

April 28, 2015

ZS-2015-0055

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 2014

In accordance with the ZionSolutions, LLC, Quality Assurance Project Plan, Appendix B, Section 5.7.3, "Radioactive Effluent Release Report," enclosed is the Radioactive Effluent Release Report for the year 2014. 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 in Attachment 4.4.

Pursuant to 10 CFR 50.4 and Offsite Dose Calculation Manual (ODCM), Section 12.7.4, there were changes made to the Zion Station Liquid Effluent Treatment System in 2014. The changes to the Liquid Effluent Treatment System are described in Attachment 7. There were surveillances conducted for an inoperable plant monitoring system that exceeded the 30 day time limit listed in ODCM Section 12.2.2. ODCM Section 12.7.2 requires explanation as to why the inoperable monitoring system was not corrected within 30 days. Attachment 8 provides this explanation and a summary of the station review conducted and corrective actions implemented to restore the plant monitoring system to operable status.

There were no changes modifying intent or methodology to the ODCM or the Process Control Program during 2014. Therefore, they are not included with the submittal.

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,



Gerard van Noordennen  
Vice President Regulatory Affairs

A009  
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NM5520  
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ZionSolutions, LLC  
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Enclosure:

Zion Station 2014 Annual Radioactive Effluent Release Report

cc: John Hickman, U.S. NRC Senior Project Manager  
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**Zion Station**

**2014**

**Annual Radioactive Effluent Release Report**

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List of Attachments

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Attachment # Description

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- 7 Summary of Liquid Radwaste System Changes
- 8 Corrective Actions for Inoperable Rad Monitor >30 days

Attachment 1- Supplemental Information

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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 releases are continuously monitored and samples collected and analyzed weekly for particulates and tritium. Particulate filters are sent to an independent lab for quarterly composite analysis. 2RIA-PR49 Unit 2 gaseous effluent release monitor was replaced during the time period of Dec.18-Dec. 29. During this time period particulate activity was continuously monitored and analyzed daily in each of the three areas feeding into Unit 2 vent stack (i.e. Unit 2 purge system, Aux. building, Fuel Handling Building). A separate composite was sent to an independent lab for composite analysis during quarter 4. Tritium activity in gaseous releases are calculated from the water evaporation of water in the spent fuel pool and water filled reactor cavities.

- c. Liquid effluents are continuously monitored and isotopic analysis performed weekly. Liquid batch releases are mixed and a representative sample taken and analyzed prior to batch release. A complete analysis of all liquid volumes was performed by an offsite laboratory to determine hard to detect nuclide activity. A conservative ratio to Co-60 was calculated for each hard to detect nuclide. Prior to each batch release, these scaling factors were used to calculate the concentration of these hard to detect nuclides.
- d. Occupancy factors were used in determining direct radiation dose to the maximally exposed member of the public based on habits of a real individual in ES&H Technical Support Document 13-009 "Member of the Public Dose from All Onsite Sources."

4. Batch Releases:

- a. Liquid:
  - 1. There were 50 liquid batch releases in 2014
  - 2. Total time period for batch releases: 1.35E+05 min.
  - 3. Maximum time period for a batch release: 6.56E+03 min.
  - 4. Average time period for batch release: 2.70E+03 min.
  - 5. Minimum time period for a batch release: 8.07E+02 min.
- b. Gaseous: There were no gaseous batch releases in 2014.

5. Abnormal Releases:

- a. Liquid: There were no liquid abnormal releases in 2014.
- b. Gaseous: There were no gaseous abnormal releases in 2014.

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

Zion Station 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.

Zion Station ODCM Section 12.7.2 requires major changes to the Process Control Program(PCP) to be submitted in the Annual Radioactive Effluent Release Report.

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.

Unit 2 Vent Stack 2RIA-PR49 SPING monitor had an electronic malfunction. The mechanical portion of the SPING monitor was still operating normally and still maintaining a representative sample of Unit 2 gaseous effluent, thus the normal pathway and mechanical components were used to perform the daily surveillances required for inoperable radiation monitor. ODCM section 12.2.2 requires the system be restored to operational status or a station review conducted to determine the course of action to restore the gaseous effluent radiation monitor to operable status. No repair parts were able to be found to repair the electronics of the SPING unit and no replacement was found to be available as the Eberline SPING radiation monitor is no longer manufactured nor supported causing Zion Station to perform surveillances from Nov. 11 to Dec. 29 (49 days). A station review was conducted and the course of action decided upon to restore the radiation effluent monitor to operable status was to replace the SPING unit that monitors Unit 2 vent stack with a new radiation monitor identical to the one currently used monitoring Unit 1 vent stack. The radiation monitor was replaced and is working properly. Attachment 8 is the summary of the review conducted and the actions taken to restore system operation.

#### 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 2014.

#### 9. Offsite Dose Calculation Manual (ODCM)

Changes to the ODCM and Process Control Program 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. ODCM Revisions: There were no major changes to the ODCM in 2014
- b. Process Control Program(PCP): There were no major changes to the PCP in 2014.

#### 10. Switchyard Area

The switchyard is an onsite area that is monitored for direct radiation dose. Access to the site is controlled by Commonwealth Edison and is not accessible to members of the



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general public. The dose limits for this area are regulated differently than the general offsite dose areas and comply with 10CFR20 annual dose limit of 100 mrem/year. ES&H TSD 13-009 lists the evaluation performed to determine habits of the real individual working in the switchyard and are calculated to be occupied no more than 2088 hours/year.

Attachment 2.1 – Unit 1 Gaseous Releases

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES  
Unit 1 Vent Stack - GROUND RELEASES

REPORT FOR 2014	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	6.95E-03	1.15E-02	1.15E-02	2.33E-02	5.32E-02
2. Avg. Release Rate	uCi/sec	8.94E-04	1.46E-03	1.44E-03	2.92E-03	1.69E-03

GASEOUS EFFLUENTS - GROUND RELEASES - CONTINUOUS MODE

REPORT FOR 2014	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	6.95E-03	1.15E-02	1.15E-02	2.33E-02	5.32E-02
Totals for Period	Ci	6.95E-03	1.15E-02	1.15E-02	2.33E-02	5.32E-02

GASEOUS EFFLUENTS - GROUND RELEASES - BATCH MODE

REPORT FOR 2014	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
No Batch Releases.						

