined	1.0E+05	gpm	Circulating Water System, single CW pump ***
RR 2-R18 2-R19 2-R13 R37	as determined	120 250 1.0E+05 1200	gpm	Determined prior to release; release rate can be adjusted for ODCM CONTROL Compliance Steam Generator Blowdown rate per Generator Circulating Water System, single CW Pump Chemical Waste Basin discharge
Setpoint 2-R18 2R19(A,B,C,D)** 2-R13(A and B)** R37 **	Calculated	N.A.	cpm	Monitor setpoints are controlled under the following calculations: S-2-RM-SC-4335 SC-RM002-08 SC-RM021-02 S-2-RM-SC-9864
Correction Factor (Non-Gamma)	as determined	0.75	Unitless	Default parameter to account for non-gamma emitting nuclides.
Allocation Factor 2-R19	0.5	0.5	Unitless	Conservatism factor to preclude exceeding MPC limit in the case of simultaneous primary-to-secondary leaks at both Salem Units

* Refer to Appendix A for derivation.

** The MPC value of I-131 (3E-7 uCi/ml) has been used for derivation of the R13, R19 and R37 monitor setpoints as discussed in Section 1.2.2.

*** During periods when Unit 1 Circulators are out of service, the CW flow for 2-R13 monitors is zero. See Section 1.2.2.

TABLE 1-2: SITE RELATED INGESTION DOSE COMMITMENT FACTOR, A_{io} (FISH AND INVERTEBRATE CONSUMPTION) (mrem/hr per uCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	-	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1
C-14	1.45E+4	2.90E+3	2.90E+3	2.90E+3	2.90E+3	2.90E+3	2.90E+3
Na-24	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1
P-32	4.69E+6	2.91E+5	1.81E+5	-	-	-	5.27E+5
Cr-51	-	-	5.58E+0	3.34E+0	1.23E+0	7.40E+0	1.40E+3
Mn-54	-	7.06E+3	1.35E+3	-	2.10E+3	-	2.16E+4
Mn-56	-	1.78E+2	3.15E+1	-	2.26E+2	-	5.67E+3
Fe-55	5.11E+4	3.53E+4	8.23E+3	-	-	1.97E+4	2.03E+4
Fe-59	8.06E+4	1.90E+5	7.27E+4	-	-	5.30E+4	6.32E+5
Co-57	-	1.42E+2	2.36E+2	-	-	-	3.59E+3
Co-58	-	6.03E+2	1.35E+3	-	-	-	1.22E+4
Co-60	-	1.73E+3	3.82E+3	-	-	-	3.25E+4
Ni-63	4.96E+4	3.44E+3	1.67E+3	-	-	-	7.18E+2
Ni-65	2.02E+2	2.62E+1	1.20E+1	-	-	-	6.65E+2
Cu-64	-	2.14E+2	1.01E+2	-	5.40E+2	-	1.83E+4
Zn-65	1.61E+5	5.13E+5	2.32E+5	-	3.43E+5	-	3.23E+5
Zn-69m	5.66E+3	1.36E+4	1.24E+3	-	8.22E+3	-	8.29E+5
As-76	4.38E+2	1.16E+3	5.14E+3	3.42E+2	1.39E+3	3.58E+2	4.30E+4
Br-82	-	-	4.07E+0	-	-	-	4.67E+0
Br-83	-	-	7.25E-2	-	-	-	1.04E-1
Br-84	-	-	9.39E-2	-	-	-	7.37E-7
Br-85	-	-	3.86E-3	-	-	-	-
Rb-86	-	6.24E+2	2.91E+2	-	-	-	1.23E+2
Rb-88	-	1.79E+0	9.49E-1	-	-	-	2.47E-11
Rb-89	-	1.19E+0	8.34E-1	-	-	-	6.89E-14
Sr-89	4.99E+3	-	1.43E+2	-	-	-	8.00E+2
Sr-90	1.23E+5	-	3.01E+4	-	-	-	3.55E+3
Sr-91	9.18E+1	-	3.71E+0	-	-	-	4.37E+2
Sr-92	3.48E+1	-	1.51E+0	-	-	-	6.90E+2
Y-90	6.06E+0	-	1.63E-1	-	-	-	6.42E+4
Y-91m	5.73E-2	-	2.22E-3	-	-	-	1.68E-1
Y-91	8.88E+1	-	2.37E+0	-	-	-	4.89E+4
Y-92	5.32E-1	-	1.56E-2	-	-	-	9.32E+3
Y-93	1.69E+0	-	4.66E-2	-	-	-	5.35E+4
Zr-95	1.59E+1	5.11E+0	3.46E+0	-	8.02E+0	-	1.62E+4
Zr-97	8.81E-1	1.78E-1	8.13E-2	-	2.68E-1	-	5.51E+4
Nb-95	4.47E+2	2.49E+2	1.34E+2	-	2.46E+2	-	1.51E+6
Nb-97	3.75E+0	9.49E-1	3.46E-1	-	1.11E+0	-	3.50E+3
Mo-99	-	1.28E+2	2.43E+1	-	2.89E+2	-	2.96E+2
Tc-99m	1.30E-2	3.66E-2	4.66E-1	-	5.56E-1	1.79E-2	2.17E+1
Tc-101	1.33E-2	1.92E-2	1.88E-1	-	3.46E-1	9.81E-3	5.77E-14

TABLE 1-2: SITE RELATED INGESTION DOSE COMMITMENT FACTOR, A_{io} (FISH AND INVERTEBRATE CONSUMPTION) (mrem/hr per uCi/ml) (Continued)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
Ru-103	1.07E+2	-	4.60E+1	-	4.07E+2	-	1.25E+4
Ru-105	8.89E+0	-	3.51E+0	-	1.15E+2	-	5.44E+3
Ru-106	1.59E+3	-	2.01E+2	-	3.06E+3	-	1.03E+5
Ag-110m	1.56E+3	1.45E+3	8.60E+2	-	2.85E+3	-	5.91E+5
Sb-122	1.98E+1	4.55E-1	6.82E+0	3.06E-1	-	1.19E+1	7.51E+3
Sb-124	2.77E+2	5.23E+0	1.10E+2	6.71E-1	-	2.15E+2	7.86E+3
Sb-125	1.77E+2	1.98E+0	4.21E+1	1.80E-1	-	1.36E+2	1.95E+3
Sb-126	1.14E+2	2.31E+0	4.10E+1	6.96E-1	-	6.97E+1	9.29E+3
Te-125m	2.17E+2	7.86E+1	2.91E+1	6.52E+1	8.82E+2	-	8.66E+2
Te-127m	5.48E+2	1.96E+2	6.68E+1	1.40E+2	2.23E+3	-	1.84E+3
Te-127	8.90E+0	3.20E+0	1.93E+0	6.60E+0	3.63E+1	-	7.03E+2
Te-129m	9.31E+2	3.47E+2	1.47E+2	3.20E+2	3.89E+3	-	4.69E+3
Te-129	2.54E+0	9.55E-1	6.19E-1	1.95E+0	1.07E+1	-	1.92E+0
Te-131m	1.40E+2	6.85E+1	5.71E+1	1.08E+2	6.94E+2	-	6.80E+3
Te-131	1.59E+0	6.66E-1	5.03E-1	1.31E+0	6.99E+0	-	2.26E-1
Te-132	2.04E+2	1.32E+2	1.24E+2	1.46E+2	1.27E+3	-	6.24E+3
I-130	3.96E+1	1.17E+2	4.61E+1	9.91E+3	1.82E+2	-	1.01E+2
I-131	2.18E+2	3.12E+2	1.79E+2	1.02E+5	5.35E+2	-	8.23E+1
I-132	1.06E+1	2.85E+1	9.96E+0	9.96E+2	4.54E+1	-	5.35E+0
I-133	7.45E+1	1.30E+2	3.95E+1	1.90E+4	2.26E+2	-	1.16E+2
I-134	5.56E+0	1.51E+1	5.40E+0	2.62E+2	2.40E+1	-	1.32E-2
I-135	2.32E+1	6.08E+1	2.24E+1	4.01E+3	9.75E+1	-	6.87E+1
Cs-134	6.84E+3	1.63E+4	1.33E+4	-	5.27E+3	1.75E+3	2.85E+2
Cs-136	7.16E+2	2.83E+3	2.04E+3	-	1.57E+3	2.16E+2	3.21E+2
Cs-137	8.77E+3	1.20E+4	7.85E+3	-	4.07E+3	1.35E+3	2.32E+2
Cs-138	6.07E+0	1.20E+1	5.94E+0	-	8.81E+0	8.70E-1	5.12E-5
Ba-139	7.85E+0	5.59E-3	2.30E-1	-	5.23E-3	3.17E-3	1.39E+1
Ba-140	1.64E+3	2.06E+0	1.08E+2	-	7.02E-1	1.18E+0	3.38E+3
Ba-141	3.81E+0	2.88E-3	1.29E-1	-	2.68E-3	1.63E-3	1.80E-9
Ba-142	1.72E+0	1.77E-3	1.08E-1	-	1.50E-3	1.00E-3	2.43E-18
La-140	1.57E+0	7.94E-1	2.10E-1	-	-	-	5.83E+4
La-142	8.06E-2	3.67E-2	9.13E-3	-	-	-	2.68E+2
Ce-141	3.43E+0	2.32E+0	2.63E-1	-	1.08E+0	-	8.86E+3
Ce-143	6.04E-1	4.46E+2	4.94E-2	-	1.97E-1	-	1.67E+4
Ce-144	1.79E+2	7.47E+1	9.59E+0	-	4.43E+1	-	6.04E+4
Pr-143	5.79E+0	2.32E+0	2.87E-1	-	1.34E+0	-	2.54E+4
Pr-144	1.90E-2	7.87E-3	9.64E-4	-	4.44E-3	-	2.73E-9
Nd-147	3.96E+0	4.58E+0	2.74E-1	-	2.68E+0	-	2.20E+4
W-187	9.16E+0	7.66E+0	2.68E+0	-	-	-	2.51E+3
Np-239	3.53E-2	3.47E-3	1.91E-3	-	1.08E-2	-	7.11E+2

TABLE 1-3: BIOACCUMULATION FACTORS (pCi/kg per pCi/liter)*

ELEMENT	SALTWATER FISH	SALTWATER INVERTEBRATES
H	9.0E-01	9.3E-01
C	1.8E+03	1.4E+03
Na	6.7E-02	1.9E-01
P	3.0E+03	3.0E+04
Cr	4.0E+02	2.0E+03
Mn	5.5E+02	4.0E+02
Fe	3.0E+03	2.0E+04
Co	1.0E+02	1.0E+03
Ni	1.0E+02	2.5E+02
Cu	6.7E+02	1.7E+03
Zn	2.0E+03	5.0E+04
As	3.3E+02	3.3E+02
Br	1.5E-02	3.1E+00
Rb	8.3E+00	1.7E+01
Sr	2.0E+00	2.0E+01
Y	2.5E+01	1.0E+03
Zr	2.0E+02	8.0E+01
Nb	3.0E+04	1.0E+02
Mo	1.0E+01	1.0E+01
Tc	1.0E+01	5.0E+01
Ru	3.0E+00	1.0E+03
Rh	1.0E+01	2.0E+03
Ag	3.3E+03	3.3E+03
Sb	4.0E+01	5.4E+00
Te	1.0E+01	1.0E+02
I	1.0E+01	5.0E+01
Cs	4.0E+01	2.5E+01
Ba	1.0E+01	1.0E+02
La	2.5E+01	1.0E+03
Ce	1.0E+01	6.0E+02
Pr	2.5E+01	1.0E+03
Nd	2.5E+01	1.0E+03
W	3.0E+01	3.0E+01
Np	1.0E+01	1.0E+01

* Values in this table are taken from Regulatory Guide 1.109 except for phosphorus (fish) which is adapted from NUREG/CR-1336 and silver, arsenic and antimony which are taken from UCRL 50564, Rev. 1, October 1972.

