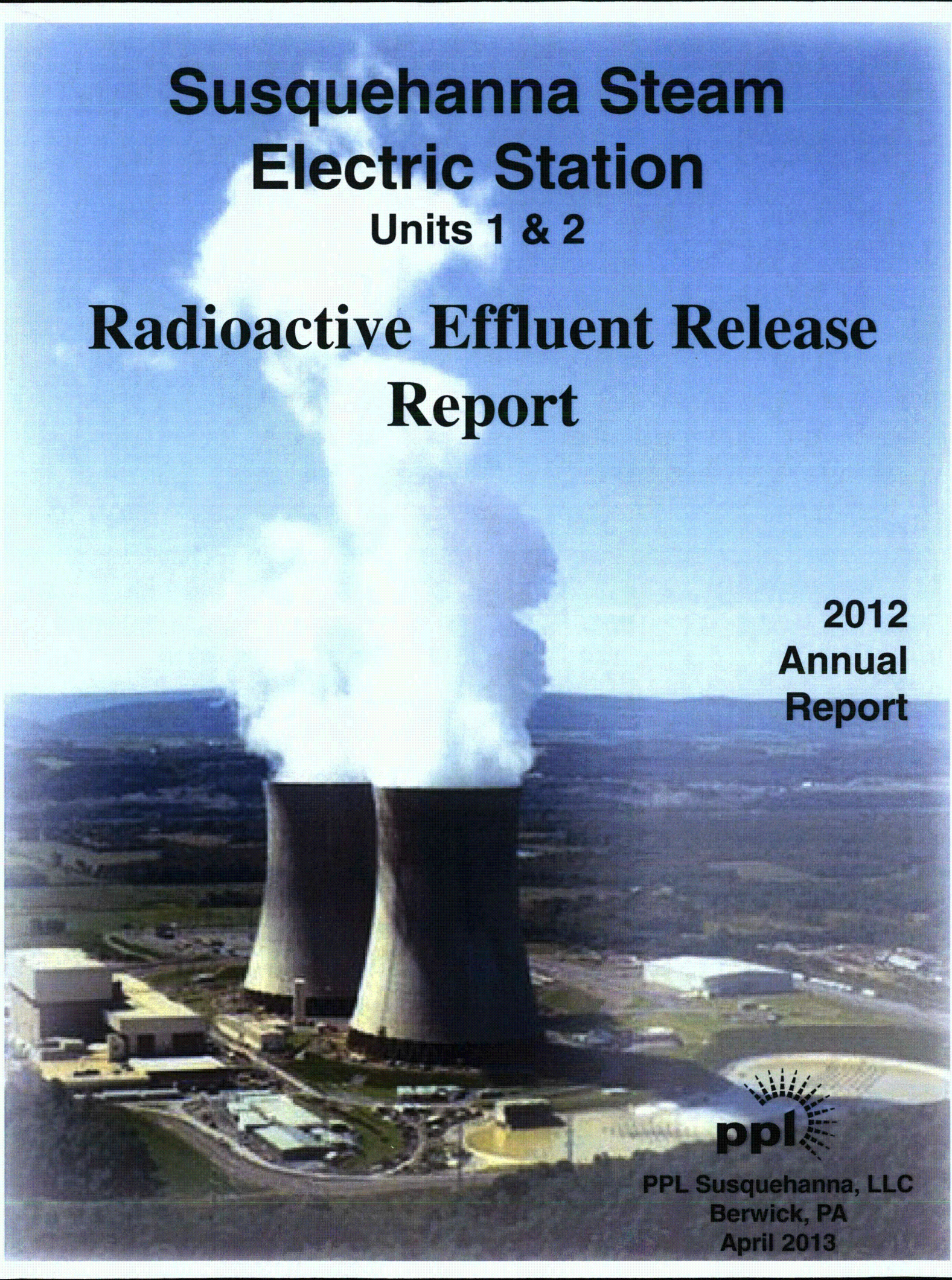
Susquehanna Steam Electric Station

Units 1 & 2

Radioactive Effluent Release Report

2012 Annual Report



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PPL Susquehanna, LLC
Berwick, PA
April 2013

Attachment 1 to PLA-6994

Radioactive Effluent Release Report for SSES Units 1 and 2

RADIOACTIVE EFFLUENT RELEASE REPORT

REPORT PERIOD: 01/01/12 - 12/31/12

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SECTION 1

INTRODUCTION, SUMMARY AND SUPPLEMENTAL INFORMATION

INTRODUCTION

The submittal of the 2012 Radioactive Effluent Release Report is in accordance with PPL Susquehanna, LLC Tech Spec. 5.6.3. The enclosed information is consistent with the objectives outlined in the Offsite Dose Calculation Manual (ODCM) and Process Control Program (PCP). The 2012 Radioactive Effluent Release Report is in conformance with 10CFR50.36a and 10CFR50, Appendix I, Section IV.B.1.

PPL Susquehanna, LLC is located in Salem Township, Luzerne County, Pennsylvania. It is on the west bank of the Susquehanna River, 8 km northeast of Berwick. The station consists of two boiling water reactor generating units. Each unit has completed an Extended Power Uprate process which has increased licensed thermal power from 3489 MWt (megawatt thermal) to 3952 MWt. Unit-1 completed the power uprate in 2010 and Unit 2 completed the power uprate in 2011. The reactor and generating units were supplied by General Electric, while the Bechtel Corporation served as architect-engineer and constructor.

Construction of the Station began in the early 1970s. Fuel load began in Unit 1 in July of 1982. Initial criticality was achieved in the Unit 1 reactor on September 10, 1982. The reactor reached 100% power for the first time on February 4, 1983. Commercial operation of Unit 1 was declared on June 8, 1983. Initial criticality of Unit 2 occurred on May 8, 1984. Unit 2 was declared commercial on February 12, 1985.

Airborne effluents are released from the Station via five rooftop vents on the reactor building (see Figure 1-1). Continuous sampling for particulates and iodines is performed at each vent as well as continuous monitoring for noble gases. A program of periodic sampling and analysis for tritium and noble gases along with periodic analysis of particulate and iodine samples is conducted as specified in the plant Technical Requirements. All waterborne effluents are released in batch mode and are sampled and analyzed prior to release. Waterborne effluents from the site are released into the cooling tower blowdown line for dilution prior to release to the Susquehanna River (see Figure 1-2). Blowdown line flow rates are at least 5,000 gpm during periods of liquid radwaste release. The diluted effluent is introduced to the river by way of a perforated diffuser pipe placed on the river bed. The diffuser serves to mix the station discharge with the main flow of the river.

This report presents a summary of the quantities of radioactive materials which were released from the Station during the period from January 1, 2012 to December 31, 2012. In addition, this report serves as a medium for notifying the US Nuclear Regulatory Commission staff of changes to the ODCM, PCP and documentation of any exceptions to the effluent monitoring program which must be reported per Technical Requirements.

Airborne and waterborne radioactive effluent releases to the environment during the report period were sampled and analyzed in accordance with the Technical

Requirements. All radioactive effluent releases were within the concentration and release limits specified in the Technical Requirements. Calculations and terms utilized in this report are those outlined in the ODCM.

Section 1 contains supplemental information pertaining to effluents from the Susquehanna plant. Included are regulatory limits (Table 1-1), sampling and analysis methods, characterization of the number and duration of batch and abnormal releases and a brief summary of the applicable year's effluents.

