VISTRA ENERGY

TXU energy | Luminant

Thomas P. McCool
Site Vice President
Luminant
P.O. Box 1002
6322 North FM 56
Glen Rose, TX 76043
o 254.897.6042
m 817.776.0308

CP-201700255
TXX-17043

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Ref 10 CFR 50.36a
Tech Spec 5.6.3

4/27/2017

SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT
DOCKET NOS. 50-445 AND 50-446
TRANSMITTAL OF YEAR 2016 RADIOACTIVE EFLUENT RELEASE REPORT

Dear Sir or Madam:

In accordance with Comanche Peak Nuclear Power Plant[1] Units 1 and 2 Technical Specifications (TS) 5.6.3 and Section 6.9.1.4 of the Comanche Peak Offsite Dose Calculation Manual (ODCM), enclosed is the Radioactive Effluent Release Report which covers the reporting period from January 1, 2016 through December 31, 2016.

The tabular summaries of radioactive liquid and gaseous releases are provided in the format defined in Appendix B of Regulatory Guide 1.21, Rev. 1, dated June, 1974.

During this reporting period there were no revisions to the ODCM.

If there are any questions regarding this report, please contact Steve Dixon at (254) 897-5482 or Kerry Cooper at (254) 897-0462.

IE48
NRR

[1] TEX Operations Company LLC and Comanche Peak Company LLC are the current NRC licensees. On December 14, 2016, License Amendment Request 16-003 (ML16351A200) submitted an administrative change to change the licensee name "TEX Operations Company LLC" to "Vistra Operations Company LLC".

Sincerely,

Thomas P. McCool

Enclosure 1. Comanche Peak 2016 Radioactive Effluent Release Report

c - K. M. Kennedy, Region IV
M. Watford, NRR
Resident Inspectors, Comanche Peak

Enclosure 1

Comanche Peak 2016 Radioactive Effluent Release Report

Luminant CPNPP Comanche Peak Nuclear Power Plant

2016 RADIOACTIVE EFFLUENT RELEASE REPORT

January 1, 2016 - December 31, 2016

Prepared By: Donald Rebstock Date: 4/23/17

Reviewed By: David Valentine Date: 4/23/17

Approved By (Print/Signature): Jeanne Rodgers/ J. Rodgers Date: 4/23/17

Chemistry Manager

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

1.0 INTRODUCTION

1.1 Executive Summary

1.2 Historical Trend Graphs

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

2.2 Effluent Concentration Limits

2.3 Measurements and Approximations of Total Radioactivity

2.4 Batch Releases

2.5 Abnormal or Unplanned Releases

3.0 GASEOUS EFFLUENTS

4.0 LIQUID EFFLUENTS

5.0 SOLID WASTES

6.0 RADIOLOGICAL IMPACT ON MAN

6.1 Dose Due to Liquid Effluents

6.2 Dose Due to Gaseous Effluents

6.3 Dose Due to Radioiodines, Tritium, and Particulates

6.4 40CFR190 Dose Evaluation

6.5 Dose to a MEMBER OF THE PUBLIC from Activities inside the Site Boundary

7.0 METEROLOGICAL DATA

7.1 Meteorological Monitoring Program

8.0 RELATED INFORMATION

8.1 Operability of Liquid and Gaseous Monitoring Instrumentation

8.2 Changes to the Offsite Dose Calculation Manual

TABLE OF CONTENTS

8.3 New Locations for Dose Calculations or Environmental Monitoring

8.4 Liquid Holdup and Gas Storage Tanks

8.5 Noncompliance with Radiological Effluent Control Requirements

8.6 Resin Releases to the LVW Pond

8.7 Changes to the Liquid, Gaseous, and Solid Waste Treatment Systems

8.8 Groundwater Tritium Monitoring Program

9.0 TABLES

9.1 Liquid and Gaseous Batch Release Summary

9.2 Abnormal Batch Liquid and Gaseous Release Summary

9.3 Gaseous Effluents-Summation of All Releases

9.4 Gaseous Effluents-Ground Level Releases

9.5 Liquid Effluents Summation of All Releases

9.6 Liquid Effluents

9.7 Dose to a member of the public due to Liquid Releases

9.8 Dose Due to Gaseous Releases

9.9 Dose to a Member of the Public Due to Radioiodines, Particulates, Tritium, and C-14 in Gaseous Releases

9.10 Solid Waste and Irradiated Fuel Shipments

10.0 ATTACHMENTS

10.1 Meteorological Joint Frequency Distribution Tables

10.2 Atmospheric Dispersion (X/Q) and Deposition (D/Q) Calculation Methodology Discussion

10.3 Carbon 14 Supplemental Information

ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
CPNPP	Comanche Peak Nuclear Power Plant
ECL	Effluent Concentration Limit
IFSFI	Independent Spent Fuel Storage Installation
LDCR	Licensing Document Change Request
LHMT	Laundry Holdup and Monitor Tanks
LVW	Low Volume Waste
ODCM	Offsite Dose Calculation Manual
PET	Primary Effluent Tanks
pCi	Pico-Curie
REC	Radiological Effluent Control
SORC	Station Operations Review Committee
uCi	Micro-Curie
WMT	Waste Monitor Tanks
WWHT	Waste Water Holdup Tanks

1.0 Introduction

This Radioactive Effluent Release Report, for Comanche Peak Nuclear Power Plant (CPNPP) Unit 1 and Unit 2, is submitted as required by Technical Specification 5.6.3 and Offsite Dose Calculation Manual (ODCM) Administrative Control 6.9.1.4 for the period January 1, 2016, through December 31, 2016. Data in this report were calculated in accordance with the CPNPP ODCM using the Canberra OpenEMS software.

1.1 Executive Summary

The radioactive effluent monitoring program for 2016 was conducted as described in the following report. Results of the monitoring program indicate continued effort to maintain the release of radioactive effluents to the environment as low as reasonably achievable (ALARA).

In June 2009, the NRC provided revised guidance in Regulatory Guide 1.21, *Measuring, Evaluating and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste, Revision 2*, establishing an updated approach for identifying principal radionuclides. Because the overall quantity of radioactive releases has steadily decreased due to improvements in power plant operations, Carbon-14 (C-14) now qualifies as a "principal radionuclide" (anything greater than one percent of overall radioactivity in effluents) under federal regulations at many plants. In other words, C-14 has not increased and C-14 is not a new nuclear plant emission. Rather, improvements in the mitigation of other isotopes have made C-14 more prominent. Attachment 10.3 provides more detail about C-14.

1.1 Executive Summary (continued)

Gaseous Effluents:

Two year summary of all the radioactive gaseous releases to the environment:

Gaseous Waste	2015	2016	Comments
Tritium (Ci)	38.2	35.3	1
C-14 (Ci)	25.3	25.9	2
Total Fission and Activation Products (Ci)	0.55	0.43	
Total Particulate (Ci)	0	0	3
Gross Alpha (Ci)	0	0	3
Iodine (Ci)	0	0	3
Calculated Gamma Air Dose (mRad)	3.71E-04	3.72E-04	
Calculated Beta Air Dose (mRad)	1.62E-04	1.41E-04	
Total Body Dose (mRem)	0.10	0.10	

Comments:

1. The major contributor to gaseous tritium activity is evaporation from the spent fuel pools. Factors contributing to the tritium activity in the pools are related to the type of fuel used (i.e., 18-month fuel) the core life, power output, and number of core cycles. The small decrease from 2015 to 2016 is within the historical statistical variation.

2. C-14 activity released from the site is estimated using reactor power in accordance with EPRI document "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents".

3. No particulate, Iodine, or alpha activity was released.

Overall the gaseous radioactivity releases from CPNPP are well controlled and maintained ALARA. CPNPP is well below all applicable limits for gaseous releases. Neither unit had fuel defects during the year of this report.

1.1 Executive Summary (continued)

Liquid Effluents:

Two year summary of all the radioactive liquid releases to the environment:

Liquid Waste	2015	2016	Comments
Total Activity Excluding Tritium (Ci)	1.83E-03	1.92E-03	
Tritium Activity (Ci)	1950	1390	1
Total Body Dose (mRem)	0.19	0.16	
Total Volume Released (Gallons)	665,178	678,996	

Comments:

1. Tritium released values can vary significantly from year to year based on a couple of factors. First, reactor coolant tritium production changes based on fuel burnup characteristics. Tritium activity increases following reactor startup, then plateaus mid-cycle, and begins to decline towards the end of cycle. Second, the tritium released value is dependent upon on how many outages there were during a calendar year. More liquid waste is processed and released during unit outages.

Meteorological Data

During 2016, the CPNPP meteorological system achieved a greater than 97% mean recoverable data rate for the joint frequency parameters required by Regulatory Guide 1.23 for wind speed, wind direction and delta temperature. See section 7.1 for the actual recovery percentages.

Monitors OOS > 30 Days

During 2016, there were no Technical Specification/ODCM effluent radiation monitors out of service for > 30 days.

ODCM Changes

No changes were made to the ODCM during 2016.

1.1 Executive Summary (continued)

Solid Waste

Two year summary of the solid waste production:

Total Waste	2015	2016	% Error
Shipped (m^3)	316	261	25%
Shipped (Ci)	52.1	45.6	25%
Buried (m^3)	44.5	30.0	25%
Buried (Ci)	52.1	45.6	25%

Comments:

Solid waste shipments and burials have generally trended downward over the past 5 years due to solid waste reduction measures. 2016 was a single outage year which led to less solid waste shipped and buried, consistent with single outage years.

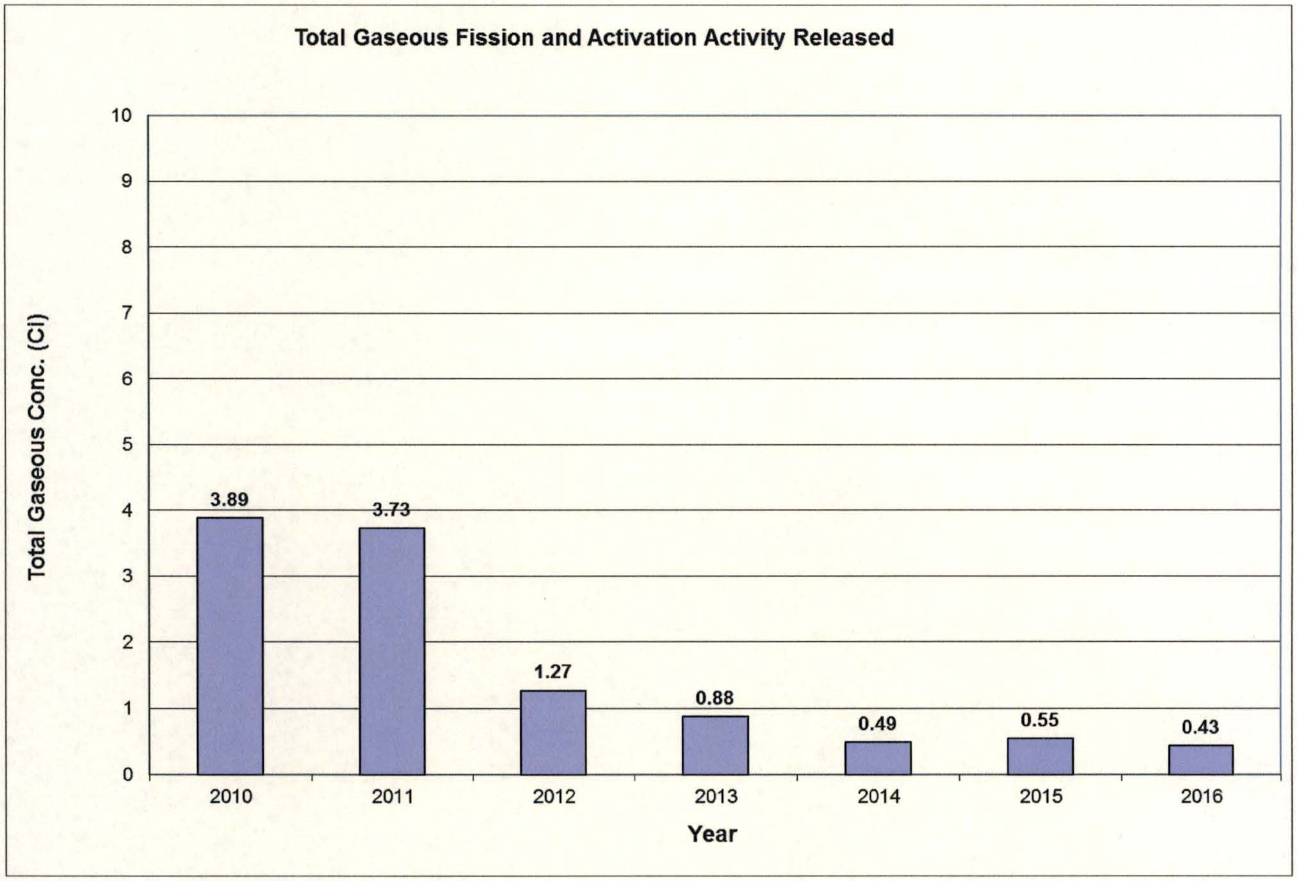
Groundwater Tritium

Sentinel Well location CP-A near the Water Plant and Monitor Well 11 (which is directly down gradient from CP-A) continued showing intermittent positive results for tritium. The positive results were from a leak in the filtered water storage tank (FWST) and from a leak in piping from the Low Volume Waste (LVW) Pond to the Water Treatment Waste Sump. The FWST leak was repaired mid-2016 and the LVW leak was repaired in January of 2017.
See section 8.8 for details.

