

April 28, 2014

ZS-2014-0100

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

Zion Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-39 and DPR-48
NRC Docket Nos. 50-295, 50-304 and 72-1037

Subject: Radioactive Effluent Release Report, Radioactive Effluent Control Program Report, Offsite Dose Calculation Manual and Process Control Program for 2013.

In accordance with Facility Operation License Nos. DPR-39 and DPR-48, Appendix A, Technical Specification 5.7.3, "Radioactive Effluent Release Report," for Zion Nuclear Power Station, Units 1 and 2, this is the submittal of a Radioactive Effluent Release Report for the year 2013. The report is required to be submitted prior to May 1, 2014 and is provided as Attachments 1 through 6 to this letter. A listing of commitments contained in this submittal is provided in Attachment 1. Certificate of Compliance No. 1031 for the MAGNASTOR SYSTEM, Appendix A, Technical Specifications 5.1.1 and 5.1.3 require submittal of an Annual Radioactive Effluent Control Program report which is included in this document.

Pursuant to 10 CFR 50.4 and Technical Specification 5.6.1.c. there were changes made to the Zion Station Offsite Dose Calculation Manual (ODCM) during the period of January through December 2013. Attachment 1, Supplemental Information, summarizes the changes made to the ODCM during the calendar year of 2013. Attachment 7 is a copy of Zion Station ODCM, current as of December 31, 2013.

There are no new regulatory commitments in this submittal.

If you have any questions about this submittal please contact Mr. Christopher Keene at (224)789-4073.

Respectfully,



Gary Bouchard
VP Operations & Engineering & Decommissioning Plant Manager
ZionSolutions, LLC

A009
JE48
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FSME

Attachments:

1. Supplemental Information
2. Effluent & Waste Disposal Summary
 - 2.1. Unit 1 Gaseous Effluent
 - 2.2. Unit 2 Gaseous Effluent
 - 2.3. Liquid Effluent
 - 2.4. Direct Radiation
 - 2.5. LLD's
 - 2.6. Error Estimation
3. Solid Waste and Irradiated Fuel Shipments
4. Radiological Impact on Man
 - 4.1. 40CFR190 & 10CFR72 Compliance summary
 - 4.2. Unit 1
 - 4.3. Unit 2
 - 4.4. ISFSI
 - 4.5. Combined 40CFR190 report
5. Meteorology Data
6. Errata Data from previous years
7. Zion Station ODCM
8. ZS-WM-123 Process Control Program Requirements

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1. Regulatory Limits: The dose to a member of the public from direct radiation, liquid and gaseous effluents released from each unit to areas at or beyond site boundary shall be limited to the following:
 - a. Fission and Activation products:
 - i. Tech Spec Whole Body: 500 mrem/year
 - ii. Tech Spec Skin: 3000 mrem/year
 - b. Particulates with half-lives > 8 days, tritium and Iodine:
 - i. Tech Spec Organ: 1500 mrem/year
 - ii. 10CFR50 Organ: 7.5 mrem/quarter, 15 mrem/year
 - c. Liquid Effluents:
 - i. 10CFR50 Whole body: 1.5 mrem/quarter, 3 mrem/year
 - ii. 10CFR50 Organ: 5 mrem/quarter, 10 mrem/year
 - d. Combined dose to real individual beyond controlled area:
 - i. 10CFR72 Whole body: 25 mrem/year
 - ii. 10CFR72 Thyroid: 75 mrem/year
 - iii. 10CFR72 Organ: 25 mrem/year
2. Effluent Concentration Limits (ECL): Limits used in determining allowable release rates or concentrations.
 - a. Gaseous Effluents: 10CFR20 Appendix B Table 2 Column 1.
 - b. Liquid Effluents: 10 X 10CFR20 Appendix B Table 2 Column 2.
3. Measurements and Approximations of Total Radioactivity.
 - a. Fission and Activation Products: 100% Kr-85 is assumed in calculations since other isotopes have decayed. Vent stack activity is continuously monitored for fission and activation gases.
 - b. Particulate and tritium releases are continuously monitored and samples collected and analyzed weekly. Particulate filters are sent to an independent lab for quarterly composite analysis. Tritium activity is monitored in gaseous releases from evaporation of water in the spent fuel pool and water filled reactor cavities.
 - c. Liquid effluents are continuously monitored and isotopic analysis performed weekly.
 - d. Occupancy factors to accurately estimate dose due to habits of the real individual that are used to calculate maximum exposed member of the public are discussed in ES&H Technical Support Document 13-009 "Member of the Public Dose from All Onsite Sources."
4. Batch Releases:
 - a. Liquid: There were no liquid batch releases in 2013.
 - b. Gaseous: There were no gaseous batch releases in 2013.
5. Abnormal Releases:
 - a. Liquid: There were no liquid abnormal releases in 2013.
 - b. Gaseous: there were no gaseous abnormal releases in 2013.