Section 2 contains effluent and waste disposal data for the report period. Table 2-1 contains a summation of all airborne releases, grouped into the radionuclide categories of gases, particulates, iodines, and tritium. Average release rates are presented and compared to the applicable limits. Table 2-2 presents the activity totals of specific radionuclides in airborne effluents.

Waterborne effluents are summarized in Table 2-3. Average diluted concentrations are presented and compared to the applicable limits. Table 2-4 presents the release quantities of specific radionuclides in waterborne effluents over the report period. Figures 2-1 and 2-2 present the Susquehanna River Monthly Average Flow Rates for 2012 and the Monthly Liquid Radwaste Discharge Totals for 2012, respectively.

Table 2-5 contains estimates of the errors associated with the measurements involved in quantifying effluents. Sampling errors, counting errors, and errors associated with determining effluent flow rates and volumes all contribute to the total error of effluent measurements. Error estimates are presented for each category of radionuclide detected in airborne and waterborne effluents and solid wastes during the report period (Error Analysis of the Radioactive Effluent Sampling and Analysis Program at the SSES, Hydro Nuclear Services; 1985).

Tables 2-7 through 2-15 present a characterization of the solid radioactive waste shipped offsite during the report period. An estimate of major nuclide composition is presented for each waste type. Also included are the volumes and curie contents associated with each type of solid waste. The number of waste shipments from the site transported directly for burial or disposal are listed in Table 2-6.

Section 3 presents meteorological data for 2012, including data recovery, joint frequency distribution of wind speed and direction, stability class distribution, and atmospheric dispersion estimates for selected locations.

Section 4 of this report contains an assessment of the calculated doses attributed to the reported radiological effluents for the calendar year. The Radioactive Effluent Tracking and Dose Assessment Software (RETDAS) computer code was used for calculation of doses from waterborne effluents. Site-specific parameters used in the calculations for the Danville receiver are shown in Table 4-1. The RETDAS code was also used for calculation of doses from airborne effluents. The calculated doses and direct radiation estimates can be used to estimate the doses to maximally exposed members of the

public. Table 4-2 summarizes maximum calculated doses to members of the public from airborne and waterborne effluents. Table 4-3 presents calculated collective doses to members of the public within the Riverlands/Energy Information Center Complex. Table 4-4 summarizes the calculated doses for residences and other occupied areas within the site boundary and the nearest dairy. Additionally, Section 4 includes a description of the methodology used in the calculation and resultant dose impact of Carbon-14 released from the station.

Section 5 of this report documents changes to the Offsite Dose Calculation Manual, Technical Requirements Manual and the Solid Radioactive Waste Process Control Program.

Section 6 presents a listing of cases (if any) in which airborne or waterborne effluent monitoring instrumentation was declared inoperable and was not restored to operability within the time period specified in Technical Requirements 3.11.1.4, 3.11.1.5 and 3.11.2.6 Action Statements. In addition, this section presents issues (if any) with the collection of milk or fresh leafy vegetables per Technical Requirement 3.11.4.1 and changes due to the land use census per Technical Requirement 3.11.4.2. Section 6 also includes reporting associated with the Nuclear Energy Institute (NEI) Groundwater Protection Initiative.

Section 7 contains corrections (if any) to previous Radioactive Effluent Release Reports.

Section 8 contains information on effluent and offsite dose from the systems classified as insignificant effluent pathways.

SUMMARY

During 2012 there were one hundred eighty (180) liquid batch releases resulting in a total release volume of two million three hundred twenty two thousand (2,322,000) gallons. The total number of liquid batch releases and total volume released in 2012 was higher than the corresponding values for 2011 (148 releases resulting in 1,488,000 gallons released in 2011) primarily due to multiple outage periods on both Units. The predominant radionuclide released in liquid effluents during 2012 was tritium. Approximately seventy-five (75) curies of tritium were released in liquid effluents in 2012, compared to fifty two (52) curies released in 2011. When compared with all radionuclides released in liquid effluents in 2012, tritium was the main contributor to the resultant offsite dose. Consistent with previous years, the offsite dose from liquid releases in 2012 was less than one percent (1%) of the annual limits for both organ and whole body dose.

In 2010, an industry initiative (supported by EPRI and NEI) was established to evaluate and report Carbon-14 (C-14) in the Annual Radioactive Effluent Release Report. The initiative is rooted in Regulatory Guide 1.21, Revision 2, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste", in that the NRC has recommended that U.S. nuclear power plants evaluate whether C-14 is a "principal radionuclide", and if so, report the amount of C-14 released. The C-14 reported as released from the Susquehanna station in 2012 is based on samples taken from each units Offgas system, specifically the Offgas post-treatment sample stream. Approximately 38 Curies of C-14 were released in gaseous effluents in 2012. See section 4 for additional details on C-14 released in airborne effluents.

Historically, tritium has been the predominant radionuclide (both in Curies and resultant offsite dose) released in gaseous effluents from the Susquehanna station. Approximately seven (7) curies of tritium were released in gaseous effluents in 2012 compared to forty-seven (47) curies in 2011. The resultant maximum offsite organ dose due to gaseous effluents from Unit-1 for 2012 was 3.62E-1 mrem, which is 2.4% of the per unit annual limit of fifteen (15) mrem. The resultant maximum offsite organ dose due to gaseous effluents from Unit-2 for 2012 was 3.70E-1 mrem, which is 2.5% of the per unit annual limit of fifteen (15) mrem. The maximum offsite dose from gaseous effluents in 2012 is similar to the maximum offsite dose from gaseous effluents in 2011.