LLD values are listed on attachment 2.5  
Total Error values are listed on attachment 2.6

Attachment 2.2 – Unit 2 Gaseous Releases

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES  
Unit 2 Vent Stack - GROUND RELEASES

REPORT FOR 2014	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	4.05E-05	4.05E-05
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	5.10E-06	1.29E-06
Tritium						
1. Total Release	Ci	6.95E-03	1.15E-02	1.15E-02	2.33E-02	5.32E-02
2. Avg. Release Rate	uCi/sec	8.94E-04	1.46E-03	1.44E-03	2.92E-03	1.69E-03

GASEOUS EFFLUENTS - GROUND RELEASES - CONTINUOUS MODE

REPORT FOR 2014	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						
CO-60	Ci	<LLD	<LLD	<LLD	1.81E-06	1.81E-06
CS-137	Ci	<LLD	<LLD	<LLD	1.34E-06	1.34E-06
NI-63	Ci	<LLD	<LLD	<LLD	3.74E-05	3.74E-05
Totals for Period...	Ci	<LLD	<LLD	<LLD	4.05E-05	4.05E-05
Tritium						
H-3	Ci	6.95E-03	1.15E-02	1.15E-02	9.10E-03	3.25E-02
Totals for Period	Ci	6.95E-03	1.15E-02	1.15E-02	9.10E-03	3.25E-02

GASEOUS EFFLUENTS - GROUND RELEASES - BATCH MODE

REPORT FOR 2014	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
No Batch Releases.						

LLD values are listed on attachment 2.5  
Total Error values are listed on attachment 2.6

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Attachment 2.3 – Liquid Effluent Releases

LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES (Unit 1 & Unit 2 combined)

REPORT FOR 2014	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation products (not including Alpha and Tritium)						
1. Total Release	Ci	<LLD	1.40E-03	1.68E-02	1.87E-02	3.69E-02
2. Avg. Release Rate	uCi/sec	<LLD	1.78E-04	2.11E-03	2.35E-03	1.17E-03
Tritium						
1. Total Release	Ci	<LLD	1.21E-01	6.94E-01	2.48E-01	1.06E+00
2. Avg. Release Rate	uCi/sec	<LLD	1.54E-02	8.73E-02	3.12E-02	3.36E-02
Dissolved and Entrained Gases						
1. Total Release	Ci	<LLD	<LLD	<LLD	<LLD	<LLD
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	<LLD	<LLD	<LLD
Gross Alpha Radioactivity						
1. Total Release	Ci	<LLD	<LLD	1.57E-06	<LLD	1.57E-06
2. Avg. Release Rate	uCi/sec	<LLD	<LLD	1.97E-07	<LLD	4.98E-08
Volume of liquid waste	liters	2.64E+06	4.28E+06	6.09E+06	5.15E+06	1.82E+07
Volume of dil. water	liters	1.23E+09	1.24E+09	1.25E+09	1.25E+09	4.97E+09

LIQUID EFFLUENTS - CONTINUOUS MODE (Unit 1 & Unit 2 combined)

REPORT FOR 2014	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Gases		<LLD	<LLD	<LLD	<LLD	<LLD
Tritium		<LLD	<LLD	<LLD	<LLD	<LLD
Dissolved and Entrained Gases		<LLD	<LLD	<LLD	<LLD	<LLD
Gross Alpha Radioactivity		<LLD	<LLD	<LLD	<LLD	<LLD

## Attachment 2.3 – Liquid Effluent Releases (continued)

## LIQUID EFFLUENTS - BATCH MODE (Unit 1 &amp; Unit 2 combined)

REPORT FOR 2014	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Fission and Activation Products						
AG-108M	Ci	N/A	6.88E-09	1.95E-07	0.00E+00	2.02E-07
C-14	Ci	N/A	2.52E-07	4.38E-04	5.40E-04	9.78E-04
CO-60	Ci	N/A	8.00E-04	2.50E-03	1.23E-03	4.53E-03
CS-137	Ci	N/A	0.00E+00	2.10E-04	1.31E-06	2.11E-04
FE-55	Ci	N/A	2.82E-06	1.55E-04	1.92E-04	3.50E-04
NI-59	Ci	N/A	8.44E-06	3.01E-04	3.71E-04	6.80E-04
NI-63	Ci	N/A	5.44E-04	1.30E-02	1.62E-02	2.97E-02
PU-241	Ci	N/A	7.82E-07	1.03E-05	1.27E-05	2.38E-05
SB-125	Ci	N/A	4.62E-05	2.53E-05	0.00E+00	7.15E-05
SR-90	Ci	N/A	3.55E-07	1.68E-04	2.08E-04	3.77E-04
Totals for Period	Ci	N/A	1.40E-03	1.68E-02	1.87E-02	3.69E-02
Tritium						
H-3	Ci	N/A	1.21E-01	6.94E-01	2.48E-01	1.06E+00
Totals for Period	Ci	N/A	1.21E-01	6.94E-01	2.48E-01	1.06E+00
Dissolved and Entrained Gases		N/A	<LLD	<LLD	<LLD	<LLD
Gross Alpha Radioactivity						
ALPHA	Ci	N/A	0.00E+00	1.57E-06	0.00E+00	1.57E-06
Totals for Period	Ci	N/A	0.00E+00	1.57E-06	0.00E+00	1.57E-06

LLD values are listed in attachment 2.5

Total Error values are listed on attachment 2.6

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Attachment 2.3 – Liquid Effluent Releases (continued)

SUPPLEMENTAL INFORMATION  
LIQUID EFFLUENTS - BATCH MODE

REPORT FOR 2014	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
Number of releases		0	4	23	23	50
Total release time	minutes	N/A	1.14E+04	5.94E+04	6.44E+04	1.35E+05
Maximum release time	minutes	N/A	3.85E+03	4.25E+03	6.56E+03	6.56E+03
Average release time	minutes	N/A	2.85E+03	2.58E+03	2.80E+03	2.70E+03
Minimum release time	minutes	N/A	2.42E+03	8.07E+02	1.12E+03	8.07E+02
Permit dilution vol	ltr	N/A	1.24E+08	7.35E+08	6.81E+08	1.54E+09
Permit dilution flow	gpm	N/A	2.87E+03	3.27E+03	2.80E+03	3.01E+03
Permit max total diluted concentration (no H-3)	uCi/ml	N/A	1.83E-08	1.60E-07	1.62E-07	1.62E-07
Period dilution vol	ltr	1.23E+09	1.24E+09	1.25E+09	1.25E+09	4.97E+09
Period dilution flow	gpm	2.51E+03	2.50E+03	2.49E+03	2.49E+03	2.50E+03