6. Gaseous and Liquid Waste Treatment Systems and Process Control Program

Zion Station ODCM Section 12.7.2 pursuant to ODCM Section 12.7.4 requires major changes to the Gaseous and Liquid Waste Treatment Systems to be reported in the Annual Radioactive Effluent Release Report. There are major changes ongoing with the physical configuration of the liquid radwaste system, along with associated DSAR and ODCM descriptive changes; however the changes were not completed and further revisions were being evaluated as of Dec. 31, 2013; therefore the completed change package will be submitted in the reporting year during which the change was complete.

Zion Station ODCM Section 12.6.2 requires major changes to the Process Control Program(PCP) to be submitted in the Annual Radioactive Effluent Release Report. There were no major changes to the PCP.

The Waste Gas Hold-up System was permanently vented. In Zion's defueled configuration this system is no longer applicable.

In Zion's defueled configuration, the charcoal iodine removal system is no longer applicable.

Due to radioactive decay and no means of production, radioactive iodine is not a concern at Zion.

7. Limiting Conditions of Operation (LCOs)

Zion Station ODCM Section 12.7.2 requires explanation as to why the inoperability of liquid or gaseous monitoring instrumentation was not corrected within the time specified in the ODCM to be submitted with the Annual Radioactive Effluent Release Report.

There are no such occurrences.

8. Liquid Holdup Tanks and Gas Storage Tanks

Zion Station ODCM Section 12.7.2 requires a description of events leading to liquid holdup tanks or gas storage tanks exceeding technical specification limits to be included in the Annual Radioactive Effluent Release Report.

The contents of the six gas decay tanks have been sampled and determined to have negligible activity. The Gas Decay Tanks have been abandoned in place.

No liquid holdup tanks exceeded the limits of Permanently Defueled Technical Specifications 5.6.3 during 2013.

9. Offsite Dose Calculation Manual (ODCM)

Changes to the ODCM are required by Zion Station Permanently Defueled Technical Specification 5.6.1. and ODCM Section 12.6.3 to be submitted as part of, or concurrent with, the Annual Radioactive Effluent Release Report.

A summary of changes made to the ODCM during 2013 and an entire copy of the ODCM, current as of December 31, 2013 are required to be submitted.

Revisions to ODCM and Process Control Program are listed below:

a. ODCM Revisions:

Chapter	Section	Description
10	10.2.1	Grammatical change
10	10.2.1.1	Renamed Boric Acid Monitor Tank to Lake Release Tank; There are 2 Lake Release tanks in the new system each with a nominal capacity of 35,000 gallons.
10	10.2.1.2	Added section: The existing Holdup Tanks are added as the dedicated location to receive and store unprocessed liquid waste.
10	10.2.2.1	Revised the discussion of monitoring releases. The new radiation monitor OR-PR04 monitors the release from the Lake Release tank that is discharging. Previously, the radiation monitor was located in the AB at the 542' elevation and the isolation valve was approximately 250 feet downstream of the radiation monitor which provided a margin of time for the monitor to process an alarm and close the valve prior to the release entering the discharge canal. This was necessary due to the discharge line connecting to the discharge canal downstream of the dilution flow stream. As such, any water that entered the canal would be released to the lake with the dilution flow such that when the release is terminated, that water is stagnant in the canal and does not enter into the dilution stream.
10	10.2.3.1	Changed "condenser cooling" water to "service" water. Renamed Boric Acid Monitor Tank to Lake Release Tank.
10	10.2.3.2.1	Renamed Boric Acid Monitor Tank to Lake Release Tank
10	10.2.4	Renamed Boric Acid Monitor Tank to Lake Release Tank.
11	Table 11-1.b	Section b. added to include new control air sample location
12	Table 12.5-1.b	Section b. added to include new control air sample location
11	Table 11-1.2.b	Added control TLD location
11	Table 11-1.2.c & 11-1.2.d	Added sections c. and d. To include TLD's placed for ISFSI background trending. Added section to re-establish 5 mile ring REMP TLD's.
11	Figure 11-1.	Renamed to figure 11-1a. and updated with new REMP monitoring locations
11	Figure 11-1b.	Figure added to show 5 mile ring TLD placement locations
12	Table 12.5-1	Updated table for new TLD locations.
12	Table 12.3-2.A & 12.3-2.B	Removed Sr-89 from analysis, added Ni-63
12	Table 12.4-1.C & 12.4-1.D	Removed Sr-89 from analysis, added Ni-63