FIGURE 1-1

AIRBORNE EFFLUENT RELEASE POINTS

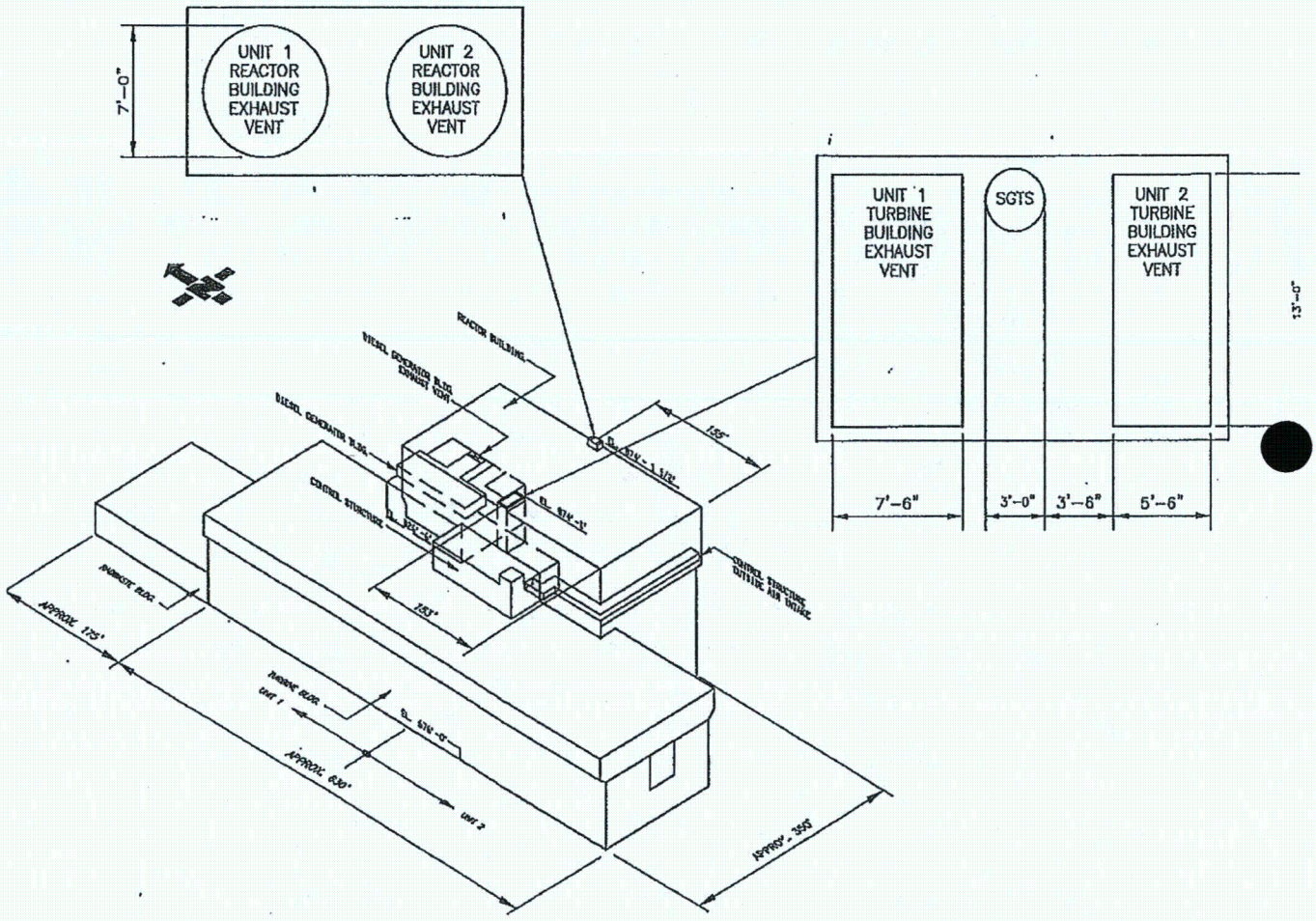
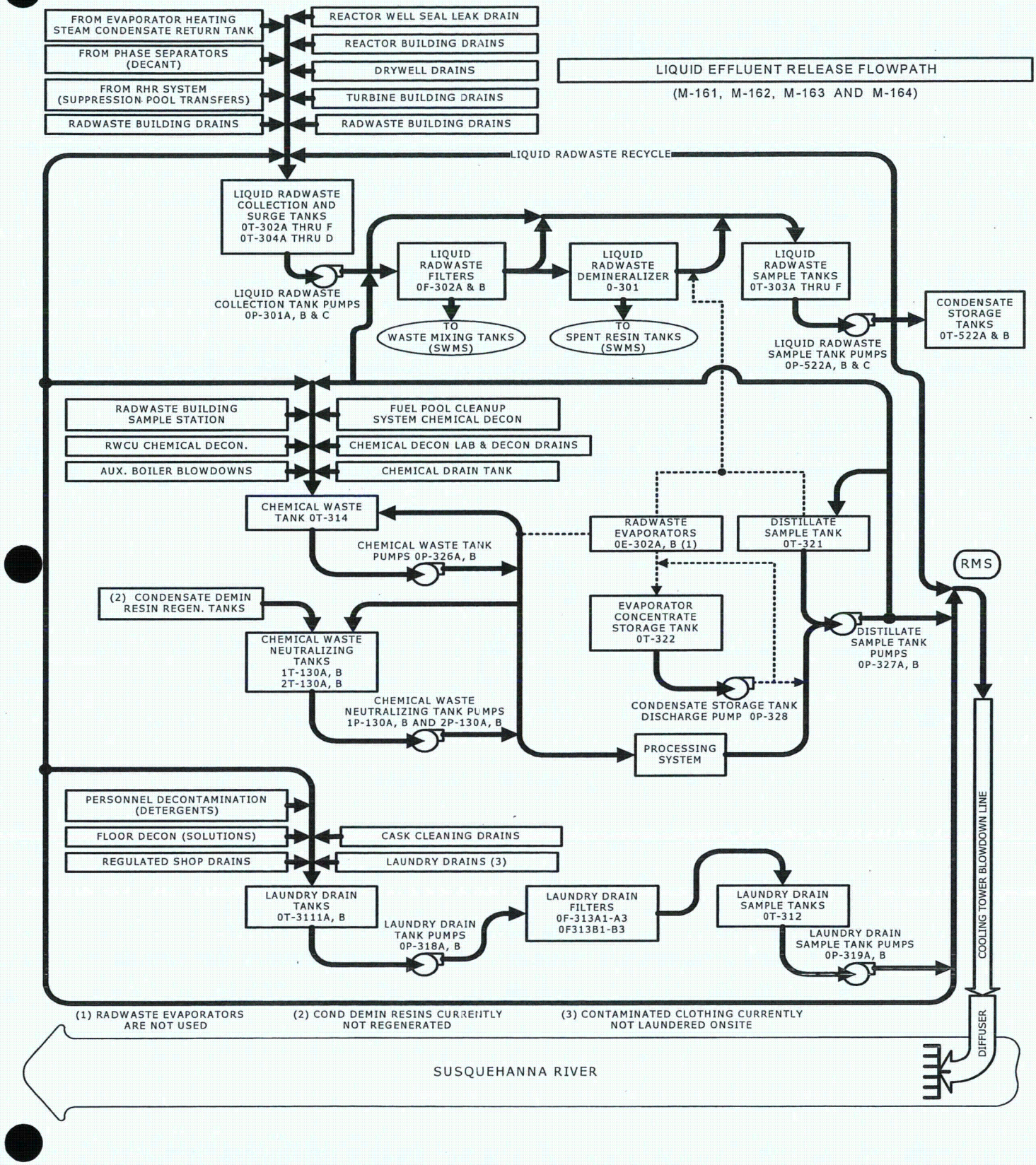


FIGURE 1-2

WATERBORNE EFFLUENT PATHWAY



SUPPLEMENTAL INFORMATION

1. Regulatory Limits

Technical Requirements 3.11.1 and 3.11.2 outline requirements for release of radioactive liquid and gaseous effluents, respectively. Concentration of radioactive materials released in liquid effluents and resulting dose are limited in unrestricted areas. Dose and dose rate due to radioactive materials released in gaseous effluents are limited in areas at or beyond the site boundary. Technical Requirement limits are listed in Table 1-1.

2. Maximum Permissible Concentrations in Waterborne Effluents

The concentration of radioactive material released in liquid effluents to unrestricted areas is limited to 10 times the concentrations specified in 10 CFR Part 20 Appendix B Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases.

For dissolved or entrained noble gases, the concentration is limited to 2.0E-04 µCi/ml total activity (TRO 3.11.1.1).

3. Average Energy of Fission and Activation Gas

The Calculation of Noble Gas Effluent Average Energies E-Bar Beta and Gamma was not performed due to the fact that no noble gases were measured in Station Vent Air Samples above detection limits during 2012.

4. Measurements and Approximations of Total Radioactivity

Analyses of specific radionuclides in effluent samples are used to evaluate the radioactive composition and concentration of effluents.