FIGURE 2-1: SALEM VENTILATION EXHAUST SYSTEMS AND EFFLUENT MONITOR INTERFACES

Simplified One Line

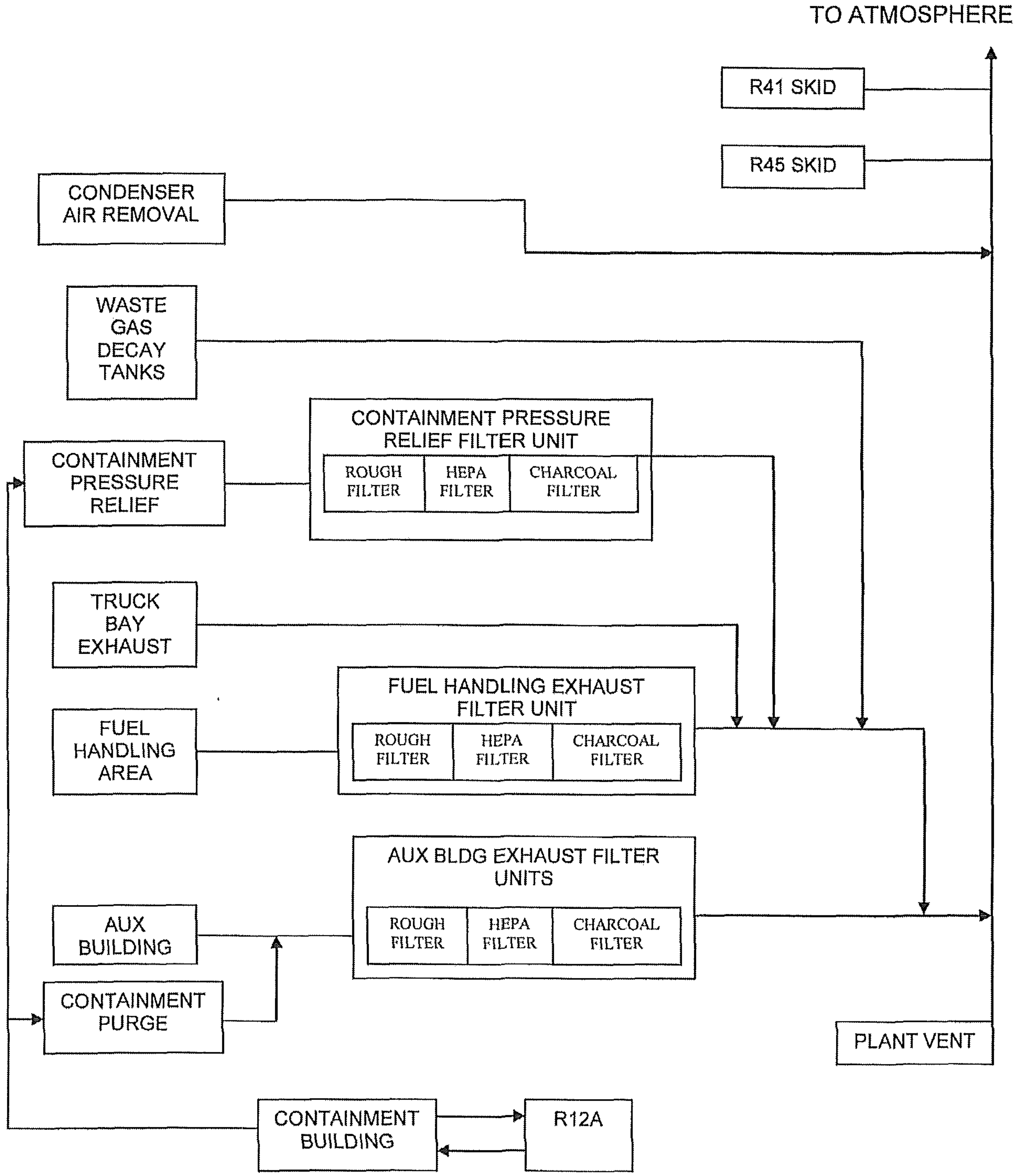


FIGURE 2-2: GASEOUS RADIOACTIVE WASTE DISPOAL SYSTEM

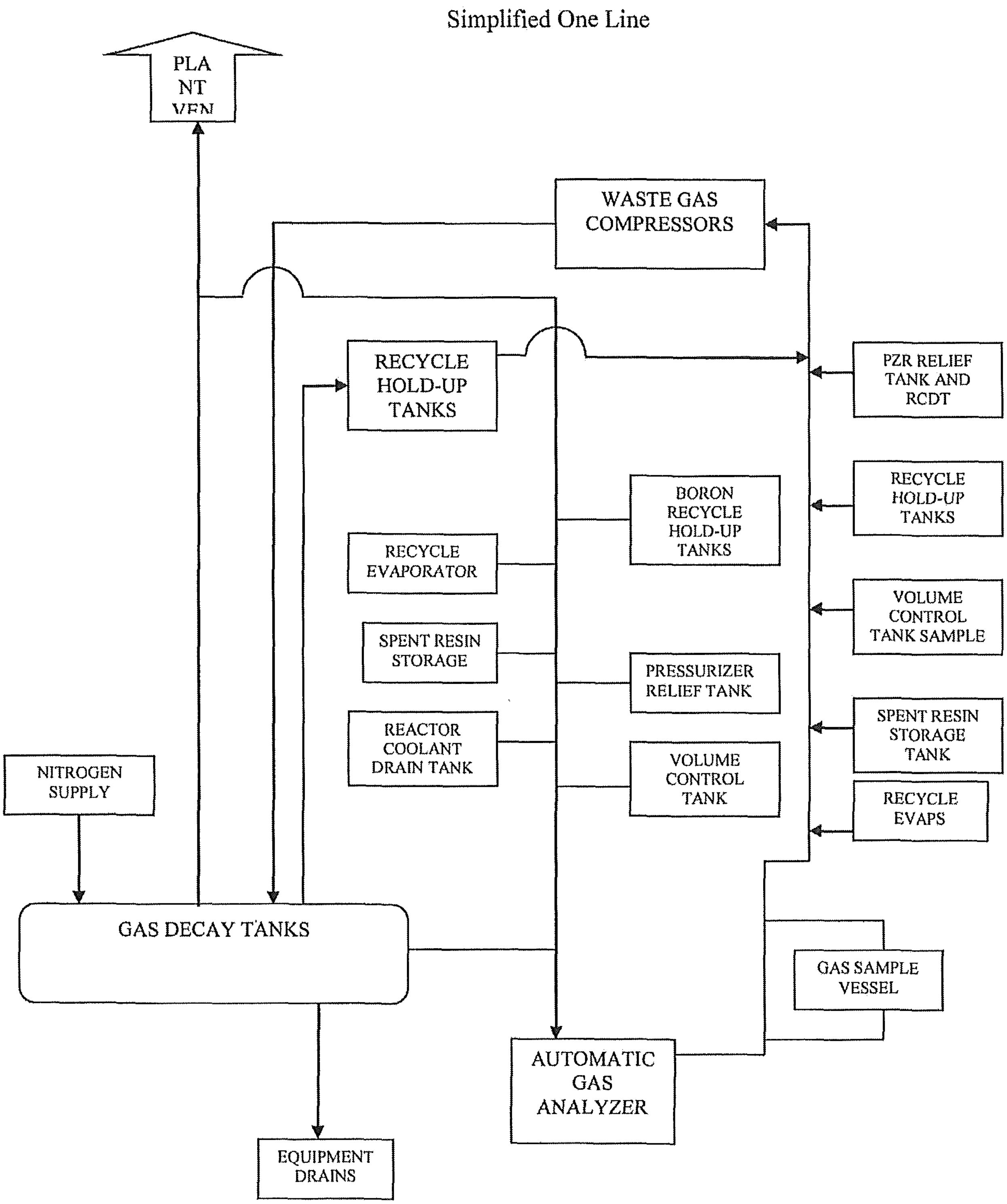


TABLE 2-1: DOSE FACTORS FOR NOBLE GASES

Radionuclide	Total Body Dose Factor Ki (mrem/yr per uCi /m3)	Skin Dose Factor Li (mrem/yr per uCi/m3)	Gamma Air Dose Factor Mi (mrad/yr per uCi/m3)	Beta Air Dose Factor Ni (mrad/yr per uCi/m3)
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

TABLE 2-2.1: PARAMETERS FOR GASEOUS ALARM SETPOINT DETERMINATIONS – UNIT 1

Parameter	Actual Value	Default Value	Units	Comments
X/Q	calculated	2.2E-06	sec/m^3	USNRC Salem Safety Evaluation, Sup 3
VF (Plant Vent) (Cont Purge)	as measured or fan curves	 1.30E+05 3.50E+04	ft^3/min	Plant Vent - normal operation Containment Purge
AF	coordinated	0.25	N.A	Administrative allocation factor with HCGS to ensure combined releases do not exceed release rate limit for site.
C_i	measured	N.A	uCi/cm^3	Taken from gamma spectral analysis of gaseous effluent
K_i	nuclide specific	N.A	mrem/yr per uCi/m^3	Values from Table 2-1
L_i	nuclide specific	N.A	mrem/yr per uCi/m^3	Values from Table 2-1
M_i	nuclide specific	N.A	mrem/yr per uCi/m^3	Values from Table 2-1
Sensitivities 1-R41 1-R12A	as determined	N.A	cpm per uCi/m^3 or cpm per uCi/cc	Monitor sensitivities are controlled under the following calculations: SC-RM004-01 (1-R41) SC-RM020-01 (1-R12A)
Setpoint 1-R41D 1-R12A **	 2.00E+04 1.15E+05	 2.00E+04 1.15E+05	 uCi/sec uCi/sec	Monitor setpoints are controlled under the following calculations: SC-RM004-01 (1-R41) SC-RM020-01 (1-R12A)

** Automatic Isolation function is applicable in all MODES except MODE 6.

TABLE 2-2.2: PARAMETERS FOR GASEOUS ALARM SETPOINT DETERMINATIONS – UNIT 2

Parameter	Actual Value	Default Value	Units	Comments
X/Q	Calculated	2.2E-6	sec/m^3	USNRC Salem Safety Evaluation, Sup 3
VF Plant Vent Cont. Purge	as measured or fan curves	 1.30E+05 3.50E+04	ft^3/min	 Plant Vent – normal operation Containment Purge
AF	Coordinated with HCGS	0.25	N.A.	Administrative allocation factor to ensure combined releases do not exceed release rate for site.
C_I	Measured	N.A.	uCi/cm^3	Taken from gamma spectral analysis of gaseous effluent
K_I	Nuclide specific	N.A.	mrem/yr per uCi/m^3	Values from Table 2-1
L_I	Nuclide specific	N.A.	mrem/yr per uCi/m^3	Values from Table 2-1
M_I	Nuclide specific	N.A.	mrem/yr per uCi/m^3	Values from Table 2-1
Sensitivities 2-R41 2-R12A	as determined	N.A.	cpm per uCi/m^3 or cpm per uCi/cc	Monitor sensitivities are controlled under the following calculations: SC-RM004-02 (2-R41) SC-RM002-03 (2-R12A)
Setpoint 2-R41D 2-R12A **	 2.00E+04 1.15E+05	 2.00E+04 1.15E+05	 uCi/sec uCi/sec	Monitor setpoints are controlled under the following calculations: SC-RM004-02 (2-R41) SC-RM002-03 (2-R12A)

** Automatic Isolation function is applicable in all MODES except MODE 6.

TABLE 2-3: CONTROLLING LOCATIONS, PATHWAYS AND ATMOSPHERIC DISPERSION FOR DOSE CALCULATIONS*

ODCM Control	Location	Pathway(s)	Controlling Age Group	Atmospheric Dispersion X/Q (sec/m^3)	Atmospheric Dispersion D/Q (1/m^2)
3.11.2.1a	Site Boundary (0.83 mile, N)	Noble Gases direct exposure	N.A.	2.2 E-06	N.A.
3.11.2.1b	Site Boundary (0.83 mile, N)	Inhalation and ground plane	Child	2.2 E-06	N.A.
3.11.2.2	Site Boundary (0.83 mile, N)	Gamma-Air Beta-Air	N.A.	2.2 E-06	N.A.
3.11.2.3	Residence/Dairy** (4.9 miles, W)	Milk, ground plane and inhalation	Infant	5.4E-08	2.1 E-10
3.11.2.3	Residence/Garden/ Beef (4.6 mi, SW)**	Ground plane, inhalation, garden produce, meat ingestion	Child	8.0 E-8	2.4 E-10

* The identified controlling locations, pathways and atmospheric dispersion are from the Safety Evaluation Report, Supplement No. 3, for the Salem Nuclear Generating Station, Unit 2 (NUREG-0157, December 1978).

** Location and distance are determined from the performance of the annual land use census as required by ODCM CONTROL 3.12.2.

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, INHALATION PATHWAY DOSE FACTORS

ADULT (mrem/yr per uCi/m^3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3
C-14	1.82E+4	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3
P-32	1.32E+6	7.71E+4	-	-	-	8.64E+4	5.01E+4
Cr-51	-	-	5.95E+1	2.28E+1	1.44E+4	3.32E+3	1.00E+2
Mn-54	-	3.96E+4	-	9.84E+3	1.40E+6	7.74E+4	6.30E+3
Fe-55	2.46E+4	1.70E+4	-	-	7.21E+4	6.03E+3	3.94E+3
Fe-59	1.18E+4	2.78E+4	-	-	1.02E+6	1.88E+5	1.06E+4
Co-57	-	6.92E+2	-	-	3.70E+5	3.14E+4	6.71E+2
Co-58	-	1.58E+3	-	-	9.28E+5	1.06E+5	2.07E+3
Co-60	-	1.15E+4	-	-	5.97E+6	2.85E+5	1.48E+4
Ni-63	4.32E+5	3.14E+4	-	-	1.78E+5	1.34E+4	1.45E+4
Zn-65	3.24E+4	1.03E+5	-	6.90E+4	8.64E+5	5.34E+4	4.66E+4
Rb-86	-	1.35E+5	-	-	-	1.66E+4	5.90E+4
Sr-89	3.04E+5	-	-	-	1.40E+6	3.50E+5	8.72E+3
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+6
Y-91	4.62E+5	-	-	-	1.70E+6	3.85E+5	1.24E+4
Zr-95	1.07E+5	3.44E+4	-	5.42E+4	1.77E+6	1.50E+5	2.33E+4
Nb-95	1.41E+4	7.82E+3	-	7.74E+3	5.05E+5	1.04E+5	4.21E+3
Ru-103	1.53E+3	-	-	5.83E+3	5.05E+5	1.10E+5	6.58E+2
Ru-106	6.91E+4	-	-	1.34E+5	9.36E+6	9.12E+5	8.72E+3
Ag-110m	1.08E+4	1.00E+4	-	1.97E+4	4.63E+6	3.02E+5	5.94E+3
Sb-124	3.12E+4	5.89E+2	7.55E+1	-	2.48E+6	4.06E+5	1.24E+4
Sb-125	5.34E+4	5.95E+2	5.40E+1	-	1.74E+6	1.01E+5	1.26E+4
Te-125m	3.42E+3	1.58E+3	1.05E+3	1.24E+4	3.14E+5	7.06E+4	4.67E+2
Te-127m	1.26E+4	5.77E+3	3.29E+3	4.58E+4	9.60E+5	1.50E+5	1.57E+3
Te-129m	9.76E+3	4.67E+3	3.44E+3	3.66E+4	1.16E+6	3.83E+5	1.58E+3
I-131	2.52E+4	3.58E+4	1.19E+7	6.13E+4	-	6.28E+3	2.05E+4
I-132	1.16E+3	3.26E+3	1.14E+5	5.18E+3	-	4.06E+2	1.16E+3
I-133	8.64E+3	1.48E+4	2.15E+6	2.58E+4	-	8.88E+3	4.52E+3
I-134	6.44E+2	1.73E+3	2.98E+4	2.75E+3	-	1.01E+0	6.15E+2
I-135	2.68E+3	6.98E+3	4.48E+5	1.11E+4	-	5.25E+3	2.57E+3
Cs-134	3.73E+5	8.48E+5	-	2.87E+5	9.76E+4	1.04E+4	7.28E+5
Cs-136	3.90E+4	1.46E+5	-	8.56E+4	1.20E+4	1.17E+4	1.10E+5
Cs-137	4.78E+5	6.21E+5	-	2.22E+5	7.52E+4	8.40E+3	4.28E+5
Ba-140	3.90E+4	4.90E+1	-	1.67E+1	1.27E+6	2.18E+5	2.57E+3
Ce-141	1.99E+4	1.35E+4	-	6.26E+3	3.62E+5	1.20E+5	1.53E+3
Ce-144	3.43E+6	1.43E+6	-	8.48E+5	7.78E+6	8.16E+5	1.84E+5
Pr-143	9.36E+3	3.75E+3	-	2.16E+3	2.81E+5	2.00E+5	4.64E+2
Nd-147	5.27E+3	6.10E+3	-	3.56E+3	2.21E+5	1.73E+5	3.65E+2

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, INHALATION PATHWAY DOSE FACTORS (Continued)

TEENAGER (mrem/yr per uCi/m^3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3
C-14	2.60E+4	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3
P-32	1.89E+6	1.10E+5	-	-	-	9.28E+4	7.16E+4
Cr-51	-	-	7.50E+1	3.07E+1	2.10E+4	3.00E+3	1.35E+2
Mn-54	-	5.11E+4	-	1.27E+4	1.98E+6	6.68E+4	8.40E+3
Fe-55	3.34E+4	2.38E+4	-	-	1.24E+5	6.39E+3	5.54E+3
Fe-59	1.59E+4	3.70E+4	-	-	1.53E+6	1.78E+5	1.43E+4
Co-57	-	6.92E+2	-	-	5.86E+5	3.14E+4	9.20E+2
Co-58	-	2.07E+3	-	-	1.34E+6	9.52E+4	2.78E+3
Co-60	-	1.51E+4	-	-	8.72E+6	2.59E+5	1.98E+4
Ni-63	5.80E+5	4.34E+4	-	-	3.07E+5	1.42E+4	1.98E+4
Zn-65	3.86E+4	1.34E+5	-	8.64E+4	1.24E+6	4.66E+4	6.24E+4
Rb-86	-	1.90E+5	-	-	-	1.77E+4	8.40E+4
Sr-89	4.34E+5	-	-	-	2.42E+6	3.71E+5	1.25E+4
Sr-90	1.08E+8	-	-	-	1.65E+7	7.65E+5	6.68E+6
Y-91	6.61E+5	-	-	-	2.94E+6	4.09E+5	1.77E+4
Zr-95	1.46E+5	4.58E+4	-	6.74E+4	2.69E+6	1.49E+5	3.15E+4
Nb-95	1.86E+4	1.03E+4	-	1.00E+4	7.51E+5	9.68E+4	5.66E+3
Ru-103	2.10E+3	-	-	7.43E+3	7.83E+5	1.09E+5	8.96E+2
Ru-106	9.84E+4	-	-	1.90E+5	1.61E+7	9.60E+5	1.24E+4
Ag-110m	1.38E+4	1.31E+4	-	2.50E+4	6.75E+6	2.73E+5	7.99E+3
Sb-124	4.30E+4	7.94E+2	9.76E+1	-	3.85E+6	3.98E+5	1.68E+4
Sb-125	7.38E+4	8.08E+2	7.04E+1	-	2.74E+6	9.92E+4	1.72E+4
Te-125m	4.88E+3	2.24E+3	1.40E+3	-	5.36E+5	7.50E+4	6.67E+2
Te-127m	1.80E+4	8.16E+3	4.38E+3	6.54E+4	1.66E+6	1.59E+5	2.18E+3
Te-129m	1.39E+4	6.58E+3	4.58E+3	5.19E+4	1.98E+6	4.05E+5	2.25E+3
I-131	3.54E+4	4.91E+4	1.46E+7	8.40E+4	-	6.49E+3	2.64E+4
I-132	1.59E+3	4.38E+3	1.51E+5	6.92E+3	-	1.27E+3	1.58E+3
I-133	1.22E+4	2.05E+4	2.92E+6	3.59E+4	-	1.03E+4	6.22E+3
I-134	8.88E+2	2.32E+3	3.95E+4	3.66E+3	-	2.04E+1	8.40E+2
I-135	3.70E+3	9.44E+3	6.21E+5	1.49E+4	-	6.95E+3	3.49E+3
Cs-134	5.02E+5	1.13E+6	-	3.75E+5	1.46E+5	9.76E+3	5.49E+5
Cs-136	5.15E+4	1.94E+5	-	1.10E+5	1.78E+4	1.09E+4	1.37E+5
Cs-137	6.70E+5	8.48E+5	-	3.04E+5	1.21E+5	8.48E+3	3.11E+5
Ba-140	5.47E+4	6.70E+1	-	2.28E+1	2.03E+6	2.29E+5	3.52E+3
Ce-141	2.84E+4	1.90E+4	-	8.88E+3	6.14E+5	1.26E+5	2.17E+3
Ce-144	4.89E+6	2.02E+6	-	1.21E+6	1.34E+7	8.64E+5	2.62E+5
Pr-143	1.34E+4	5.31E+3	-	3.09E+3	4.83E+5	2.14E+5	6.62E+2
Nd-147	7.86E+3	8.56E+3	-	5.02E+3	3.72E+5	1.82E+5	5.13E+2

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES R(io), INHALATION PATHWAY DOSE FACTORS (Continued)