Chapter	Section	Description
12	Table 12.4-1 Note c.	Removed Sr-89 from analysis, added Ni-63
12	Table 12.2-1.1.A	Renamed Boric Acid Monitor Tanks (BAMT) to Lake Release Tanks.
12	Table 12.2-1.1.A.1	Changed 0R-PR05 to 0R-PR04
12	Table 12.2-1.3.A	Renamed Boric Acid Monitor Tank to Lake Release Tank #1
12	Table 12.2-1.3.B & 12.2-1.3.B.1	Added Item 3.B and 3.B.1 Lake Release tank #2 is monitored for flow from new flow meter 0FI-WD-006
12	Table 12.2-2.1.A & 12.2-2.1.A.1	Renamed Boric Acid Monitor Tank to Lake Release Tank.
12	Table 12.2-2.3.A	Renamed Boric Acid Monitor Tank to Lake Release Tank #1
12	12.2-2.3.b & 12.2-2.3.b.1	Lake Release Tank #2 is monitored for flow from new flow meter 0FI-WD006
12	Table 12.3-2.1.A	Renamed Boric Acid Monitor Tank to Lake Release Tank.
12	Table 12.2-4.3.A.4	Added Item A.4 to include 0RT-AR24
12	Table 12.2-4 Note 3	Changed note to include 0RT-AR24
12	Table 12.2-3.3.A.4	Added section 4 to include 0RT-AR24
12	Table 12.2-3 Surveillance 13	Deleted surveillance 13 subsections 1-4 and added surveillance for 0RT-AR24
10 r 15	Table 10-2	Corrected inadvertently changed table from previous revision.
12	Table 12.2-3.3.A.2	Surveillance requirement of 0RT-AR22 changed from 14 to 12 to match 0RT-AR21.
App. A	A.0	Added instance of 10CFR72
App. A	A.4	Added several instances of "10CFR72"
App. A	A.4.1.2)	Added "ISFSI" to clarify contained sources
App. A	A.5.1.1	Added requirements for Zion to comply with 10CFR72
App. A	A.5.1.2	Added instance of "10CFR72"
App. A	A.5.2	Added instance of 10CFR72.104 and added "ISFSI" to example of sources
App. A	A.5.2	Added instance of 10CFR72 to compliance assessment requirements
App. A	A.5.3	Added ISFSI direct dose contribution in compliance methodology, provided references to ISFSI NAC dose calculation for methodology, added reference to TSD#13-002 for occupancy factor determinations and additional regulatory requirements of 10CFR72 as additional regulations requiring compliance.
App. A	Table A-1	Added 10CFR72 to Compliance matrix.
App. A	Table A-4	Added 10CFR72.104(a) dose limit requirements.
12	Table 12.2-4	Changed 0RT-AR24 Channel function chest to Q
App. A	Section A.5.3	Paragraphs 1&3: Changed wording referring to TSD#13-002 to: TSD 13-008 "Evaluation of Independent Spent Fuel Storage Installation and Associated Process Dose Rates" and TSD 13-009 "Member of the Public Dose from All Onsite sources"
12	Table 12.2-1	Added item 4.A Dilution flow instrument 0FIT-SW54
12	Table 12.2-2	Item 3.A.1 Changed "channel calibration to include sensor

Chapter	Section	Description
12	12.2-2	Item 3.B.1 Changed “channel calibration” to include sensor
12	12.2-2	Added Item 4.A 0FIT-SW54 dilution flowrate instrument.
12	12.2-1	Modified surveillance 1. Added Plant Manager Approval required for all releases without a rad monitor.
Chapter	Section	Description
11	Table 11-1.b	Section b. added to include new control air sample location
12	Table 12.5-1.b	Section b. added to include new control air sample location
11	Table 11-1.2.b	Added control TLD location
11	Table 11-1.2.c & 11-1.2.d	Added sections c. and d. To include TLD’s placed for ISFSI background trending. Added section to re-establish 5 mile ring REMP TLD’s.
11	Figure 11-1	Renamed to figure 11-1a. and updated with new REMP monitoring locations
11	Figure 11-1b.	Figure added to show 5 mile ring TLD placement locations
12	Table 12.5-1	Updated table for new TLD locations.
12	Table 12.3-2.A & 12.3-2.B	Removed Sr-89 from analysis, added Ni-63
12	Table 12.4-1.C & 12.4-1.D	Removed Sr-89 from analysis, added Ni-63
12	Table 12.4-1 Note c.	Removed Sr-89 from analysis, added Ni-63
12	Table 12.2-1.1.A	Renamed Boric Acid Monitor Tanks (BAMT) to Lake Release Tanks.
12	Table 12.2-1.1.A.1	Changed 0R-PR05 to 0R-PR04
12	Table 12.2-1.3.A	Renamed Boric Acid Monitor Tank to Lake Release Tank #1
12	Table 12.2-1.3.B & 12.2-1.3.B.1	Added Item 3.B and 3.B.1 Lake Release Tank #2 is monitored for flow from new flow meter 0FI-WD-006
12	Table 12.2-2.1.A & 12.2-2.1.A.1	Renamed Boric Acid Monitor Tank to Lake Release Tank.
12	Table 12.2-2.3.A	Renamed Boric Acid Monitor Tank to Lake Release Tank #1
12	12.2-2.3.b & 12.2-2.3.b.1	Lake Release Tank #2 is monitored for flow from new flow meter 0FI-WD006
12	Table 12.3-2.1.A	Renamed Boric Acid Monitor Tank to Lake Release Tank.
12	Table 12.2-4.3.A.4	Added Item A.4 to include 0RT-AR24
12	Table 12.2-4 Note 3	Changed note to include 0RT-AR24
12	Table 12.2-3.3.A.4	Added section 4 to include 0RT-AR24
12	Table 12.2-3 Surveillance 13	Deleted surveillance 13 subsections 1-4 and added surveillance for 0RT-AR24
10 r 15	Table 10-2	Corrected inadvertently changed table from previous revision.
12	Table 12.2-3.3.A.2	Surveillance requirement of 0RT-AR22 changed from 14 to 12 to match 0RT-AR21.
App. A	A.0	Added instance of 10CFR72
App. A	A.4	Added several instances of “10CFR72”
App. A	A.4.1.2)	Added “ISFSI” to clarify contained sources
App. A	A.5.1.1	Added requirements for Zion to comply with 10CFR72
App. A	A.5.1.2	Added instance of “10CFR72”