## Attachment 2.4-Direct Radiation

## Maximally exposed sector: J (25mrem/year limit)

Unit	Qtr 1 (mrem)	Qtr 2 (mrem)	Qtr 3 (mrem)	Qtr 4 (mrem)	2014 (mrem)
Unit 1	2.23E-01	7.77E-01	1.97E+00	1.03E+00	4.00E+00
Unit 2	2.23E-01	7.77E-01	1.97E+00	1.03E+00	4.00E+00
ISFSI – gamma	2.23E-01	7.77E-01	1.97E+00	1.03E+00	4.00E+00
ISFSI – neutron	0.00E+00	1.50E-01	5.08E-01	2.95E-01	9.53E-01
Sum:	7.75E-01	2.48E+00	6.42E+00	3.39E+00	1.30E+01

## Maximally exposed switchyard: Switchyard South (100mrem/year limit)

Switchyard	Qtr 1 (mrem)	Qtr 2 (mrem)	Qtr 3 (mrem)	Qtr 4 (mrem)	2014 (mrem)
Gamma	7.15E-01	1.30E+01	1.45E+01	1.98E+01	4.81E+01
Neutron	0.00E+00	8.35E-01	1.25E+00	1.89E+00	3.98E+00
Sum	7.15E-01	1.38E+01	1.58E+01	2.17E+01	5.21E+01

## 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

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## 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%
<u>Sample Volume Error</u>	<u>10%</u>
Total Error	23%

## b. Liquid Effluents

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

Attachment 3 - Solid Waste and Irradiated Fuel Shipments

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

## 1. Types of Waste

Types of Waste	Total Quantity (m <sup>3</sup> )	Total Activity (Ci)	Period	Est. Total Error %
a. Spent Resins, filter sludges, evaporator bottoms	2.91E+01	3.07E+01	2014	2.50E+01
b. Dry compressible waste, contaminated equipment	2.14E+03	3.58E+01	2014	2.50E+01
c. Irradiated components, control rods, etc.	6.96E+02	2.46E+04	2014	2.50E+01
d. Other (describe)	0.00E+00	0.00E+00	2014	2.50E+01

## Attachment 3 - Solid Waste and Irradiated Fuel Shipments (continued)

## 1. 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	1.04E-07	0.00E+00
Am-241	1.10E-08	2.15E-04	9.27E-08	0.00E+00
C-14	5.08E-04	4.66E-04	4.97E-04	0.00E+00
Ce-144	0.00E+00	1.25E-04	1.76E-08	0.00E+00
Cm-242	2.57E-12	8.43E-07	2.11E-10	0.00E+00
Cm-243	1.33E-09	6.84E-05	2.31E-08	0.00E+00
Cm-244	1.30E-09	5.22E-07	1.77E-08	0.00E+00
Co-60	7.30E-01	5.25E-01	5.80E-01	0.00E+00
Cs-134	6.64E-09	1.43E-05	3.84E-07	0.00E+00
Cs-137	1.80E-06	1.71E-01	5.34E-05	0.00E+00
Fe-55	9.33E-02	1.13E-01	8.67E-02	0.00E+00
H-3	1.29E-03	3.94E-04	1.20E-03	0.00E+00
I-129	5.80E-10	1.09E-05	4.11E-08	0.00E+00
Mn-54	7.22E-07	7.22E-04	2.80E-05	0.00E+00
Nb-94	9.62E-06	9.72E-04	9.97E-06	0.00E+00
Ni-59	3.01E-03	2.96E-03	3.03E-03	0.00E+00
Ni-63	0.00E+00	1.73E-01	0.00E+00	0.00E+00
Ni-63am	1.72E-01	0.00E+00	3.28E-01	0.00E+00
Np-237	0.00E+00	0.00E+00	2.68E-07	0.00E+00
Pu-238	9.81E-09	2.06E-04	8.53E-08	0.00E+00
Pu-239	2.04E-09	6.07E-05	1.91E-08	0.00E+00
Pu-240	2.04E-09	2.73E-06	1.35E-08	0.00E+00
Pu-241	2.31E-07	1.71E-03	1.89E-06	0.00E+00
Pu-242	7.33E-12	2.24E-07	5.22E-10	0.00E+00
Ra-226	1.27E-07	3.66E-04	7.44E-06	0.00E+00
Sb-125	1.68E-07	6.45E-03	2.98E-06	0.00E+00
Sr-89	0.00E+00	1.39E-04	3.32E-08	0.00E+00
Sr-90	3.20E-08	1.26E-03	1.17E-06	0.00E+00
Tc-99	6.23E-07	6.90E-04	9.13E-07	0.00E+00
Zn-65	2.06E-07	1.25E-03	1.08E-07	0.00E+00

\* Ni-63AM – activated metal

Attachment 3 - Solid Waste and Irradiated Fuel Shipments (continued)

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2. Solid Waste Disposition

Number of shipments	Mode of Transportation	Destination
23	Truck	Clive CWF
3	Rail	Clive CWF
16	Rail	Clive BWF
21	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:

None

Attachment 4.1 – 40CFR190, 10CFR72 & 10CFR20 Compliance Summary  
Radiological Impact on Man

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

EXECUTIVE SUMMARY

A review of **2014** effluent data indicates that the activity released from the station was far below any regulatory limit. There was no noble gas released in **2014**. 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	3.43E-04 mrem	3.43E-04 mrem
Skin	2.28E-04 mrem	2.28E-04 mrem
Organ	3.70E-03mrem (Child Bone)	3.70E-03mrem (Child Bone)