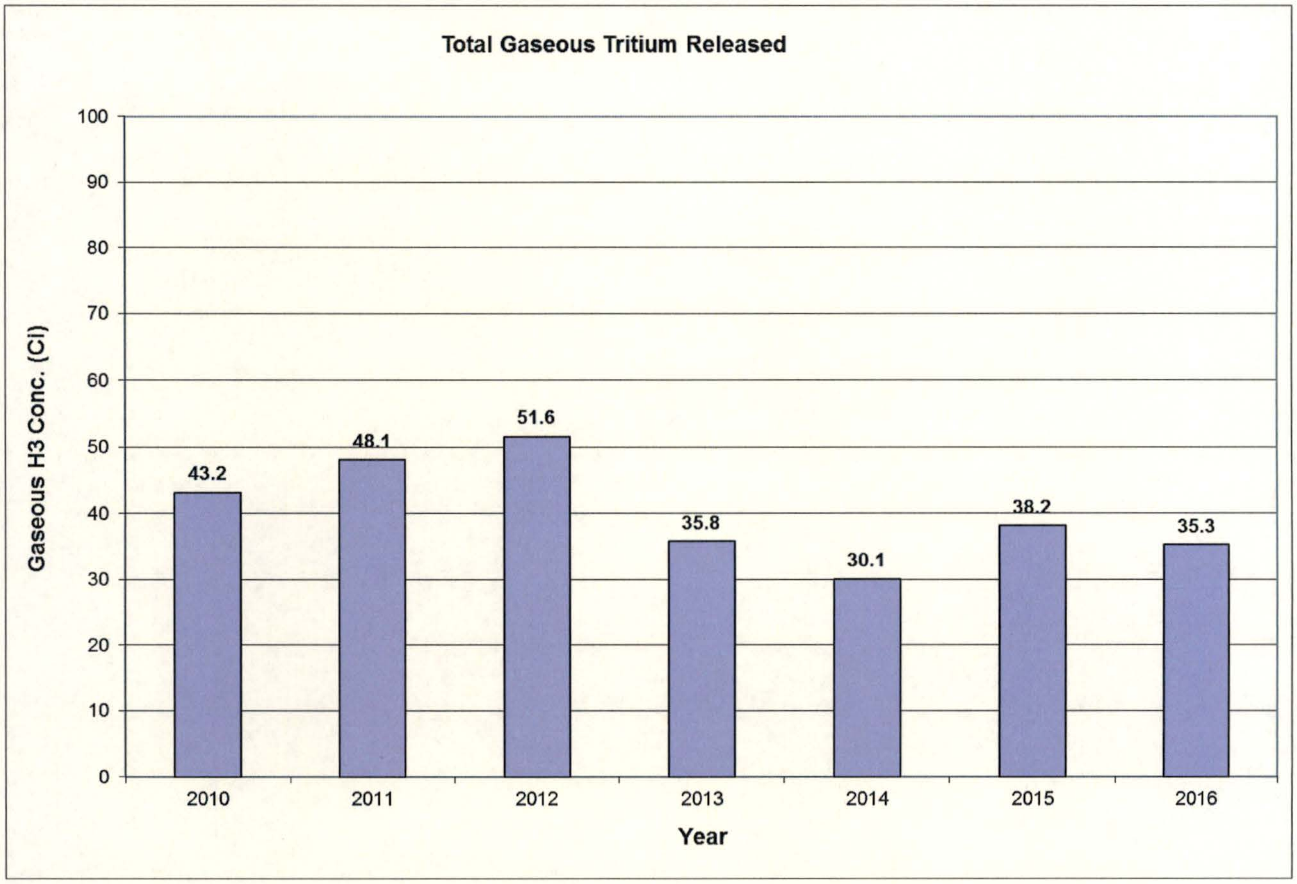
Conclusion

During 2016, the radioactive effluent monitoring program has been conducted in an appropriate manner to ensure the activity released and associated dose to the public has been maintained as low as reasonably achievable (ALARA).

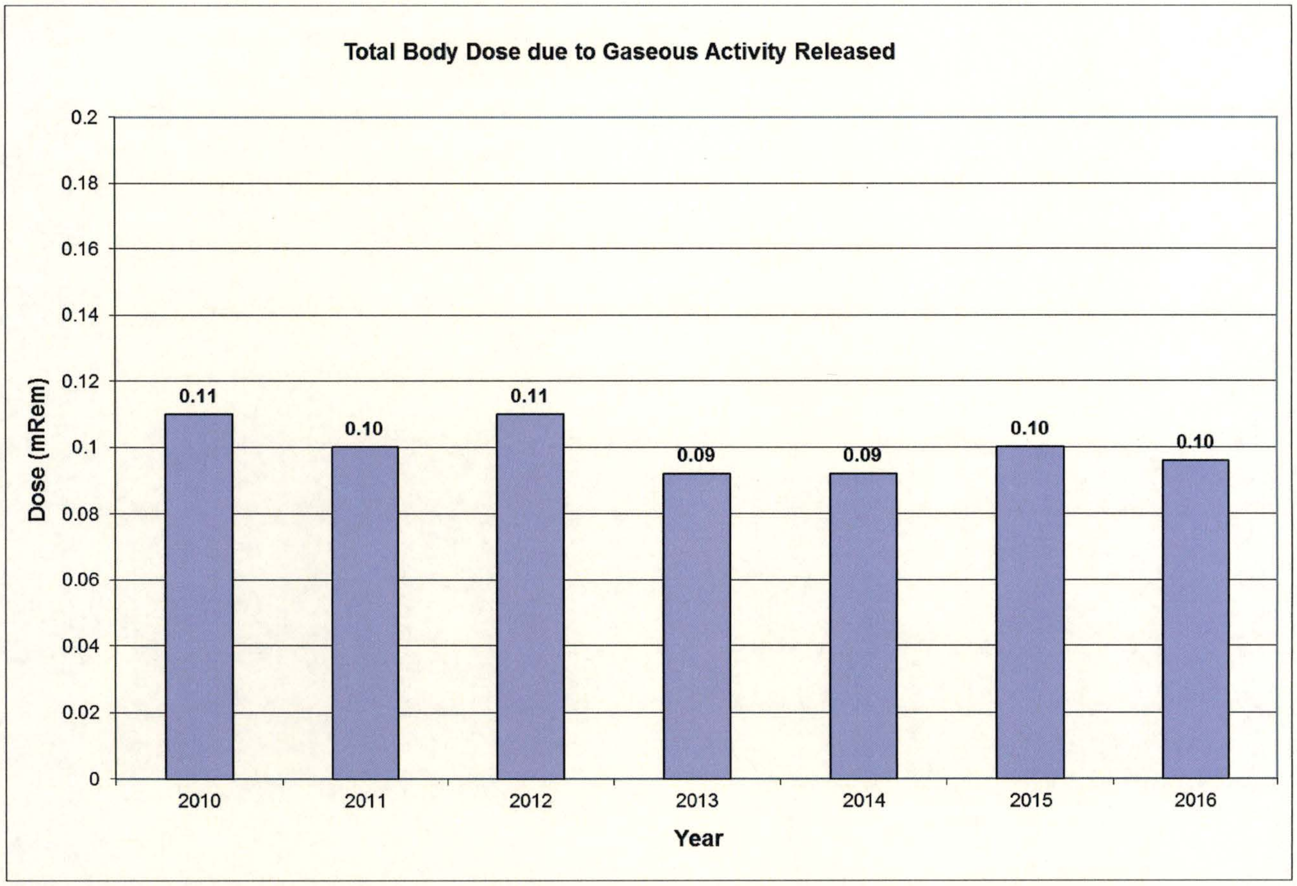
1.2 Historical Trend Graphs



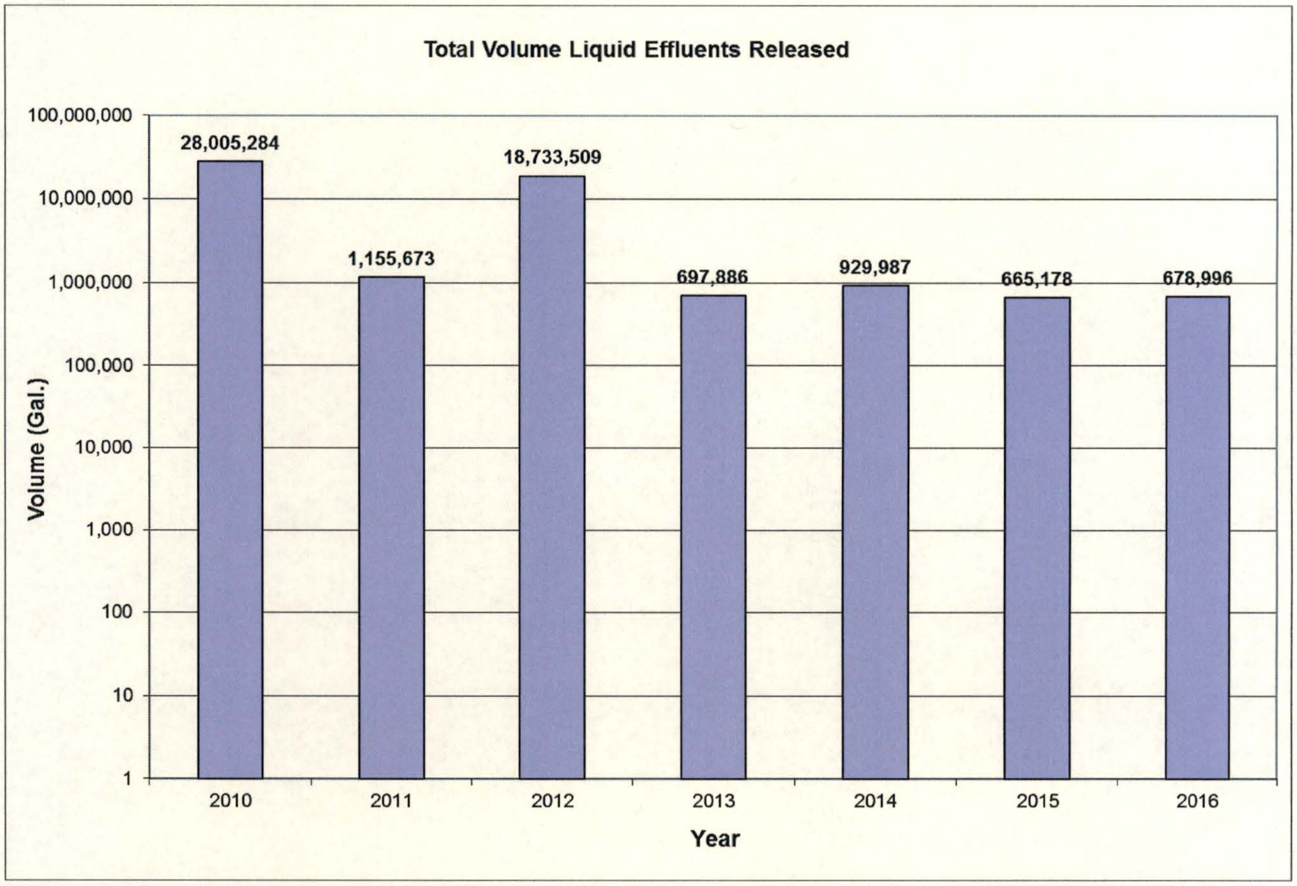
Year	Total Gaseous Fission and Activation Activity Released Comments
2010	Higher gas activity released from the site due to fuel leaks occurring between 2004 and 2008.
2011	Higher gas activity released from the site due to fuel leaks occurring between 2004 and 2008. Another fuel leak occurred in 2011.
2012	Lower gas activity released from the site due to recovery from previous fuel leaks.