Chapter	Section	Description
App. A	A.5.2	Added instance of 10CFR72.104 and added "ISFSI" to example of sources
App. A	A.5.2	Added instance of 10CFR72 to compliance assessment requirements
App. A	A.5.3	Added ISFSI direct dose contribution in compliance methodology, provided references to ISFSI NAC dose calculation for methodology, added reference to TSD#13-002 for occupancy factor determinations and additional regulatory requirements of 10CFR72 as additional regulations requiring compliance.
App. A	Table A-1	Added 10CFR72 to Compliance matrix.
App. A	Table A-4	Added 10CFR72.104(a) dose limit requirements.
12	Table 12.2-4	Changed 0RT-AR24 Channel function chest to Q
App. A	Section A.5.3	Paragraphs 1&3: Changed wording referring to TSD 13-002 to: TSD 13-008 "Evaluation of Independent Spent Fuel Storage Installation and Associated Process Dose Rates" and TSD 13-009 "Member of the Public Dose from All Onsite sources"
12	Table 12.2-1	Added item 4.A Dilution flow instrument 0FIT-SW54
12	Table 12.2-2	Item 3.A.1 Changed "channel calibration to include sensor
12	12.2-2	Item 3.B.1 Changed "channel calibration" to include sensor
12	12.2-2	Added Item 4.A 0FIT-SW54 dilution flowrate instrument.
12	12.2-1	Modified surveillance 1. Added plant Manager Approval required for all releases without a rad monitor.

b. Process Control Program (PCP) ZS-WM-123 Revisions:

Section	Description of change
3.8	Definition of Process Control Program revised for clarity and to match Reg. guide 1.21 rev.1
4.2.1.7	Revised notation to references
5.10	Revised Reference
Attachment 3 Section 2.0	Bead ion exchange resin dewatering criteria wording revised.
Attachment 3 Section 3.0	Miscellaneous metals and irradiated hardware dewatering criteria wording revised.
Section	Description of change
3.8	Definition of Process Control Program revised for clarity and to match Reg. guide 1.21 rev.1
4.2.1.7	Revised notation to references
5.10	Revised Reference
Attachment 3 Section 2.0	Bead ion exchange resin dewatering criteria wording revised.
Attachment 3 Section 3.0	Miscellaneous metals and irradiated hardware dewatering criteria wording revised.

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ZS-2014-0100: Attachment 2- Effluent & Waste Disposal Summary

Attachment 2.1 – Unit 1 Gaseous Releases

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES
Unit 1 Vent Stack

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Gases						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Iodine-131						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Particulates Half Life >= 8 days						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Tritium						
1. Total Release	Ci	9.35E-03	6.50E-03	7.50E-03	9.10E-03	3.25E-02
2. Avg. Release Rate	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

GASEOUS EFFLUENTS - GROUND RELEASES - CONTINUOUS MODE

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Gases						
Iodines		<LLD	<LLD	<LLD	<LLD	<LLD
Particulates Half Life >= 8 days		<LLD	<LLD	<LLD	<LLD	<LLD
Tritium						
H-3	Ci	9.35E-03	6.50E-03	7.50E-03	9.10E-03	3.25E-02
Totals for Period	Ci	9.35E-03	6.50E-03	7.50E-03	9.10E-03	3.25E-02

GASEOUS EFFLUENTS - GROUND RELEASES - BATCH MODE

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
No Batch Releases.						