Aquatic

	Dose to Maximally Exposed Receptor (Any) from Unit 1	Dose to Maximally Exposed Receptor (Any) from Unit 2
Total Body	9.75E-03 mrem	9.75E-03 mrem
Organ	1.44E-01 mrem	1.44E-01 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	4.00E+00mrem	4.00E+00mrem	4.95E+00mrem
Organ	4.00E+00mrem	4.00E+00mrem	4.95E+00mrem

Switchyard Direct Radiation (10CFR20 limit 100mrem/year)

	Dose to Maximally Exposed Switchyard worker
Total Body	5.21E+01 mrem
Organ	5.21E+01 mrem

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 4.01E+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 1.60E+01%
- 5. % Max exposed organ 1.66E+01% child bone (5.53E+00% thyroid)

	Qtr 1 mrem	Qtr 2 mrem	Qtr 3 mrem	Qtr 4 mrem	2014 mrem
TEDE	2.23E-01	7.77E-01	1.98E+00	1.03E+00	4.01E+00
Organ	2.23E-01	7.79E-01	2.04E+00	1.11E+00	4.15E+00

B. Maximally Exposed Receptor:

1. Airborne

	Qtr Obj	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	Yearly limit 10CFR 50 App. I	Total Dose 2014	% 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	1.77E-05	2.93E-05	2.92E-05	2.67E-04	15.0	3.43E-04	2.29E-03
Skin (mrem)	7.5	1.18E-05	1.95E-05	1.94E-05	1.77E-04	15.0	2.28E-04	1.52E-03
Organ (mrem)	7.5	1.77E-05	2.93E-05	2.92E-05	3.70E-03	15.0	3.70E-03	2.47E-02
Critical Organ		Child liver	Child liver	Child liver	Child bone		Child bone	Child bone

3. Aquatic

	Qtr Obj	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	Yearly limit 10CFR 50 App. I	Total Dose 2014	% of Yearly limit
Total Body (mrem)	2.5	0.00E+00	1.19E-04	7.85E-03	2.41E-03	3.0	9.75E-03	3.26E-01
Organ (mrem)	2.5	0.00E+00	2.09E-03	6.80E-02	7.30E-02	10.0	1.44E-01	2.87E+00
Critical Organ		Child bone	Child bone	Child bone	Child bone		Child bone	Child bone

4. Direct

	Qtr Obj	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	Yearly limit 40CFR 190	Total Dose 2014	% of Yearly limit
Total body (mrem)	6.25	2.23E-01	7.77E-01	1.97E+00	1.03E+00	25.0	4.00E+00	1.60E-01

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 4.01E+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 1.60E+01%
- 5. % Max exposed organ 1.66E+01% child bone (5.53E+00% thyroid)

	Qtr 1 mrem	Qtr 2 mrem	Qtr 3 mrem	Qtr 4 mrem	2014 mrem
TEDE	2.23E-01	7.77E-01	1.98E+00	1.03E+00	4.01E+00
Organ	2.23E-01	7.79E-01	2.04E+00	1.11E+00	4.15E+00

B. Maximally Exposed Receptor:

1. Airborne

	Qtr Obj	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	Yearly limit 10CFR 50 App. 1	Total Dose 2014	% 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	1.77E-05	2.93E-05	2.92E-05	2.67E-04	15.0	3.43E-04	2.29E-03
Skin (mrem)	7.5	1.18E-05	1.95E-05	1.94E-05	1.77E-04	15.0	2.28E-04	1.52E-03
Organ (mrem)	7.5	1.77E-05	2.93E-05	2.92E-05	3.70E-03	15.0	3.70E-03	2.47E-02
Critical Organ		Child liver	Child liver	Child liver	Child bone		Child bone	Child bone

2. Aquatic

	Qtr Obj	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	Yearly limit 10CFR 50 App. 1	Total Dose 2014	% of Yearly limit
Total Body (mrem)	2.5	0.00E+00	1.19E-04	7.85E-03	2.41E-03	3.0	9.75E-03	3.26E-01
Organ (mrem)	2.5	0.00E+00	2.09E-03	6.80E-02	7.30E-02	10.0	1.44E-01	2.87E+00
Critical Organ		Child bone	Child bone	Child bone	Child bone		Child bone	Child bone

3. Direct

	Qtr Obj	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	Yearly limit 40CFR 190	Total Dose 2014	% of Yearly limit
Total body (mrem)	6.25	2.23E-01	7.77E-01	1.97E+00	1.03E+00	25.0	4.00E+00	1.60E+01

Attachment 4.4 – ISFSI

III. ISFSI (Docket Number 72-1037)

A. 10CFR72 & 40CFR190 Compliance Assessment:

1. Total Effective Dose Equivalent 4.95+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 1.98E+01%
5. % Max exposed organ(child bone/thyroid) 1.98E+01% / 6.60E+00%

	Qtr 1 mrem	Qtr 2 mrem	Qtr 3 mrem	Qtr 4 mrem	2014 mrem
TEDE	2.23E-01	9.27E-01	2.49E+00	1.33E+00	4.95E+00
Organ	2.23E-01	9.27E-01	2.49E+00	1.33E+00	4.95E+00

B. Maximally Exposed Receptor:

1. Direct (gamma + neutron)

	Qtr Obj	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr	Yearly limit 40CFR190/10CFR72.104	Total Dose 2014	% of Yearly limit
Total body (mrem)	6.25	2.23E-01	9.27E-01	2.49E+00	1.33E+00	25.0	4.95E+00	1.98E+01



Attachment 4.5 – Combined 40CFR190 Report

IV. Combined 40CFR190 Report:

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

LIQUID ANNUAL DOSE SUMMARY

2014 Zion 40CFR190

Year.....: 2014  
 From Unit.....: 1  
 To Unit.....: 2  
 Liquid Receptor.....: 0 Liquid Receptor

=== 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	ADULT	BONE	0.00E+00	Quarter	2.50E+00	0.00E+00	2.50E+00	0.00E+00
Quarter 2	CHILD	BONE	4.17E-03	Quarter	2.50E+00	1.67E-01	2.50E+00	1.67E-01
Quarter 3	CHILD	BONE	1.36E-01	Quarter	2.50E+00	5.44E+00	2.50E+00	5.44E+00
Quarter 4	CHILD	BONE	1.46E-01	Quarter	2.50E+00	5.85E+00	2.50E+00	5.85E+00
Annual	CHILD	BONE	2.87E-01	Annual	5.00E+00	5.73E+00	5.00E+00	5.73E+00