CHILD (mrem/yr per uCi/m³)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3
C-14	3.59E+4	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3
P-32	2.60E+6	1.14E+5	-	-	-	4.22E+4	9.88E+4
Cr-51	-	-	8.55E+1	2.43E+1	1.70E+4	1.08E+3	1.54E+2
Mn-54	-	4.29E+4	-	1.00E+4	1.58E+6	2.29E+4	9.51E+3
Fe-55	4.74E+4	2.52E+4	-	-	1.11E+5	2.87E+3	7.77E+3
Fe-59	2.07E+4	3.34E+4	-	-	1.27E+6	7.07E+4	1.67E+4
Co-57	-	9.03E+2	-	-	5.07E+5	1.32E+4	1.07E+3
Co-58	-	1.77E+3	-	-	1.11E+6	3.44E+4	3.16E+3
Co-60	-	1.31E+4	-	-	7.07E+6	9.62E+4	2.26E+4
Ni-63	8.21E+5	4.63E+4	-	-	2.75E+5	6.33E+3	2.80E+4
Zn-65	4.26E+4	1.13E+5	-	7.14E+4	9.95E+5	1.63E+4	7.03E+4
Rb-86	-	1.98E+5	-	-		7.99E+3	1.14E+5
Sr-89	5.99E+5	-	-	-	2.16E+6	1.67E+5	1.72E+4
Sr-90	1.01E+8	-	-	-	1.48E+7	3.43E+5	6.44E+6
Y-91	9.14E+5	-	-	-	2.63E+6	1.84E+5	2.44E+4
Zr-95	1.90E+5	4.18E+4	-	5.96E+4	2.23E+6	6.11E+4	3.70E+4
Nb-95	2.35E+4	9.18E+3	-	8.62E+3	6.14E+5	3.70E+4	6.55E+3
Ru-103	2.79E+3	-	-	7.03E+3	6.62E+5	4.48E+4	1.07E+3
Ru-106	1.36E+5	-	-	1.84E+5	1.43E+7	4.29E+5	1.69E+4
Ag-110m	1.69E+4	1.14E+4	-	2.12E+4	5.48E+6	1.00E+5	9.14E+3
Sb-124	5.74E+4	7.40E+2	1.26E+2	-	3.24E+6	1.64E+5	2.00E+4
Sb-125	9.84E+4	7.59E+2	9.10E+1	-	2.32E+6	4.03E+4	2.07E+4
Te-125m	6.73E+3	2.33E+3	1.92E+3	-	4.77E+5	3.38E+4	9.14E+2
Te-127m	2.49E+4	8.55E+3	6.07E+3	6.36E+4	1.48E+6	7.14E+4	3.02E+3
Te-129m	1.92E+4	6.85E+3	6.33E+3	5.03E+4	1.76E+6	1.82E+5	3.04E+3
I-131	4.81E+4	4.81E+4	1.62E+7	7.88E+4	-	2.84E+3	2.73E+4
I-132	2.12E+3	4.07E+3	1.94E+5	6.25E+3	-	3.22E+3	1.88E+3
I-133	1.66E+4	2.03E+4	3.85E+6	3.38E+4	-	5.48E+3	7.70E+3
I-134	1.17E+3	2.16E+3	5.07E+4	3.30E+3	-	9.55E+2	9.95E+2
I-135	4.92E+3	8.73E+3	7.92E+5	1.34E+4	-	4.44E+3	4.14E+3
Cs-134	6.51E+5	1.01E+6	-	3.30E+5	1.21E+5	3.85E+3	2.25E+5
Cs-136	6.51E+4	1.71E+5	-	9.55E+4	1.45E+4	4.18E+3	1.16E+5
Cs-137	9.07E+5	8.25E+5	-	2.82E+5	1.04E+5	3.62E+3	1.28E+5
Ba-140	7.40E+4	6.48E+1	-	2.11E+1	1.74E+6	1.02E+5	4.33E+3
Ce-141	3.92E+4	1.95E+4	-	8.55E+3	5.44E+5	5.66E+4	2.90E+3
Ce-144	6.77E+6	2.12E+6	-	1.17E+6	1.20E+7	3.89E+5	3.61E+5
Pr-143	1.85E+4	5.55E+3	-	3.00E+3	4.33E+5	9.73E+4	9.14E+2
Nd-147	1.08E+4	8.73E+3	-	4.81E+3	3.28E+5	8.21E+4	6.81E+2

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES R(io), INHALATION PATHWAY DOSE FACTORS (Continued)

INFANT (mrem/yr per uCi/m³)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2
C-14	2.65E+4	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3
P-32	2.03E+6	1.12E+5	-	-	-	1.61E+4	7.74E+4
Cr-51	-	-	5.75E+1	1.32E+1	1.28E+4	3.57E+2	8.95E+1
Mn-54	-	2.53E+4	-	4.98E+3	1.00E+6	7.06E+3	4.98E+3
Fe-55	1.97E+4	1.17E+4	-	-	8.69E+4	1.09E+3	3.33E+3
Fe-59	1.36E+4	2.35E+4	-	-	1.02E+6	2.48E+4	9.48E+3
Co-57	-	6.51E+2	-	-	3.79E+5	4.86E+3	6.41E+2
Co-58	-	1.22E+3	-	-	7.77E+5	1.11E+4	1.82E+3
Co-60	-	8.02E+3	-	-	4.51E+6	3.19E+4	1.18E+4
Ni-63	3.39E+5	2.04E+4	-	-	2.09E+5	2.42E+3	1.16E+4
Zn-65	1.93E+4	6.26E+4	-	3.25E+4	6.47E+5	5.14E+4	3.11E+4
Rb-86	-	1.90E+5	-	-	-	3.04E+3	8.82E+4
Sr-89	3.98E+5	-	-	-	2.03E+6	6.40E+4	1.14E+4
Sr-90	4.09E+7	-	-	-	1.12E+7	1.31E+5	2.59E+6
Y-91	5.88E+5	-	-	-	2.45E+6	7.03E+4	1.57E+4
Zr-95	1.15E+5	2.79E+4	-	3.11E+4	1.75E+6	2.17E+4	2.03E+4
Nb-95	1.57E+4	6.43E+3	-	4.72E+3	4.79E+5	1.27E+4	3.78E+3
Ru-103	2.02E+3	-	-	4.24E+3	5.52E+5	1.61E+4	6.79E+2
Ru-106	8.68E+4	-	-	1.07E+5	1.16E+7	1.64E+5	1.09E+4
Ag-110m	9.98E+3	7.22E+3	-	1.09E+4	3.67E+6	3.30E+4	5.00E+3
Sb-124	3.79E+4	5.56E+2	1.01E+2	-	2.65E+6	5.91E+4	1.20E+4
Sb-125	5.17E+4	4.77E+2	6.23E+1	-	1.64E+6	1.47E+4	1.09E+4
Te-125m	4.76E+3	1.99E+3	1.62E+3	-	4.47E+5	1.29E+4	6.58E+2
Te-127m	1.67E+4	6.90E+3	4.87E+3	3.75E+4	1.31E+6	2.73E+4	2.07E+3
Te-129m	1.41E+4	6.09E+3	5.47E+3	3.18E+4	1.68E+6	6.90E+4	2.23E+3
I-131	3.79E+4	4.44E+4	1.48E+7	5.18E+4	-	1.06E+3	1.96E+4
I-132	1.69E+3	3.54E+3	1.69E+5	3.95E+5	-	1.90E+3	1.26E+3
I-133	1.32E+4	1.92E+4	3.56E+6	2.24E+4	-	2.61E+3	5.60E+3
I-134	9.21E+2	1.88E+3	4.45E+4	2.09E+3	-	1.29E+3	6.65E+2
I-135	3.86E+3	7.60E+3	6.96E+5	8.47E+3	-	1.83E+3	2.77E+3
Cs-134	3.96E+5	7.03E+5	-	1.90E+5	7.97E+4	1.33E+3	7.45E+4
Cs-136	4.83E+4	1.35E+5	-	5.64E+4	1.18E+4	1.43E+3	5.29E+4
Cs-137	5.49E+5	6.12E+5	-	1.72E+5	7.13E+4	1.33E+3	4.55E+4
Ba-140	5.60E+4	5.60E+1	-	1.34E+1	1.60E+6	3.84E+4	2.90E+3
Ce-141	2.77E+4	1.67E+4	-	5.25E+3	5.17E+5	2.16E+4	1.99E+3
Ce-144	3.19E+6	1.21E+6	-	5.38E+5	9.84E+6	1.48E+5	1.76E+5
Pr-143	1.40E+4	5.24E+3	-	1.97E+3	4.33E+5	3.72E+4	6.99E+2
Nd-147	7.94E+3	8.13E+3	-	3.15E+3	3.22E+5	3.12E+4	5.00E+2

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES R(io), GRASS-COW-MILK PATHWAY DOSE FACTORS (Continued)

ADULT (mrem/yr per uCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per uCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2
C-14	3.63E+5	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4
P-32	1.71E+10	1.06E+9	-	-	-	1.92E+9	6.60E+8
Cr-51	-	-	1.71E+4	6.30E+3	3.80E+4	7.20E+6	2.86E+4
Mn-54	-	8.40E+6	-	2.50E+6	-	2.57E+7	1.60E+6
Fe-55	2.51E+7	1.73E+7	-	-	9.67E+6	9.95E+6	4.04E+6
Fe-59	2.98E+7	7.00E+7	-	-	1.95E+7	2.33E+8	2.68E+7
Co-57	-	1.28E+6	-	-	-	3.25E+7	2.13E+6
Co-58	-	4.72E+6	-	-	-	9.57E+7	1.06E+7
Co-60	-	1.64E+7	-	-	-	3.08E+8	3.62E+7
Ni-63	6.73E+9	4.66E+8	-	-	-	9.73E+7	2.26E+8
Zn-65	1.37E+9	4.36E+9	-	2.92E+9	-	2.75E+9	1.97E+9
Rb-86	-	2.59E+9	-	-	-	5.11E+8	1.21E+9
Sr-89	1.45E+9	-	-	-	-	2.33E+8	4.16E+7
Sr-90	4.68E+10	-	-	-	-	1.35E+9	1.15E+10
Y-91	8.60E+3	-	-	-	-	4.73E+6	2.30E+2
Zr-95	9.46E+2	3.03E+2	-	4.76E+2	-	9.62E+5	2.05E+2
Nb-95	8.25E+4	4.59E+4	-	4.54E+4	-	2.79E+8	2.47E+4
Ru-103	1.02E+3	-	-	3.89E+3	-	1.19E+5	4.39E+2
Ru-106	2.04E+4	-	-	3.94E+4	-	1.32E+6	2.58E+3
Ag-110m	5.83E+7	5.39E+7	-	1.06E+8	-	2.20E+10	3.20E+7
Sb-124	2.57E+7	4.86E+5	6.24E+4	-	2.00E+7	7.31E+8	1.02E+7
Sb-125	2.04E+7	2.28E+5	2.08E+4	-	1.58E+7	2.25E+8	4.86E+6
Te-125m	1.63E+7	5.90E+6	4.90E+6	6.63E+7	-	6.50E+7	2.18E+6
Te-127m	4.58E+7	1.64E+7	1.17E+7	1.86E+8	-	1.54E+8	5.58E+6
Te-129m	6.04E+7	2.25E+7	2.08E+7	2.52E+8	-	3.04E+8	9.57E+6
I-131	2.96E+8	4.24E+8	1.39E+11	7.27E+8	-	1.12E+8	2.43E+8
I-132	1.64E-1	4.37E-1	1.53E+1	6.97E-1	-	8.22E-2	1.53E-1
I-133	3.97E+6	6.90E+6	1.01E+9	1.20E+7	-	6.20E+6	2.10E+6
I-134	-	-	-	-	-	-	-
I-135	1.39E+4	3.63E+4	2.40E+6	5.83E+4	-	4.10E+4	1.34E+4
Cs-134	5.65E+9	1.34E+10	-	4.35E+9	1.44E+9	2.35E+8	1.10E+10
Cs-136	2.61E+8	1.03E+9	-	5.74E+8	7.87E+7	1.17E+8	7.42E+8
Cs-137	7.38E+9	1.01E+10	-	3.43E+9	1.14E+9	1.95E+8	6.61E+9
Ba-140	2.69E+7	3.38E+4	-	1.15E+4	1.93E+4	5.54E+7	1.76E+6
Ce-141	4.84E+3	3.27E+3	-	1.52E+3	-	1.25E+7	3.71E+2
Ce-144	3.58E+5	1.50E+5	-	8.87E+4	-	1.21E+8	1.92E+4
Pr-143	1.59E+2	6.37E+1	-	3.68E+1	-	6.96E+5	7.88E+0
Nd-147	9.42E+1	1.09E+2	-	6.37E+1	-	5.23E+5	6.52E+0

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, GRASS-COW-MILK PATHWAY DOSE FACTORS (Continued)

TEENAGER (mrem/yr per uCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per uCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2
C-14	6.70E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5
P-32	3.15E+10	1.95E+9	-	-	-	2.65E+9	1.22E+9
Cr-51	-	-	2.78E+4	1.10E+4	7.13E+4	8.40E+6	5.00E+4
Mn-54	-	1.40E+7	-	4.17E+6	-	2.87E+7	2.78E+6
Fe-55	4.45E+7	3.16E+7	-	-	2.00E	1.37E+7	7.36E+6
Fe-59	5.20E+7	1.21E+8	-	-	3.82E+7	2.87E+8	4.68E+7
Co-57	-	2.25E+6	-	-	-	4.19E+7	3.76E+6
Co-58	-	7.95E+6	-	-	-	1.10E+8	1.83E+7
Co-60	-	2.78E+7	-	-	-	3.62E+8	6.26E+7
Ni-63	1.18E+10	8.35E+8	-	-	-	1.33E+8	4.01E+8
Zn-65	2.11E+9	7.31E+9	-	4.68E+9	-	3.10E+9	3.41E+9
Rb-86	-	4.73E+9	-	-	-	7.00E+8	2.22E+9
Sr-89	2.67E+9	-	-	-	-	3.18E+8	7.66E+7
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+6
Y-91	1.58E+4	-	-	-	-	6.48E+6	4.24E+2
Zr-95	1.65E+3	5.22E+2	-	7.67E+2	-	1.20E+6	3.59E+2
Nb-95	1.41E+5	7.80E+4	-	7.57E+4	-	3.34E+8	4.30E+4
Ru-103	1.81E+3	-	-	6.40E+3	-	1.52E+5	7.75E+2
Ru-106	3.75E+4	-	-	7.23E+4	-	1.80E+6	4.73E+3
Ag-110m	9.63E+7	9.11E+7	-	1.74E+8	-	2.56E+10	5.54E+7
Sb-124	4.59E+7	8.46E+5	1.04E+5	-	4.01E+7	9.25E+8	1.79E+7
Sb-125	3.65E+7	3.99E+5	3.49E+4	-	3.21E+7	2.84E+8	8.54E+6
Te-125m	3.00E+7	1.08E+7	8.39E+6	-	-	8.86E+7	4.02E+6
Te-127m	8.44E+7	2.99E+7	2.01E+7	3.42E+8	-	2.10E+8	1.00E+7
Te-129m	1.11E+8	4.10E+7	3.57E+7	4.62E+8	-	4.15E+8	1.75E+7
I-131	5.38E+8	7.53E+8	2.20E+11	1.30E+9	-	1.49E+8	4.04E+8
I-132	2.90E-1	7.59E-1	2.56E+1	1.20E+0	-	3.31E-1	2.72E-1
I-133	7.24E+6	1.23E+7	1.72E+9	2.15E+7	-	9.30E+6	3.75E+6
I-134	-	-	-	-	-	-	-
I-135	2.47E+4	6.35E+4	4.08E+6	1.00E+5	-	7.03E+4	2.35E+4
Cs-134	9.81E+9	2.31E+10	-	7.34E+9	2.80E+9	2.87E+8	1.07E+10
Cs-136	4.45E+8	1.75E+9	-	9.53E+8	1.50E+8	1.41E+8	1.18E+9
Cs-137	1.34E+10	1.78E+10	-	6.06E+9	2.35E+9	2.53E+8	6.20E+9
Ba-140	4.85E+7	5.95E+4	-	2.02E+4	4.00E+4	7.49E+7	3.13E+6
Ce-141	8.87E+3	1.35E+4	-	2.79E+3	-	1.69E+7	6.81E+2
Ce-144	6.58E+5	2.72E+5	-	1.63E+5	-	1.66E+8	3.54E+4
Pr-143	2.92E+2	1.17E+2	-	6.77E+1	-	9.61E+5	1.45E+1
Nd-147	1.81E+2	1.97E+2	-	1.16E+2	-	7.11E+5	1.18E+1

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES R(io), GRASS-COW-MILK PATHWAY DOSE FACTORS (Continued)

CHILD (mrem/yr per uCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per uCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3
C-14	1.65E+6	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5
P-32	7.77E+10	3.64E+9	-	-	-	2.15E+9	3.00E+9
Cr-51	-	-	5.66E+4	1.55E+4	1.03E+5	5.41E+6	1.02E+5
Mn-54	-	2.09E+7	-	5.87E+6	-	1.76E+7	5.58E+6
Fe-55	1.12E+8	5.93E+7	-	-	3.35E+7	1.10E+7	1.84E+7
Fe-59	1.20E+8	1.95E+8	-	-	5.65E+7	2.03E+8	9.71E+7
Co-57	-	3.84E+6	-	-	-	3.14E+7	7.77E+6
Co-58	-	1.21E+7	-	-	-	7.08E+7	3.72E+7
Co-60	-	4.32E+7	-	-	-	2.39E+8	1.27E+8
Ni-63	2.96E+10	1.59E+9	-	-	-	1.07E+8	1.01E+9
Zn-65	4.13E+9	1.10E+10	-	6.94E+9	-	1.93E+9	6.85E+9
Rb-86	-	8.77E+9	-	-	-	5.64E+8	5.39E+9
Sr-89	6.62E+9	-	-	-	-	2.56E+8	1.89E+8
Sr-90	1.12E+11	-	-	-	-	1.51E+9	2.83E+10
Y-91	3.91E+4	-	-	-	-	5.21E+6	1.04E+3
Zr-95	3.84E+3	8.45E+2	-	1.21E+3	-	8.81E+5	7.52E+2
Nb-95	3.18E+5	1.24E+5	-	1.16E+5	-	2.29E+8	8.84E+4
Ru-103	4.29E+3	-	-	1.08E+4	-	1.11E+5	1.65E+3
Ru-106	9.24E+4	-	-	1.25E+5	-	1.44E+6	1.15E+4
Ag-110m	2.09E+8	1.41E+8	-	2.63E+8	-	1.68E+10	1.13E+8
Sb-124	1.09E+8	1.41E+8	2.40E+5	-	6.03E+7	6.79E+8	3.81E+7
Sb-125	8.70E+7	1.41E+6	8.06E+4	-	4.85E+7	2.08E+8	1.82E+7
Te-125m	7.38E+7	2.00E+7	2.07E+7	-	-	7.12E+7	9.84E+6
Te-127m	2.08E+8	5.60E+7	4.97E+7	5.93E+8	-	1.68E+8	2.47E+7
Te-129m	2.72E+8	7.61E+7	8.78E+7	8.00E+8	-	3.32E+8	4.23E+7
I-131	1.30E+9	1.31E+9	4.34E+11	2.15E+9	-	1.17E+8	7.46E+8
I-132	6.86E-1	1.26E+0	5.85E+1	1.93E+0	-	1.48E+0	5.80E-1
I-133	1.76E+7	2.18E+7	4.04E+9	3.63E+7	-	8.77E+6	8.23E+6
I-134	-	-	-	-	-	-	-
I-135	5.84E+4	1.05E+5	9.30E+6	1.61E+5	-	8.00E+4	4.97E+4
Cs-134	2.26E+10	3.71E+10	-	1.15E+10	4.13E+9	2.00E+8	7.83E+9
Cs-136	1.00E+9	2.76E+9	-	1.47E+9	2.19E+8	9.70E+7	1.79E+9
Cs-137	3.22E+10	3.09E+10	-	1.01E+10	3.62E+9	1.93E+8	4.55E+9
Ba-140	1.17E+8	1.03E+5	-	3.34E+4	6.12E+4	5.94E+7	6.84E+6
Ce-141	2.19E+4	1.09E+4	-	4.78E+3	-	1.36E+7	1.62E+3
Ce-144	1.62E+6	5.09E+5	-	2.82E+5	-	1.33E+8	8.66E+4
Pr-143	7.23E+2	2.17E+2	-	1.17E+2	-	7.80E+5	3.59E+1
Nd-147	4.45E+2	3.60E+2	-	1.98E+2	-	5.71E+5	2.79E+1