5. Methods of Quantifying Effluents

a. **Fission and Activation Gases**: Gas samples are routinely collected monthly and analyzed with a high resolution (HPGE) detector system which incorporates a data reduction program to determine radionuclide composition in terms of specific activity. Data from the continuous vent monitors are used to determine the average concentration of noble gases. The high resolution (HPGE) isotopic scan is used to convert the continuous vent monitor activity to actual activity based on the determined nuclide mixture. The vent and sample flow rates are continuously monitored and the average flow rates for each vent are used to calculate the total activity released in a given time period. When the continuous monitors are out of service, manual grab samples are taken from each vent once every eight hours (once every four

hours for the standby gas treatment vent when standby gas treatment system is in service).

b. **Iodines**: Iodine is continuously collected on charcoal or silver zeolite cartridges via an isokinetic sampling assembly in each vent. Filters are normally exchanged once per week and analyzed on a high resolution (HPGE) system. The daily average flow rates for the vents and sample pumps are averaged for the duration of the sampling period and a ratio of vent flow rate to sample flow rate is determined. The ratio is used to determine the total activity of each isotope released during the time period in question. When the continuous samplers are out of service, iodine is continuously collected from alternate sampling ports available on the sample lines or directly from the affected rooftop vent(s).

c. **Particulates**: Particulates are continuously collected via an isokinetic sampling assembly in each vent. Filters are normally exchanged once per week and analyzed on a high resolution (HPGE) system. Flow rate corrections are performed as for iodines. When the continuous samplers are out of service, particulates are continuously collected from alternate sampling ports available on the sample lines or directly from the affected rooftop vent(s).

d. **Tritium**: Airborne tritium is collected monthly via bubbler sampler. The sample is collected for one hour at a flow rate of approximately 1000 cc/min. Tritium activity in the bubbler sample is determined by liquid scintillation counting. The liquid sample tritium concentration is then converted to air concentration by volume proportion.

e. **Waterborne Effluents**: Each tank of liquid radwaste is sampled and analyzed for principal gamma emitters prior to release. Each sample tank is recirculated for a sufficient amount of time prior to sampling to ensure that a representative sample is obtained. Samples are analyzed on a high resolution (HPGE) system and release permits are generated based on the values obtained from the isotopic analysis and the most recent values for tritium, gross alpha, iron-55, and strontium-89 and -90. An aliquot based on release volume is saved and added to monthly and quarterly composite containers. The monthly tritium analysis is done in-house. A monthly composite is sent to a vendor laboratory for gross alpha analysis. A quarterly composite is sent to a vendor laboratory for iron-55, strontium-89 and-90 analyses.

The concentration of each radionuclide in each batch is multiplied by the volume of the batch to determine the total quantity of each nuclide released in each batch. The isotopic totals for each batch are summed to determine the total source term for the report period.

TABLE 1-1

TECHNICAL REQUIREMENT LIMITS

A. NOBLE GASES:

1. ≤500 mrem/year - TOTAL BODY
   ≤3000 mrem/year - SKIN

   - instantaneous dose rate limit at and beyond the site boundary (TRO 3.11.2.1.I)

2. ≤5 mrad - AIR GAMMA
   ≤10 mrad - AIR BETA

   - quarterly air dose limits per reactor unit at and beyond the site boundary (TRO 3.11.2.2a)

3. ≤10 mrad - AIR GAMMA
   ≤20 mrad - AIR BETA

   - annual air dose limits per reactor unit at and beyond the site boundary (TRO 3.11.2.2.b)

B. AIRBORNE I-131, I-133, TRITIUM, PARTICULATES WITH HALF-LIVES > 8 DAYS:

1. ≤1500 mrem/year - ORGAN
   (inhalation pathways only)

   - instantaneous dose rate limit at and beyond the site boundary (TRO 3.11.2.1.II.A)

2. ≤7.5 mrem - ORGAN

   - quarterly dose limit per reactor unit at and beyond the site boundary (TRO 3.11.2.3.a)

3. ≤15 mrem - ORGAN

   - annual dose limit per reactor unit at and beyond the site boundary (TRO 3.11.2.3.b)

C. **LIQUID EFFLUENTS**:

1. ≤1.5 mrem - TOTAL BODY
   ≤5.0 mrem - ORGAN
   - quarterly dose limits per unit (TRO 3.11.1.2.a)

2. ≤3.0 mrem - TOTAL BODY
   ≤10.0 mrem - ORGAN
   - annual dose limits per unit (TRO 3.11.1.2.b)

D. **AIRBORNE EFFLUENT: BASES FOR PERCENT OF APPLICABLE LIMIT VALUES IN TABLE 2-1**

Fission and Activation Gases

Derived release rate limits based on the Technical Requirement (TRO 3.11.2.1.I.A and B) limits of 500 mrem/yr to the total body and 3000 mrem/yr to the skin were calculated (PPL calculation EC-ENVR-1041 Rev. 2) from the expected mix of noble gas radionuclides presented in Attachment A of ODCM-QA-003, Effluent Monitor Setpoints. The lower limit of 1.00E+06 µCi/min (1.67E+04 µCi/sec) based on total body dose rate is used.

Iodine-131

A derived release rate limit for I-131 based on the Technical Requirement (TRO 3.11.2.1.II.A) limit of 1500 mrem/yr from I-131, I-133, tritium and particulates with half-lives greater than 8 days was calculated (PPL calculation EC-ENVR-1041 Rev. 2) based on the ratio of the expected annual release quantities of I-131 and I-133 provided in Attachment E of ODCM-QA-004, Airborne Effluent Dose Calculations. The limit is 1.04E+02 µCi/min I-131 (1.73E+00 µCi/sec).

Particulates

A derived release rate limit for particulate activity other than iodines based on the Technical Requirement (TRO 3.11.2.1.II.A) limit of 1500 mrem/yr from I-131, I-133, tritium and particulates with half-lives greater than 8 days was calculated (PPL calculation EC-ENVR-1041 Rev. 2) based on the expected annual release quanities of particulate radionuclides provided in Attachment E of ODCM-QA-004, Airborne Effluent Dose Calculations. The limit is 3.02E+03 µCi/min (5.03E+01 µCi/sec).

Tritium

A derived release rate was calculated based on the 10 CFR 20, Appendix B, Table 2, Column 1, Effluent Concentration Limit for tritium (1.0E-07 µCi/cc) to unrestricted areas. A relative concentration of 4.1E-05 sec/m^3 was assumed (PPL calculation EC-ENVR-1040). The limit is 1.46E+05 µCi/min (2.44E+03 µCi/sec).

Radionuclide Fractional Summation

The sum of the percents of applicable limits for particulates, iodine and tritium must be less than 100%.

E. WATERBORNE EFFLUENT: BASES FOR PERCENT OF APPLICABLE LIMIT VALUES IN TABLE 2-3

Fission and Activation Products

Concentrations of fission and activation products in liquid effluent from radwaste effluent are determined for each batch prior to release. Each isotope concentration is compared to ten times the 10CFR20 Appendix B, Table 2, Column 2 Effluent Concentration Values (TRO 3.11.1.1).

Tritium

Liquid effluent quarterly tritium concentrations are compared to ten times the 10 CFR 20 Appendix B, Table 2, Column 2, Effluent Concentration value of 1.0E-03 µCi/ml to unrestricted areas.

Dissolved and Entrained Gases

Liquid effluent concentrations for dissolved and entrained gases are compared to the limiting value for total noble gas activity of 2.0E-04 µCi/ml (TRO 3.11.1.1).

Radionuclide Fractional Summation

The sum of the percents of applicable limits for fission and activation products, tritium and dissolved and entrained gases must be less than 100%.