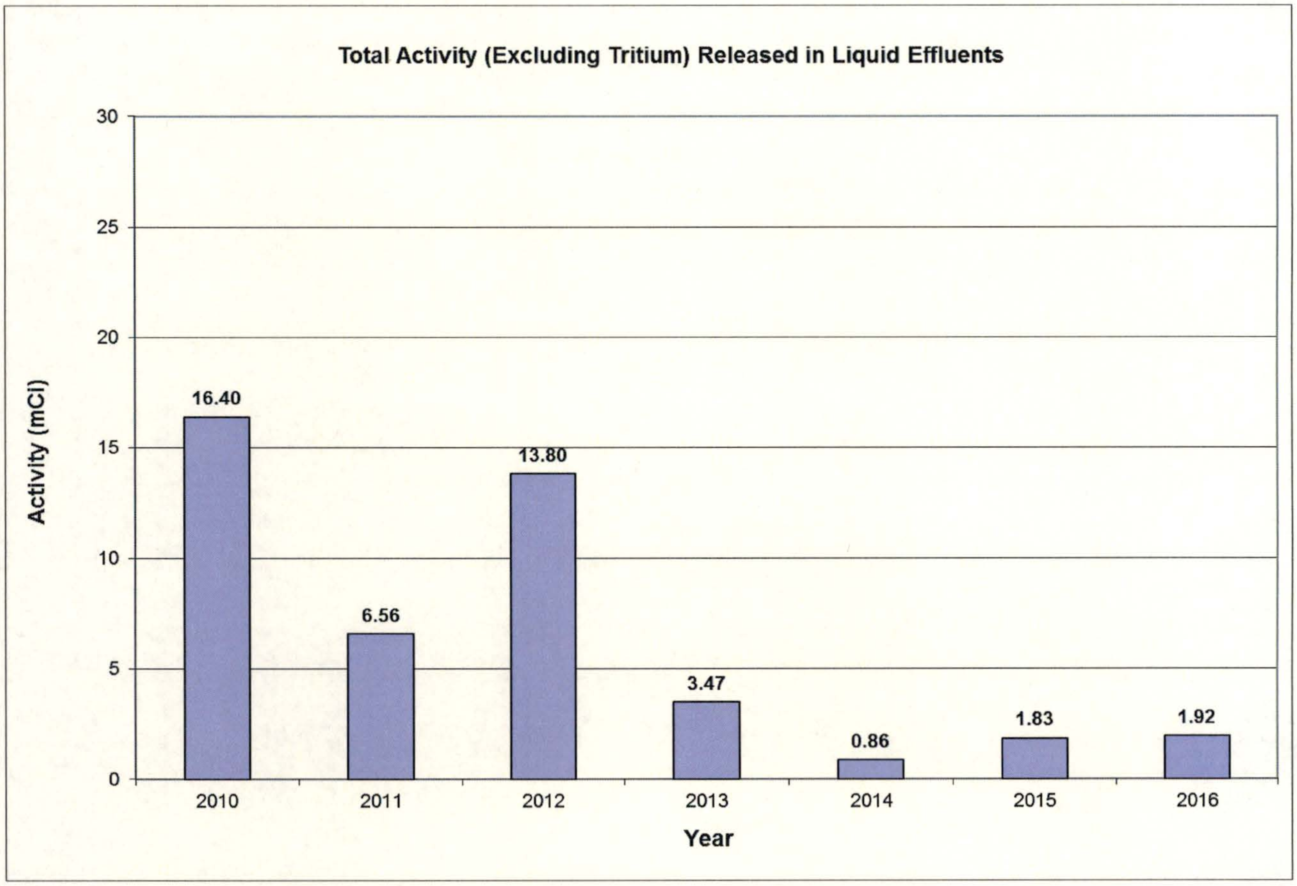
Year	Total Gaseous Tritium Released Comments
N/A	The major contributor to gaseous tritium activity is evaporation from the spent fuel pools. Factors contributing to the tritium activity in the pools is related to the type of fuel used (i.e., 18-month fuel) the core life, power output, and number of core cycles.



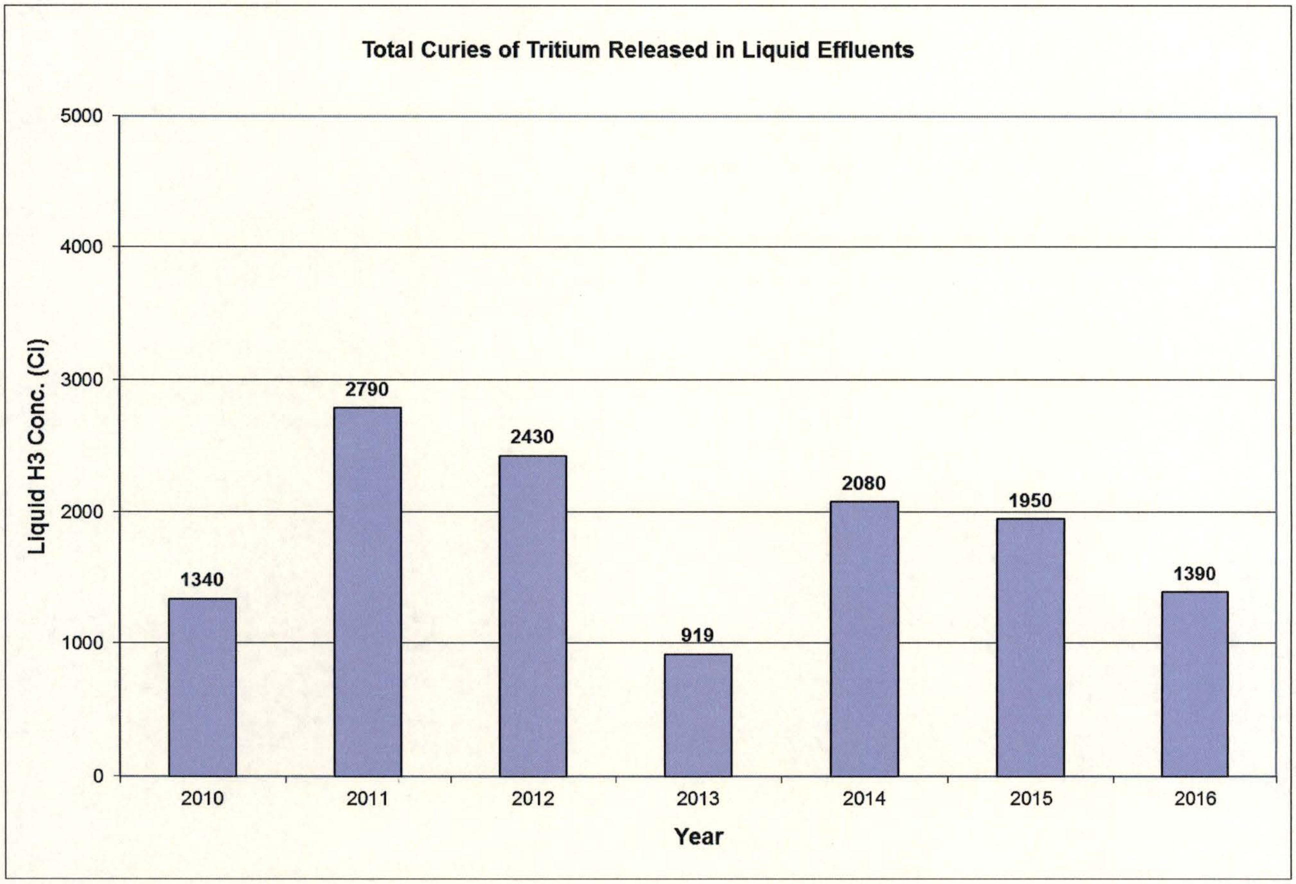
Year	Total Body Dose due to Gaseous Activity Released Comments
2010	Despite the inclusion of C-14, total whole body dose is very low (0.71% of Technical Specification).
2012	There was a mid-cycle outage during 2012 that required degassing of the RCS in addition to a planned refueling outage resulting in slightly higher total body dose for 2012.



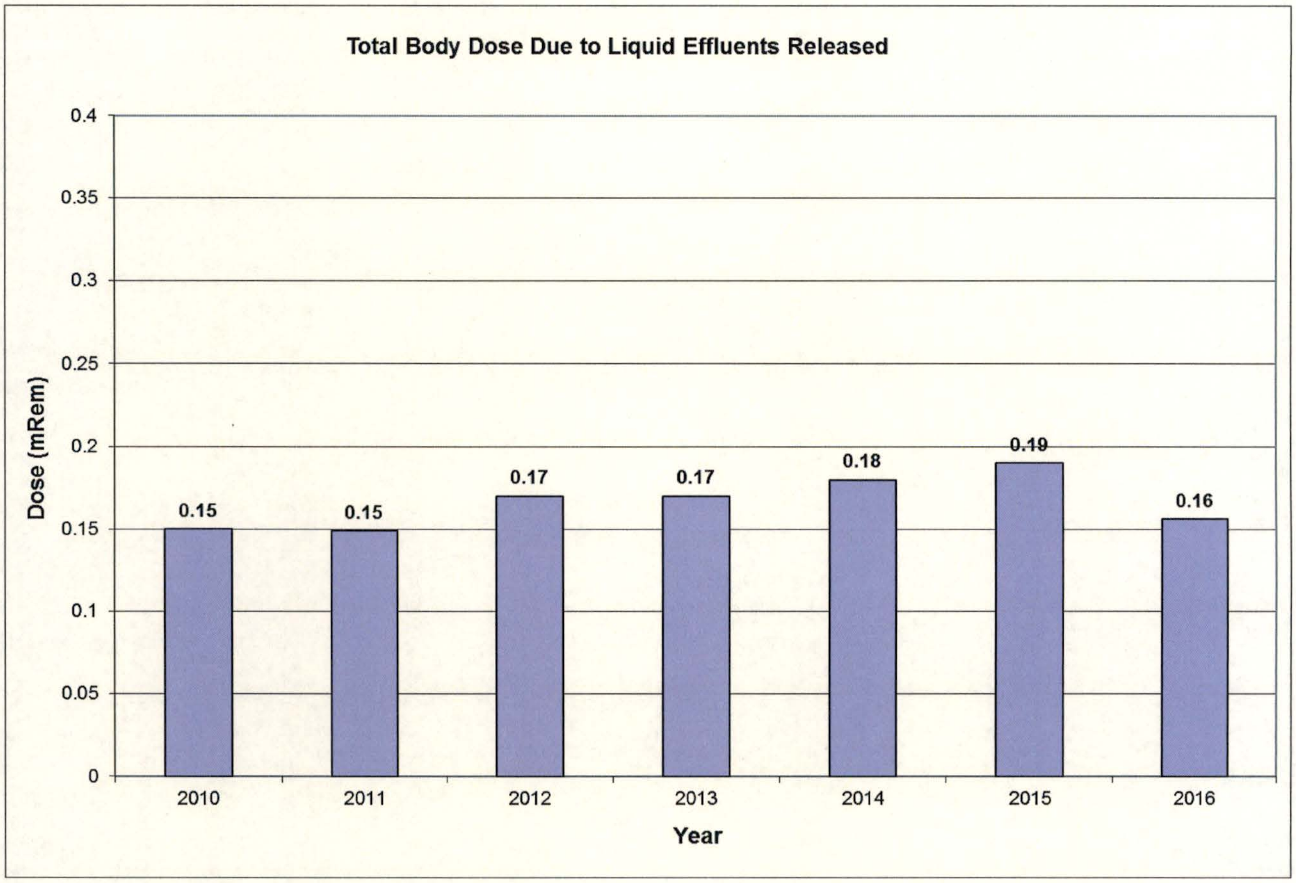
Year	Total Body Dose due to Gaseous Activity Released Comments
2010	CPNPP processes many millions of gallons of non-radioactive water each year from the secondary portion of the plant. Water plant waste, turbine building sumps and other sources all contribute to these totals. This waste water is processed through the low volume waste (LVW) system which then discharged to Squaw Creek Reservoir. A monthly composite sample of from the LVW is analyzed quarterly for activity. Normally, this waste water does not contain any radionuclides. However, in late 2009, the refueling water storage tank (RWST) overflowed into the turbine building sumps. Initially this water was diverted to the waste processing system. Once the cleanup was complete, the turbine building sump was directed back to the LVW system. A small amount of tritium remained in the turbine building sumps and was sent to the LVW. The first quarter LVW composite sample tested positive for tritium (a small amount above background). Consequently, the volume discharged from the LVW had to be accounted for as liquid waste. Because the LVW sample is a quarterly composite, the volume processed as liquid waste for the first quarter (and for the year) is 20 times larger than normal.
2012	Analysis of the 2nd quarter LVW composite indicated a small concentration of tritium. Consequently, the volume discharged from the LVW had to be accounted for as radioactive liquid waste for that quarter resulting in a much larger than normal total annual liquid waste volume.