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, GRASS-COW-MILK PATHWAY DOSE FACTORS (Continued)

INFANT (mrem/yr per uCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per uCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3
C-14	3.23E+6	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5
P-32	1.60E+11	9.42E+9	-	-	-	2.17E+9	6.21E+9
Cr-51	-	-	1.05E+5	2.30E+4	2.05E+5	4.71E+6	1.61E+5
Mn-54	-	3.89E+7	-	8.63E+6	-	1.43E+7	8.83E+6
Fe-55	1.35E+8	8.72E+7	-	-	4.27E+7	1.11E+7	2.33E+7
Fe-59	2.25E+8	3.93E+8	-	-	1.16E+8	1.88E+8	1.55E+8
Co-57	-	8.95E+6	-	-	-	3.05E+7	1.46E+7
Co-58	-	2.43E+7	-	-	-	6.05E+7	6.06E+7
Co-60	-	8.81E+7	-	-	-	2.10E+8	2.08E+8
Ni-63	3.49E+10	2.16E+9	-	-	-	1.07E+8	1.21E+9
Zn-65	5.55E+9	1.90E+10	-	9.23E+9	-	1.61E+10	8.78E+9
Rb-86	-	2.22E+10	-	-	-	5.69E+8	1.10E+10
Sr-89	1.26E+10	-	-	-	-	2.59E+8	3.61E+8
Sr-90	1.22E+11	-	-	-	-	1.52E+9	3.10E+10
Y-91	7.33E+4	-	-	-	-	5.26E+6	1.95E+3
Zr-95	6.83E+3	1.66E+3	-	1.79E+3	-	8.28E+5	1.18E+3
Nb-95	5.93E+5	2.44E+5	-	1.75E+5	-	2.06E+8	1.41E+5
Ru-103	8.69E+3	-	-	1.81E+4	-	1.06E+5	2.91E+3
Ru-106	1.90E+5	-	-	2.25E+5	-	1.44E+6	2.38E+4
Ag-110m	3.86E+8	2.82E+8	-	4.03E+8	-	1.46E+10	1.86E+8
Sb-124	2.09E+8	3.08E+6	5.56E+5	-	1.31E+8	6.46E+8	6.49E+7
Sb-125	1.49E+8	1.45E+6	1.87E+5	-	9.38E+7	1.99E+8	3.07E+7
Te-125m	1.51E+8	5.04E+7	5.07E+7	-	-	7.18E+7	2.04E+7
Te-127m	4.21E+8	1.40E+8	1.22E+8	1.04E+9	-	1.70E+8	5.10E+7
Te-129m	5.59E+8	1.92E+8	2.15E+8	1.40E+9	-	3.34E+8	8.62E+7
I-131	2.72E+9	3.21E+9	1.05E+12	3.75E+9	-	1.15E+8	1.41E+9
I-132	1.42E+0	2.89E+0	1.35E+2	3.22E+0	-	2.34E+0	1.03E+0
I-133	3.72E+7	5.41E+7	9.84E+9	6.36E+7	-	9.16E+6	1.58E+7
I-134	-	-	1.01E-9	-	-	-	-
I-135	1.21E+5	2.41E+5	2.16E+7	2.69E+5	-	8.74E+4	8.80E+4
Cs-134	3.65E+10	6.80E+10	-	1.75E+10	7.18E+9	1.85E+8	6.87E+9
Cs-136	1.96E+9	5.77E+9	-	2.30E+9	4.70E+8	8.76E+7	2.15E+9
Cs-137	5.15E+10	6.02E+10	-	1.62E+10	6.55E+9	1.88E+8	4.27E+9
Ba-140	2.41E+8	2.41E+5	-	5.73E+4	1.48E+5	5.92E+7	1.24E+7
Ce-141	4.33E+4	2.64E+4	-	8.15E+3	-	1.37E+7	3.11E+3
Ce-144	2.33E+6	9.52E+5	-	3.85E+5	-	1.33E+8	1.30E+5
Pr-143	1.49E+3	5.59E+2	-	2.08E+2	-	7.89E+5	7.41E+1
Nd-147	8.82E+2	9.06E+2	-	3.49E+2	-	5.74E+5	5.55E+1

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, VEGETATION PATHWAY DOSE FACTORS (Continued)

ADULT (mrem/yr per uCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per uCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3
C-14	8.97E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5
P-32	1.40E+9	8.73E+7	-	-	-	1.58E+8	5.42E+7
Cr-51	-	-	2.79E+4	1.03E+4	6.19E+4	1.17E+7	4.66E+4
Mn-54	-	3.11E+8	-	9.27E+7	-	9.54E+8	5.94E+7
Fe-55	2.09E+8	1.45E+8	-	-	8.06E+7	8.29E+7	3.37E+7
Fe-59	1.27E+8	2.99E+8	-	-	8.35E+7	9.96E+8	1.14E+8
Co-57	-	1.17E+7	-	-	-	2.97E+8	1.95E+7
Co-58	-	3.09E+7	-	-	-	6.26E+8	6.92E+7
Co-60	-	1.67E+8	-	-	-	3.14E+9	3.69E+8
Ni-63	1.04E+10	7.21E+8	-	-	-	1.50E+8	3.49E+8
Zn-65	3.17E+8	1.01E+9	-	6.75E+8	-	6.36E+8	4.56E+8
Rb-86	-	2.19E+8	-	-	-	4.32E+7	1.02E+8
Sr-89	9.96E+9	-	-	-	-	1.60E+9	2.86E+8
Sr-90	6.05E+11	-	-	-	-	1.75E+10	1.48E+10
Y-91	5.13E+6	-	-	-	-	2.82E+9	1.37E+5
Zr-95	1.19E+6	3.81E+5	-	5.97E+5	-	1.21E+9	2.58E+5
Nb-95	1.42E+5	7.91E+4	-	7.81E+4	-	4.80E+8	4.25E+4
Ru-103	4.80E+6	-	-	1.83E+7	-	5.61E+8	2.07E+6
Ru-106	1.93E+8	-	-	3.72E+8	-	1.25E+10	2.44E+7
Ag-110m	1.06E+7	9.76E+6	-	1.92E+7	-	3.98E+9	5.80E+6
Sb-124	1.04E+8	1.96E+6	2.52E+5	-	8.08E+7	2.95E+9	4.11E+7
Sb-125	1.36E+8	1.52E+6	1.39E+5	-	1.05E+8	1.50E+9	3.25E+7
Te-125m	9.66E+7	3.50E+7	2.90E+7	3.93E+8	-	3.86E+8	1.29E+7
Te-127m	3.49E+8	1.25E+8	8.92E+7	1.42E+9	-	1.17E+9	4.26E+7
Te-129m	2.55E+8	9.50E+7	8.75E+7	1.06E+9	-	1.28E+9	4.03E+7
I-131	8.09E+7	1.16E+8	3.79E+10	1.98E+8	-	3.05E+7	6.63E+7
I-132	5.74E+1	1.54E+2	5.38E+3	2.45E+2	-	2.89E+1	5.38E+1
I-133	2.12E+6	3.69E+6	5.42E+8	6.44E+6	-	3.31E+6	1.12E+6
I-134	1.06E-4	2.88E-4	5.00E-3	4.59E-4	-	2.51E-7	1.03E-4
I-135	4.08E+4	1.07E+5	7.04E+6	1.71E+5	-	1.21E+5	3.94E+4
Cs-134	4.66E+9	1.11E+10	-	3.59E+9	1.19E+9	1.94E+8	9.07E+9
Cs-136	4.20E+7	1.66E+8	-	9.24E+7	1.27E+7	1.89E+7	1.19E+8
Cs-137	6.36E+9	8.70E+9	-	2.95E+9	9.81E+8	1.68E+8	5.70E+9
Ba-140	1.29E+8	1.62E+5	-	5.49E+4	9.25E+4	2.65E+8	8.43E+6
Ce-141	1.96E+5	1.33E+5	-	6.17E+4	-	5.08E+8	1.51E+4
Ce-144	3.29E+7	1.38E+7	-	8.16E+6	-	1.11E+10	1.77E+6
Pr-143	6.34E+4	2.54E+4	-	1.47E+4	-	2.78E+8	3.14E+3
Nd-147	3.34E+4	3.86E+4	-	2.25E+4	-	1.85E+8	2.31E+3

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, VEGETATION PATHWAY DOSE FACTORS (Continued)

TEENAGER (mrem/yr per uCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per uCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3
C-14	1.45E+6	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5
P-32	1.61E+9	9.96E+7	-	-	-	1.35E+8	6.23E+7
Cr-51	-	-	3.44E+4	1.36E+4	8.85E+4	1.04E+7	6.20E+4
Mn-54	-	4.52E+8	-	1.35E+8	-	9.27E+8	8.97E+7
Fe-55	3.25E+8	2.31E+8	-	-	1.46E+8	9.98E+7	5.38E+7
Fe-59	1.81E+8	4.22E+8	-	-	1.33E+8	9.98E+8	1.63E+8
Co-57	-	1.79E+7	-	-	-	3.34E+8	3.00E+7
Co-58	-	4.38E+7	-	-	-	6.04E+8	1.01E+8
Co-60	-	2.49E+8	-	-	-	3.24E+9	5.60E+8
Ni-63	1.61E+10	1.13E+9	-	-	-	1.81E+8	5.45E+8
Zn-65	4.24E+8	1.47E+9	-	9.41E+8	-	6.23E+8	6.86E+8
Rb-86	-	2.73E+8	-	-	-	4.O5E+7	1.28E+8
Sr-89	1.51E+10	-	-	-	-	1.80E+9	4.33E+8
Sr-90	7.51E+11	-	-	-	-	2.11E+10	1.85E+11
Y-91	7.87E+6	-	-	-	-	3.23E+9	2.11E+5
Zr-95	1.74E+6	5.49E+5	-	8.07E+5	-	1.27E+9	3.78E+5
Nb-95	1.92E+5	1.06E+5	-	1.03E+5	-	4.55E+8	5.86E+4
Ru-103	6.87E+6	-	-	2.42E+7	-	5.74E+8	2.94E+6
Ru-106	3.09E+8	-	-	5.97E+8	-	1.48E+10	3.90E+7
Ag-110m	1.52E+7	1.44E+7	-	2.74E+7	-	4.04E+9	8.74E+6
Sb-124	1.55E+8	2.85E+6	3.51E+5	-	1.35E+8	3.11E+9	6.03E+7
Sb-125	2.14E+8	2.34E+6	2.04E+5	-	1.88E+8	1.66E+9	5.00E+7
Te-125m	1.48E+8	5.34E+7	4.14E+7	-	-	4.37E+8	1.98E+7
Te-127m	5.51E+8	1.96E+8	1.31E+8	2.24E+9	-	1.37E+9	6.56E+7
Te-129m	3.67E+8	1.36E+8	1.18E+8	1.54E+9	-	1.38E+9	5.81E+7
I-131	7.70E+7	1.08E+8	3.14E+10	1.85E+8	-	2.13E+7	5.79E+7
I-132	5.18E+1	1.36E+2	4.57E+3	2.14E+2	-	5.91E+1	4.87E+1
I-133	1.97E+6	3.34E+6	4.66E+8	5.86E+6	-	2.53E+6	1.02E+6
I-134	9.59E-5	2.54E-4	4.24E-3	4.01E-4	-	3.35E-6	9.13E-5
I-135	3.68E+4	9.48E+4	6.10E+6	1.50E+5	-	1.05E+5	3.52E+4
Cs-134	7.09E+9	1.67E+10	-	5.30E+9	2.02E+9	2.08E+8	7.74E+9
Cs-136	4.29E+7	1.69E+8	-	9.19E+7	1.45E+7	1.36E+7	1.13E+8
Cs-137	1.01E+10	1.35E+10	-	4.59E+9	1.78E+9	1.92E+8	4.69E+9
Ba-140	1.38E+8	1.69E+5	-	5.75E+4	1.14E+5	2.13E+8	8.91E+6
Ce-141	2.82E+5	1.88E+5	-	8.86E+4	-	5.38E+8	2.16E+4
Ce-144	5.27E+7	2.18E+7	-	1.30E+7	-	1.33E+10	2.83E+6
Pr-143	7.12E+4	2.84E+4	-	1.65E+4	-	2.34E+8	3.55E+3
Nd-147	3.63E+4	3.94E+4	-	2.32E+4	-	1.42E+8	2.36E+3

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES R(io), VEGETATION PATHWAY DOSE FACTORS (Continued)

CHILD (mrem/yr per uCi/m^3) FOR H-3 AND C-14
(m^2 * mrem/yr per uCi/sec) FOR OTHERS

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3
C-14	3.50E+6	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5
P-32	3.37E+9	1.58E+8	-	-	-	9.30E+7	1.30E+8
Cr-51	-	-	6.54E+4	1.79E+4	1.19E+5	6.25E+6	1.18E+5
Mn-54	-	6.61E+8	-	1.85E+8	-	5.55E+8	1.76E+8
Fe-55	8.00E+8	4.24E+8	-	-	2.40E+8	7.86E+7	1.31E+8
Fe-59	4.01E+8	6.49E+8	-	-	1.88E+8	6.76E+8	3.23E+8
Co-57	-	2.99E+7	-	-	-	2.45E+8	6.04E+7
Co-58	-	6.47E+7	-	-	-	3.77E+8	1.98E+8
Co-60	-	3.78E+8	-	-	-	2.10E+9	1.12E+9
Ni-63	3.95E+10	2.11E+9	-	-	-	1.42E+8	1.34E+9
Zn-65	8.12E+8	2.16E+9	-	1.36E+9	-	3.80E+8	1.35E+9
Rb-86	-	4.52E+8	-	-	-	2.91E+7	2.78E+8
Sr-89	3.59E+10	-	-	-	-	1.39E+9	1.03E+9
Sr-90	1.24E+12	-	-	-	-	1.67E+10	3.15E+11
Y-91	1.87E+7	-	-	-	-	2.49E+9	5.01E+5
Zr-95	3.90E+6	8.58E+5	-	1.23E+6	-	8.95E+8	7.64E+5
Nb-95	4.10E+5	1.59E+5	-	1.50E+5	-	2.95E+8	1.14E+5
Ru-103	1.55E+7	-	-	3.89E+7	-	3.99E+8	5.94E+6
Ru-106	7.45E+8	-	-	1.01E+9	-	1.16E+10	9.30E+7
Ag-110m	3.22E+7	2.17E+7	-	4.05E+7	-	2.58E+9	1.74E+7
Sb-124	3.52E+8	4.57E+6	7.78E+5	-	1.96E+8	2.20E+9	1.23E+8
Sb-125	4.99E+8	3.85E+6	4.62E+5	-	2.78E+8	1.19E+9	1.05E+8
Te-125m	3.51E+8	9.50E+7	9.84E+7	-	-	3.38E+8	4.67E+7
Te-127m	1.32E+9	3.56E+8	3.16E+8	3.77E+9	-	1.07E+9	1.57E+8
Te-129m	8.54E+8	2.39E+8	2.75E+8	2.51E+9	-	1.04E+9	1.33E+8
I-131	1.43E+8	1.44E+8	4.76E+10	2.36E+8	-	1.28E+7	8.18E+7
I-132	9.20E+1	1.69E+2	7.84E+3	2.59E+2	-	1.99E+2	7.77E+1
I-133	3.59E+6	4.44E+6	8.25E+8	7.40E+6	-	1.79E+6	1.68E+6
I-134	1.70E-4	3.16E-4	7.28E-3	4.84E-4	-	2.10E-4	1.46E-4
I-135	6.54E+4	1.18E+5	1.04E+7	1.81E+5	-	8.98E+4	5.57E+4
Cs-134	1.60E+10	2.63E+10	-	8.14E+9	2.92E+9	1.42E+8	5.54E+9
Cs-136	8.06E+7	2.22E+8	-	1.18E+8	1.76E+7	7.79E+6	1.43E+8
Cs-137	2.39E+10	2.29E+10	-	7.46E+9	2.68E+9	1.43E+8	3.38E+9
Ba-140	2.77E+8	2.43E+5	-	7.90E+4	1.45E+5	1.40E+8	1.62E+7
Ce-141	6.35E+5	3.26E+5	-	1.43E+5	-	4.07E+8	4.84E+4
Ce-144	1.27E+8	3.98E+7	-	2.21E+7	-	1.04E+10	6.78E+6
Pr-143	1.48E+5	4.46E+4	-	2.41E+4	-	1.60E+8	7.37E+3
Nd-147	7.16E+4	5.80E+4	-	3.18E+4	-	9.18E+7	4.49E+3