SECTION 2

EFFLUENT AND WASTE DISPOSAL DATA

Airborne Effluents

Summaries of the radionuclide total curie activities and average release rates are included in Tables 2-1 and 2-2. Carbon-14 (C-14) activity released is not included in Tables 2-1 or 2-2. See Section 4 for additional details on the calculation of C-14 released in 2012 from the Susquehanna station. If a radionuclide was not detected, zero activity was used for that isotope in dose calculations and the activity is listed as "<MDC" (less than the minimum detectable concentration) in Tables 2-1 and 2-2. <MDC indicates that no activity was positively detected in any sample when samples were analyzed with techniques which achieved the required Lower Limits of Detection (LLD) as specified in the Technical Requirement (TRO) Table 3.11.2.1-1, Radioactive Gaseous Effluent Sampling and Analysis Program. In all cases, the measurement laboratory MDCs were at or below the LLD levels required by Technical Requirements. The following are typical measurement laboratory MDCs.

Typical MDCs

Radionuclide	MDC (µCi/cc)
Kr-87	4.3 E-08
Kr-88	4.6 E-08
Xe-133	3.0 E-08
Xe-133m	1.1 E-07
Xe-135	1.5 E-08
Xe-135m	8.0 E-08
Xe-138	1.5 E-07
Mn-54	2.9 E-13
Fe-59	2.8 E-13
Co-58	1.8 E-13
Co-60	3.8 E-13
Zn-65	1.0 E-13
Mo-99	1.0 E-12
Cs-134	2.4 E-13
Cs-137	1.1 E-13
Ce-141	1.0 E-13
Ce-144	5.0 E-13
I-131	4.4 E-14
Sr-89	1.1 E-13
Sr-90	1.3 E-14
H-3	1.5 E-08
Gross Alpha	2.3 E-14

Batch Releases

1. Number of Batch Releases:	0
2. Total Time Period for Batch Release:	NA
3. Maximum Time Period for a Batch Release:	NA
4. Average Time Period for a Batch Release:	NA
5. Minimum Time Period for a Batch Release:	NA

Abnormal Releases

1. Number of Releases	0
2. Total Activity Released	NA

TABLE 2-1

AIRBORNE EFFLUENT - SUMMATION OF ALL RELEASES

A. Fission and Activation Gas	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Total Release	Ci	<MDC	<MDC	<MDC	<MDC
Average Release Rate for Period	µCi/sec	0	0	0	0
Percent of Applicable Limit (1.67E+04 µCi/sec)	%	0	0	0	0

B. Iodines					
Total I-131	Ci	<MDC	<MDC	<MDC	<MDC
Average Release Rate for Period	µCi/sec	0	0	0	0
Percent of Applicable Limit (1.73E+00 µCi/sec)	%	0	0	0	0

C. Particulate					
Particulate with Half-Life >8 Days	Ci	<MDC	8.70E-05	<MDC	<MDC
Average Release Rate for Period	µCi/sec	0	1.11E-05	0	0
Percent of Applicable Limit (5.03E+01 µCi/sec)	%	0	2.20E-05	0	0
Gross Alpha Radioactivity	Ci	<MDC	<MDC	<MDC	<MDC

D. Tritium					
Total Release	Ci	2.44E+00	<MDC	4.50E+00	<MDC
Average Release Rate for Period	µCi/sec	3.11E-01	0	5.66E-01	0
Percent of Applicable Limit (2.44E+03 µCi/sec)	%	1.27E-02	0	2.32E-02	0

E. Radionuclide Fractional Summation					
Sum of Percent of Applicable Limit During Period for B, C and D (Limit = 100%)	%	0.01	<0.01	0.02	0

TABLE 2-2

AIRBORNE EFFLUENT - RADIONUCLIDES RELEASED

Nuclides Released	Unit	Releases in Continuous Mode			
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter
A. Fission and Activation Gases					
N-13	Ci	<MDC	<MDC	<MDC	<MDC
Ar-41	Ci	<MDC	<MDC	<MDC	<MDC
Kr-85	Ci	<MDC	<MDC	<MDC	<MDC
Kr-85m	Ci	<MDC	<MDC	<MDC	<MDC
Kr-87	Ci	<MDC	<MDC	<MDC	<MDC
Kr-88	Ci	<MDC	<MDC	<MDC	<MDC
Kr-89	Ci	<MDC	<MDC	<MDC	<MDC
Xe-133	Ci	<MDC	<MDC	<MDC	<MDC
Xe-135	Ci	<MDC	<MDC	<MDC	<MDC
Xe-135m	Ci	<MDC	<MDC	<MDC	<MDC
Xe-137	Ci	<MDC	<MDC	<MDC	<MDC
Xe-138	Ci	<MDC	<MDC	<MDC	<MDC
Total for Period	**Ci**	**0**	**0**	**0**	**0**
B. Iodines					
I-131	Ci	<MDC	<MDC	<MDC	<MDC
I-133	Ci	<MDC	<MDC	<MDC	<MDC
I-135	Ci	<MDC	<MDC	<MDC	<MDC
Total for Period	**Ci**	**0**	**0**	**0**	**0**
C. Particulate					
Cr-51	Ci	<MDC	3.05E-05	<MDC	<MDC
Mn-54	Ci	<MDC	<MDC	<MDC	<MDC
Fe-59	Ci	<MDC	<MDC	<MDC	<MDC
Co-57	Ci	<MDC	<MDC	<MDC	<MDC
Co-58	Ci	<MDC	<MDC	<MDC	<MDC
Co-60	Ci	<MDC	5.65E-05	<MDC	<MDC
Zn-65	Ci	<MDC	<MDC	<MDC	<MDC
Sr-89	Ci	<MDC	<MDC	<MDC	<MDC
Sr-90	Ci	<MDC	<MDC	<MDC	<MDC
Cs-134	Ci	<MDC	<MDC	<MDC	<MDC
Cs-137	Ci	<MDC	<MDC	<MDC	<MDC
Ce-141	Ci	<MDC	<MDC	<MDC	<MDC
Ce-144	Ci	<MDC	<MDC	<MDC	<MDC
Nb-95	Ci	<MDC	<MDC	<MDC	<MDC
Ba-La-140	Ci	<MDC	<MDC	<MDC	<MDC
Total for Period	**Ci**	**0**	**8.70E-05**	**0**	**0**

Waterborne Effluents

Summaries of the radionuclide total curie activities, average diluted concentrations, and percent of applicable Technical Requirement limits are included in Tables 2-3 and 2-4.

	Batch Releases*	Qtr. 1	Qtr. 2	Qtr. 3	Qtr. 4	Annual
1.	Number of Batch Releases	22	67	33	58	180
2.	Total Time Period for Batch Releases	1.64E+03	1.24E+04	4.10E+03	1.16E+04	2.98E+04
3.	Maximum Time Period for a Batch Release	2.84E+02	3.33E+02	3.07E+02	3.20E+02	3.33E+02
4.	Average Time Period for a Batch Release	7.45E+01	1.85E+02	1.24E+02	2.00E+02	1.65E+02
5.	Minimum Time Period for a Batch Release	3.00E+01	2.70E+01	3.00E+01	3.00E+01	2.70E+01
6.	Average Cooling Tower Blowdown Flow Rate During Periods of Release	1.03E+04	1.14E+04	1.43E+04	1.23E+04	1.21E+04
7.	Susquehanna River Flow Rate	7.80E+06	5.36E+06	1.04E+06	5.50E+06	4.92E+06

*Units of time and flow are expressed in minutes and gallons per minute (gpm), respectively.