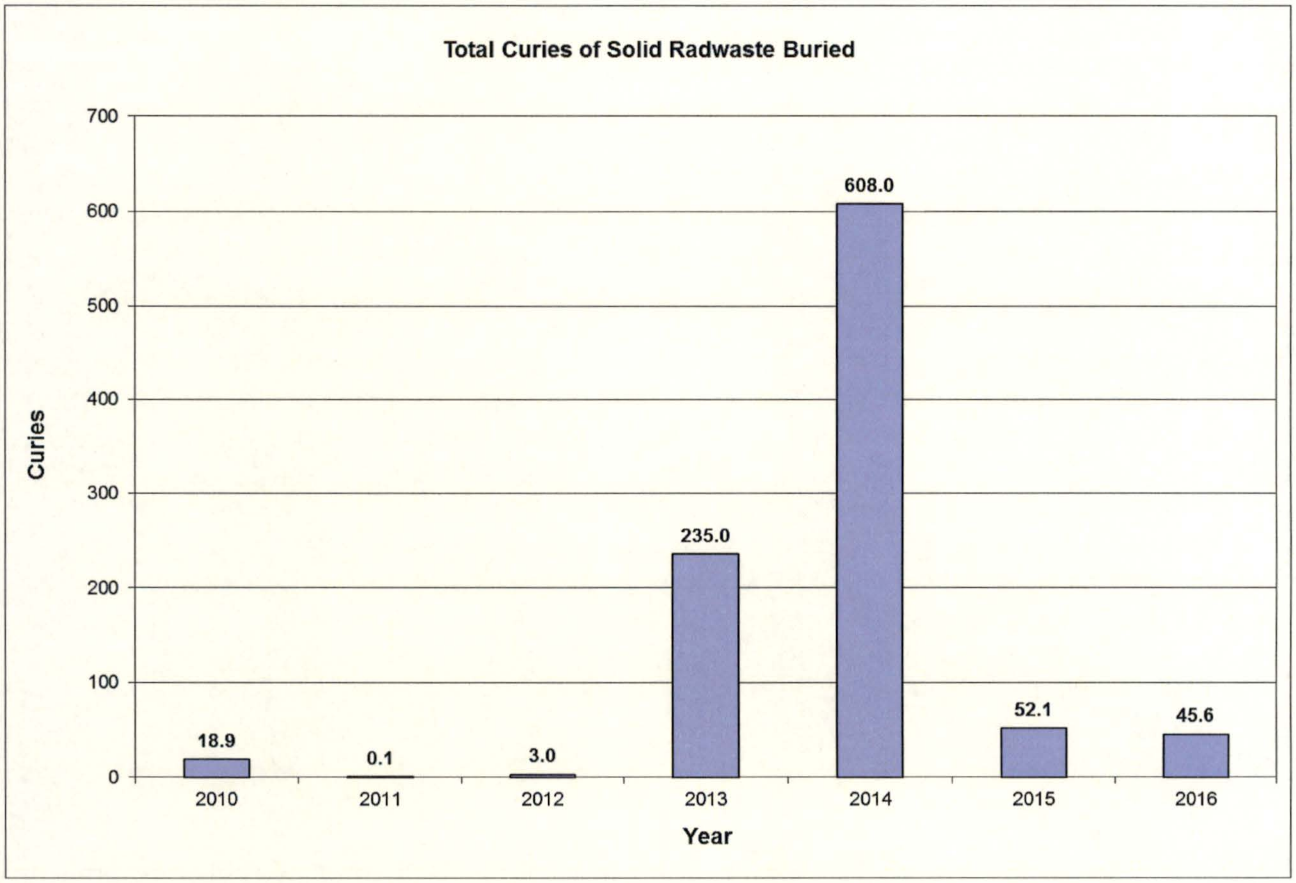
Year	Total Activity (Excluding H3) Released in Liquid Effluents Comments
2010	The increase in activity in 2010 was due to issues with the liquid waste processing equipment from March to June. Changes in media and processing methodology solved the problem and restored processing efficiency. Despite this, total liquid waste released in 2010 was very low.
2012	The increased activity for 2012 is attributed to waste water processing for 1 refueling outage, 1 forced outage, and dry cask storage operations.



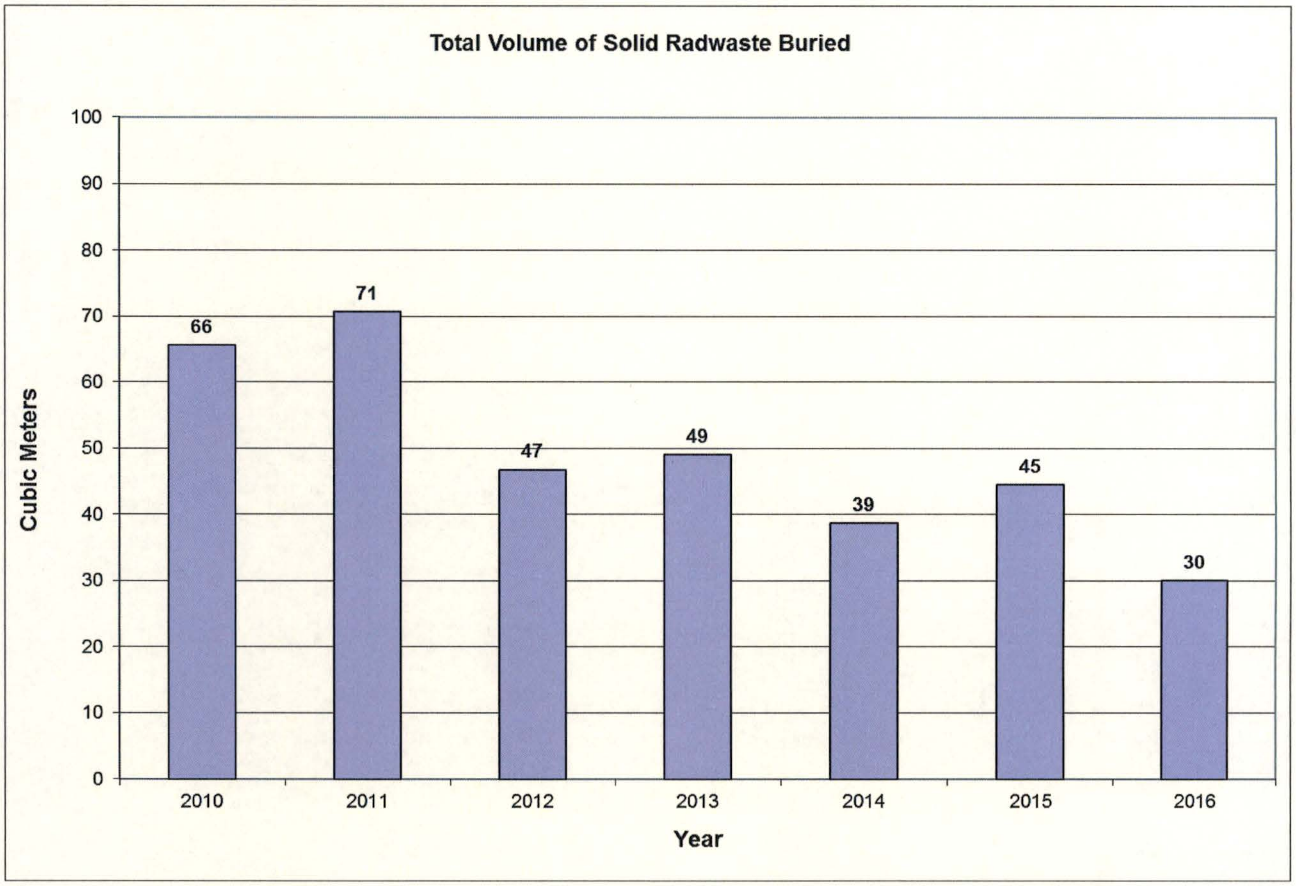
Year	Total Curies of Tritium Released in Liquid Effluents Comments
All	Tritium released values can vary significantly from year to year based on a couple of factors. First, reactor coolant tritium production changes based on fuel burnup characteristics. Tritium activity increases following reactor startup, then plateaus mid-cycle, and begins to decline towards the end of cycle. Second, the tritium released value is dependent upon on how many outages there were during a calendar year. More liquid waste is processed and released during unit outages.



Year	Total Body Dose Due to Liquid Effluents Released Comments
N/A	No comments



Year	Total Curies of Solid Radwaste Buried Comments
2013	In 2013 CPNPP shipped and buried significantly more Class B and C waste to the compact disposal facility in Andrews, Texas. This waste has a very high specific activity with respect to Class A waste. In 2012, CPNPP only disposed of Class A waste and consequently the activity was very low with respect to 2013 values. The buried volume in both years are similar since Class B and C wastes are in packages of 120 cubic feet, or about 3 cubic meters, and consequently, the impact on the overall waste volume is minimal.
2014	In 2014 CPNPP continued to ship and bury stored Class B and Class C wastes at the compact disposal facility in Andrews, Texas. In advance of the compliance date for 10 CFR 37, waste containers with the highest radioactivity, particularly those exceeding category two quantities, were chosen to be shipped. In 2013, CPNPP had just began shipments to the new Andrews, Texas disposal facility and the waste containers chosen for shipment represented lower total activity to allow the staff to become familiar with the new procedure processes required by the new facility. Buried volume in both years are similar since these values are normally associated with Class A Dry Active Waste that represents an order of magnitude more volume than Class B and Class C wastes packaged in 120 cubic feet, or about 3 cubic meter, containers.



Year	Total Body Dose Due to Liquid Effluents Released Comments
2013	In 2013 CPNPP shipped and buried significantly more Class B and C waste to the compact disposal facility in Andrews, Texas. This waste has a very high specific activity with respect to Class A waste. In 2012, CPNPP only disposed of Class A waste and consequently the activity was very low with respect to 2013 values. The buried volume in both years are similar since Class B and C wastes are in packages of 120 cubic feet, or about 3 cubic meters, and consequently, the impact on the overall waste volume is minimal.
2014	In 2014 CPNPP continued to ship and bury stored Class B and Class C wastes at the compact disposal facility in Andrews, Texas. In advance of the compliance date for 10 CFR 37, waste containers with the highest radioactivity, particularly those exceeding category two quantities, were chosen to be shipped. In 2013, CPNPP had just began shipments to the new Andrews, Texas disposal facility and the waste containers chosen for shipment represented lower total activity to allow the staff to become familiar with the new procedure processes required by the new facility. Buried volume in both years are similar since these values are normally associated with Class A Dry Active Waste that represents an order of magnitude more volume than Class B and Class C wastes packaged in 120 cubic feet, or about 3 cubic meter, containers.
2016	Solid waste shipments and burials have generally trended downward over the past 5 years due to solid waste reduction measures. Also, 2016 was a single outage year which led to less solid waste shipped and buried when compared to 2015.

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

The ODCM Radiological Effluent Control limits applicable to the release of radioactive material in liquid and gaseous effluents are described in the following sections.

2.1.1 Fission and Activation Gases (Noble Gases)

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

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

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

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

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

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

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

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

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

2.1.3 Liquid Effluents

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

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

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

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

2.1.4 LVW Pond Resin Inventory

The quantity of radioactive material contained in resins transferred to the LVW pond shall be limited by the following expression:

$$(264/V) \bullet \Sigma_j A_j/C_j < 1.0$$

excluding tritium, dissolved or entrained noble gases and radionuclides with less than an 8 day half life, where:

A_j = pond inventory limit for a single radionuclide j (Curies),

C_j = 10CFR20, Appendix B, Table 2 Column 2, concentration for a single radionuclide j (μCi/mL),

V = volume of resins in the pond (gallons), and

264 = conversion factor (μCi/Ci per mL/gal)

This expression limits the total quantity of radioactive materials in resins discharged to the LVW Pond to a value such that the average concentration in the resins, calculated over the total volume of resins in the pond, will not exceed one times the Effluent Concentration Limits specified in 10 CFR 20, Appendix B, Table 2, Column 2.

2.1.5 Total Dose

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

2.2 Effluent Concentration Limits

2.2.1 Gaseous Effluents

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

2.2.2 Liquid Effluents

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

2.3 Measurements and Approximations of Total Radioactivity

Measurements of total radioactivity in liquid and gaseous radioactive effluents were accomplished in accordance with the sampling and analysis requirements of Tables 4.11-1 and 4.11-2, respectively, of the CPNPP ODCM.

2.3.1 Liquid Radioactive Effluents

Each batch release was sampled and analyzed for gamma emitting radionuclides using gamma spectroscopy. Composite samples were analyzed monthly and quarterly for the Primary Effluent Tanks (PET), Waste Monitor Tanks (WMT), Laundry Holdup and Monitor Tanks (LHMT) and Waste Water Holdup Tanks (WWHT). Composite samples were analyzed monthly for tritium and gross alpha radioactivity in the onsite laboratory using liquid scintillation and gas flow proportional counting techniques, respectively. Composite samples were analyzed quarterly for Sr-89, Sr-90, Fe-55, and Ni-63 by a contract laboratory. The results of the composite analyses from the previous month or quarter were used to estimate the quantities of these radionuclides in liquid effluents during the current month or quarter. The total radioactivity in liquid effluent releases was determined from the measured and estimated concentrations of each radionuclide present and the total volume of the effluent released during periods of discharge.