LLD values are listed on attachment 2.5

ZionSolutions, LLC

ZS-2014-0100: Attachment 2- Effluent & Waste Disposal Summary

Attachment 2.2 – Unit 2 Gaseous Releases

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES
Unit 2 Vent Stack

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Gases						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Iodine-131						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Particulates Half Life >= 8 days						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Tritium						
1. Total Release	Ci	9.35E-03	6.50E-03	7.50E-03	9.10E-03	3.25E-02
2. Avg. Release Rate	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

GASEOUS EFFLUENTS - GROUND RELEASES - CONTINUOUS MODE

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR	
Fission and Activation Gases							
		<LLD	<LLD	<LLD	<LLD	<LLD	
Iodines							
		<LLD	<LLD	<LLD	<LLD	<LLD	
Particulates Half Life >= 8 days							
		<LLD	<LLD	<LLD	<LLD	<LLD	
Tritium							
H-3	Ci	9.35E-03	6.50E-03	7.50E-03	9.10E-03	3.25E-02	
Totals for Period		Ci	9.35E-03	6.50E-03	7.50E-03	9.10E-03	3.25E-02

GASEOUS EFFLUENTS - GROUND RELEASES - BATCH MODE

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
No Batch Releases.						

LLD values are listed on attachment 2.5

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 ZS-2014-0100: Attachment 2- Effluent & Waste Disposal Summary

Attachment 2.3 – Liquid Effluent Releases

LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Gases						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Iodine-131						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Particulates Half Life >= 8 days						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Volume of liquid waste	gallons	8.91E+05	9.50E+05	7.09E+05	6.27E+05	3.18E+06
Volume of dil. water	gallons	3.24E+08	3.28E+08	3.31E+08	3.31E+08	1.31E+09

LIQUID EFFLUENTS - BATCH MODE

REPORT FOR 2013	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
No batch releases.						

LLD values are listed in attachment 2.5

ZionSolutions, LLC

ZS-2014-0100: Attachment 2- Effluent & Waste Disposal Summary

Attachment 2.4-Direct Radiation

Unit	Qtr 1 dose(mrem)	Qtr 2 dose(mrem)	Qtr 3 dose(mrem)	Qtr 4 dose(mrem)	2013 annual dose(mrem)
Unit 1	2.34E+00	0.00E+00	0.00E+00	0.00E+00	2.34E+00
Unit 2	2.34E+00	0.00E+00	0.00E+00	0.00E+00	2.34E+00
ISFSI	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Attachment 2.5-LLD's

Various detectors were used on different counting platforms for the gaseous and liquid weekly effluent samples. The lower limit of detection(LLD) accompanies each counted sample and is verified to meet the following maximum LLD's:

A. Liquid

Sample frequency	Type of analysis	Lower Limit of Detection (LLD) uCi/mL
Weekly/prior to each release	Principal Gamma Emitters:	<5.00E-07
	Dissolved and Entrained Gases	<1.00E-05
Monthly composite	Tritium	<1.00E-05
	Gross Alpha	<1.00E-07
Quarterly composite	Sr-90	5.00E-08
	Fe-55, Ni-63	1.00E-06

B. Gaseous

Sample frequency	Type of analysis	Lower Limit of Detection (LLD) uCi/mL
Continuous/daily/weekly	Principle gamma emitters	<1.00E-11
Continuous	Noble gas	<1.00E-06
Monthly	Noble Gas / Principle gamma emitters	<1.00E-04
	Tritium	1.00E-06
Quarterly composite	Sr-90	<1.00E-11
	Fe-55	<3.00E-11
	Ni-63	<1.00E-11
	Gross Alpha	<1.00E-11

Attachment 2.6-Error Estimation

Estimates of Total Error

The following is a calculated estimate of the maximum potential total error associated with reported values in the Annual Radioactive Effluent Release Report. The Total Error is determined by calculating the square root of the sum of the squares of the individual errors.

a. Gaseous Effluents

Sampling Error	5%
Calibration Error	10%
Counting Statistics Error	17%
Sample Volume Error	10%
<hr/>	
Total Error	23%

b. Liquid Effluents

Sampling Error	5%
Calibration Error	10%
Counting Statistics Error	16%
Sample Volume Error	2%
<hr/>	
Total Error	20%

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ZS-2014-0100: Attachment 3- Solid Waste and Irradiated Fuel Shipments

A. Solid Waste Shipped Offsite for Burial or Disposal (Not irradiated fuel)

1. Types of Waste

Types of Waste	Total Quantity (m ³)	Total Activity (Ci)	Period	Est. Total Error %
a. Spent resins, filter sludges, evaporator bottoms, etc.	3.78E+02	2.26E+01	2013	2.50E+01
b. Dry compressible waste, contaminated equip, etc.	9.03E+04	1.38E+01	2013	2.50E+01
c. Irradiated components, control rods, etc.	4.40E+03	1.73E+03	2013	2.50E+01
d. Other (describe)	0.00E+00	0.00E+00	2013	0.00E+00