If a radionuclide was not detected, zero activity was used for that isotope in dose calculations and the activity is listed as "<MDC" (less than the miniumum detectable concentration) in Tables 2-3 and 2-4. <MDC indicates that no activity was positively detected in any sample when samples were analyzed with techniques which achieved the required Lower Limits of Detection (LLD) as specified in the Technical Requirement 3.11.1.1-1, Radioactive Liquid Waste Sampling and Analysis Program. In all cases, the measurement laboratory MDCs were at or below the LLD levels required by Technical Requirements. The following are typical measurement laboratory MDCs.

Radionuclide	MDC (µCi/ml)
Mn-54	4.5 E-08
Fe-59	5.0 E-08
Co-58	4.0 E-08
Co-60	5.4 E-08
Zn-65	4.9 E-08
Mo-99	1.7 E-07
I-131	2.0 E-08
Cs-134	2.2 E-08
Cs-137	2.6 E-08
Ce-141	3.2 E-08
Ce-144	1.3 E-07
Sr-89	4.4 E-08
Sr-90	1.6 E-08
Fe-55	8.2 E-07
H-3	3.6 E-06
Gross Alpha	3.7 E-09

Abnormal Releases

1.	Number of releases	0	0	0	0
2.	Volume Released (Gallons)	N/A	N/A	N/A	N/A
3.	Total Activity Released (Ci)	N/A	N/A	N/A	N/A

TABLE 2-3

WATERBORNE EFFLUENT - SUMMATION OF ALL RELEASES

A. Fission and Activation Products	Unit	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1. Total Release (excluding: Tritium, Ent. Gases, Alpha)	Ci	1.61E-03	1.69E-03	2.93E-04	3.94E-05
2. Average Diluted Concentration During Period	µCi/ml	2.51E-08	3.15E-09	1.32E-09	7.29E-11
3. Sum of Average Diluted C_n/L_n Ratio During Period	Unitless	7.38E-04	6.67E-05	3.10E-05	2.28E-06
4. Percent of Applicable Limit (Ratio < 1.0)	%	0.07	0.007	0.003	<0.001
B. Tritium					
1. Total Release	Ci	4.42E+00	2.98E+01	8.35E+00	3.20E+01
2. Average Diluted Concentration During Period	µCi/ml	6.91E-05	5.57E-05	3.77E-05	5.92E-05
3. Percent of Applicable Limit (1.0E-2 µCi/ml)	%	0.69	0.56	0.38	0.59
C. Dissolved and Entrained Gases					
1. Total Release	Ci	<MDC	<MDC	<MDC	1.05E-05
2. Average Diluted Concentration During Period	µCi/ml	0.00E+00	0.00E+00	0.00E+00	1.95E-11
3. Percent of Applicable Limit (2.0E-4 µCi/ml)	%	0.00E+00	0.00E+00	0.00E+00	9.76E-06
D. Radionuclide Fractional Summation					
1. Sum of Percent of Applicable Limit During Period for A, B and C (Limit = 100%)	%	0.76	0.57	0.38	0.59
E. Gross Alpha Radioactivity					
1. Total Release	Ci	4.10E-06	5.82E-06	<MDC	<MDC
F. Volume of Water Released (Prior to Dilution)	Gallons	1.13E+05	9.80E+05	3.06E+05	9.19E+05
	Liters	4.29E+05	3.71E+06	1.16E+06	3.48E+06
G. Volume of Dilution Water Used During Period of Release	Gallons	1.68E+07	1.41E+08	5.84E+07	1.42E+08
	Liters	6.36E+07	5.32E+08	2.21E+08	5.36E+08
H. Volume of Dilution Water Used Over Entire Period	Gallons	1.21E+09	1.26E+09	1.85E+09	1.66E+09
	Liters	4.58E+09	4.77E+09	7.00E+09	6.30E+09

TABLE 2-4

WATERBORNE EFFLUENT - RADIONUCLIDES RELEASED

Nuclides Released	Unit	Releases in Batch Mode			
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter
A. Fission and Activation Products					
Ag-110m	Ci	<MDC	1.51E-06	<MDC	<MDC
Cr-51	Ci	<MDC	4.00E-04	3.23E-05	<MDC
Mn-54	Ci	6.83E-06	1.38E-04	4.17E-05	1.97E-06
Fe-55	Ci	<MDC	<MDC	<MDC	<MDC
Co-58	Ci	1.01E-04	9.28E-05	1.90E-05	8.48E-07
Fe-59	Ci	<MDC	3.95E-06	<MDC	<MDC
Co-60	Ci	1.26E-03	1.03E-03	1.99E-04	3.66E-05
Zn-65	Ci	2.37E-04	8.19E-06	7.88E-07	<MDC
Sr-89	Ci	<MDC	<MDC	<MDC	<MDC
Sr-90	Ci	<MDC	<MDC	<MDC	<MDC
Nb-95	Ci	<MDC	8.95E-07	<MDC	<MDC
Tc-99m	Ci	<MDC	1.92E-06	5.08E-07	<MDC
Nb-97	Ci	<MDC	1.09E-06	<MDC	<MDC
Cs-137	Ci	<MDC	<MDC	<MDC	<MDC
Sb-125	Ci	<MDC	1.67E-06	<MDC	<MDC
Ta-182	Ci	<MDC	1.99E-06	<MDC	<MDC
Total for Period	**Ci**	**1.61E-03**	**1.69E-03**	**2.93E-04**	**3.94E-05**
B. Tritium					
Total for Period	**Ci**	**4.42E+00**	**2.98E+01**	**8.35E+00**	**3.20E+01**
C. Dissolved and Entrained Gases					
Ar-41	Ci	<MDC	<MDC	<MDC	<MDC
Kr-85	Ci	<MDC	<MDC	<MDC	<MDC
Kr-85m	Ci	<MDC	<MDC	<MDC	<MDC
Kr-87	Ci	<MDC	<MDC	<MDC	<MDC
Kr-88	Ci	<MDC	<MDC	<MDC	<MDC
Xe-131m	Ci	<MDC	<MDC	<MDC	<MDC
Xe-133m	Ci	<MDC	<MDC	<MDC	<MDC
Xe-133	Ci	<MDC	<MDC	<MDC	7.46E-06
Xe-135m	Ci	<MDC	<MDC	<MDC	<MDC
Xe-135	Ci	<MDC	<MDC	<MDC	3.08E-06
Total for Period	**Ci**	**0**	**0**	**0**	**1.05E-05**