For batch releases of powdex resin to the LVW pond, samples were analyzed for gamma emitting radionuclides, using gamma spectroscopy techniques. Composite samples were analyzed quarterly for Sr-89 and Sr-90 by a contract laboratory.

For continuous releases to the Circulating Water Discharge from the LVW pond, daily grab samples were obtained over the period of pond discharge. These samples were composited and analyzed for gamma emitting radionuclides, using gamma spectroscopy techniques. Composite samples were also analyzed for tritium and gross alpha radioactivity using liquid scintillation and gas flow proportional counting techniques respectively. Composite samples were analyzed quarterly for Sr-89, Sr-90, Fe-55, and Ni-63 by a contract laboratory.

2.3.2 Gaseous Radioactive Effluents

Each gaseous batch release was sampled and analyzed for radioactivity prior to release. Waste Gas Decay Tank samples were analyzed for gamma emitting radionuclides. Containment Building charcoal (iodine), particulate, noble gas, and tritium grab samples were also analyzed for radioactivity prior to each release. The results of the analyses and the total volume of effluent released were used to determine the total amount of radioactivity released in the batch mode.

For continuous effluent release pathways, noble gas and tritium grab samples were collected and analyzed weekly. Samples were analyzed for gamma emitting radionuclides by gamma spectroscopy and liquid scintillation counting techniques. Continuous release pathways were continuously sampled using radioiodine adsorbers and particulate filters. The radioiodine adsorbers and particulate filters were analyzed weekly for I-131 and gamma emitting radionuclides using gamma spectroscopy. Results of the noble gas and tritium grab samples, radioiodine adsorber and particulate filter analyses from the current week and the average effluent flow rate for the previous week were used to determine the total amount of radioactivity released in the continuous mode. Monthly composites of particulate filters were analyzed for gross alpha activity, in the onsite laboratory using the gas flow proportional counting technique. Quarterly composites of particulate filters were analyzed for Sr-89 and Sr-90 by a contract laboratory.

C-14 was estimated in accordance with the methodology in the EPRI report *Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents.* EPRI, Palo Alto, CA: 2010, 1021106. See attachment 10.3 on page 50 for more information on C-14.

2.4 Batch Releases

A summary of information for liquid and gaseous batch releases is included in Table 9.1.

2.5 Abnormal or Unplanned Releases

Abnormal or unplanned radioactive releases are defined as the unintended discharge of a volume of liquid or airborne radioactivity to the environment. There were no abnormal or unplanned liquid or gaseous radioactive effluent releases during 2016.

3.0 GASEOUS EFFLUENTS

The quantities of radioactive material released in gaseous effluents are summarized in Tables 9.3 and 9.4. All releases of radioactive material in gaseous form are considered to be ground level releases.

4.0 LIQUID EFFLUENTS

The quantities of radioactive material released in liquid effluents are summarized in Tables 9.5 and 9.6.

5.0 SOLID WASTES

The quantities of radioactive material released as solid effluents are summarized in Table 9.10.

6.0 RADIOLOGICAL IMPACT ON MAN

6.1 Dose Due to Liquid Effluents

The dose to an adult from the fish and cow-meat consumption pathways from Squaw Creek Reservoir were calculated in accordance with the methodology and parameters in the ODCM. The results of the calculations are summarized on a quarterly and annual basis in table 9.7.

6.2 Dose Due to Gaseous Effluents

The air dose due to gamma emissions and the air dose due to beta emissions were calculated using the highest annual average atmospheric dispersion factor at the Site Boundary location, in accordance with the methodology and parameters in the ODCM. The results of the calculations are summarized on a quarterly and annual basis in Table 9.8.

6.3 Dose Due to Radioiodines, Tritium and Particulates

The dose to an adult, teen, child, and infant from radio-iodines and particulates, for the pathways listed in Part II, Table 2.4 of the ODCM, were calculated using the highest dispersion and deposition factors, as appropriate, in accordance with the methodology and parameters in the ODCM. The results of the calculations are summarized on a quarterly and annual basis in Table 9.9. Because of pathway similarity, C-14 dose is included in this table.

6.4 40CFR190 Dose Evaluation

ODCM Radiological Effluent Control 3.11.4 requires dose evaluations to demonstrate compliance with 40 CFR Part 190 only if the calculated quarterly or yearly dose exceed two times the applicable quarterly or annual dose limits. At no time during 2016 were any of these limits exceeded; therefore no evaluations are required.

6.5 Dose to a MEMBER OF THE PUBLIC from Activities Inside the Site Boundary

Dose to a MEMBER OF THE PUBLIC from activities inside the site boundary was evaluated. The highest dose resulted from recreational fishing on Squaw Creek Reservoir. A dose of 3.23E-03 mRem/yr was calculated based on an individual fishing twice a week, five hours each day, six months per year. Pathways included in the calculation were gaseous inhalation and submersion. Liquid pathways are not considered since all doses are calculated at the point of circulation water discharge into the reservoir.

This calculation was performed in accordance with the methodology and parameters in the ODCM.

7.0 METEROLOGICAL DATA

7.1 Meteorological Monitoring Program

In accordance with ODCM Administrative Control 6.9.1.4, a summary of hourly meteorological data, collected during 2016 is retained onsite. This data is available for review by the NRC upon request. Joint Frequency Tables are included in Attachment 10. During the year of this report, the goal of > 90% joint data recovery was met. The individual percent recoveries are listed below:

Meteorological Data Recovery	
Channel	**% Recovery**
10 m Wind Speed	97.5
10 m Wind Direction	99.6
Delta Temperature A	97.5
Delta Temperature B	97.4

8.0 RELATED INFORMATION

8.1 Operability of Liquid and Gaseous Monitoring Instrumentation

ODCM Radiological Effluent Controls 3.3.3.4 and 3.3.3.5 require an explanation of why designated inoperable liquid and gaseous monitoring instrumentation was not restored to operable status within thirty days.

During 2016, there were no instances where these instruments were inoperable for more than thirty days.

8.2 Changes to the Offsite Dose Calculation Manual (ODCM)

There were no changes to the ODCM during 2016.

8.3 New Locations for Dose Calculations or Environmental Monitoring

ODCM Administrative Control 6.9.1.4 requires any new locations for dose calculations and/or environmental monitoring, identified by the Land Use Census, to be included in the Radioactive Effluent Release Report. Based on the 2016 Land Use Census, no new receptor locations were identified which resulted in changes requiring a revision in current environmental sample locations. Values for the current nearest resident, milk animal, garden, X/Q and D/Q values in all sectors surrounding CPNPP were included in the 2016 Land Use Census.

8.4 Liquid Holdup and Gas Storage Tanks

ODCM Administrative Control 6.9.1.4 requires a description of the events leading to liquid holdup or gas storage tanks exceeding the limits required to be established by Technical Specification 5.5.12. Technical Requirements Manual 13.10.33 limits the quantity of radioactive material contained in each unprotected outdoor tank to less than or equal to ten curies, excluding tritium and dissolved or entrained noble gases. Technical Requirements Manual 13.10.32 limits the quantity of radioactive material contained in each gas storage tank to less than or equal to 200,000 curies of noble gases (considered as Xe-133 equivalent). These limits were not exceeded during the period covered by this report.

8.5 Noncompliance with Radiological Effluent Control Requirements

This section provides a listing and description of Abnormal Releases, issues that did not comply with the applicable requirements of the Radiological Effluents Controls given in Part I of the CPNPP ODCM and/or issues that did not comply with associated Administrative Controls and that failed to meet CPNPP expectations regarding Station Radioactive Effluent Controls. Detailed documentation concerning evaluations of these events and corrective actions is maintained onsite.

8.5.1 Abnormal, Unplanned Gaseous Effluent Release

No abnormal, unplanned gaseous effluent releases occurred during 2016.

8.5.2 Abnormal, Unplanned Liquid Effluent Releases

No abnormal, unplanned liquid effluent releases occurred during 2016.

8.6 Resin Releases to the LVW Pond

A total of 92 ft^3 of powdex resin was transferred to the LVW pond during 2016. The cumulative activity deposited in the LVW pond since operations began through the end of 2016 is 2.00e-3 Curies, consisting of Co-58, Co-60, Cs-134, Cs-137, I-131, Sr-90 and Sb-125.

8.7 Changes to the Liquid, Gaseous, and Solid Waste Treatment Systems

In accordance with the CPNPP Process Control Program, Section 6.2.6.2, changes to the Radwaste Treatment Systems (liquid, gaseous and solid) should be summarized and reported to the Commission in the Radioactive Effluent Release Report if the changes implemented required a 10CFR50.59 safety evaluation.

During 2016, no changes to the Radwaste Treatment Systems occurred meeting the reporting criteria of the Process Control Program.

8.8 Groundwater Tritium Monitoring Program

The wells used to monitor CPNPP for tritium leaks into the ground water all had results that were less than detectable with the exception of sentinel well CP-A and MW-11 near the Water Treatment Plant. CR-2016-001459 and CR-2016-008692 documents these issues.

CR-2016-001459 documents positive indications in Sentinel Groundwater Well 11 and the up-gradient Well CP-A is likely from percolation originating from the Filtered Water Storage Tank (FWST) X-02 leak, which contains treated Squaw Creek Reservoir (SCR) water. Because SCR water always contains low background concentrations of tritium, SCR water used in the plant will contain similar concentrations.

CP-A again had positive results for samples taken on 9/27/16 and 12/14/16. CR-2016-008692 documents a leak in a line from the Low Volume Waste (LVW) Pond to the Water Treatment Waste Sump. Water Treatment water is produced using from SCR water and therefore contains tritium.

All of these sample results were well below the state drinking water reportable criteria of 20,000 pCi/L and the environmental reportable criteria of 30,000 pCi/L. The FWST leak was repaired in mid-2016 and the monitor well results both returned to less than detectable. The LVW line was repaired in January 2017. It is expected that the CP-A concentration will continue to decrease.

Other areas also monitored, but not considered part of the ground monitoring program include the seepage sump, and Leachate Basins A, B, and C. These sample points are actually of perched (surface) water and not indicative of ground water tritium.

Previous hydrogeology studies performed by Pastor, Behling and Wheeler LLC, showed that this perched water sits above an impermeable layer of bedrock. This prevents the migration of the tritiated perched water into the Twin Mountain Aquifer and a potential new pathway to drinking water sources but is re-routed back to SCR.

Groundwater monitoring wells below the perched layer have not identified any tritium above the MDA and confirm the claims of the hydrogeology study. Based on this information and the guidance in NEI 07-07, there is no requirement for notification to the NRC or local officials and no requirement for remediation as it is not considered licensed material. Continued monitoring of these perched water sample points will occur as part of the Groundwater Monitoring Program (STA-654) and any new sources of tritium or increase in the activity will be evaluated and remediated as necessary.

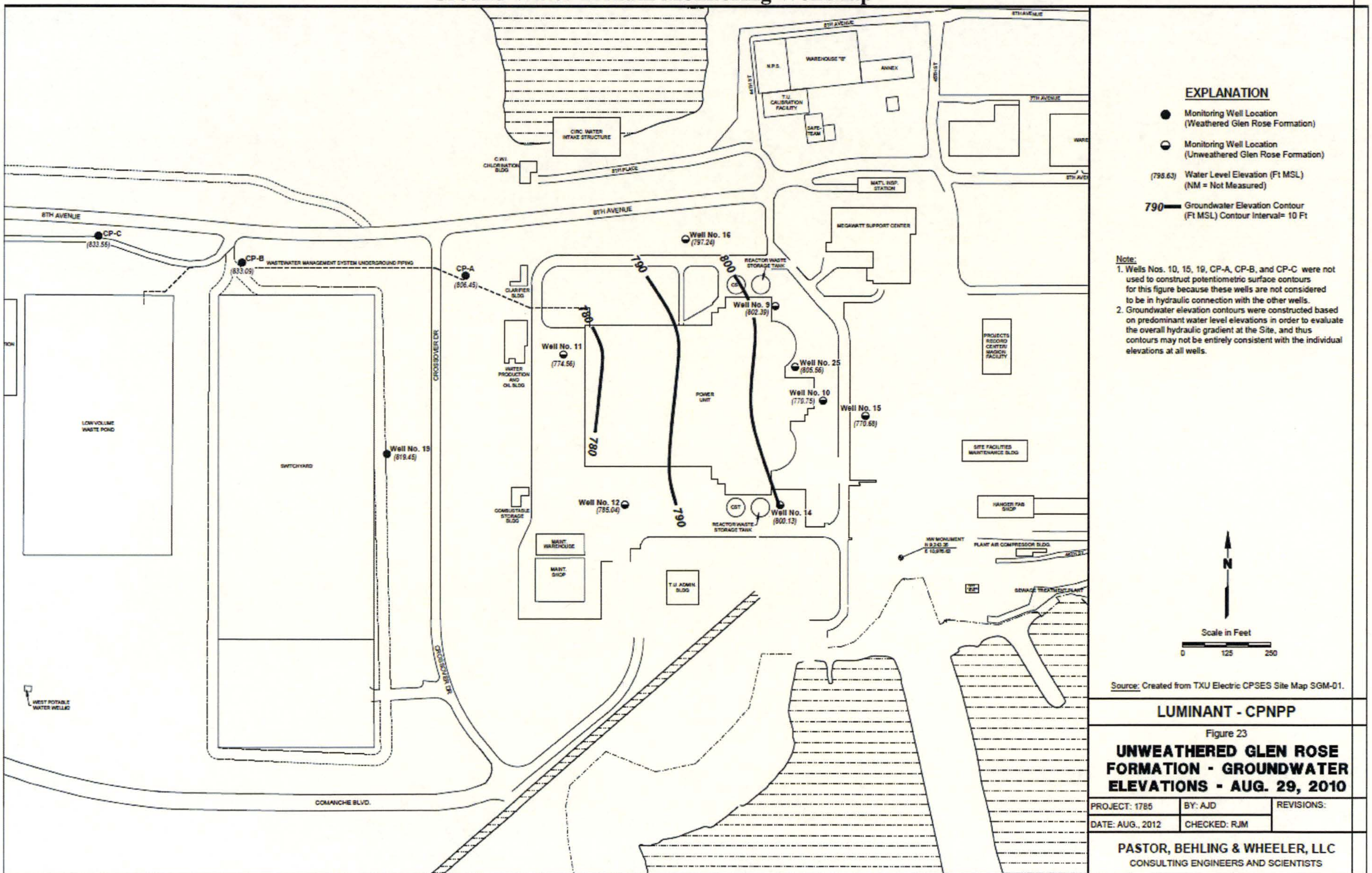
Ground Water Tritium Results (pCi/L)