=== 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	ADULT	TBODY	0.00E+00	Quarter	1.50E+00	0.00E+00	1.50E+00	0.00E+00
Quarter 2	CHILD	TBODY	2.37E-04	Quarter	1.50E+00	1.58E-02	1.50E+00	1.58E-02
Quarter 3	ADULT	TBODY	1.57E-02	Quarter	1.50E+00	1.04E+00	1.50E+00	1.04E+00
Quarter 4	CHILD	TBODY	4.81E-03	Quarter	1.50E+00	3.21E-01	1.50E+00	3.21E-01
Annual	ADULT	TBODY	1.95E-02	Annual	3.00E+00	6.52E-01	3.00E+00	6.52E-01

Attachment 4.5 – Combined 40CRF190 Report

LIQUID RELEASE AND DOSE SUMMARY REPORT  
 ----- (PERIOD BASIS) -----

Release ID.....: 1 All Liquid Release Types  
 Period Start Date.....: 01/01/2014 00:00  
 Period End Date.....: 01/01/2015 00:00  
 Period Duration (mins): 5.256E+05  
 Receptor.....: 0 Liquid Receptor

=== 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
Strt->End	CHILD	BONE	2.87E-01	31-day	5.00E+00	5.73E+00	5.00E+00	5.73E+00
				Quarter	2.50E+00	1.15E+01	2.50E+00	1.15E+01
				Annual	5.00E+00	5.73E+00	5.00E+00	5.73E+00

Critical Pathway.....: 1 Fresh Water Fish - Sport (FFSP)  
 Major Contributors.....: 0.0 % or greater to total

Nuclide Percentage

H-3	0.00E+00
FE-55	1.98E-02
CO-60	0.00E+00
NI-63	7.85E+01
SR-90	1.49E+01
CS-137	6.67E+00

=== 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
Strt->End	ADULT	TBODY	1.95E-02	31-day	3.00E+00	6.52E-01	3.00E+00	6.52E-01
				Quarter	1.50E+00	1.30E+00	1.50E+00	1.30E+00
				Annual	3.00E+00	6.52E-01	3.00E+00	6.52E-01

Critical Pathway.....: 1 Fresh Water Fish - Sport (FFSP)  
 Major Contributors.....: 0.0 % or greater to total

Nuclide Percentage

H-3	2.55E-01
FE-55	3.37E-02
CO-60	2.34E+00
NI-63	2.81E+01
SR-90	4.39E+00
CS-137	6.50E+01

Attachment 4.5(continued) – Combined 40CFR190 Report

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GAS ANNUAL DOSE SUMMARY

2014 Zion 40CFR190

Year.....: 2014  
 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	3.54E-05	Quarter	5.63E+00	6.30E-04	7.50E+00	4.72E-04
Quarter 2	CHILD	LIVER	5.86E-05	Quarter	5.63E+00	1.04E-03	7.50E+00	7.82E-04
Quarter 3	CHILD	LIVER	5.84E-05	Quarter	5.63E+00	1.04E-03	7.50E+00	7.79E-04
Quarter 4	CHILD	BONE	7.40E-03	Quarter	5.63E+00	1.32E-01	7.50E+00	9.87E-02
Annual	CHILD	BONE	7.40E-03	Annual	1.13E+01	6.58E-02	1.50E+01	4.93E-02

=== 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	3.54E-05	Quarter	5.25E+00	6.75E-04	7.50E+00	4.72E-04
Quarter 2	CHILD	TBODY	5.86E-05	Quarter	5.25E+00	1.12E-03	7.50E+00	7.82E-04
Quarter 3	CHILD	TBODY	5.84E-05	Quarter	5.25E+00	1.11E-03	7.50E+00	7.79E-04
Quarter 4	CHILD	TBODY	5.34E-04	Quarter	5.25E+00	1.02E-02	7.50E+00	7.12E-03
Annual	CHILD	TBODY	6.86E-04	Annual	1.05E+01	6.54E-03	1.50E+01	4.57E-03

Attachment 4.5(continued) – Combined 40CRF190 Report

GASEOUS RELEASE AND DOSE SUMMARY REPORT  
(Composite Critical Receptor - Limited Analysis)

Release ID.....: 1 All Gas Releases  
 Period Start Date....: 01/01/2014 00:00  
 Period End Date.....: 01/01/2015 00:00  
 Period Duration (min): 5.256E+05  
 Coefficient Type.....: Historical  
 Receptor.....: 5 Composite Crit. Receptor - IP  
 Distance (meters)....: 0.0  
 Compass Point.....: 0.0

=== 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
Strt->End	CHILD	BONE	7.40E-03	31-day	2.25E-01	3.29E+00	3.00E-01	2.47E+00
				Quarter	5.63E+00	1.32E-01	7.50E+00	9.87E-02
				Annual	1.13E+01	6.58E-02	1.50E+01	4.93E-02

Critical Pathway.....: 2 Vegetation (VEG)  
 Major Contributors.....: 0.0 % or greater to total

Nuclide	Percentage
H-3	0.00E+00
CO-60	1.08E+00
NI-63	9.32E+01
CS-137	5.65E+00

=== 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
Strt->End	CHILD	TBODY	6.86E-04	31-day	1.50E-01	4.57E-01	2.00E-01	3.43E-01
				Quarter	5.25E+00	1.31E-02	7.50E+00	9.15E-03
				Annual	1.05E+01	6.54E-03	1.50E+01	4.57E-03

Critical Pathway.....: 2 Vegetation (VEG)  
 Major Contributors.....: 0.0 % or greater to total

Nuclide	Percentage
H-3	3.95E+01
CO-60	1.24E+01
NI-63	3.42E+01
CS-137	1.39E+01

Attachment 4.5(continued) – Combined 40CRF190 Report

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

-----  
 COMBINED MAXIMUM ANNUAL DOSE SUMMARY  
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2014 Zion 40CFR190