TABLE 2-4: PATHWAY DOSE FACTORS – ATMOSPHERIC RELEASES $R_{(io)}$, GROUND PLANE PATHWAY DOSE FACTORS (Continued)

(m^2 * mrem/yr per uCi/sec)

Nuclide	Any Organ
H-3	-
C-14	-
P-32	-
Cr-51	4.68E+6
Mn-54	1.34E+9
Fe-55	-
Fe-59	2.75E+8
Co-58	3.82E+8
Co-60	2.16E+10
Ni-63	-
Zn-65	7.45E+8
Rb-86	8.98E+6
Sr-89	2.16E+4
Sr-90	-
Y-91	1.08E+6
Zr-95	2.48E+8
Nb-95	1.36E+8
Ru-103	1.09E+8
Ru-106	4.21E+8
Ag-110m	3.47E+9
Te-125m	1.55E+6
Te-127m	9.17E+4
Te-129m	2.00E+7
I-131	1.72E+7
I-132	1.24E+6
I-133	2.47E+6
I-134	4.49E+5
I-135	2.56E+6
Cs-134	6.75E+9
Cs-136	1.49E+8
Cs-137	1.04E+10
Ba-140	2.05E+7
Ce-141	1.36E+7
Ce-144	6.95E+7
Pr-143	-
Nd-147	8.40E+6

APPENDIX A

EVALUATION OF DEFAULT PARAMETERS

FOR LIQUID EFFLUENTS

APPENDIX A: EVALUATION OF DEFAULT PARAMETERS FOR LIQUID EFFLUENTS

A. Effective Maximum Permissible Concentration (MPC_e)

In accordance with the requirements of ODCM CONTROL 3.3.3.8 the radioactive liquid effluent monitors shall be operable with alarm setpoints established to ensure that the concentration of radioactive material at the discharge point does not exceed the MPC value of the "old" 10 CFR 20, Appendix B, Table II, Column 2, (ODCM Appendix F). The determination of allowable radionuclide concentration and corresponding alarm setpoint is a function of the individual radionuclide distribution and corresponding MPC values.

In order to limit the need for routinely having to re-establish the alarm setpoints as a function of changing radionuclide distributions, a default alarm setpoint can be established. This default setpoint can be based on an evaluation of the radionuclide distribution of the liquid effluents from Salem and the effective MPC value for this distribution.

The effective MPC value for a radionuclide distribution is calculated by the equation:

$$MPC_e = \frac{\sum_i C_i \ (gamma)}{\sum_i \frac{C_i}{MPC_i} \ (gamma)}$$

WHERE: MPC_e = An effective MPC value for a mixture of gamma emitting radionuclides (uCi/ml).

C_i = Concentration of radionuclide i in the mixture.

MPC_i = The "old" 10 CFR 20, Appendix B, Table II, Column 2 MPC value for radionuclide i (ODCM Appendix F) (uCi/ml).

The equation for determining the liquid effluent setpoints (Section 1.2.1, equation 1.2) is based on a multiplication of the effective MPC times the monitor sensitivity. Considering the average effective MPC value for the years 1993, 1994, and 1998, it is reasonable to select an MPCe value of 6.05E-06 uCi/ml for Unit 1 and 4.81E-06 uCi/ml for Unit 2 as typical of liquid radwaste discharges.

B. Correction Factor

The type of radiation detector used to monitor radioactive releases is not capable of detecting non-gamma emitting radionuclides such as H-3, Fe-55, Sr-89, and Sr-90, as required by ODCM CONTROL 3.11.1.1. A conservative default safety factor can be determined to account for non-gamma emitting radionuclides. Non-gamma emitting radionuclides are analyzed at Salem station on a monthly basis from a composite sample of liquid releases.

Nuclide	**MPC (uCi/ml)**	**Activity (uCi/ml)**	**Activity/MPC**
H-3	3E-3	5.2E-1	173.3
Fe-55	8E-4	2.5E-3	3.1
Sr-89	3E-6	2.0E-5	6.7
Sr-90	3E-7	7.2E-7	2.4
Total			185.5

The values in the table above represent the maximum reactor coolant values for non-gamma emitting nuclides in 1994 for Unit 1 and 2. Reactor coolant values were chosen to represent the maximum concentration of non-gamma emitting nuclides that could be released from Salem Station. The activity values in the table will be diluted by a minimum factor of 800 prior to release. The minimum dilution factor is obtained by using the minimum circulating water flowrate of 100,000 gpm and the maximum release rate of 120 gpm.

A conservative non-gamma factor for non-gamma emitting nuclides can be obtained using the highest Activity/MPC fraction and the minimum dilution factor as follows:

Non-Gamma Factor = 185.5 / 800 = 0.23 (Rounded up to 0.25)

Correction Factor = 1 - 0.25 = 0.75

C. Default setpoint determination:

Using the information and parameters described above a default setpoint can be calculated for Unit 1 and 2 liquid radwaste disposal process radiation monitors (R18).

Using these values to calculate the default R18 alarm setpoint value, results in a setpoint that:

1. Will not require frequent re-adjustment due to minor variations in the nuclide distribution which are typical of routine plant operations, and

2. Will provide for a liquid radwaste discharge rate (as evaluated for each batch release) that is compatible with plant operations (refer to Tables 1-1.1 and 1-1.2).

TABLE A-1: CALCULATION OF EFFECTIVE MPC - UNIT 1

		Activity Released (Ci)		
NUCLIDE	**MPC* (uCi/ml)**	**1993 CURIES**	**1994 CURIES**	**1998 CURIES**
BE-7	2.00E-03	8.88E-04	ND	ND
NA-24	3.00E-05	6.68E-04	1.62E-04	1.00E-04
CR-51	2.00E-03	5.38E-03	2.02E-03	ND
MN-54	1.00E-04	3.52E-02	1.37E-02	7.16E-04
MN-56	1.00E-04	ND	ND	0.00E+00
FE-59	5.00E-05	4.76E-04	4.84E-03	ND
CO-57	4.00E-04	1.03E-02	3.10E-03	1.78E-05
CO-58	9.00E-05	1.71E+00	6.47E-01	3.39E-02
CO-60	3.00E-05	3.04E-01	1.10E-01	2.42E-02
ZR-95	6.00E-05	3.29E-03	7.13E-04	ND
NB-95	1.00E-04	5.78E-03	1.28E-03	ND
NB-97	9.00E-04	1.27E-03	1.07E-03	4.90E-05
TC-99M	3.00E-03	2.66E-04	ND	ND
SR-89	3.00E-06	ND	ND	2.18E-04
SR-92	6.00E-05	ND	7.32E-06	ND
MO-99	4.00E-05	1.76E-04	1.76E-04	ND
AG-110m	3.00E-05	1.19E-02	1.10E-02	6.58E-05
SN-113	8.00E-05	7.88E-05	4.91E-05	ND
SB-122	3.00E-05	1.21E-03	5.35E-04	1.12E-03
SB-124	2.00E-05	2.08E-02	1.75E-02	1.73E-02
SB-125	1.00E-04	9.04E-02	8.23E-02	3.56E-02
SB-126	3.00E-06	ND	6.18E-05	2.23E-04
I-131	3.00E-07	1.27E-01	1.82E-02	2.32E-03
I-133	1.00E-06	2.16E-03	1.88E-04	8.32E-06
I-134	2.00E-05	ND	3.63E-04	ND
CE-141	9.00E-05	ND	4.24E-05	ND
CE-143	4.00E-05	5.42E-05	ND	ND
CS-134	9.00E-06	3.54E-01	6.46E-01	2.49E-02
CS-136	6.00E-05	3.61E-03	1.59E-03	ND
CS-137	2.00E-05	4.53E-01	8.54E-01	7.51E-02
CS-138	3.00E-06	4.15E-06	1.35E-04	ND
BA-140	2.00E-05	ND	8.62E-05	ND
LA-140	2.00E-05	2.12E-04	1.86E-04	ND
RU-105	1.00E-04	2.21E-04	1.35E-04	ND
RU-106	1.00E-05	ND	1.03E-03	ND
ZN-65	1.00E-04	6.72E-04	ND	ND
Total Ci	Gamma	**3.14E+00**	**2.42E+00**	**2.16E-01**
MPCe	(uCi/ml)	**6.05E-06**	**1.28E-05**	**1.28E-05**

* MPC value for unrestricted area from the "old" 10 CFR 20, Appendix B, Table II, Column 2, [ODCM Appendix F].

ND - not detected.

TABLE A-2: CALCULATION OF EFFECTIVE MPC - UNIT 2

		Activity Released (Ci)		
NUCLIDE	**MPC* (uCi/ml)**	**1993 CURIES**	**1994 CURIES**	**1998 CURIES**
BE-7	2.00E-03	1.59E-03	2.88E-04	ND
NA-24	3.00E-05	1.05E-03	5.77E-05	7.39E-05
CR-51	2.00E-03	4.39E-03	1.55E-03	1.14E-04
MN-54	1.00E-04	3.73E-02	1.37E-02	7.54E-04
MN-56	1.00E-04	ND	ND	4.66E-05
FE-59	5.00E-05	4.83E-04	3.25E-03	ND
CO-57	4.00E-04	1.17E-02	3.24E-03	ND
CO-58	9.00E-05	1.75E+00	6.60E-01	4.52E-02
CO-60	3.00E-05	3.47E-01	1.03E-01	2.12E-02
ZR-95	6.00E-05	2.34E-03	3.22E-04	ND
NB-95	1.00E-04	3.97E-03	1.11E-03	ND
NB-97	9.00E-04	1.46E-03	1.10E-03	4.22E-05
TC-99M	3.00E-03	3.77E-04	ND	2.35E-06
SR-89	3.00E-06	ND	ND	2.71E-04
SR-92	6.00E-05	ND	1.43E-05	ND
MO-99	4.00E-05	ND	ND	ND
AG-110m	3.00E-05	1.03E-02	1.34E-02	ND
SN-113	8.00E-05	7.45E-05	ND	ND
SB-122	3.00E-05	1.20E-03	ND	6.37E-04
SB-124	2.00E-05	3.77E-02	9.82E-03	1.44E-02
SB-125	1.00E-04	1.35E-01	6.03E-02	1.88E-02
SB-126	3.00E-06	3.51E-04	ND	1.97E-04
I-131	3.00E-07	1.87E-01	7.98E-03	3.14E-03
I-132	8.00E-06	8.72E-05	ND	1.68E-04
I-134	2.00E-05	2.39E-04	1.85E-04	ND
CE-141	9.00E-05	ND	2.87E-05	ND
CE-143	4.00E-05	ND	ND	ND
CS-134	9.00E-06	4.57E-01	6.44E-01	2.64E-02
CS-136	6.00E-05	4.82E-03	1.51E-03	ND
CS-137	2.00E-05	5.70E-01	8.54E-01	7.97E-02
CS-138	3.00E-06	ND	ND	4.90E-05
BA-140	2.00E-05	ND	ND	ND
LA-140	2.00E-05	2.03E-03	1.11E-04	ND
RU-105	1.00E-04	4.07E-05	ND	ND
RU-106	1.00E-05	ND	4.38E-04	ND
ZN-65	1.00E-04	1.59E-04	ND	ND
W-187	6.00E-05	ND	7.98E-05	ND
Total Ci	Gamma	**3.57E+00**	**2.38E+00**	**2.31E-01**
MPCe	(uCi/ml)	**4.81E-06**	**1.55E-05**	**1.12E-05**

* MPC value for unrestricted area from the "old" 10 CFR 20, Appendix B, Table II, Column 2, [ODCM Appendix F].
ND = not detected.

APPENDIX B

TECHNICAL BASIS FOR SIMPLIFIED DOSE CALCULATIONS

LIQUID RADIOACTIVE EFFLUENT

APPENDIX B: TECHNICAL BASIS FOR SIMPLIFIED DOSE CALCULATIONS - LIQUID EFFLUENTS

The radioactive liquid effluents for the years 1993, 1994, and 1998 were evaluated to determine the dose contribution of the radionuclide distribution. These were the most recent years of full power operation for both Units. This analysis was performed to evaluate the use of a limited dose analysis for determining environmental doses, providing a simplified method of determining compliance with the dose limits of ODCM CONTROL 3.11.1.2.

For the radionuclide distribution of effluents from Salem, the controlling organ is typically the GI-LLI. The calculated GI-LLI dose is predominately a function of the Fe-55, Co-58, Co-60, Fe-59 and Ag-110m releases. The radionuclides, Cs-134 and Cs-137 contribute the large majority of the calculated total body dose. The results of the evaluation for 1993, 1994, and 1998 are presented in Table B-1 and Table B-2.

For purposes of simplifying the details of the dose calculational process, it is conservative to identify a controlling, dose significant radionuclide and limit the calculation process to the use of the dose conversion factor for this nuclide. Multiplication of the total release (i.e., cumulative activity for all radionuclides) by this dose conversion factor provides for a dose calculation method that is simplified while also being conservative.

For the evaluation of the maximum organ dose, it is conservative to use the Nb-95 dose conversion factor (1.51 E+06 mrem/hr per uCi/ml, GI-LLI). By this approach, the maximum organ dose will be overestimated since this nuclide has the highest organ dose factor of all the radionuclides evaluated.

For the total body calculation, the Fe-59 dose factor (7.27E+04 mrem/hr per uCi/ml, total body) is the highest among the identified dominant nuclides. For evaluating compliance with the dose limits of ODCM CONTROL 3.11.1.2, the following simplified equations may be used:

<u>Total Body</u>

$$D_{tb} = \frac{1.67\text{E-}02 * VOL}{CW} * A_{Fe-59,TB} * \sum_i C_i \qquad \textbf{(B.1)}$$

WHERE:

D_{tb}	=	Dose to the total body (mrem).
$A_{Fe\text{-}59,TB}$	=	7.27E+04, total body ingestion dose conversion factor for Fe-59 (mrem/hr per uCi/ml).
VOL	=	Volume of liquid effluent released (gal).
C_i	=	Total concentration of all radionuclides (uCi/ml).
CW	=	Average circulating water discharge rate during release period(gal/min).
1.67E-02	=	Conversion factor (hr/min).

Substituting the value for the Fe-59 total body dose conversion factor, the equation simplifies to:

$$D_{tb} = \frac{1.21\text{E}+03 * VOL}{CW} * \sum_i C_i \tag{B.2}$$

Maximum Organ

$$D_{\max} = \frac{1.67\text{E}-02 * VOL}{CW} * A_{Nb-95,GI-LLI} * \sum_i C_i \tag{B.3}$$

WHERE: D_{max} = Maximum organ dose (mrem).

$A_{Nb-95,GI-LLI}$ = 1.51E+06, Gi-LLI ingestion dose conversion factor for Nb-95 (mrem/hr per uCi/ml)

Substituting the value for $A_{Nb-95,GI-LLI}$ the equation simplifies to:

$$D_{\max} = \frac{2.52\text{E}+04 * VOL}{CW} * \sum_i C_i \tag{B.4}$$

Tritium is not included in the limited analysis dose assessment for liquid releases, because the potential dose resulting from normal reactor releases is relatively negligible. The average annual tritium release from each Salem Unit is approximately 350 curies. The calculated total body dose from such a release is 2.4E-03 mrem/yr via the fish and invertebrate ingestion pathways. This amounts to 0.08% of the design limit dose of 3 mrem/yr. Furthermore, the release of tritium is a function of operating time and power level and is essentially unrelated to radwaste system operation.