MW Location	03/25/15	06/24/15	9/22/15	11/18/15	3/24/2016	6/9/2016	9/27/2016	12/14/2016
9	<665	<661	<638	<630	<597	<693	<664	<744
10	<665	<661	<638	<630	<597	<693	<664	<744
11	<665	3410(1)	2270(1)	2270(1)	1450(2)	<693	<664	<744
12	<665	<661	<638	<630	<597	<693	<664	<744
14	<665	<661	<638	<630	<597	<693	<664	<744
15	DRY	DRY	DRY	DRY	DRY	<693	DRY	DRY
16	<665	<661	<638	<630	<597	<693	<664	<744
19	<665	<661	<638	<630	<597	<693	<664	<744
25	<665	<661	<638	<630	<597	<693	<664	<744
CP-A	<665	<661	1300(1)	3250(1)	5940(1)	<693	3190(2)	2100(2)
CP-B	<665	<661	<638	<630	<597	<693	<664	<744
CP-C	<665	<661	<638	<630	<597	<693	<664	<744

(1) CR-2016-001459; SCR water leakage via Water Treatment Plant's FWST.

(2) CR-2016-008692; Leak in the line from Low Volume Waste pond line to the Water Treatment Waste Sump.

Ground Water Tritium Monitoring Well Map



SECTION 9.0
EFFLUENT TABLES

Table 9.1
Liquid and Gaseous Batch Release Summary

A. Liquid Releases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
1. Number of batch releases		8	16	6	5	35
2. Total time period for Batch releases	(Minutes)	2.70E+03	5.50E+03	2.13E+03	1.68E+03	1.20E+04
3. Maximum time period for a batch release	(Minutes)	3.50E+02	4.10E+02	3.80E+02	3.46E+02	4.10E+02
4. Average time period for a batch release	(Minutes)	3.37E+02	3.44E+02	3.55E+02	3.36E+02	3.43E+02
5. Minimum time period for a batch release	(Minutes)	3.15E+02	2.90E+02	3.38E+02	3.19E+02	2.90E+02

B. Gaseous Releases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
1. Number of batch releases		27	28	25	28	108
2. Total time period for batch releases	(Minutes)	1.16E+04	1.20E+04	8.13E+03	2.19E+04	5.36E+04
3. Maximum time period for a batch release	(Minutes)	1.85E+03	1.92E+03	3.68E+02	1.21E+04	1.21E+04
4. Average time period for a batch release	(Minutes)	4.29E+02	4.29E+02	3.25E+02	7.81E+02	4.96E+02
5. Minimum time period for a batch release	(Minutes)	3.16E+02	1.67E+02	1.59E+02	2.66E+02	1.59E+02

Table 9.2
Abnormal Liquid and Gaseous Batch Release Summary

A. Liquid Abnormal Release Totals	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Totals
1. Number of abnormal releases		0	0	0	0	0
2. Total activity of abnormal releases	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B. Gas Abnormal Release Totals	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Totals
1. Number of abnormal releases		0	0	0	0	0
2. Total activity of abnormal releases	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 9.3
Gaseous Effluents - Summation of All Releases

Type of Effluent	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
A. Fission And Activation Gases						
1. Total Release	Curies	9.98E-02	1.58E-01	7.62E-02	1.00E-01	4.34E-01
2. Average Release rate for period	uCi/sec	1.27E-02	2.02E-02	9.59E-03	1.26E-02	1.38E-02
3. Percent of Applicable Limit	%	*	*	*	*	*
B. Radioiodines						
1. Total Iodine-131	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Average Release rate for period		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Percent of Applicable Limit	%	*	*	*	*	*
C. Particulates						
1. Particulates (Half-Lives > 8 Days)	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Average Release rate for period		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Percent of Applicable Limit	%	*	*	*	*	*
D. Tritium						
1. H3 Release	Curies	7.23E+00	9.59E+00	1.07E+01	7.75E+00	3.53E+01
2. Average Release rate for period	uCi/sec	9.19E-01	1.22E+00	1.34E+00	9.75E-01	1.11E+00
3. Percent of Applicable Limit	%	*	*	*	*	*
D. C-14						
1. C14 Release	Curies	6.71E+00	5.57E+00	6.80E+00	6.80E+00	2.59E+01
2. Average Release rate for period	uCi/sec	8.53E-01	7.09E-01	8.52E-01	8.55E-01	8.17E-01
3. Percent of Applicable Limit	%	*	*	*	*	*
E. Gross Alpha						
1. Total Release	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*** Applicable limits are expressed in terms of dose.**

Estimated Total Error For All Values Reported Is < 1.0%

Table 9.4
Gaseous Effluents - Ground Level Releases

Continuous Mode Nuclides Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Fission Gases						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Iodines						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Particulates						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium & C-14						
H-3	Curies	6.98E+00	9.50E+00	1.06E+01	7.61E+00	3.47E+01
C14						
C-14	Curies	2.01E+00	1.67E+00	2.04E+00	2.04E+00	7.77E+00
Gross Alpha						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 9.4 (cont)
Gaseous Effluents - Ground Level Releases

Batch Mode

Nuclides Released	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Fission Gases						
Ar-41	Curies	9.98E-02	1.07E-01	7.62E-02	9.83E-02	3.81E-01
Kr-85	Curies	0.00E+00	3.88E-02	0.00E+00	0.00E+00	3.88E-02
Xe-133m	Curies	0.00E+00	8.48E-05	0.00E+00	0.00E+00	8.48E-05
Xe-133	Curies	0.00E+00	9.65E-03	9.19E-06	1.78E-03	1.14E-02
Xe-135m	Curies	0.00E+00	2.91E-05	0.00E+00	0.00E+00	2.91E-05
Xe-135	Curies	0.00E+00	2.87E-03	0.00E+00	0.00E+00	2.87E-03
Total For Period	**Curies**	9.98E-02	1.58E-01	7.62E-02	1.00E-01	4.34E-01
Iodines						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Particulates						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium						
H-3	Curies	2.51E-01	9.01E-02	5.72E-02	1.38E-01	5.36E-01
Carbon 14						
C-14	Curies	4.70	3.90	4.76	4.76	18.13
Gross Alpha						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

* Zeroes in this table indicate that no radioactivity was present at detectable levels.

Table 9.5
Liquid Effluents - Summation Of All Releases

	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
A. Fission And Activation Products						
1. Total Release (not including tritium, gases, alpha)	Curies	7.93E-04	9.62E-04	1.13E-04	5.45E-05	1.92E-03
2. Average diluted concentration during period	uCi/ml	9.98E-11	4.79E-11	1.50E-11	8.74E-12	4.60E-11
3. Percent of Applicable Limit	%	*	*	*	*	*
B. Tritium						
1. Total Release	Curies	2.71E+02	7.59E+02	7.78E+01	2.78E+02	1.39E+03
2. Average diluted concentration during period	uCi/ml	3.41E-05	3.78E-05	1.04E-05	4.47E-05	3.32E-05
3. Percent of Applicable Limit	%	*	*	*	*	*
C. Dissolved and Entrained Gases						
1. Total Release	Curies	2.82E-04	4.79E-04	0.00E+00	1.02E-05	7.72E-04
2. Average diluted concentration during period	uCi/ml	3.56E-11	2.38E-11	0.00E+00	1.64E-12	1.85E-11
3. Percent of Applicable Limit	%	*	*	*	*	*
D: Gross Alpha Radioactivity						
1. Total Release	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Average diluted concentration during period	uCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E: Waste Vol Release (Pre-Dilution)	Liters	5.80E+05	1.17E+06	4.57E+05	3.61E+05	2.57E+06
F. Volume of Dilution Water Used	Liters	7.94E+09	2.01E+10	7.51E+09	6.23E+09	4.18E+10

*** Applicable limits are expressed in terms of dose.**
Estimated Total Error For All Values Reported Is < 1.0%

Table 9.6
Liquid Effluents

Continuous Mode

Nuclides Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Fission & Activation Products						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium						
H-3	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dissolved And Entrained Gases						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Gross Alpha Radioactivity	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Batch Mode

Nuclides Released	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Fission & Activation Products						
Mn-54	Curies	4.80E-06	0.00E+00	0.00E+00	0.00E+00	4.80E-06
Fe-55	Curies	3.81E-04	6.72E-04	0.00E+00	0.00E+00	1.05E-03
Co-57	Curies	0.00E+00	0.00E+00	6.45E-07	0.00E+00	6.45E-07
Co-58	Curies	8.87E-05	2.76E-04	1.12E-04	4.78E-05	5.24E-04
Co-60	Curies	3.00E-05	1.42E-05	0.00E+00	6.66E-06	5.08E-05
Ni-63	Curies	2.83E-04	0.00E+00	0.00E+00	0.00E+00	2.83E-04
Nb-95	Curies	5.20E-06	0.00E+00	0.00E+00	0.00E+00	5.20E-06
Total For Period	**Curies**	7.93E-04	9.62E-04	1.13E-04	5.45E-05	1.92E-03
Tritium						
H-3	Curies	2.71E+02	7.59E+02	7.78E+01	2.78E+02	1.39E+03
Dissolved And Entrained Gases						
Kr-85	Curies	2.52E-04	2.80E-04	0.00E+00	0.00E+00	5.32E-04
Xe-133	Curies	3.07E-05	1.89E-04	0.00E+00	1.02E-05	2.30E-04
Xe-138	Curies	0.00E+00	1.01E-05	0.00E+00	0.00E+00	1.01E-05
Total For Period	Curies	2.83E-04	4.79E-04	0.00E+00	1.02E-05	7.72E-04
Gross Alpha Activity						
No Nuclides Found	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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

Table 9.7
Dose to a member of the public due to Liquid Releases

Organ Dose	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Bone	mRem	5.36E-05	1.97E-06	0.00E+00	0.00E+00	5.56E-05
Limit	mRem	5	5	5	5	10
Percent of Limit	%	0.001	0	0	0	0.001
Liver	mRem	4.44E-02	3.95E-02	3.75E-02	3.42E-02	1.56E-01
Limit	mRem	5	5	5	5	10
Percent of Limit	%	0.887	0.791	0.75	0.684	1.556
Total Body	mRem	4.44E-02	3.95E-02	3.75E-02	3.42E-02	1.56E-01
Limit	mRem	1.5	1.5	1.5	1.5	3
Percent of Limit	%	2.957	2.636	2.5	2.281	5.187
Thyroid	mRem	4.44E-02	3.95E-02	3.75E-02	3.42E-02	1.56E-01
Limit	mRem	5	5	5	5	10
Percent of Limit	%	0.887	0.791	0.75	0.684	1.556
Kidney	mRem	4.44E-02	3.95E-02	3.75E-02	3.42E-02	1.56E-01
Limit	mRem	5	5	5	5	10
Percent of Limit	%	0.887	0.791	0.75	0.684	1.556
Lung	mRem	4.44E-02	3.95E-02	3.75E-02	3.42E-02	1.56E-01
Limit	mRem	5	5	5	5	10
Percent of Limit	%	0.887	0.791	0.75	0.684	1.556
GI-Lli	mRem	4.44E-02	3.95E-02	3.75E-02	3.42E-02	1.56E-01
Limit	mRem	5	5	5	5	10
Percent of Limit	%	0.888	0.791	0.75	0.684	1.556