Year.....: 2014  
 From Unit.....: 1  
 To Unit.....: 2  
 Liquid Receptor.....: 0 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	Limit	Percent of Limit
Quarter 1	CHILD	LIVER	3.54E-05	Quarter	6.25E+00	5.67E-04
Quarter 2	CHILD	BONE	4.17E-03	Quarter	6.25E+00	6.67E-02
Quarter 3	CHILD	BONE	1.36E-01	Quarter	6.25E+00	2.18E+00
Quarter 4	CHILD	BONE	1.54E-01	Quarter	6.25E+00	2.46E+00
Annual	CHILD	BONE	2.94E-01	Annual	2.50E+01	1.18E+00

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

Dose Period	Age Group	Organ	Dose (mrem)	Limit Period	Limit	Percent of Limit
Quarter 1	CHILD	TBODY	3.54E-05	Quarter	6.25E+00	5.67E-04
Quarter 2	CHILD	TBODY	2.95E-04	Quarter	6.25E+00	4.72E-03
Quarter 3	ADULT	TBODY	1.57E-02	Quarter	6.25E+00	2.51E-01
Quarter 4	CHILD	TBODY	5.34E-03	Quarter	6.25E+00	8.55E-02
Annual	ADULT	TBODY	2.00E-02	Annual	2.50E+01	8.00E-02

ZionSolutions LLC

ZS-2015-0055: Zion Station Radioactive Effluent Release Report for 2014

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Attachment 5 – Meteorological Data  
And Meteorological Data Appendix

**Annual Report  
on the  
Meteorological Monitoring Program  
at the  
Zion Nuclear Power Station  
2014**

*prepared for*

**Zion Solutions, LLC.**  
Zion, Illinois 60099

*by*

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**For Zion Solutions Use Only**

Reviewed By: 

Date: 3-21-15

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## 1. Introduction

The purpose of the meteorological program being conducted at the Zion Station site is to provide information sufficient to assess the local weather conditions and to determine the degree of atmospheric dispersion of airborne radioactive effluent from the station.

The meteorological tower is 250 ft. high and is instrumented at two levels. Wind speed and direction are measured at 35 ft. and 250 ft. Ambient temperature is measured at 35 ft. Differential temperature, referenced to 35 ft., is measured at 250 ft. Dew point temperature is measured approximately ten feet from the tower at an elevation of 5 ft. Precipitation is measured by a rain gauge located on the roof of the meteorological shelter building.

Joint frequency stability wind rose tables of wind direction, wind speed, and stability are routinely tabulated from hourly measurements. The quarterly and annual tables are included in this report.

Descriptions of the instruments and recorders are given in Section 3 (Data Acquisition) of this report. Data reduction and processing are described in Section 4 (Data Analysis). The results given in Section 5 of this report include modeled maximum whole body doses, skin doses, organ doses based upon airborne releases, and site meteorology.

## 2. Summary

The Zion Station meteorological monitoring program produced 52,350 hours of valid data out of a possible 52,560 parameter hours during 2014 (365 days x 24 hours/day x 6 measured priority parameters), which represents an overall data recovery rate of 99.6%. Priority parameters are all parameters except dew point temperature and precipitation.

The stability wind rose tables included in this report have been generated using the 35 ft. wind data with the 250-35 ft. differential temperature data.

The maximum annual calculated cumulative doses resulting from airborne releases were as follows.

### **Zion Generating Station:**

#### **Unit 1:**

gamma air dose	-	0.000 x 10 <sup>-0</sup> mrad
beta air dose	-	0.000 x 10 <sup>-0</sup> mrad
whole body dose	-	3.315 x 10 <sup>-4</sup> mrem
skin dose	-	2.203 x 10 <sup>-4</sup> mrem
organ (child bone)	-	3.129 x 10 <sup>-3</sup> mrem

#### **Unit 2:**

gamma air dose	-	0.000 x 10 <sup>-0</sup> mrad
beta air dose	-	0.000 x 10 <sup>-0</sup> mrad
whole body dose	-	3.315 x 10 <sup>-4</sup> mrem
skin dose	-	2.203 x 10 <sup>-4</sup> mrem
organ (child bone)	-	3.129 x 10 <sup>-3</sup> mrem

### 3. Data Acquisition

Wind speed is measured with Teledyne Geotech model 1564 sensors and wind direction is measured with Teledyne Geotech model 1565 sensors. The wind speed sensors have a starting speed of 0.63 mph (0.28 mps), a range of 0 to 100 mph (0 to 44.7 mps), and a system accuracy of  $\pm 1\%$ . The wind direction sensors have a threshold speed of 0.7 mph (0.31 mps), a range of 0 to 540°, and a system accuracy of  $\pm 5^\circ$ .

Ambient and differential temperatures are measured with RDF model 23789-4 sensors, and dew point temperature is measured with a Foxboro model 2781-18-CGN dewcell. Ambient temperature is measured within the range of -40 to 120°F (-40 to 48.9°C) with an accuracy of  $\pm 0.5^\circ\text{F}$  ( $\pm 0.3^\circ\text{C}$ ). Differential temperature is measured within the range of -10 to 30°F (-5.6 to 16.7°C) with an accuracy of  $\pm 0.18^\circ\text{F}$  ( $\pm 0.10^\circ\text{C}$ ), and dew point temperature is measured within the range of -40 to 120°F (-40 to 48.9°C) with an accuracy of  $\pm 2.7^\circ\text{F}$  ( $\pm 2.0^\circ\text{C}$ ). Precipitation is measured with a Climatronics model 100097 rain gauge. Precipitation is measured in increments of one one-hundredth of an inch with a system accuracy of  $\pm 0.01"$  ( $\pm 0.25\text{mm}$ ).

Instrument types and locations are summarized in Table 1.

The meteorological data are collected and stored by a Microtel 4.0 data acquisition system. The Microtel measures the analog voltages of the instruments and records the digital equivalent within the range of 0 to +1 volt. The Microtel has the capability of storing 24 hours of minute data and one week of hourly data. Data are obtained from the Microtel by a direct dial telephone hookup to an in-house computer system. Data are sampled every second.

As a backup to the Microtel, data are also recorded with a Johnson Yokogawa Corp. digital recorder (JYC DA100 data acquisition unit and Contec IPC-PT/M300(PC)WOU PC). Data are sampled every 10 seconds.

Data logger information is summarized in Table 2.