2. Estimate of major nuclide composition (by waste type)

Major Nuclide Composition	Waste Type a. Resins, sludges bottoms (%)	Waste Type b. DAW contaminated equipment (%)	Waste Type d. Irradiated components (%)	Waste Type d. Other %
Ag-110m	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-241	1.20E-03	5.48E-02	0.00E+00	0.00E+00
C-14	1.93E-02	1.47E-01	4.97E-02	0.00E+00
Ce-144	5.20E-03	3.07E-01	0.00E+00	0.00E+00
Cm-242	0.00E+00	3.00E-04	0.00E+00	0.00E+00
Cm-243	5.00E-04	1.81E-02	0.00E+00	0.00E+00
Cm-244	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	1.51E+01	3.53E+01	5.80E+01	0.00E+00
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.42E+00	2.28E+01	5.30E-03	0.00E+00
Fe-55	9.28E-02	1.77E+01	8.67E+00	0.00E+00
H-3	5.00E-03	3.44E-01	1.20E-01	0.00E+00
I-129	4.00E-04	1.25E-02	0.00E+00	0.00E+00
Mn-54	0.00E+00	3.80E-02	2.80E-03	0.00E+00
Nb-94	2.40E-02	6.69E-02	1.00E-03	0.00E+00
Ni-59	1.01E+00	4.51E-01	3.03E-01	0.00E+00
Ni-63	8.00E+01	2.16E+01	0.00E+00	0.00E+00
Ni-63am	0.00E+00	0.00E+00	3.28E+01	0.00E+00
Np-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	6.00E-04	5.37E-02	0.00E+00	0.00E+00
Pu-239	3.00E-04	1.73E-02	0.00E+00	0.00E+00
Pu-240	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-241	1.41E-01	1.70E-01	2.00E-04	0.00E+00
Pu-242	0.00E+00	8.00E-04	0.00E+00	0.00E+00
Ra-226	0.00E+00	0.00E+00	7.00E-04	0.00E+00
Sb-125	3.68E-02	2.43E-01	3.00E-04	0.00E+00
Sr-89	8.90E-03	8.24E-02	0.00E+00	0.00E+00
Sr-90	1.11E-01	2.09E-01	1.00E-04	0.00E+00
Tc-99	4.60E-03	2.03E-01	1.00E-04	0.00E+00
Zn-65	5.58E-02	2.01E-01	0.00E+00	0.00E+00

ZionSolutions, LLC

ZS-2014-0100: Attachment 3- Solid Waste and Irradiated Fuel Shipments

3. Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
10	Truck	Clive CWF
22	Rail	Clive BWF
1	Truck	WCS

B. Irradiated Fuel Shipments (disposition)

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

C. Changes to the Process Control Program:

Changes to the PCP are included in Attachment 1 along with changes to the ODCM.

UNIT 1, 2 & ISFSI (DOCKET Numbers 50-295, 50-304 & 72-1037)

EXECUTIVE SUMMARY

A review of 2013 effluent data indicates that the activity released from the station was far below any regulatory limit. There was no noble gas released in 2013. This trend can be attributed to the shutdown of both units since late September 1997.

Airborne

	Dose to Maximally Exposed Receptor from Unit 1	Dose to Maximally Exposed Receptor from Unit 2
Gamma Air	0.00E+00 mrad	0.00E+00 mrad
Beta Air	0.00E+00 mrad	0.00E+00 mrad
Total Body	0.00E+00 mrem	0.00E+00 mrem
Skin	0.00E+00 mrem	0.00E+00 mrem
Organ	8.25E-05 mrem (Child Liver)	8.25E-05 mrem (Child Liver)

Aquatic

There was NO Aquatic release of radioactivity from Zion Station for 2013.

	Dose to Maximally Exposed Receptor (Any) from Unit 1	Dose to Maximally Exposed Receptor (Any) from Unit 2
Total Body	0 mrem	0 mrem
Organ	0 mrem	0 mrem

Direct Radiation

	Dose to Maximally Exposed Member of the public from Unit 1	Dose to Maximally Exposed Member of the public from Unit 2	Dose to Maximally Exposed Member of the public from ISFSI
Total Body	2.34E+00mrem	2.34E+00mrem	0.00E+00mrem

Attachment 4.2 – Unit 1

I. Unit 1 (Docket Number 50-295)

A. 10 CFR20 & 40CFR190 Compliance Assessment: The demonstration of compliance with 40CFR190 will be used to demonstrate compliance with 10CFR20.