Table 9.8
Air Dose Due To Gaseous Releases

NG Dose	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Gamma Air	mRad	9.72E-05	1.05E-04	7.41E-05	9.57E-05	3.72E-04
Limit	mRad	5	5	5	5	10
Percent of Limit	%	0.002	0.002	0.001	0.002	0.004
Beta Air	mRad	3.43E-05	4.65E-05	2.62E-05	3.39E-05	1.41E-04
Limit	mRad	10	10	10	10	20
Percent of Limit	%	0	0	0	0	0.001
NG Total Body	mRem	9.24E-05	9.99E-05	7.05E-05	9.10E-05	3.54E-04
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.001	0.001	0.001	0.001	0.002
NG Skin	mRem	1.35E-04	1.52E-04	1.03E-04	1.33E-04	5.23E-04
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.002	0.002	0.001	0.002	0.003

Table 9.9
Dose to a Member of the Public Due to Radioiodines, Particulates, Tritium, and C-14 in Gaseous Releases

Organ Dose	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Liver	mRem	2.22E-02	2.35E-02	2.72E-02	2.31E-02	9.60E-02
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.296	0.314	0.363	0.309	0.640
Total Body	mRem	2.22E-02	2.35E-02	2.72E-02	2.31E-02	9.60E-02
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.296	0.314	0.363	0.309	0.640
Thyroid	mRem	2.22E-02	2.35E-02	2.72E-02	2.31E-02	9.60E-02
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.296	0.314	0.363	0.309	0.640
Kidney	mRem	2.22E-02	2.35E-02	2.72E-02	2.31E-02	9.60E-02
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.296	0.314	0.363	0.309	0.640
Lung	mRem	2.22E-02	2.35E-02	2.72E-02	2.31E-02	9.60E-02
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.296	0.314	0.363	0.309	0.640
GI-Lli	mRem	2.22E-02	2.35E-02	2.72E-02	2.31E-02	9.60E-02
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.296	0.314	0.363	0.309	0.640
Bone	mRem	6.25E-02	5.19E-02	6.33E-02	6.33E-02	2.41E-01
Limit	mRem	7.5	7.5	7.5	7.5	15
Percent of Limit	%	0.83	0.69	0.84	0.84	1.61

TABLE 9.10
Solid Radwaste and Irradiated Fuel Shipments

A. Solid Waste Shipped Offsite for Burial or Disposal (Not Irradiated Fuel)

1. Type of Waste	Shipped m^3	Shipped Ci	Buried m^3	Buried Ci	Percent Error
a. Spent resins/filters	6.8E+00	4.56E+01	6.80E+00	4.56E+01	± 25%
b. Dry active waste	2.54E+02	3.69E-02	2.32E+01	3.68E-02	± 25%
c. Irradiated components	-0-	-0-	-0-	-0-	N/A
d. Other (oil/miscellaneous liquids sent to processor for volume reduction)	-0-	-0-	-0-	-0-	N/A
TOTAL	2.61E+02	4.56E+01	3.00E+01	4.56E+01	± 25%

Note: Shipped volumes and curies are not always equal to the buried volumes and curies as a result of volume reducing processing, and some disposal occurs outside the twelve month time period in which shipments occurred.

Dry active waste also includes some low-level radioactive resins, tank sediments, and filters that are handled and processed in a manner that is consistent with this waste stream.

2. Estimate of Major Nuclide Composition (by type of waste)	Nuclide	% Abundance	Activity Ci
a. Spent resins/filters	H-3	37.13	1.70E+01
	Ni-63	31.52	1.44E+01
	Fe-55	17.00	7.77E+00
	Co-60	12.33	5.64E+00
	Cs-137d	1.58	7.22E-01
	C-14	0.07	3.20E-02
	Tc-99	0.01	3.12E-03
	I-129	LLD	-0-
	Other(1)	0.36	1.67E-01
	Total	100.00	4.57E+01
b. Dry active waste	Fe-55	40.91	1.51E-02
	Co-60	29.48	1.09E-02
	Ni-63	18.43	6.80E-03
	Co-58	5.21	1.92E-03
	Mn-54	1.82	6.71E-04
	Sb-125	1.07	3.93E-04
	C-14	0.87	3.19E-04
	H-3	LLD	-0-
	Tc-99	LLD	-0-
	I-129	LLD	-0-
	Other(1)	2.21	8.18E-04
	Total	100.00	3.69E-02
d. Other (oil/miscellaneous liquids sent to processor for volume reduction)	N/A	N/A	N/A

(1) Nuclides representing <1% of total shipped activity: Cr-51, Co-57, Sr-90d, Zr-95, Nb-95, Cs-137d, and Ce-144d.

TABLE 9.10
SOLID RADWASTE AND IRRADIATED FUEL SHIPMENTS

3. Solid Waste Disposition (Mode of Transportation: Truck)				
Waste Type	**Waste Class**	**Container Type**	**Number of Shipments**	**Destination**
a. Resin/filters	B	Poly HIC*	1	Waste Conrol Specialists, Andrews, TX
	C	Poly HIC*	1	
b. Dry active waste	A	General Design	4	Energy Solutions Oak Ridge, TN
d. Other	NA	NA	NA	NA

*High Integrity Container

B. **Irradiated Fuel Shipments (Disposition)**

Number of Shipments	Mode of Transportation	Destination
0	N/A	N/A

Attachment 10.1
Meteorological Joint Frequency Tables

Reg. Guide 1.21 Joint Frequency Table

CPNPP

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: 1-JAN-2016 00:00 to 31-DEC-2016 23:59

STABILITY CLASS **A**

ELEVATION: 10 m

WIND DIRECTION	Wind Speed (mph)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	10	34	19	1	0	65
NNE	2	5	26	19	3	0	55
NE	5	6	9	3	0	0	23
ENE	2	13	0	0	0	0	15
E	0	4	3	0	0	0	7
ESE	2	29	26	2	0	0	59
SE	1	24	31	4	0	0	60
SSE	0	25	77	22	2	0	126
S	1	19	32	24	8	0	84
SSW	0	9	5	3	1	0	18
SW	2	3	3	0	0	0	8
WSW	2	0	0	0	0	0	2
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	1	2	1	0	0	4
NNW	0	5	16	27	8	3	59
VARIABLE	2	2	0	0	0	0	4
TOTAL	20	55	264	124	23	3	589
Periods of calm (hours):		1					
Hours of missing data:		3					

Reg. Guide 1.21 Joint Frequency Table

CPNPP

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: 1-JAN-2016 00:00 to 31-DEC-2016 23:59

STABILITY CLASS **B**

ELEVATION: 10 m

WIND DIRECTION	Wind Speed (mph)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	1	13	13	12	4	0	43
NNE	2	9	13	15	3	0	42
NE	7	12	7	0	0	0	26
ENE	6	6	4	1	0	0	17
E	1	12	3	0	0	0	16
ESE	4	20	14	1	0	0	39
SE	0	18	22	9	0	0	49
SSE	0	26	46	17	2	0	91
S	1	20	64	81	16	0	182
SSW	0	8	19	6	1	0	34
SW	1	4	8	1	0	0	14
WSW	0	2	0	1	0	0	3
W	0	0	0	3	0	0	3
WNW	0	0	0	0	0	0	0
NW	0	2	6	3	2	0	13
NNW	0	13	13	20	8	5	59
VARIABLE	0	0	2	0	0	0	9
TOTAL	30	165	234	170	36	5	640
Periods of calm (hours):	1						
Hours of missing data:	2						

Reg. Guide 1.21 Joint Frequency Table

CPNPP

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: 1-JAN-2016 00:00 to 31-DEC-2016 23:59

STABILITY CLASS **C**

ELEVATION: 10 m

WIND DIRECTION	Wind Speed (mph)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	4	16	19	20	3	0	62
NNE	5	8	15	14	2	0	44
NE	10	8	7	1	0	0	21
ENE	7	12	10	1	0	0	30
E	7	13	5	0	0	0	25
ESE	1	40	15	2	0	0	58
SE	2	28	35	3	0	0	68
SSE	2	25	40	31	3	0	101
S	3	22	59	77	9	0	170
SSW	2	8	30	22	3	0	65
SW	3	7	16	6	1	0	33
WSW	2	2	6	3	0	0	13
W	1	2	4	6	0	0	13
WNW	0	1	0	1	0	0	2
NW	2	3	11	6	4	0	26
NNW	3	25	12	9	16	1	66
VARIABLE	10	0	2	0	0	0	12
TOTAL	64	215	286	202	41	1	809
Periods of calm (hours):		5					
Hours of missing data:		6					

Reg. Guide 1.21 Joint Frequency Table

CPNPP

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: 1-JAN-2016 00:00 to 31-DEC-2016 23:59

STABILITY CLASS **D**

ELEVATION:
10 m

WIND DIRECTION	Wind Speed (mph)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	19	143	227	60	2	0	451
NNE	16	99	101	21	1	0	238
NE	23	53	31	8	0	0	115
ENE	11	42	26	2	0	0	81
E	23	87	16	0	0	0	126
ESE	36	155	54	5	0	0	250
SE	34	190	214	26	0	0	464
SSE	20	138	357	238	21	0	774
S	6	78	328	224	34	5	675
SSW	8	57	80	57	12	2	216
SW	16	17	29	32	3	0	97
WSW	10	30	14	11	0	0	65
W	6	8	6	5	0	0	25
WNW	3	19	27	4	0	0	53
NW	9	39	50	23	7	0	128
NNW	8	65	164	81	6	1	335
VARIABLE	74	40	11	1	0	0	126
TOTAL	322	1260	1735	798	96	8	4219
Periods of calm (hours):	5						
Hours of missing data:	61						

Reg. Guide 1.21 Joint Frequency Table

CPNPP

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: 1-JAN-2016 00:00 to 31-DEC-2016 23:59

STABILITY CLASS **E**

ELEVATION: 10 m

WIND DIRECTION	Wind Speed (mph)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	9	59	34	1	0	0	103
NNE	4	49	25	1	0	0	79
NE	3	16	1	0	0	0	20
ENE	6	13	1	0	0	0	20
E	12	19	1	0	0	0	32
ESE	15	56	4	0	0	0	75
SE	22	321	113	1	1	0	458
SSE	13	171	189	9	1	0	383
S	15	62	66	2	0	1	146
SSW	14	46	39	10	0	0	109
SW	16	11	17	2	1	0	47
WSW	11	0	6	5	0	0	32
W	6	7	5	0	0	0	18
WNW	12	19	13	3	1	0	48
NW	29	59	29	2	0	0	119
NNW	12	30	16	1	0	0	59
VARIABLE	58	11	6	1	0	0	76
TOTAL	257	959	565	38	4	1	1824
Periods of calm (hours):		5					
Hours of missing data:		45					

Reg. Guide 1.21 Joint Frequency Table

CPNPP

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: 1-JAN-2016 00:00 to 31-DEC-2016 23:59

STABILITY CLASS **F**

ELEVATION: 10 m

WIND DIRECTION	Wind Speed (mph)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	2	2	0	0	0	0	4
NNE	0	4	1	0	0	0	5
NE	0	0	0	1	0	0	1
ENE	0	0	0	0	0	0	0
E	0	1	0	0	0	0	1
ESE	5	0	0	0	0	0	5
SE	3	28	1	0	0	0	32
SSE	11	10	7	0	0	0	28
S	12	9	14	0	0	0	35
SSW	23	19	10	1	0	0	53
SW	26	20	11	2	0	0	59
WSW	27	24	0	0	0	0	51
W	10	4	1	0	0	0	15
WNW	15	5	0	0	0	0	20
NW	12	23	2	0	0	0	37
NNW	5	5	0	0	0	0	10
VARIABLE	15	3	2	0	0	0	20
TOTAL	166	157	49	4	0	0	376
Periods of calm (hours):		1					
Hours of missing data:		13					

Reg. Guide 1.21 Joint Frequency Table

CPNPP

HOURS AT EACH WIND SPEED AND DIRECTION

PERIOD OF RECORD: 1-JAN-2016 00:00 to 31-DEC-2016 23:59

STABILITY CLASS **G**

ELEVATION: 10 m

WIND DIRECTION	Wind Speed (mph)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	0	1	0	0	0	0	1
NNE	1	0	0	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	1	0	0	0	0	1
SSE	0	0	0	0	0	0	0
S	4	2	1	0	0	0	7
SSW	10	17	5	0	0	0	32
SW	14	23	5	0	0	0	42
WSW	17	21	3	0	0	0	41
W	17	4	0	0	0	0	21
WNW	9	1	0	0	0	0	10
NW	5	8	0	0	0	0	13
NNW	0	2	0	0	0	0	2
VARIABLE	6	0	0	0	0	0	6
TOTAL	83	80	14	0	0	0	177
Periods of calm (hours):		1					
Hours of missing data:		0					