TABLE B-1: ADULT DOSE CONTRIBUTIONS - FISH AND INVERTEBRATE PATHWAYS – UNIT 1

Nuclide	Release (Ci)			T.Body Dose Fraction			GI-LLI Dose Fraction			Liver Dose Fraction		
	1994	1993	1998	1994	1993	1998	1994	1993	1998	1994	1993	1998
Mn-54	1.32E-2	3.51E-2	7.16E-4	*	*	*	0.03	0.02	*	*	0.02	*
Fe-55	1.49E-1	6.40E-2	8.39E-2	0.07	0.04	0.37	0.12	0.03	0.52	0.19	0.14	0.67
Fe-59	4.84E-3	4.77E-4	ND	0.02	*	*	0.12	0.01	*	0.03	0.01	*
Co-58	6.47E-1	1.71E+0	3.39E-2	0.05	0.18	0.02	0.31	0.51	0.13	0.01	0.07	*
Co-60	1.10E-1	3.04E-1	2.42E-2	0.02	0.09	0.05	0.14	0.24	0.24	*	0.03	0.01
Zn-65	ND	6.72E-4	ND	*	0.01	*	*	0.01	*	*	0.02	*
Nb-95	1.28E-3	5.78E-3	ND	*	*	*	*	0.01	*	*	*	*
Ag-110m	1.10E-2	1.19E-2	6.58E-5	*	*	*	0.26	0.17	0.01	*	*	*
Sb-124	1.75E-2	2.58E-2	1.73E-2	*	*	*	*	*	0.04	*	*	*
Sb-125	8.23E-2	9.04E-2	3.56E-2	*	*	*	*	*	0.02	*	*	*
Cs-134	6.46E-1	3.54E-1	2.49E-2	0.47	0.38	0.18	*	*	*	0.38	0.37	0.09
Cs-137	8.54E-1	4.53E-1	7.51E-2	0.37	0.28	0.32	*	*	*	0.37	0.35	0.20
Total	2.53E+0	3.21E+0	3.31E-1									

* Less than 0.01

ND = not detected

TABLE B-2: ADULT DOSE CONTRIBUTIONS - FISH AND INVERTEBRATE PATHWAYS - UNIT 2

Nuclide	Release (Ci)			T.Body Dose Fraction			GI-LLI Dose Fraction			Liver Dose Fraction		
	1994	1993	1998	1994	1993	1998	1994	1993	1998	1994	1993	1998
Mn-54	1.37E-2	3.73E-2	7.54E-4	*	*	*	0.01	0.02	*	*	0.01	*
Fe-55	1.38E-1	6.61E-2	1.64E-2	0.06	0.04	0.10	0.10	0.03	0.18	0.18	0.12	0.27
Fe-59	3.25E-3	4.82E-4	ND	0.01	*	*	0.08	0.01	*	0.02	*	*
Co-58	6.60E-1	1.75E+0	4.52E-2	0.05	0.16	0.04	0.29	0.51	0.29	0.01	0.06	0.01
Co-60	1.03E-1	3.47E-1	2.12E-2	0.02	0.09	0.06	0.12	0.27	0.37	0.01	0.03	0.02
Zn-65	ND	1.59E-4	ND	*	*	*	*	*	*	*	*	*
Nb-95	1.11E-3	3.97E-3	ND	*	*	*	0.06	0.01	*	*	*	*
Ag-110m	1.34E-2	1.03E-2	ND	*	*	*	0.31	0.14	*	*	*	*
Sb-124	9.82E-3	3.77E-2	1.44E-2	*	*	*	*	0.01	0.06	*	*	*
Sb-125	6.03E-2	1.35E-1	1.88E-2	*	*	*	*	0.01	0.02	*	*	*
Cs-134	6.44E-1	4.58E-1	2.64E-2	0.48	0.41	0.26	0.01	*	*	0.39	0.40	0.20
Cs-137	8.54E-1	5.70E-1	7.97E-2	0.37	0.30	0.46	*	*	*	0.38	0.36	0.45
Total	2.48E+0	3.65E+0	2.23E-1									

* Less than 0.01

ND = not detected

APPENDIX C

TECHNICAL BASES FOR EFFECTIVE DOSE FACTORS

GASEOUS RADIOACTIVE EFFLUENT

APPENDIX C: TECHNICAL BASES FOR EFFECTIVE DOSE FACTORS - GASEOUS EFFLUENTS

A. Overview

The evaluation of doses due to releases of radioactive material to the atmosphere can be simplified by the use of effective dose transfer factors instead of using dose factors which are radionuclide specific.

These effective factors, which can be based on typical radionuclide distributions of releases, can be applied to the total radioactivity released to approximate the dose in the environment (i.e., instead of having to perform individual radionuclide dose analyses only a single multiplication (K_{eff}, M_{eff} or N_{eff}) times the total quantity of radioactive material released would be needed).

This approach provides a reasonable estimate of the actual dose while eliminating the need for a detailed calculational technique.

B. Determination of Effective Dose Factors

Effective dose transfer factors are calculated by the following equations:

$$K_{eff} = \sum_i (K_i * f_i) \qquad \textbf{(C.1)}$$

WHERE: K_{eff} = The effective total body dose factor due to gamma emissions from all noble gases released.

K_i = The total body dose factor due to gamma emissions from each noble gas radionuclide i released.

f_i = The fractional abundance of noble gas radionuclide i relative to the total noble gas activity.

$$(L_i + 1.1M_i)_{eff} = \sum_i \left[(L_i + 1.1M_i) * f\right] \qquad \textbf{(C.2)}$$

WHERE: $(L + 1.1\ M)_{eff}$ = The effective skin dose factor due to beta and gamma emissions from all noble gases released.

$(L_i + 1.1\ M_i)$ = The skin dose factor due to beta and gamma emissions from each noble gas radionuclide i released.

$$M_{eff} = \sum_i (M_i * f_i) \qquad \textbf{(C.3)}$$

WHERE: M_{eff} = The effective air dose factor due to gamma emissions from all noble gases released.

M_i = The air dose factor due to gamma emissions from each noble gas radionuclide i released.

$$N_{eff} = \sum_i (N_i * f_i) \qquad \textbf{(C.4)}$$

WHERE: N_{eff} = The effective air dose factor due to beta emissions from all noble gases released.

N_i = The air dose factor due to beta emissions from each noble gas radionuclide i released.

Normally, it would be expected that past radioactive effluent data would be used for the determination of the effective dose factors. However, the noble gas releases from Salem have been maintained to such negligible quantities that the inherent variability in the data makes any meaningful evaluations difficult.

Therefore, in order to provide a reasonable basis for the derivation of the effective noble gas dose factors, the primary coolant source term from ANSI N237-1976/ANS-18.1, "Source Term Specifications," has been used as representing a typical distribution. The effective dose factors as derived are presented in Table C-1.

C. Application

To provide an additional degree of conservatism, a factor of 0.50 is introduced into the dose calculational process when the effective dose transfer factor is used. This conservatism provides additional assurance that the evaluation of doses by the use of a single effective factor will not significantly underestimate any actual doses in the environment.

For evaluating compliance with the dose limits of ODCM CONTROL 3.11.2.2, the following simplified equations may be used:

$$D\gamma = \frac{3.17\text{E-}08}{0.50} * \chi/Q * M_{eff} * \sum_i Q_i \tag{C.5}$$

and

$$D\beta = \frac{3.17\text{E-}08}{0.50} * \chi/Q * N_{eff} * \sum_i Q_i \tag{C.6}$$

WHERE:

D_γ	=	Air dose due to gamma emissions for the cumulative release of all noble gases (mrad).
D_β	=	Air dose due to beta emissions for the cumulative release of all noble gases (mrad).
X/Q	=	Atmospheric dispersion to the controlling site boundary (sec/m^3).
M_{eff}	=	5.3E+02, effective gamma-air dose factor (mrad/yr per uCi/m^3).
N_{eff}	=	1.1E+03, effective beta-air dose factor (mrad/yr per uCi/m^3).
Q_i	=	Cumulative release for all noble gas radionuclides (uCi).
3.17E-08	=	Conversion factor (yr/sec).
0.50	=	Conservatism factor to account for the variability in the effluent data.

Combining the constants, the dose calculational equations simplify to:

$$D_\gamma = 3.5\text{E-}05 * \chi/Q * \sum_i Q_i \tag{C.7}$$

and

$$D_\beta = 7.0\text{E-}05 * \chi/Q * \sum_i Q_i \tag{C.8}$$

The effective dose factors are used on a very limited basis for the purpose of facilitating the timely assessment of radioactive effluent releases, particularly during periods of computer malfunction where a detailed dose assessment may be unavailable.

TABLE C-1: EFFECTIVE DOSE FACTORS NOBLE

Total Body and Skin Dose

Radionuclide	f_i*	**Total Body Effective Dose Factor (K_{eff}) (mrem/yr per uCi/m^3)**	**Skin Effective Dose Factor ($L + 1.1\ M_{eff}$) (mrem/yr per uCi/m^3)**
Kr-83m	0.01	--	1.4E+01
Kr-88	0.01	1.5E+02	1.9E+02
Xe-133m	0.01	2.5E+00	1.4E+01
Xe-133	0.95	2.8E+02	6.6E+02
Xe-135	0.02	3.6E+01	7.9E+01
Total		4.7E+02	9.6E+02

Noble Gases - Air

Radionuclide	f_i	**Gamma Air Effective Dose Factor (M_{eff}) (mrad/yr per uCi/m^3)**	**Beta Air Effective Dose Factor (N_{eff}) (mrad/yr per uCi/m^3)**
Kr-85	0.01	--	2.0E+01
Kr-88	0.01	1.5E+02	2.9E+01
Xe-133m	0.01	3.3E+00	1.5E+01
Xe-133	0.95	3.4E+02	1.0E+03
Xe-135	0.02	3.8E+01	4.9E+01
Total		5.3E+02	1.1E+03

* Based on Noble gas distribution from ANSI N237-1976/ANSI-18.1, "Source Term Specifications."

APPENDIX D

TECHNICAL BASIS FOR SIMPLIFIED DOSE CALCULATION

GASEOUS RADIOACTIVE EFFLUENT

APPENDIX D: TECHNICAL BASIS FOR SIMPLIFIED DOSE CALCULATION - GASEOUS EFFLUENTS

The pathway dose factors for the controlling infant age group were evaluated to determine the controlling pathway, organ and radionuclide. This analysis was performed to provide a simplified method for determining compliance with ODCM CONTROL 3.11.2.3

For the infant age group, the controlling pathway is the grass-cow-milk (g/c/m) pathway. An infant receives a greater radiation dose from the g/c/m pathway than any other pathway. Of this g/c/m pathway, the maximum exposed organ including the total body, is the thyroid, and the highest dose contributor is radionuclide I-131. The results for this evaluation are presented in Table D-1.

For purposes of simplifying the details of the dose calculation process, it is conservative to identify a controlling, dose significant organ and radionuclide and limit the calculation process to the use of the dose conversion factor for the organ and radionuclide. Multiplication of the total release (i.e., cumulative activity for all radionuclides) by this dose conversion factor provides for a dose calculation method that is simplified while also being conservative.

For the evaluation of the dose commitment via a controlling pathway and age group, it is conservative to use the infant, g/c/m, thyroid, I-131 pathway dose factor (1.05E12 m^2 mrem/yr per uCi/sec). By this approach, the maximum dose commitment will be overestimated since I-131 has the highest pathway dose factor of all radionuclides evaluated.

For evaluating compliance with the dose limits of ODCM CONTROL 3.11.2.3, the following simplified equation may be used:

$$D_{\max} = 3.17\text{E-}08 * W * R_{I-131} * \sum_i Q_i$$

WHERE: D_{max} = Maximum organ dose (mrem).

W = Atmospheric dispersion parameters to the controlling location(s) as identified in Table 2-3.

X/Q = Atmospheric dispersion for inhalation pathway and H-3 dose contribution via other pathways (sec/m^3).

D/Q = Atmospheric deposition for vegetation, milk and ground plane exposure pathways (m^{-2}).

Q_i = Cumulative release over the period of interest for radioiodines and particulates.

3.17E-8 = Conversion factor (yr/sec).

R_{I-131} = I-131 dose parameter for the thyroid for the identified controlling pathway.

= 1.05E+12 (m^2 mrem/yr per uCi/sec), infant thyroid dose parameter with the grass-cow-milk pathway controlling.

The ground plane exposure and inhalation pathways need not be considered when the above simplified calculation method is used because of the overall negligible contribution of these pathways to the total thyroid dose.

It is recognized that for some particulate radionuclides (e.g., Co-60 and Cs-137), the ground exposure pathway may represent a higher dose contribution than either the vegetation or milk pathway. However, use of the I-131 thyroid dose parameter for all radionuclides will maximize the organ dose calculation, especially considering that no other radionuclide has a higher dose parameter for any organ via any pathway than I-131 for the thyroid via the milk pathway (see Table D-1).

The dose should be evaluated based on the predetermined controlling pathways as identified in Table 2-3. If more limiting pathways in the surrounding environment of Salem are identified by the annual land use census, Table 2-3 will be revised as specified in ODCM CONTROL 3.12.2.

TABLE D-1: INFANT DOSE CONTRIBUTIONS – FRACTION OF TOTAL ORGAN AND BODY DOSE

PATHWAY

Target Organs	Grass – Cow – Milk	Ground Plan
Total Body	0.02	0.15
Bone	0.23	0.14
Liver	0.09	0.15
Thyroid	0.59	0.15
Kidney	0.02	0.15
Lung	0.01	0.14
GI-LLI	0.02	0.15

FRACTION OF DOSE CONTRIBUTION BY PATHWAY

Pathway	f
Grass – Cow – Milk	0.92
Ground Plane	0.08
Inhalation	N.A

APPENDIX E

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SAMPLE TYPE, LOCATION AND ANALYSIS

APPENDIX E: RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SAMPLE DESIGNATION

Samples locations are identified by a three part code. 1) The first two letters are the program identification code. Because of the proximity of the Salem and Hope Creek Stations, a common environmental surveillance program is conducted. The identification code, "SA", has been applied to Salem and Hope Creek stations. 2) The next three letters identify the media sampled.

AIO = Air Iodine	IDM = Immersion Dose (TLD)
APT = Air Particulate	MLK = Milk
ECH = Hard Shell Blue Crab	PWR = Potable Water (Raw)
ESF = Edible Fish	PWT = Potable Water (Treated)
ESS = Sediment	SOL = Soil
FPL = Green Leaf Vegetables	SWA = Surface Water
FPV = Vegetables (Various)	VGT = Fodder Crops (Various)
GAM = Game (Muskrat)	WWA= Well Water

3) The last three or four symbols are a location code based on direction and distance from a standard reference point. The reference point is located at the midpoint between the center of the Salem Unit 1 and Salem Unit 2 containments. Of these, the first one or two represent each of the sixteen angular sectors of 22.5 degrees centered about the reactor site. Sector one is divided evenly by the north axis and other sectors are numbered in a clockwise direction as follows:

1 = N	5 = E	9 = S	13 = W
2 = NNE	6 = ESE	10 = SSW	14 = WNW
3 = NE	7 = SE	11 = SW	15 = NW
4 = ENE	8 = SSE	12 = WSW	16= NNW

The next digit is a letter which represents the radial distance from the reference point:

S = On-site location	E = 4-5 miles off-site
A = 0-1 miles off-site	F = 5-10 miles off-site
B = 1-2 miles off-site	G = 10-20 miles off-site
C = 2-3 miles off-site	H = >20 miles off-site
D = 3-4 miles off-site	

The last number is the station numerical designation within each sector and zone; e.g. 1,2,3,...etc. For example, the designation SA-WWA-3E1 would indicate a sample in the Salem and Hope Creek program (SA) consisting of well water (WWA) which was collected in sector number 3, centered at 45 degrees (north east) with respect to the midpoint between Salem 1 and 2 containments at a radial distance of 4 to 5 miles offsite, (therefore, radial distance E). The number 1 indicates that this is sampling station number 1 in that particular sector.

SAMPLING LOCATIONS

All sampling locations and specific information about the individual locations are given here in Table E-1. Maps E-1, E-2, and E-3 show the locations of sampling stations with respect to the site. Not all stations in Table E-1 are required sample locations. Some of the stations identified in Table E-1 are used for management audit samples. Minimum sampling requirements are specified in Table 3.12-1.