Figure 2-1

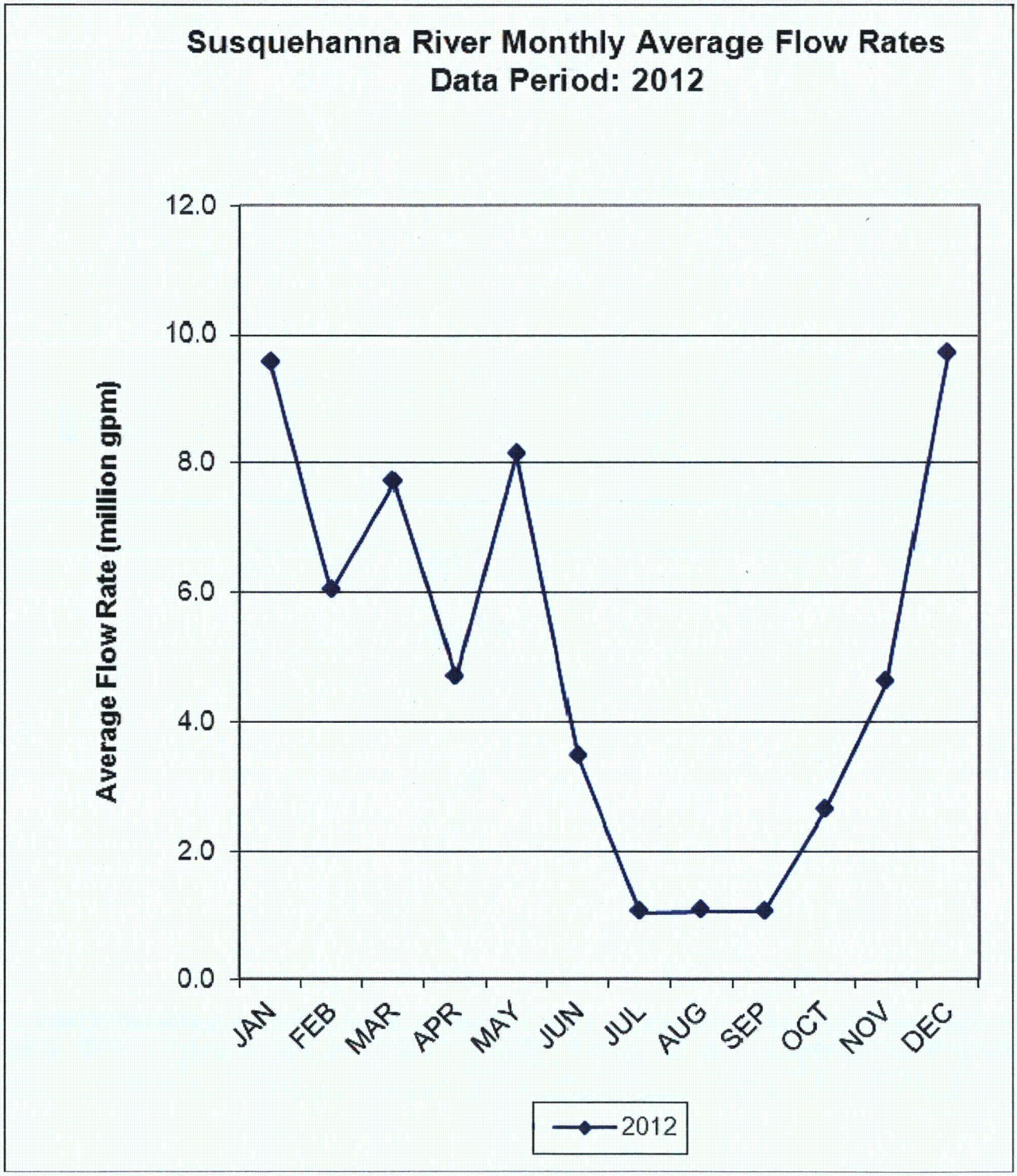

Susquehanna River Monthly Average Flow Rates
Data Period: 2012
Average Flow Rate (million gpm)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
2012

Figure 2-2

Monthly Liquid Radwaste Discharge Totals

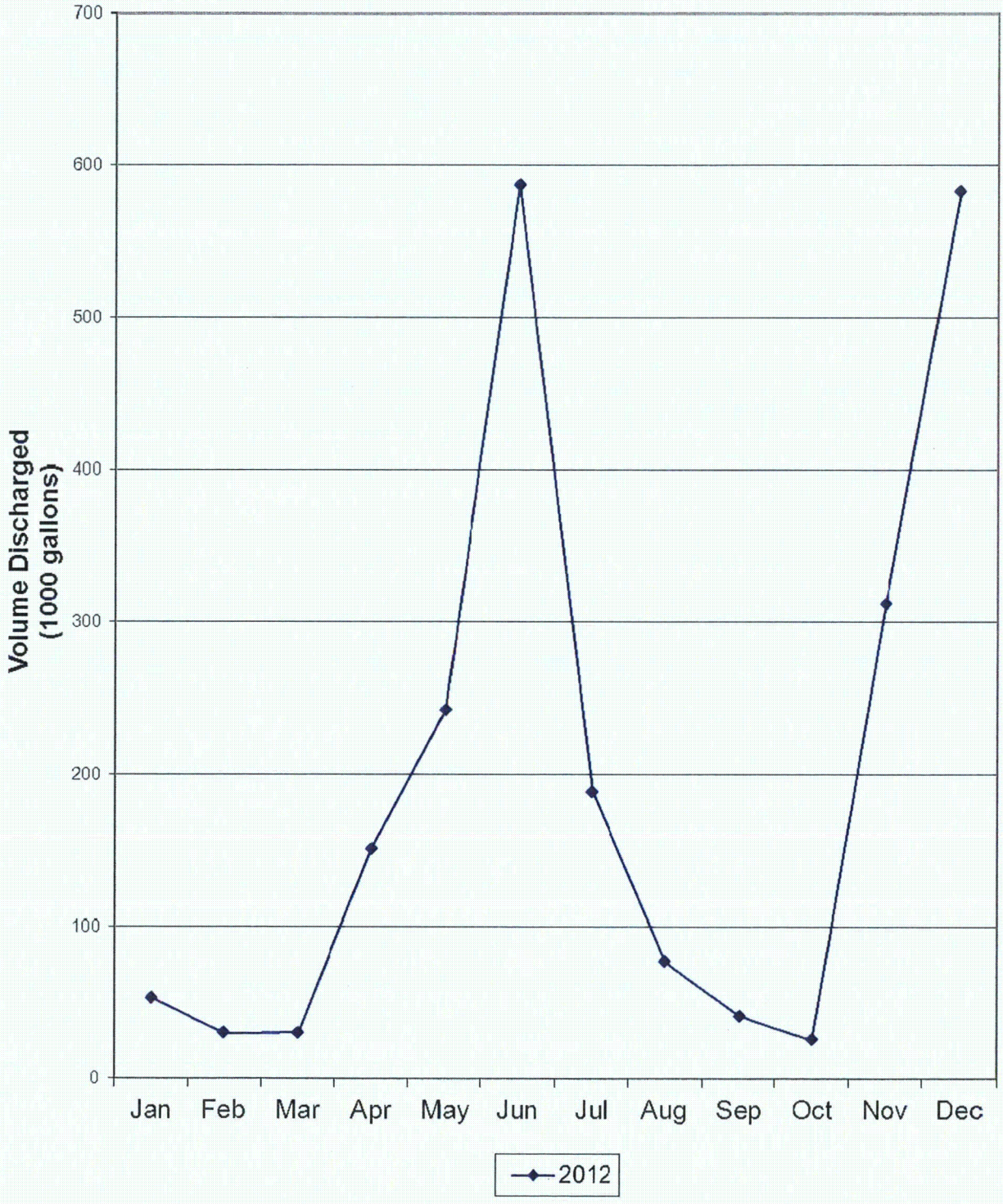


TABLE 2-5

ESTIMATED TOTAL ERRORS ASSOCIATED WITH EFFLUENTS MEASUREMENTS

	MEASUREMENT	ESTIMATED TOTAL ERROR
1.	**Airborne Effluents**	
a.	Fission and Activation Gases	15.9%
b.	I-131	13.3%
c.	Particulates (incl. Gross Alpha)	15.8%
d.	Tritium	13.6%
2.	**Waterborne Effluents**	
a.	Fission and Activation Products	5.0%
b.	Tritium	3.3%
c.	Dissolved and Entrained Gases	8.4%
d.	Gross Alpha Activity	6.0%
e.	Volume of Waste Released (Prior to Dilution)	5.0%
f.	Volume of Dilution Water Used During Period	15.0%
		ESTIMATED MAXIMUM MEASUREMENT ERROR
3.	**Solid Wastes**	
a.	Cartridge Filters – Class A HIC (Overfilled)	±25%
b.	Condensate Demineralizer / Radwaste Demineralizer - Class A HIC (Pyrolysis)	±25%
c.	Liquid Radwaste Filter Media – Class A HIC (Pyrolysis)	±25%
d.	Processed DAW – Class A Strong Tight Container (Compacted)	±25%