Reg. Guide 1.21 Joint Frequency Table

CPNPP

HOURS AT EACH WIND SPEED AND DIRECTION

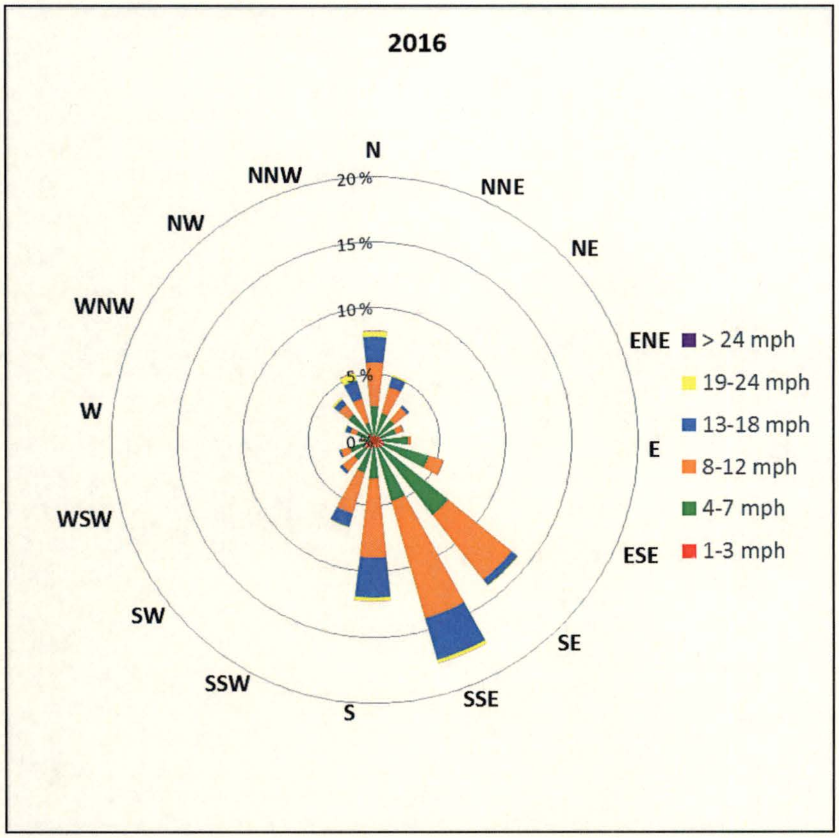
PERIOD OF RECORD: 1-JAN-2016 00:00 to 31-DEC-2016 23:59

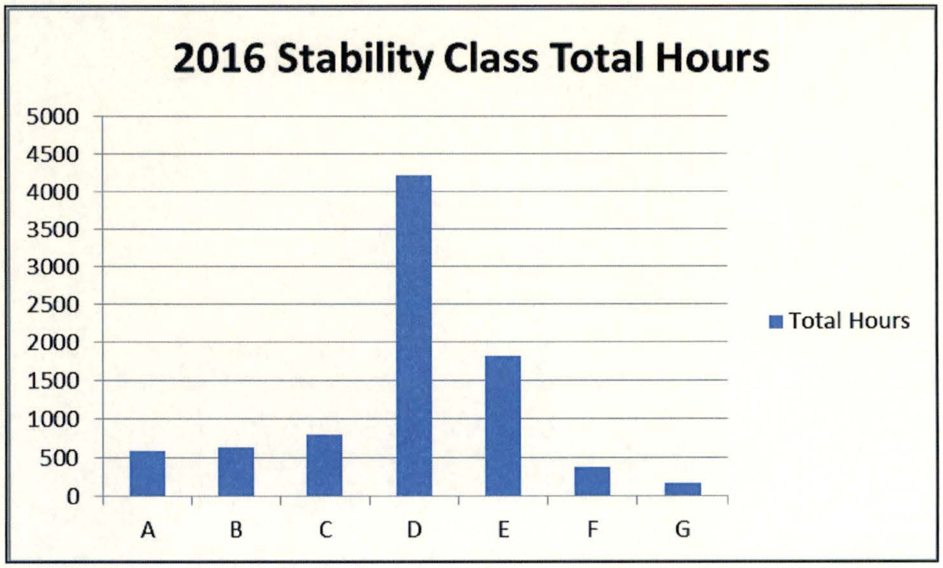
STABILITY CLASS **ALL**

ELEVATION: 10 m

WIND DIRECTION	Wind Speed (mph)						
	1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N	36	244	327	112	10	0	729
NNE	30	174	181	70	9	0	464
NE	48	90	55	13	0	0	206
ENE	32	86	41	4	0	0	163
E	43	136	28	0	0	0	207
ESE	63	300	113	10	0	0	486
SE	62	610	416	43	1	0	1132
SSE	46	395	716	317	29	0	1503
S	42	212	564	408	67	6	1299
SSW	57	164	188	99	17	2	527
SW	78	85	89	43	5	0	300
WSW	69	89	29	20	0	0	207
W	40	25	16	14	0	0	95
WNW	39	45	40	8	1	0	133
NW	57	135	100	35	13	0	340
NNW	28	145	221	138	48	10	590
VARIABLE	172	56	23	2	0	0	253
TOTAL	942	2991	3147	1336	200	18	8634
Periods of calm (hours):	19						
Hours of missing data:	131						

2016 Wind Rose and Stability Class Graphs





Attachment 10.2

Atmospheric Dispersion (X/Q) and Deposition (D/Q) Calculation Methodology Discussion

Introduction

CR-2013-001059 evaluated the atmospheric dispersion (X/Q) and deposition (D/Q) calculation methodology and frequency as they relate to the meteorological data to ensure they are up to date. The CPNPP ODCM does not require a re-evaluation on any frequency or specific criteria for comparison. The NRC guidance documents cited in the ODCM also do not provide any requirements for re-evaluation. Revision 2 of Regulatory Guide 1.21, to which we are not committed, recommends that 5 years of meteorological data be used to evaluate the dispersion factors and that variation in the factors be within 10% in the non-conservative direction. The evaluation of our meteorological data included 6 years of data and meets the criteria.

Discussion

Meteorological data collected for the original FSAR, the NuBuild FSAR and historical Radiological Effluent Reports were reviewed. The data list the predominant wind direction, as a percentage, averaged for all speeds and stability classes within the period. For periods not summarized and when the plant was operable (1990-2000) only 1990, 1995 and 1996 show the predominant wind direction to be from the SSE. This information was not included, however, since the data should include a summary of at least 5 years of data. The original dispersion and deposition factors were calculated based on meteorological data collected and summarized from 1972 through 1976 at Comanche Peak. This data show the predominant wind direction to be from the South but only slightly more than winds originating from the SSE. The historical data from 1957-1976 was included in the original FSAR for comparison and show more bias toward the southerly direction but was collected from the Dallas-Fort Worth Airport location. Wind patterns for the DFW Airport were reviewed on the National Weather Service website for 1981-2010 and show that the prevailing wind direction remains from the South. This accounts for the slight variation in prevailing winds between historical and current data collected on site. During the New Build project for Units 3&4 and from OE 25286 the meteorological data were again summarized from 1997-2006, for Comanche Peak, and showed that the predominant wind direction shifted to the SSE. Using this data, new dispersion and deposition factors were calculated. The new factors were less conservative when compared to the original dispersion and deposition factors at the Exclusion Area Boundary (See Reference 3). The conclusion was to continue reporting offsite exposures based on the original values. The last column of data in Table 1 is summarized for the purposes of this evaluation and includes meteorological data since the New Build evaluation through 2012. This data, like the NuBuild data, show the predominant wind direction to be from the SSE.

Conclusion

Although the predominant wind direction frequency changes slightly from SSE to S when comparing the NuBuild Data to the original FSAR and Historical Data, the NuBuild calculations show that dispersion and deposition factors do not increase. Following the NuBuild evaluation, the wind direction remains the same and does not impact the calculation of the dispersion and deposition. Using the original factors would be conservative when calculating doses to the public.

CR-2017-004071 was initiated to document the evaluation of prevailing wind directions for all stability classes over the calendar year 2016. This evaluation is performed annually in accordance with Chemistry Guideline 25 to ensure the predominant wind direction has not changed based on the last 5 years of meteorological data including the current year. The 2016 predominant wind direction for the ALL stability class categories did not change when compared with the five year rolling average which includes 2016. No recalculations of X/Q or D/Q values are required at this time.

Attachment 10.3

Carbon 14 Supplemental Information

Carbon-14 Supplemental Information

Carbon-14 (C-14) is a naturally occurring isotope of carbon produced by interactions with cosmic radiation in the atmosphere with a half-life of 5730 years. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts are much less than the amounts produced from natural formation or from weapons testing.

In June 2009, the NRC provided revised guidance in Regulatory Guide 1.21, *Measuring, Evaluating and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste, Revision 2*, establishing an updated approach for identifying principal radionuclides. Because the overall quantity of radioactive releases has steadily decreased due to improvements in power plant operations, C-14 now qualifies as a "principal radionuclide" (anything greater than one percent of overall radioactivity in effluents) under federal regulations at many plants. In other words, C-14 has not increased and C-14 is not a new nuclear plant emission. Rather, the improvements in the mitigation of other isotopes have made C-14 more prominent.

The dose contribution of C-14 from liquid radioactive waste is essentially insignificant compared to that contributed by gaseous radioactive waste. Therefore the evaluation of C-14 in liquid radioactive waste is not required by the new Reg. Guide 1.21, Rev. 2. The Reg. Guide 1.21, Rev. 2 also states that the quantity of gaseous C-14 released to the environment can be estimated by use of a C-14 source term production model.

A recent study produced by EPRI (*Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents,* EPRI, Palo Alto, CA: 2010, 1021106) developed a model for estimation of C-14 source production. This model was used by CPNPP for the 2010 Radioactive Effluent Release Report. Also in the CPNPP report, the assumption that 70% of the C-14 gaseous effluent is estimated to be from batch releases (e.g. WGDTs), and 30% of C-14 gaseous effluent is estimated to be from continuous releases through the unit vents (Ref. IAEA Technical Reports Series no. 421, "Management of Waste Containing Tritium and Carbon-14", 2004).

The C-14 released from PWR's is primarily a mix of organic carbon and carbon dioxide released from the waste gas system. The C-14 species initially produced are primarily in the organic form, such as methane. The C-14 in the primary coolant can be converted to an inorganic chemical form of primarily carbon dioxide through a chemical transformation. Studies documented by the EPRI Report *Characterization of Carbon-14 Generated by the Nuclear Power Industry,* EPRI Palo Alto, CA: 1995, TR-105715, measured C-14 releases from PWRs indicating a range of 70% to 95% organic. The average value was indicated to be 80% organic with the remainder being carbon dioxide. As a result, a value of 80% organic C-14 is assumed by the CPNPP Radioactive Effluent Release Report methodology.

The public dose estimates from airborne C-14 in the CPNPP Effluent report are performed using dose models from NUREG-0133 and Regulatory Guide 1.109. The dose models and assumptions used for the dose estimates of C-14 are documented in the 2011 ODCM changes. The estimated C-14 dose impact on the maximum organ dose from airborne effluents released during 2011 is well below the 10CFR50, Appendix I, ALARA design objective of 15 mRem/yr per unit.

Putting Radiation Dose in Context

Humans are exposed to radiation every day. The majority comes from natural sources including the earth, food and water consumption, the air, the sun and outer space. A smaller fraction radiation comes from man-made source such as X-rays, nuclear medical treatments, building materials, nuclear power plants, smoke detectors and televisions.

Radiation is measured in units called millirem (mRem). One mRem is a very small amount of exposure. On average, Americans receive 620 mRem of radiation dose every year. Approximately one-half of the dose comes from natural sources and the other half comes from medical procedures such as CAT scans.

The table below can help to give some perspective to dose from various sources.

Source	Average Annual Dose
Smoke detector in the home	0.008 mRem
Live within 50 miles of a nuclear power plant	0.009 mRem
Live within 50 miles of a coal-fired power plant*	0.03 mRem
NRC guideline for keeping radiation dose from nuclear power plants as low as reasonably achievable (ALARA)	5 mRem
Round trip flight from New York City to Los Angeles	5 mRem
Medical X-ray	10 mRem
EPA limit for dose to the public from the commercial nuclear fuel cycle	25 mRem
Food and water consumed throughout the course of one year	30 mRem
NRC limit for dose to the public from nuclear power plants	100 mRem
Mammogram	100 mRem
Average annual exposure for a nuclear power plant worker	120 mRem
Average annual exposure from background radiation	300 mRem
CT scan	1,000 mRem
NRC's annual limit for occupational exposure	5,000 mRem
Cardiac catheterization or coronary angiogram	5,000 mRem

*Coal is naturally radioactive.

Sources: U.S. Environmental Protection Agency, Health Physics Society.