TABLE E-1: REMP SAMPLE LOCATIONS

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
A. Direct Radiation Monitoring Locations (IDM)			
1S1	0.56 mi. N	39.47103333	-75.53698333
2S2	0.42 mi. NNE	39.4685	-75.53318333
2S4	0.61 mi. NNE; in the equipment laydown area	39.47071667	-75.53075
3S1	0.61 mi. NE	39.46901667	-75.52796667
4S1	0.63 mi ENE; access road near intersection to TB-02	39.46705	-75.52573333
5S1	0.89 mi. E; site access road	39.46113333	-75.51978333
6S2	0.24 mi. ESE; area around helicopter pad	39.46198333	-75.53186667
7S1	0.14 mi. SE	39.46168333	-75.53411667
8S1	0.15mi. SSE; fuel oil storage	39.46138333	-75.53428333
9S1	0.18mi. S; fuel oil storage	39.4606	-75.53485
10S1	0.09 mi. SSW; circulating water building.	39.46166667	-75.536
11S1	0.08 mi. SW; service water building.	39.46198333	-75.53708333
12S1	0.06 mi. WSW; outside security fence	39.4626	-75.53726667
13S1	0.09 mi. W; outside security fence	39.46335	-75.53778333
14S1	0.16 mi. NNW; outside security fence	39.46476667	-75.53796667
15S1	0.54 mi. NW; near river and barge slip	39.46935	-75.54208333
15S2	0.57 mi NW, near Hope Creek barge slip	39.46988333	-75.54216667
16S1	0.56 mi. NNW; on road near fuel oil storage tank	39.47033333	-75.54046667
16S2	0.58 mi. NNW; near security firing range	39.47125	-75.5381
16S3	0.87 mi NNW, Consolidated Spoils Facility	39.47451667	-75.54283333
4D2	3.97 mi. ENE; Alloway Creek Neck Road	39.4882	-75.46958333
5D1	3.50 mi. E; local farm	39.47326667	-75.47223333
10D1	3.89 mi. SSW; Taylor's Bridge Spur	39.41021667	-75.56221667
14D1	3.43 mi. WNW; Bay View, Delaware	39.48766667	-75.59201667

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
A. Direct Radiation Monitoring Locations (IDM) (Continued)			
15D1	3.87 mi. NW; Rt 9, Augustine Beach, Delaware	39.50208333	-75.588
2E1	4.43 mi. NNE; local farm	39.523	-75.50713333
3E1	4.13 mi. NE; local farm	39.50163333	-75.47743333
11E2	4.97 mi. SW; Route 9	39.40546667	-75.59243333
12E1	4.40 mi. WSW; Thomas Landing	39.4477	-75.61613333
13E1	4.07 mi. W; Diehl House Lab	39.46648333	-75.61225
16E1	4.05 mi. NNW; Port Penn	39.5127	-75.57633333
1F1	5.73 mi. N; Fort Elfsborg	39.54488333	-75.51873333
2F2	8.51 mi. NNE; Salem Substation	39.5748	-75.46938333
2F5	7.29 mi. NNE; Salem High School	39.55746667	-75.47523333
2F6	7.45 mi. NNE; PSEG EERC Salem New Jersey	39.56188333	-75.48031667
3F2	5.10 mi. NE; Hancocks Bridge, New Jersey Municipal Building	39.50683333	-75.45963333
3F3	8.66 mi. NE; Quinton Township Elementary School New Jersey	39.5436	-75.41225
4F2	5.98 mi. ENE; Mays Lane, Harmersville, New Jersey	39.49921667	-75.4346
5F1	6.40 mi. E; Canton, New Jersey	39.47266667	-75.41718333
6F1	6.46 mi. ESE; Stow Neck Road	39.43993333	-75.41913333
7F2	8.96 mi. SE; Bayside, New Jersey	39.38285	-75.40435
8F1	9.61 mi. SE; Woodland Beach, Delaware	39.33221667	-75.47438333
9F1	5.49 mi. S; off Route 9, Delaware	39.38403333	-75.54916667
10F2	5.73 mi. SSW; Route 9, Delaware	39.3839	-75.5692
11F1	5.97 mi. SW; Taylors Bridge, Delaware	39.41276667	-75.6272
12F2	9.35 mi. WSW; Townsend Elementary School, Delaware	39.3963	-75.68851667

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
A. Direct Radiation Monitoring Locations (IDM) (Continued)			
13F2	6.44 mi. W; Odessa, Delaware	39.45495	-75.6562
13F3	9.26 mi. W; Redding Middle School, Middletown, Delaware	39.45358333	-75.70905
13F4	9.80 mi. W; Middletown, Delaware	39.44761667	-75.71851667
14F2	6.62 mi. WNW; Route 13 and Boyds Corner Road	39.49965	-75.6507
15F3	5.39 mi. NW	39.51645	-75.60976667
16F2	8.06 mi. NNW; Delaware City Public School	39.5719	-75.59048333
1G3	18.99 mi. N; N. Church Street Wilmington, Delaware	39.73811667	-75.54186667
3G1	16.58 mi. NE; local farm	39.59855	-75.28006667
10G1	11.53 mi. SSW; Smyrna, Delaware	39.30371667	-75.60158333
14G1	13.38 mi. WNW; Route 286, Bethel Church Road., Delaware	39.5215	-75.77491667
16G1	15.09 mi. NNW; Wilmington Airport	39.67728333	-75.59283333
3H1	32.76 mi. NE; National Park, New Jersey	39.85998333	-75.19933333
B. Air Sampling Locations (AIO,APT)			
5S1	0.89 mi. E; site access road	39.46113333	-75.51978333
5S2	0.90 mi. E; site access road (duplicate sample)	39.46086667	-75.51968333
7S2	0.20 mi. SE; old Salem parking lot	39.46171667	-75.53255
15S2	0.57 mi. NW, near Hope Creek barge slip	39.46988333	-75.54216667
5D1	3.50 mi. E; local farm	39.47326667	-75.47223333
16E1	4.05 mi. NNW; Port Penn	39.5127	-75.57633333
1F1	5.73 mi. N; Fort Elfsborg	39.54488333	-75.51873333
2F6	7.45 mi. NNE; PSEG EERC Salem New Jersey	39.56188333	-75.48031667
14G1	13.38 mi. WNW; Route 286, Bethel Church Road, Delaware	39.5215	-75.77491667

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
C. Surface Water Locations (SWA) - Delaware River			
11A1	0.19 mi. SW; Salem outfall area	39.46051135	-75.53809583
11A1a	Alternate 0.15 SE; barge slip area	39.461667	-75.53375
12C1	1.81 mi. WSW; West bank of Delaware River	39.45366667	-75.568
12C1a	Alternate 3.71 mi. WSW at the tip of Augustine Beach Boat Ramp	39.50472222	-75.58
7E1	4.42 mi. SE; 1.0 mi. west of Mad Horse Creek	39.418	-75.47733333
7E1a	Alternate 9.27 mi SE end of Bayside Road	39.37616667	-75.404
1F2	7.28 mi. N; midpoint of Delaware River	39.56783333	-75.55166667
16F1	6.89 mi. NNW; C&D Canal	39.55916667	-75.57083333
16F1a	Alternate 6.52 mi. NNW; tip of C&D Canal	39.55566667	-75.55933333
D. Ground Water Locations (WWA)			
3E1	4.13 mi. NE; local farm	39.50163333	-75.47743333
No groundwater samples are required as liquid effluents discharged from Hope Creek and Salem Generating Stations do not directly affect this pathway. However, this location (3E1) is being monitored as a management audit sample			
E. Drinking Water Locations (PWR, PWT)			
2F3	7.85 mi NNE, City of Salem Water and Sewage Dept.	39.55666667	-75.453
No public drinking water samples or irrigation water samples are required as these pathways are not directly affected by liquid effluents discharged from Hope Creek and Salem Generating Stations. However, this location (2F3) is being monitored as a management audit sample			

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
F. Water Sediment Locations (ESS)			
11A1	0.19 mi. SW; Salem outfall area	39.46051135	-75.53809583
15A1	0.65 mi. NW; Hope Creek outfall area	39.4709	-75.5434
16A1	0.64 mi. NNW; south storm drain outfall	39.47066667	-75.543
12C1	1.81 mi. WSW; West bank of Delaware River	39.45366667	-75.568
7E1	4.42 mi. SE; 1.0 mi. west of Mad Horse Creek	39.418	-75.47733333
16F1	6.89 mi. NNW; C&D Canal	39.55916667	-75.57083333
6A1	0.27 mi. ESE; near shoreline	39.461135	-75.531853
G. Milk Sampling Locations (MLK)			
2G3	11.85 mi. NNE, local farm	39.6035	-75.40883333
3G1	16.58 mi. NE; local farm	39.59855	-75.28006667
13E3	4.62 mi W, local farm	39.45283333	-75.62166667
14F4	8.04 mi. WNW; local farm	39.50733333	-75.67533333
H. Fish and Invertebrate Locations (ESF, ECH)			
11A1	0.19 mi. SW; Salem outfall area	39.46051135	-75.53809583
12C1	1.81 mi. WSW; West bank of Delaware River	39.45366667	-75.568
7E1	4.42 mi. SE; 1.0 mi. west of Mad Horse Creek	39.418	-75.47733333

TABLE E-1: REMP SAMPLE LOCATIONS (Continued)

STATION CODE	STATION LOCATION*	LATITUDE	LONGITUDE
		Decimal Degrees	Decimal Degrees
I. Food Product Locations (FPL, FPV)			
1S1	0.56 mi. N	39.47103333	-75.53698333
7S2	0.20 mi. SE; old Salem parking lot	39.46171667	-75.53255
15S2	0.57 mi. NW, near Hope Creek barge slip	39.46988333	-75.54216667
16S1	0.56 mi. NNW; on road near fuel oil storage tank	39.47033333	-75.54046667
10D1	3.89 mi. SSW; Taylor's Bridge Spur	39.41021667	-75.56221667
The Delaware River at the location of Salem and Hope Creek Nuclear Power Plants is a brackish water source. No irrigation of food products is performed using water in the vicinity from which liquid plant wastes have been discharged. However, 12 management audit food samples are collected from various locations			
*All distances and directions for the Station Locations are referenced to the midpoint between the two Salem units' containments. The WGS 84 coordinates for this site center point location are: Latitude N 39° - 27' – 46.5" and Longitude W 75° - 32' – 10.6".			

TABLE E-2: SAMPLES COLLECTION AND ANALYSIS

SAMPLE	COLLECTION METHOD	ANALYSIS
Air Particulate	Continuous low volume air sampler. Sample collected every week along with the filter change.	Gross Beta analysis on each weekly sample. Gamma spectrometry shall be performed if gross beta exceeds10 times the yearly mean of the control station value. Samples shall be analyzed 24 hours or more after collection to allow for radon and thorium daughter decay. Gamma isotopic analysis on quarterly composites.
Air Iodine	A TEDA impregnated charcoal cartridge is connected to air particulate air sampler and is collected weekly at filter change.	Iodine 131 analysis are performed on each weekly sample.
Crab and Fish	Two batch samples are sealed in a plastic bag or jar and frozen semi-annually or when in season.	Gamma isotopic analysis of edible portion on collection.
Sediment	A sediment sample is taken semi-annually.	Gamma isotopic analysis semi-annually.
Direct	2 PD's will be collected from each location quarterly.	Gamma dose quarterly.
Milk	Sample of fresh milk is collected for each farm semi-monthly when cows are in pasture, monthly at other times.	Gamma isotopic analysis and I-131analysis on each sample on collection.
Water (Potable)	Sample to be collected monthly.	Gamma isotopic monthly and H-3 monthly
Water (Surface)	Sample to be collected semi-monthly providing winter icing conditions allow.	Gamma isotopic on monthly composite and H-3 on quarterly composite.