**Table 1***Instrument Locations*

<u>Measurement</u>	<u>Sensor Type</u>	<u>Location</u>	<u>Elevation</u>
Wind Speed	Teledyne Geotech 1564	Tower	250 ft.
Wind Direction	Teledyne Geotech 1565	Tower	250 ft.
Differential Temperature	RDF 23789-4	Tower	250 ft.
Wind Speed	Teledyne Geotech 1564	Tower	35 ft.
Wind Direction	Teledyne Geotech 1565	Tower	35 ft.
Ambient Temperature	RDF 23789-4	Tower	35 ft.
Precipitation	Climatronics 100097 Tipping Bucket	Meteorological shelter roof	10 ft.
Dew Point Temperature	Foxboro 2781-18-CGN	Instrument Shelter	5 ft.

**Table 2***Data Loggers*

<u>Measurement</u>	<u>Logger Type</u>	<u>Sampling Frequency</u>
Winds, Temperatures, and Precipitation	Microtel 4.0 data acquisition system	1 sec.
Winds, Temperatures, and Precipitation	Johnson Yokogawa Corp. Digital Recorder (JYC DA100 and Contec IPC-PT/M300(PC)WOU) digital recorder	10 sec.

#### 4. Data Analysis

The Zion Microtel is routinely interrogated to obtain hourly average data. The data are then stored in the meteorological data-base and listings of the data are generated. The data listings are examined by qualified personnel and any apparent problems are brought to the attention of the Project Manager or Meteorological Technician and the Instrument Maintenance staff.

Hourly values of wind speed, wind direction, ambient temperature, differential temperature, dew point temperature, and precipitation are obtained through measurements taken at the site. The standard deviation of wind direction ( $\sigma$ ) is derived. The wind direction variation is described in terms of the standard deviation of the direction about the mean direction. The Microtel computes an hourly value of wind  $\sigma$  by taking the Root-Mean-Square (RMS) of the four quarter-hour wind  $\sigma$  values. The quarter-hour wind  $\sigma$  values are calculated directly from the one second wind direction samples during the 15 minute period.

The data base files are edited approximately once a week. Missing Microtel values are replaced with recorder values, when available. Invalid data are deleted from the data-base.

When an hourly value is missing or invalid, the numeral 999 is entered into the computer data file in the appropriate location. When the wind direction changes substantially relative to its short term fluctuations, the numeral 888 can be entered into the wind sigma location to indicate shifting winds. When the wind blows with velocities near the sensing threshold of the instrument, the numeral 777 can be entered into the wind direction, wind speed, and wind sigma locations to indicate light and variable winds.

A professional meteorologist reviews the data, calibration findings, equipment maintenance reports, and other information and determines which data are valid. Only the valid data are retained in the data base.

As a quality control measure, a monthly comparison is made of Microtel and digital recorder data. An investigation is made into the reasons for any significant differences between the sets of values.

Joint frequency stability wind rose tables of hourly data measured at the site are generated. These tables indicate the prevailing wind direction, wind speed, and stability classes measured during the period of observation as well as the joint frequencies of occurrence of the wind direction, wind speed, and stability classes. The values are also used as input to the atmospheric transport and diffusion models. Wind direction, wind speed, and stability classes are given in Tables 3, 4, and 5.

**Table 3**Wind Direction Classes

IF	348.75°	<	WD	<	11.25°	THEN	Class is	N
IF	11.25°	<	WD	<	33.75°	THEN	Class is	NNE
IF	33.75°	<	WD	<	56.25°	THEN	Class is	NE
IF	56.25°	<	WD	<	78.75°	THEN	Class is	ENE
IF	78.75°	<	WD	<	101.25°	THEN	Class is	E
IF	101.25°	<	WD	<	123.75°	THEN	Class is	ESE
IF	123.75°	<	WD	<	146.25°	THEN	Class is	SE
IF	146.25°	<	WD	<	168.75°	THEN	Class is	SSE
IF	168.75°	<	WD	<	191.25°	THEN	Class is	S
IF	191.25°	<	WD	<	213.75°	THEN	Class is	SSW
IF	213.75°	<	WD	<	236.25°	THEN	Class is	SW
IF	236.25°	<	WD	<	258.75°	THEN	Class is	WSW
IF	258.75°	<	WD	<	281.25°	THEN	Class is	W
IF	281.25°	<	WD	<	303.75°	THEN	Class is	WNW
IF	303.75°	<	WD	<	326.25°	THEN	Class is	NW
IF	326.25°	<	WD	<	348.75°	THEN	Class is	NNW

**Table 4**Wind Speed Classes

IF	0.0 mph	<	WS	<	0.7 mph	THEN	Class is	1
IF	0.7 mph	<	WS	<	3.5 mph	THEN	Class is	2
IF	3.5 mph	<	WS	<	7.5 mph	THEN	Class is	3
IF	7.5 mph	<	WS	<	12.5 mph	THEN	Class is	4
IF	12.5 mph	<	WS	<	18.5 mph	THEN	Class is	5
IF	18.5 mph	<	WS	<	24.5 mph	THEN	Class is	6
IF	24.5 mph	<	WS	<		THEN	Class is	7



**Table 5****Atmospheric Stability Classes**

<b>Class</b>	<b>Differential Temperature Interval (in °C/100m) <sup>(1)</sup></b>	<b>Differential Temperature Interval (in °F over the 250-35 ft. interval) <sup>(2)</sup></b>
Extremely Unstable	$\Delta T \leq -1.9$	$\Delta T \leq -2.3$
Moderately Unstable	$-1.9 < \Delta T \leq -1.7$	$-2.3 < \Delta T \leq -2.1$
Slightly Unstable	$-1.7 < \Delta T \leq -1.5$	$-2.1 < \Delta T \leq -1.8$
Neutral	$-1.5 < \Delta T \leq -0.5$	$-1.8 < \Delta T \leq -0.6$
Slightly Stable	$-0.5 < \Delta T \leq 1.5$	$-0.6 < \Delta T \leq 1.7$
Moderately Stable	$1.5 < \Delta T \leq 4.0$	$1.7 < \Delta T \leq 4.7$
Extremely Stable	$4.0 < \Delta T$	$4.7 < \Delta T$

<sup>(1)</sup> from ANSI/ANS 2.5

<sup>(2)</sup> ANSI/ANS 2.5 intervals scaled for instrument heights on the Zion meteorological tower

The following two programs were used to calculate doses resulting from radioactive releases:

1. **XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations (NUREG/CR-2919).**

The program is based on the theory that material released to the atmosphere will be normally distributed (Gaussian) about the plume centerline. A straight-line trajectory is assumed between the point of release and all receptors.