1. Total Effective Dose Equivalent 2.34+00 mrem/year
2. 40 CFR 190 Whole body limit 25 mrem/year
3. 40 CFR 190 Max exposed organ 25 mrem (75 mrem thyroid)
4. % Whole body limit 9.36E+00%
5. % Max exposed organ 9.36E+00% child liver (3.12E+00% thyroid)
- 6.

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
TEDE	2.34E+00	1.65E-05	1.91E-05	4.63E-05	2.34E+00
	mrem	mrem	mrem	mrem	mrem

B. Maximally Exposed Receptor:

1. Airborne

	Qtr Obj	1 st Qtr	2 nd Qtr	3 rd Qtr	4 th Qtr	Yearly limit 10CFR 50 App. I	Total Dose 2013	% of Yearly limit
Gamma air (mrad)	5.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	10.0	0.00E+00	0.00E+00
Beta Air (mrad)	10.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	20.0	0.00E+00	0.00E+00
Total Body (mrem)	7.5	2.38E-05	1.65E-05	1.91E-05	4.63E-05	15.0	8.25E-05	5.50E-06
Skin (mrem)	7.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	15.0	0.00E+00	0.00E+00
Organ (mrem)	7.5	2.38E-05	1.65E-05	1.91E-05	4.63E-05	15.0	8.25E-05	5.50E-06
Critical Organ		Child liver	Child liver	Child liver	Child liver		Child liver	Child liver

2. Aquatic

	Qtr Obj	1 st Qtr	2 nd Qtr	3 rd Qtr	4 th Qtr	Yearly limit 10CFR 50 App. I	Total Dose 2013	% of Yearly limit
Total Body (mrem)	2.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.0	0.00E+00	0.00E+00
Organ (mrem)	2.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	10.0	0.00E+00	0.00E+00
Critical Organ		NA	NA	NA	NA		NA	NA

3. Direct

	Qtr Obj	1 st Qtr	2 nd Qtr	3 rd Qtr	4 th Qtr	Yearly limit 40CFR190	Total Dose 2013	% of Yearly limit
Total body (mrem)	6.25	2.34E+00	0.00E+00	0.00E+00	0.00E+00	25.0	2.34E+00	9.36E-02

Attachment 4.3 – Unit 2

II. Unit 2 (Docket Number 50-304)

A. 10 CFR20 & 40CFR190 Compliance Assessment: The demonstration of compliance with 40CFR190 will be used to demonstrate compliance with 10CFR20.

- 1. Total Effective Dose Equivalent 2.34E+00 mrem/year
- 2. 40 CFR 190 Whole body limit 25 mrem/year
- 3. 40 CFR 190 Max exposed organ 25 mrem (75 mrem thyroid)
- 4. % Whole body limit 9.36E+00%
- 5. % Max exposed organ 9.36E+00% child liver (3.12E+00% thyroid)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
TEDE	2.34E+00	1.65E-05	1.91E-05	4.63E-05	2.34E+00
	mrem	mrem	mrem	mrem	mrem

B. Maximally Exposed Receptor:

1. Airborne

	Qtr Obj	1 st Qtr	2 nd Qtr	3 rd Qtr	4 th Qtr	Yearly limit 10CFR 50 App. I	Total Dose 2013	% of Yearly limit
Gamma air (mrad)	5.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	10.0	0.00E+00	0.00E+00
Beta Air (mrad)	10.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	20.0	0.00E+00	0.00E+00
Total Body (mrem)	7.5	2.38E-05	1.65E-05	1.91E-05	4.63E-05	15.0	8.25E-05	5.50E-06
Skin (mrem)	7.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	15.0	0.00E+00	0.00E+00
Organ (mrem)	7.5	2.38E-05	1.65E-05	1.91E-05	4.63E-05	15.0	8.25E-05	5.50E-06
Critical Organ		Child liver	Child liver	Child liver	Child liver		Child liver	Child liver

2. Aquatic

	Qtr Obj	1 st Qtr	2 nd Qtr	3 rd Qtr	4 th Qtr	Yearly limit 10CFR 50 App. I	Total Dose 2013	% of Yearly limit
Total Body (mrem)	2.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.0	0.00E+00	0.00E+00
Organ (mrem)	2.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	10.0	0.00E+00	0.00E+00
Critical Organ		NA	NA	NA	NA		NA	NA

3. Direct

	Qtr Obj	1 st Qtr	2 nd Qtr	3 rd Qtr	4 th Qtr	Yearly limit 40CFR190	Total Dose 2013	% of Yearly limit
Total body (mrem)	6.25	2.34E+00	0.00E+00	0.00E+00	0.00E+00	25.0	0.00E+00	0.00E+00

Attachment 4.4 – ISFSI

III. ISFSI (Docket Number 72-1037)

A. 10CFR72 & 40CFR190 Compliance Assessment:

1. Total Effective Dose Equivalent 0.00+00 mrem/year
2. 40 CFR190 / 10CFR72 Whole body limit 25 mrem/year
3. 40 CFR190 / 10CFR72 Max exposed organ 25 mrem (75 mrem thyroid)
4. % Whole body limit 0.00E+00%
5. % Max exposed organ(child liver/thyroid) 0.00E+00% / 0.00E+00%