FIGURE E-1: ON-SITE SAMPLING LOCATIONS - LOCATIONS 0 TO 1 MILE

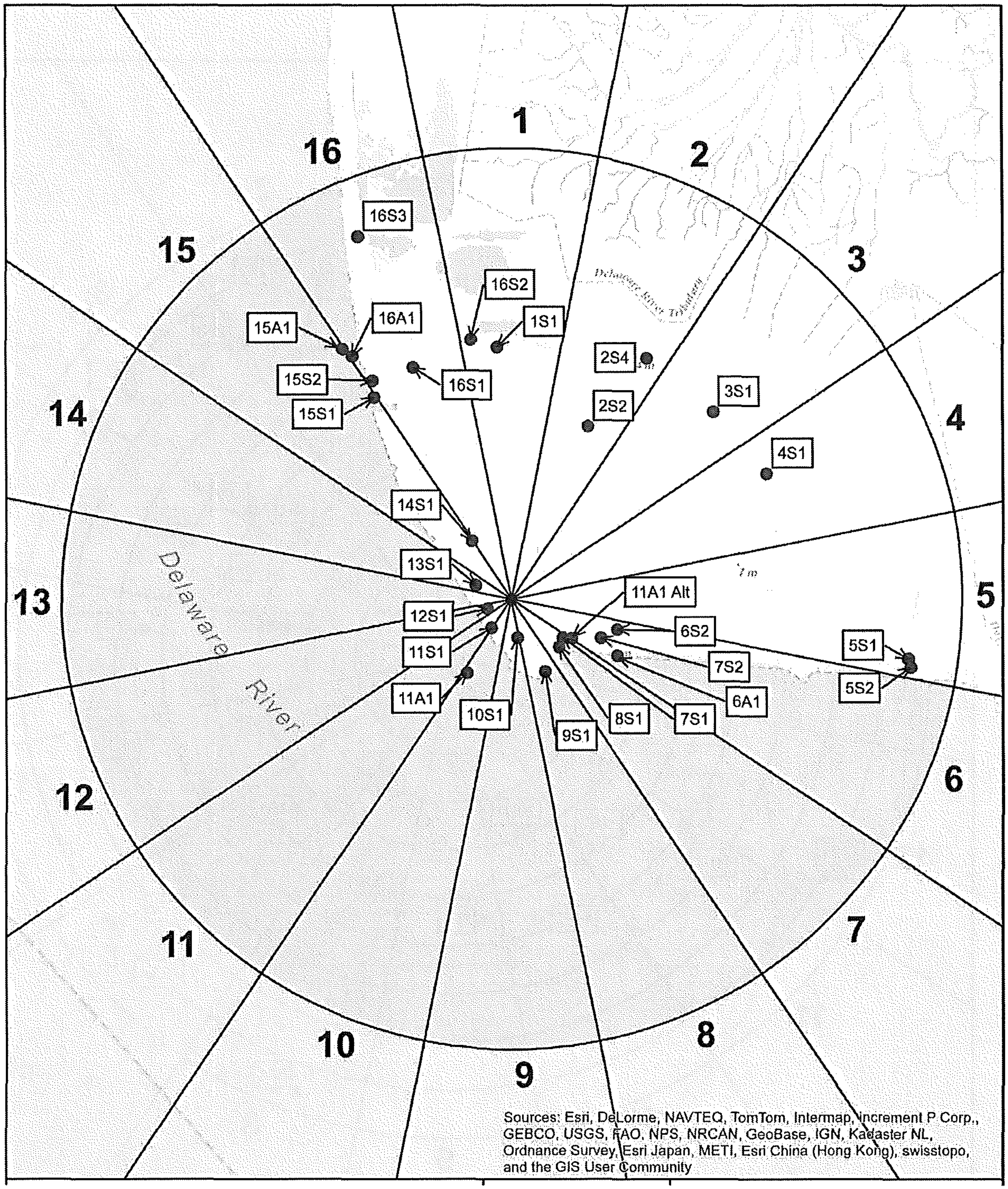


FIGURE E-2: OFF-SITE SAMPLING LOCATIONS - LOCATIONS 1 TO 10 MILES

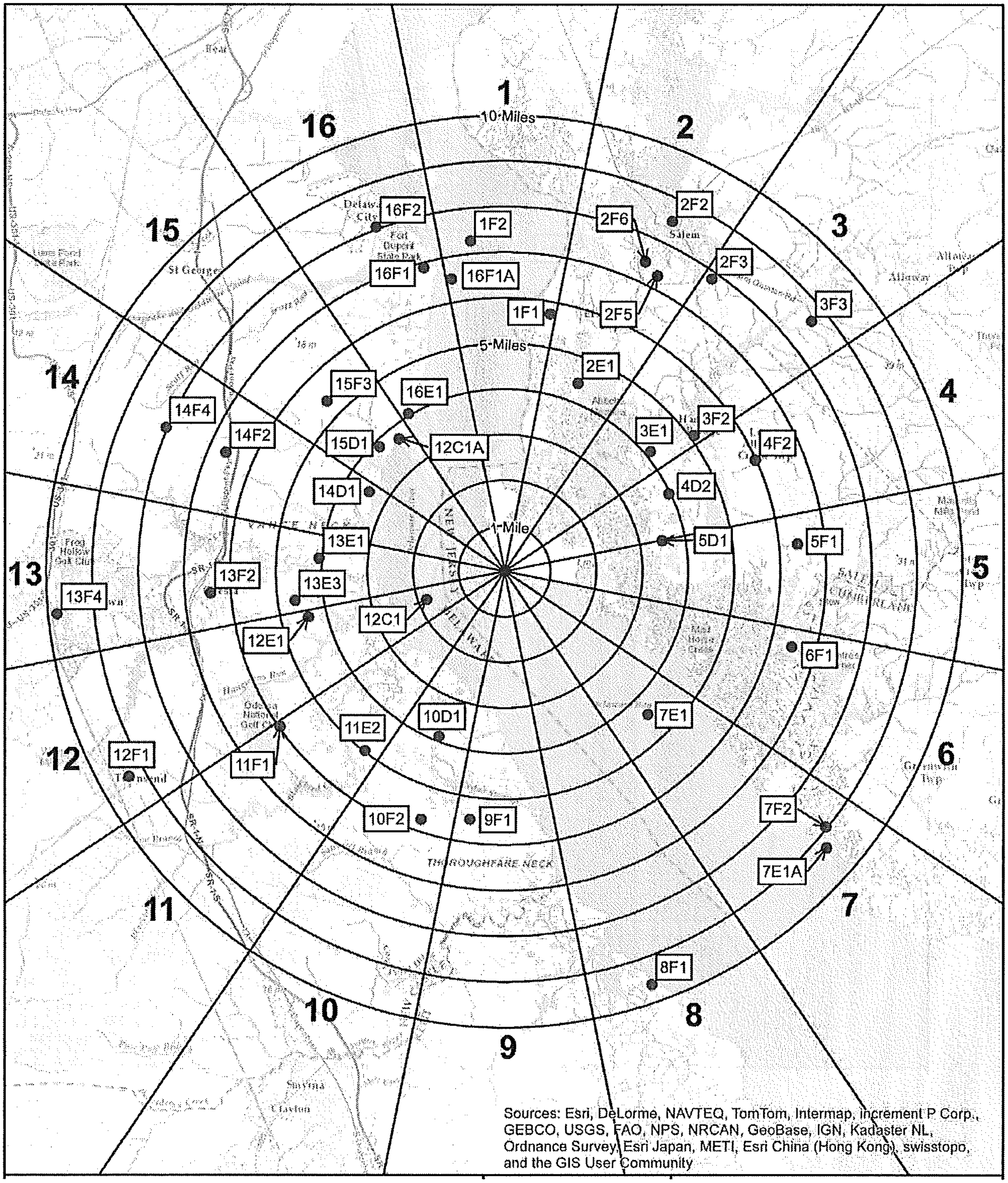
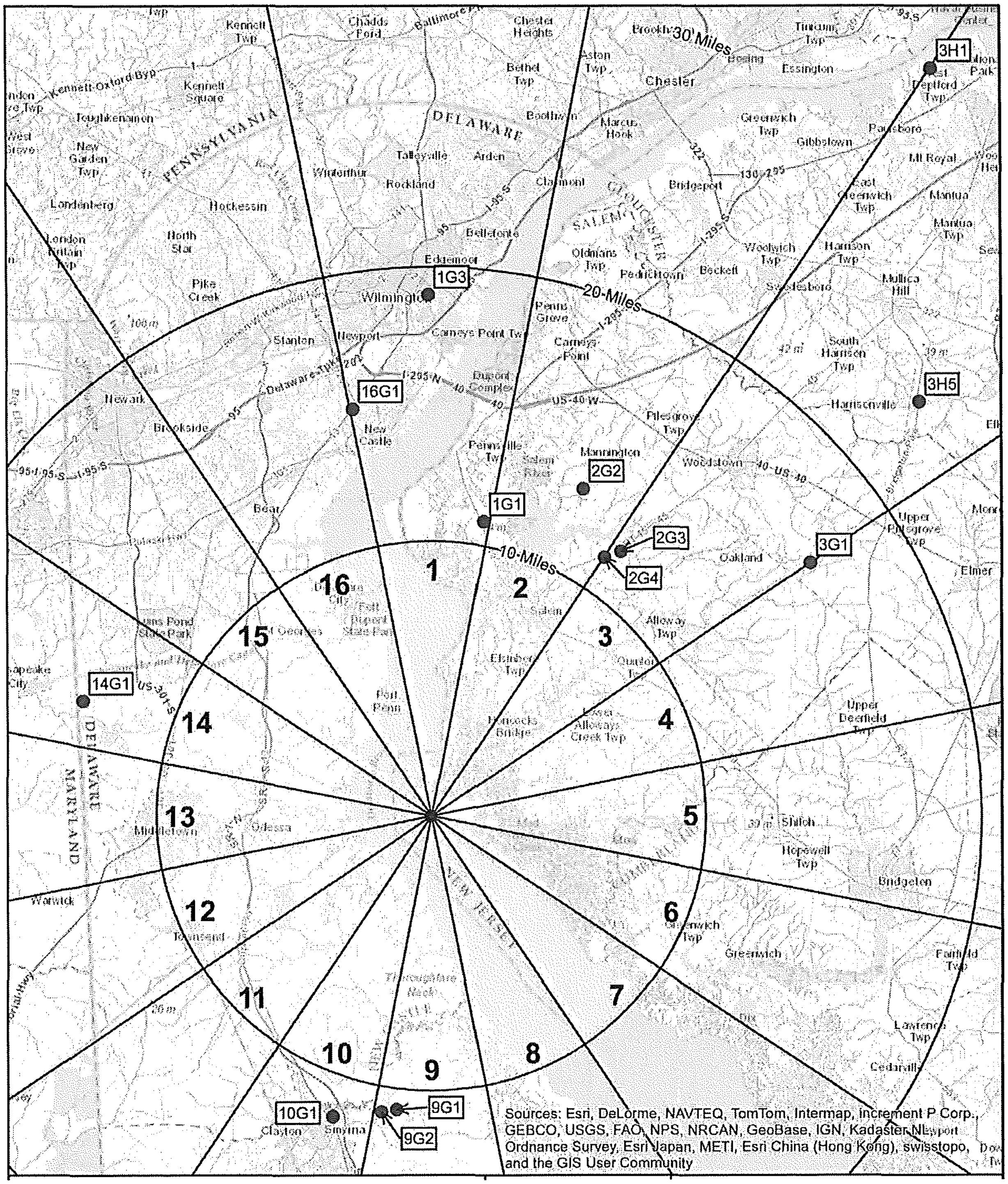


FIGURE E-3: OFF-SITE SAMPLING LOCATIONS - LOCATIONS GREATER THAN 10 MILES



APPENDIX F

MAXIMUM PERMISSIBLE CONCENTRATIONS

LIQUID EFFLUENTS

APPENDIX F: MAXIMUM PERMISSIBLE CONCENTRATION (MPC) VALUES – LIQUID EFFLUENTS

The following radionuclide concentrations were obtained from 10 CFR 20 Appendix B, Table II, Column 2 as revised January 1, 1988 and referred to as the "old" 10 CFR 20.

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS

Element	Isotope	Soluble Conc. (uCi/ml)	Insoluble Conc. (uCi/ml)
Actinium (89)	Ac-227	2E-6	3E-4
	Ac-228	9E-5	9E-5
Americium (95)	Am-241	4E-6	3E-5
	Am-242m	4E-6	9E-5
	Am-242	1E-4	1E-4
	Am-243	4E-6	3E-5
	Am-244	5E-3	5E-3
Antimony (51)	Sb-122	3E-5	3E-5
	Sb-124	2E-5	2E-5
	Sb-125	1E-4	1E-4
	Sb-126	3E-6	3E-6
Arsenic (33)	As-73	5E-4	5E-4
	As-74	5E-5	5E-5
	As-76	2E-5	2E-5
	As-77	8E-5	8E-5
Astatine (85)	At-211	2E-6	7E-5
Barium (56)	Ba-131	2E-4	2E-4
	Ba-140	3E-5	2E-5
Berkelium (97)	Bk-249	6E-4	6E-4
	Bk-250	2E-4	2E-4
Beryllium (4)	Be-7	2E-3	2E-3
Bismuth (83)	Bi-206	4E-5	4E-5
	Bi-207	6E-5	6E-5
	Bi-210	4E-5	4E-5
	Bi-212	4E-4	4E-4
Bromine (35)	Br-82	3E-4	4E-5
	Br-83	3E-6	3E-6
Cadmium (48)	Cd-109	2E-4	2E-4
	Cd-115m	3E-5	3E-5
	Cd-115	3E-5	4E-5
Calcium (20)	Ca-45	9E-6	2E-4
	Ca-47	5E-5	3E-5

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (CONTINUED)

Element	Isotope	Soluble Conc. (uCi/ml)	Insoluble Conc. (uCi/ml)
Californium (98)	Cf-249	4E-6	2E-5
	Cf-250	1E-5	3E-5
	Cf-251	4E-6	3E-5
	Cf-252	7E-6	7E-6
	Cf-253	1E-4	1E-4
	Cf-254	1E-7	1E-7
Carbon (6)	C-14	8E-4	-------
Cerium (58)	Ce-141	9E-5	9E-5
	Ce-143	4E-5	4E-5
	Ce-144	1E-5	1E-5
Cesium (55)	Cs-131	2E-3	9E-4
	Cs-134m	6E-3	1E-3
	Cs-134	9E-6	4E-5
	Cs-135	1E-4	2E-4
	Cs-136	9E-5	6E-5
	Cs-137	2E-5	4E-5
Chlorine (17)	Cl-36	8E-5	6E-5
	Cl-38	4E-4	4E-4
Chromium (24)	Cr-51	2E-3	2E-3
Cobalt (27)	Co-57	5E-4	4E-4
	Co-58m	3E-3	2E-3
	Co-58	1E-4	9E-5
	Co-60	5E-5	3E-5
Copper (29)	Cu-64	3E-4	2E-4
Curium (96)	Cm-242	2E-5	2E-5
	Cm-243	5E-6	2E-5
	Cm-244	7E-6	3E-5
	Cm-245	4E-6	3E-5
	Cm-246	4E-6	3E-5
	Cm-247	4E-6	2E-5
	Cm-248	4E-7	1E-6
	Cm-249	2E-3	2E-3
Dysprosium (66)	Dy-165	4E-4	4E-4
	Dy-166	4E-5	4E-5
Einsteinium (99)	Es-253	2E-5	2E-5
	Es-254m	2E-5	2E-5
	Es-254	1E-5	1E-5
	Es-255	3E-5	3E-5
Erbium (68)	Er-169	9E-5	9E-5
	Er-171	1E-4	1E-4

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (CONTINUED)

Element	Isotope	Soluble Conc. (uCi/ml)	Insoluble Conc. (uCi/ml)
Europium (63)	Eu-152 (9.2 hrs)	6E-5	6E-5
	Eu-152 (13 yrs)	8E-5	8E-5
	Eu-154	2E-5	2E-5
	Eu-155	2E-4	2E-4
Fermium (100)	Fm-254	1E-4	1E-4
	Fm-255	3E-5	3E-5
	Fm-256	9E-7	9E-7
Fluorine (9)	F-18	8E-4	5E-4
Gadolinium (64)	Gd-153	2E-4	2E-4
	Gd-159	8E-5	8E-5
Gallium (31)	Ga-72	4E-5	4E-5
Germanium (32)	Ge-71	2E-3	2E-3
Gold (79)	Au-196	2E-4	1E-4
	Au-198	5E-5	5E-5
	Au-199	2E-4	2E-4
Hafnium (72)	Hf-181	7E-5	7E-5
Holmium (67)	Ho-166	3E-5	3E-5
Hydrogen (3)	H-3	3E-3	3E-3
Indium (49)	In-113m	1E-3	1E-3
	In-114m	2E-5	2E-5
	In-115m	4E-4	4E-4
	In-115	9E-5	9E-5
Iodine (53)	I-125	2E-7	2E-4
	I-126	3E-7	9E-5
	I-129	6E-8	2E-4
	I-130	3E-6	3E-6
	I-131	3E-7	6E-5
	I-132	8E-6	2E-4
	I-133	1E-6	4E-5
	I-134	2E-5	6E-4
	I-135	4E-6	7E-5
Iridium (77)	Ir-190	2E-4	2E-4
	Ir-192	4E-5	4E-5
	Ir-194	3E-5	3E-5
Iron (26)	Fe-55	8E-4	2E-3
	Fe-59	6E-5	5E-5
Lanthanum (57)	La-140	2E-5	2E-5
Lead (82)	Pb-203	4E-4	4E-4
	Pb-210	1E-7	2E-4
	Pb-212	2E-5	2E-5

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (CONTINUED)

Element	Isotope	Soluble Conc. (uCi/ml)	Insoluble Conc. (uCi/ml)
Lutetium (71)	Lu-177	1E-4	1E-4
Manganese (25)	Mn-52	3E-5	3E-5
	Mn-54	1E-4	1E-4
	Mn-56	1E-4	1E-4
Mercury (80)	Hg-197m	2E-4	2E-4
	Hg-197	3E-4	5E-4
	Hg-203	2E-5	1E-4
Molybdenum (42)	Mo-99	2E-4	4E-5
Neodymium (60)	Nd-144	7E-5	8E-5
	Nd-147	6E-5	6E-5
	Nd-149	3E-4	3E-4
Neptunium (93)	Np-237	3E-6	3E-5
	Np-239	1E-4	1E-4
Nickel (28)	Ni-59	2E-4	2E-3
	Ni-63	3E-5	7E-4
	Ni-65	1E-4	1E-4
Niobium (41)	Nb-93m	4E-4	4E-4
	Nb-95	1E-4	1E-4
	Nb-97	9E-4	9E-4
Osmium (76)	Os-185	7E-5	7E-5
	Os-191m	3E-3	2E-3
	Os-191	2E-4	2E-4
	Os-193	6E-5	5E-5
Palladium (46)	Pd-103	3E-4	3E-4
	Pd-109	9E-5	7E-5
Phosphorus (15)	P-32	2E-5	2E-5
Platinum (78)	Pt-191	1E-4	1E-4
	Pt-193m	1E-3	1E-3
	Pt-193	9E-4	2E-3
	Pt-197m	1E-3	9E-4
	Pt-197	1E-4	1E-4
Plutonium (94)	Pu-238	5E-6	3E-5
	Pu-239	5E-6	3E-5
	Pu-240	5E-6	3E-5
	Pu-241	2E-4	1E-3
	Pu-242	5E-6	3E-5
	Pu-243	3E-4	3E-4
Polonium (84)	Po-210	7E-7	3E-5
Potassium (19)	K-42	3E-4	2E-5

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (CONTINUED)

Element	Isotope	Soluble Conc. (uCi/ml)	Insoluble Conc. (uCi/ml)
Praseodymium(59)	Pr-142	3E-5	3E-5
	Pr-143	5E-5	5E-5
Promethium (61)	Pm-147	2E-4	2E-4
	Pm-149	4E-5	4E-5
Protactinium(91)	Pa-230	2E-4	2E-4
	Pa-231	9E-7	2E-5
	Pa-233	1E-4	1E-4
Radium (88)	Ra-223	7E-7	4E-6
	Ra-224	2E-6	5E-6
	Ra-226	3E-8	3E-5
	Ra-228	3E-8	3E-5
Rhenium (75)	Re-183	6E-4	3E-4
	Re-186	9E-5	5E-5
	Re-187	3E-3	2E-3
	Re-188	6E-5	3E-5
Rhodium (45)	Rh-103m	1E-2	1E-2
	Rh-105	1E-4	1E-4
Rubidium (37)	Rb-86	7E-5	2E-5
	Rb-87	1E-4	2E-4
Ruthenium (44)	Ru-97	4E-4	3E-4
	Ru-103	8E-5	8E-5
	Ru-103m	3E-6	3E-6
	Ru-105	1E-4	1E-4
	Ru-106	1E-5	1E-5
Samarium (62)	Sm-147	6E-5	7E-5
	Sm-151	4E-4	4E-4
	Sm-153	8E-5	8E-5
Scandium (21)	Sc-46	4E-5	4E-5
	Sc-47	9E-5	9E-5
	Sc-48	3E-5	3E-5
Selenium (34)	Se-75	3E-4	3E-4
Silicon (14)	Si-31	9E-4	2E-4
Silver (47)	Ag-105	1E-4	1E-4
	Ag-110m	3E-5	3E-5
	Ag-111	4E-5	4E-5
Sodium (11)	Na-22	4E-5	3E-5
	Na-24	2E-4	3E-5

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (CONTINUED)

Element	Isotope	Soluble Conc. (uCi/ml)	Insoluble Conc. (uCi/ml)
Strontium (38)	Sr-85m	7E-3	7E-3
	Sr-85	1E-4	2E-4
	Sr-89	3E-6	3E-5
	Sr-90	3E-7	4E-5
	Sr-91	7E-5	5E-5
	Sr-92	7E-5	6E-5
Sulfur (16)	S-35	6E-5	3E-4
Tantalum (73)	Ta-182	4E-5	4E-5
Technetium (43)	Tc-96m	1E-2	1E-2
	Tc-96	1E-4	5E-5
	Tc-97m	4E-4	2E-4
	Tc-97	2E-3	8E-4
	Tc-99m	6E-3	3E-3
	Tc-99	3E-4	2E-4
Tellurium (52)	Te-125m	2E-4	1E-4
	Te-127m	6E-5	5E-5
	Te-127	3E-4	2E-4
	Te-129m	3E-5	2E-5
	Te-129	8E-4	8E-4
	Te-131m	6E-5	4E-5
	Te-132	3E-5	2E-5
Terbium (65)	Tb-160	4E-5	4E-5
Thallium (81)	Tl-200	4E-4	2E-4
	Tl-201	3E-4	2E-4
	Tl-202	1E-4	7E-5
	Tl-204	1E-4	6E-5
Thorium (90)	Th-227	2E-5	2E-5
	Th-228	7E-6	1E-5
	Th-230	2E-6	3E-5
	Th-231	2E-4	2E-4
	Th-232	2E-6	4E-5
	Th-natural	2E-6	2E-5
	Th-234	2E-5	2E-5
Thulium (69)	Tm-170	5E-5	5E-5
	Tm-171	5E-4	5E-4
Tin (50)	Sn-113	9E-5	8E-5
	Sn-124	2E-5	2E-5
Tungsten (74)	W-181	4E-4	3E-4
	W-185	1E-4	1E-4
	W-187	7E-5	6E-5

TABLE F-1: MAXIMUM PERMISSIBLE CONCENTRATIONS (CONTINUED)

Element	Isotope	Soluble Conc. (uCi/ml)	Insoluble Conc. (uCi/ml)
Uranium (92)	U-230	5E-6	5E-6
	U-232	3E-5	3E-5
	U-233	3E-5	3E-5
	U-234	3E-5	3E-5
	U-235	3E-5	3E-5
	U-236	3E-5	3E-5
	U-238	4E-5	4E-5
	U-240	3E-5	3E-5
	U-natural	3E-5	3E-5
Vanadium (23)	V-48	3E-5	3E-5
Ytterbium (70)	Yb-175	1E-4	1E-4
Yttrium	Y-90	2E-5	2E-5
	Y-91m	3E-3	3E-3
	Y-91	3E-5	3E-5
	Y-92	6E-5	6E-5
	Y-93	3E-5	3E-5
Zinc (30)	Zn-65	1E-4	2E-4
	Zn-69m	7E-5	6E-5
	Zn-69	2E-3	2E-3
Zirconium (40)	Zr-93	8E-4	8E-4
	Zr-95	6E-5	6E-5
	Zr-97	2E-5	2E-5
Any single radio-nuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radio - active half-life greater than 2 hours.		3E-6	3E-6
Any single radio- nuclide not listed above, which decays by alpha emission or spontaneous fission.		3E-8	3E-8

1. If the identity of any radionuclide is not known, the limiting values for purposes of this table shall be: 3E-8 uCi/ml.
2. If the identity and concentration of each radionuclide are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e. "unity").