SUSQUEHANNA STEAM ELECTRIC STATION

RADIOACTIVE WASTE REPORT

RADIOACTIVE EFFLUENT RELEASE REPORT

SOLID RADIOACTIVE WASTE

DATA PERIOD: JANUARY 1, 2012 – DECEMBER 31, 2012

PREPARED BY: _____

MICHAEL C. MICCA
HEALTH PHYSICIST

APPROVED BY: _____

ROBIN RODRIGUEZ-GILROY
RADIOLOGICAL OPERATIONS SUPERVISOR

REPORT NOTES

1. All activities reported in Milli-Curies (mCi) unless otherwise noted.

2. Reported activities, as indicated with the (<) sign, are comprised in whole or part of MDL values.

3. Estimated maximum measurement error is ±25%.

TABLE 2-6

WASTE DISPOSITION

Data Period: January 1, 2012 - December 31, 2012

A. SOLID WASTE SHIPPED OFF-SITE FOR BURIAL OR DISPOSAL

Number of Shipments	Mode of Transportation	Destination
NONE		

B. IRRADIATED FUEL SHIPMENTS

Number of Shipments	Mode of Transportation	Destination
NONE		

NOTE: The number of shipments listed in A include only the shipments from PPL Susquehanna, LLC to a disposal site. It does not include shipments made to or from volume reduction vendors.

Table 2-7

Annual Waste Release Summary Report

Year: 2012

Class: A Volume Reduction Vendor: Yes
Source: Cartridge Filters
Container: HIC (High Integrity Container)
Process: Overfilled

Nuclides	Activity (mCi)	% of Total
C-14	< 4.970E+01	0.03 %
CE-144	2.012E+01	0.01 %
CO-58	5.425E+02	0.35 %
CO-60	4.551E+04	29.50 %
CR-51	6.297E+02	0.41 %
CS-137	2.033E+02	0.13 %
FE-55	1.002E+05	64.96 %
FE-59	2.582E+02	0.17 %
H-3	< 1.140E+00	0.00 %
HF-181	1.852E+01	0.01 %
I-129	3.700E+00	0.00 %
MN-54	4.142E+03	2.69 %
NB-95	7.206E+01	0.05 %
NI-63	1.743E+03	1.13 %
SB-124	3.145E+01	0.02 %
TC-99	1.538E+02	0.10 %
ZN-65	4.910E+02	0.32 %
ZR-95	1.768E+02	0.11 %
Total Activity (Ci)	154.247	100.00 %
Container Volume	63.340 ft3	1.794 m3

Table 2-8

Annual Waste Release Summary Report

Year: 2012

Class: A Volume Reduction Vendor: Yes
Source: Condensate Demineralizer / Radwaste Demineralizer
Container: HIC (High Integrity Container)
Process: Pyrolysis

Nuclides	Activity (mCi)	% of Total
C-14	7.577E+03	49.74 %
CO-58	2.613E+02	1.72 %
CO-60	4.005E+03	26.30 %
CR-51	7.464E+01	0.49 %
CS-137	1.045E+01	0.07 %
CU-64	0.000E+00	0.00 %
FE-55	1.469E+03	9.64 %
FE-59	2.557E+01	0.17 %
H-3	3.655E+02	2.40 %
HF-181	2.533E+00	0.02 %
I-129	< 6.500E-02	0.00 %
MN-54	8.481E+02	5.57 %
NB-95	2.289E+01	0.15 %
NI-63	2.675E+02	1.76 %
SB-124	2.330E+00	0.02 %
SB-125	6.781E+00	0.04 %
SR-90	1.044E+00	0.01 %
TA-182	2.527E+01	0.17 %
TC-99	< 1.500E-01	0.00 %
ZN-65	2.419E+02	1.59 %
ZR-95	2.448E+01	0.16 %
Total Activity (Ci)	15.232	100.00 %
Container Volume	216.230 ft3	6.123 m3

Table 2-9

Annual Waste Release Summary Report

Year: 2012

Class: A Volume Reduction Vendor: Yes
Source: Liquid Radwaste Filter Media
Container: HIC (High Integrity Container)
Process: Pyrolysis

Nuclides	Activity (mCi)	% of Total
C-14	9.081E-01	0.00 %
CO-57	1.200E+00	0.00 %
CO-58	3.450E+02	0.96 %
CO-60	8.411E+03	23.35 %
CR-51	4.390E+01	0.12 %
CS-137	7.310E+00	0.02 %
CU-64	2.570E-45	0.00 %
FE-55	2.457E+04	68.21 %
FE-59	9.960E+00	0.03 %
H-3	4.720E+01	0.13 %
I-129	< 6.180E-02	0.00 %
MN-54	1.697E+03	4.71 %
NB-95	1.214E+01	0.03 %
NI-63	2.954E+02	0.82 %
RU-105	6.030E-84	0.00 %
SB-124	2.180E+00	0.01 %
SR-90	5.840E-01	0.00 %
TA-182	1.440E+01	0.04 %
TC-99	< 3.500E-01	0.00 %
ZN-65	5.500E+02	1.53 %
ZR-95	1.434E+01	0.04 %
Total Activity (Ci)	36.024	100.00 %
Container Volume	30.460 ft3	0.863 m3

Table 2-10

Annual Waste Release Summary Report

Year: 2012

Class: A Volume Reduction Vendor: Yes
Source: Processed DAW
Container: Strong Tight Container
Process: Compacted

Nuclides	Activity (mCi)	% of Total
C-14	2.191E+01	0.89 %
CE-144	2.300E-03	0.00 %
CO-57	7.108E-03	0.00 %
CO-58	1.724E+01	0.70 %
CO-60	5.895E+02	23.83 %
CR-51	7.078E+00	0.29 %
CS-137	1.060E+00	0.04 %
CU-64	9.470E-09	0.00 %
FE-55	1.650E+03	66.68 %
FE-59	1.418E+00	0.06 %
H-3	2.569E+01	1.04 %
HF-181	2.450E-03	0.00 %
I-129	< 7.050E-03	0.00 %
MN-54	1.065E+02	4.31 %
NB-95	2.352E+00	0.10 %
NI-63	2.190E+01	0.89 %
RU-105	2.330E-36	0.00 %
SB-124	1.405E-01	0.01 %
SB-125	5.951E-02	0.00 %
SR-90	2.755E-02	0.00 %
TA-182	< 6.270E-01	0.03 %
TC-99	2.440E-03	0.00 %
ZN-65	2.717E+01	1.10 %
ZR-95	1.383E+00	0.06 %
Total Activity (Ci)	2.474	100.00 %
Container Volume	2779.750 ft3	78.715 m3