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
TEDE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	mrem	mrem	mrem	mrem	mrem

B. Maximally Exposed Receptor:

1. Direct

	Qtr Obj	1 st Qtr	2 nd Qtr	3 rd Qtr	4 th Qtr	Yearly limit 40CFR190/ 10CFR72.104	Total Dose 2013	% of Yearly limit
Total body (mrem)	6.25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	25.0	0.00E+00	0.00E+00

Attachment 4.5 – Combined 40CRF190 Report

IV. Combined 40CFR190 Report:

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

 GAS ANNUAL DOSE SUMMARY

Year.....: 2013
 From Unit.....: 1
 To Unit.....: 2
 Coefficient Type.....: Historical
 Gas Receptor.....: 5 Composite Crit. Receptor - IP
 Distance (meters).....: 0.00
 Compass Point.....: NA

=== MAXIMUM PERIOD DOSE TO LIMIT (Any Organ) ===

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Quarter 1	CHILD	LIVER	4.76E-05	Quarter	5.63E+00	8.46E-04	7.50E+00	6.35E-04
Quarter 2	CHILD	LIVER	3.30E-05	Quarter	5.63E+00	5.87E-04	7.50E+00	4.41E-04
Quarter 3	CHILD	LIVER	3.82E-05	Quarter	5.63E+00	6.79E-04	7.50E+00	5.10E-04
Quarter 4	CHILD	LIVER	4.63E-05	Quarter	5.63E+00	8.24E-04	7.50E+00	6.18E-04
Annual	CHILD	LIVER	1.65E-04	Annual	1.13E+01	1.47E-03	1.50E+01	1.10E-03

=== MAXIMUM PERIOD DOSE TO LIMIT (Tot Body) ===

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Quarter 1	CHILD	TBODY	4.76E-05	Quarter	5.25E+00	9.06E-04	7.50E+00	6.35E-04
Quarter 2	CHILD	TBODY	3.30E-05	Quarter	5.25E+00	6.29E-04	7.50E+00	4.41E-04
Quarter 3	CHILD	TBODY	3.82E-05	Quarter	5.25E+00	7.28E-04	7.50E+00	5.10E-04
Quarter 4	CHILD	TBODY	4.63E-05	Quarter	5.25E+00	8.82E-04	7.50E+00	6.18E-04
Annual	CHILD	TBODY	1.65E-04	Annual	1.05E+01	1.57E-03	1.50E+01	1.10E-03

Attachment 4.5(continued) – Combined 40CRF190 Report

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

 COMBINED MAXIMUM ANNUAL DOSE SUMMARY

Year.....: 2013
 From Unit.....: 1
 To Unit.....: 2
 Liquid Receptor.....:
 Coefficient Type.....: Historical
 Gas Receptor.....: 5 Composite Crit. Receptor - IP
 Distance (meters).....: 0.00
 Compass Point.....: NA

=== MAXIMUM PERIOD DOSE TO LIMIT (Any Organ) ===

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Quarter 1	CHILD	LIVER	4.76E-05	Quarter	5.63E+00	8.46E-04	7.50E+00	6.35E-04
Quarter 2	CHILD	LIVER	3.30E-05	Quarter	5.63E+00	5.87E-04	7.50E+00	4.41E-04
Quarter 3	CHILD	LIVER	3.82E-05	Quarter	5.63E+00	6.79E-04	7.50E+00	5.10E-04
Quarter 4	CHILD	LIVER	4.63E-05	Quarter	5.63E+00	8.24E-04	7.50E+00	6.18E-04
Annual	CHILD	LIVER	1.65E-04	Annual	1.13E+01	1.47E-03	1.50E+01	1.10E-03

=== MAXIMUM PERIOD DOSE TO LIMIT (Tot Body) ===

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Admin Limit	Admin % of Limit	T.Spec Limit	T.Spec % of Limit
Quarter 1	CHILD	TBODY	4.76E-05	Quarter	5.25E+00	9.06E-04	7.50E+00	6.35E-04
Quarter 2	CHILD	TBODY	3.30E-05	Quarter	5.25E+00	6.29E-04	7.50E+00	4.41E-04
Quarter 3	CHILD	TBODY	3.82E-05	Quarter	5.25E+00	7.28E-04	7.50E+00	5.10E-04
Quarter 4	CHILD	TBODY	4.63E-05	Quarter	5.25E+00	8.82E-04	7.50E+00	6.18E-04
Annual	CHILD	TBODY	1.65E-04	Annual	1.05E+01	1.57E-03	1.50E+01	1.10E-03