The program implements the assumptions outlined in Section C of NRC Regulatory Guide 1.111. In evaluating routine releases from nuclear power plants, it primarily is designed to calculate annual relative effluent concentrations, X/Q values and annual average relative deposition, D/Q values.

Output from the XOQDOQ program is used as input to the GASPAR program.

2. **GASPAR II: A Code System for Evaluation of Radiological Impacts Due to the Release of Radioactive Material to the Atmosphere During Normal Operation of Light Water Reactors (NUREG-0597).**

GASPAR is a program written for the evaluation of radiological impacts due to the release of radioactive material to the atmosphere during normal operation of reactors. The GASPAR code implements the radiological impact models of NRC Regulatory Guide 1.109, Revision 1, for atmospheric releases. The program is used to estimate the maximum individual doses at selected locations in the vicinity of the plant.

## 5. Results

### 5.1 Instrument Maintenance

The maintenance program followed during 2014 was composed of routinely scheduled visits and equipment repairs. Routine site visits were made to inspect the sensing and recording systems for proper operation. In addition, routine maintenance and calibration checks of all tower-mounted and ground level equipment were performed every 4 months. A description of the calibration and field procedures is found in the Murray and Trettel, Inc. "P1009 Procedures Manual" (October 2013).

In February, a malfunctioning rain gauge was repaired. Also in February, an obstruction light on the tower was replaced.

In March, the 35 ft. wind speed sensor was replaced due to bad readings.

In April, the 250 ft. wind direction wind vane was replaced due to damage.

In May, the 250 ft. wind direction sensor and signal conditioning card were replaced due to suspected bad readings. The removed sensor was later bench tested and was found to be in proper working order. Also in May, the annual tower inspection was performed.

In June, new mounting brackets for the temperature assemblies were installed. This was preventative maintenance due to bracket failures seen at other sites.

In October, bad readings on the 250 ft. wind direction were investigated. The cross arm was replaced due to a stripped out set screw. The wind direction sensor was also replaced. The bad readings caused some data loss.

In November, a damaged heat lamp assembly at the 250 ft. level was replaced.

No other significant problems were encountered with the equipment, and at the end of the year, no problems were evident at the site.

## 5.2 Data Recovery

The record of data recovery for the year is summarized in Table 6.

**Table 6**

Zion Site  
Data Recovery Summary  
2014

<u>Measurement</u>	<u>Elevation</u>	<u>Recovered Hours</u>	<u>Recovered Percent</u>	<u>Lost Hours</u>	<u>Percent Changed</u>
Wind Speed	35 ft.	8737	99.7	26	0.3
Wind Speed	250 ft.	8731	99.7	29	0.3
Wind Direction	35 ft.	8748	99.9	12	0.7
Wind Direction	250 ft.	8638	98.6	122	1.5
Ambient Temperature	35 ft.	8748	99.9	12	0.1
Differential Temperature	250-33 ft.	8748	99.9	12	0.5
Dew Point Temperature	5 ft.	8712	99.5	48	6.3
Precipitation	10 ft.	8660	98.9	100	1.4
<b>AVERAGE *</b>			<b>99.6</b>		

\* average of priority parameters (all except dew point temperature and precipitation)

	<u>Valid Hours</u>	<u>Recovered Percent</u>	<u>Lost Hours</u>
Lower Level Joint Frequency %	8734	99.7	26
Upper Level Joint Frequency %	8624	98.4	136

5.3 Summary of Billings for Equipment Repairs, Replacement Parts, and Other Work not Included in Fixed-Cost Maintenance Agreement - 2014

<u>Description - Zion</u>	<u>Cost</u>
<u>January</u>	
Meteorological equipment maintenance	\$ 556.90
<u>February</u>	
Meteorological parts, materials, and contractor services	278.70
Meteorological equipment maintenance	700.85
<u>March</u>	
-none-	0.00
<u>April</u>	
Meteorological equipment maintenance	1,995.10
Meteorological parts, materials, and contractor services	0.00
2014-2014 Heat Lamp Activation	318.60
<u>May</u>	
Meteorological equipment maintenance	1,272.00
<u>June</u>	
Meteorological equipment maintenance	420.00
<u>July</u>	
Meteorological parts, materials, and contractor services	18.65
<u>August</u>	
-none-	0.00
<u>September</u>	
Meteorological parts, materials, and contractor services	300.68
<u>October</u>	
Meteorological equipment maintenance	954.70
Meteorological parts, materials, and contractor services	0.00
<u>November</u>	
Meteorological equipment maintenance	804.70
Meteorological parts, materials, and contractor services	0.00
<u>December</u>	
Meteorological parts, materials, and contractor services	851.14
<b>Annual Total: \$ 8,472.02</b>	

#### 5.4 Stability Wind Rose Data

The quarterly and annual stability wind roses are given in Tables 7 through 11. Wind speed classes have been altered to reflect the wind sensor threshold.

For the year, winds measured at 35 ft. most frequently came from the West (11.98%) and fell into the 3.6-7.5 mph wind speed class (39.11%). Calms (wind speeds at or below the sensor threshold) were measured 0.06% of the time and speeds greater than 24.5 mph were measured 0.01% of the time.

Stability based on the 250-35 ft. differential temperature most frequently fell into the neutral classification (43.74%).

**TABLE 7**

Zion Nuclear Station  
35 ft. Wind Speed and Direction

January-March, 2014  
250Ft-33Ft Delta-T (F)

Number of Observations = 2154  
Values are Percent Occurrence

SPEED CLASS	WIND DIRECTION CLASSES																STABILITY CLASSES								
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	EU	MU	SU	N	SS	MS	ES	TOTAL
EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
																									0.00
EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 SU	0.00	0.00	0.05	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- N	0.00	0.05	0.09	0.05	0.05	0.00	0.05	0.05	0.23	0.32	0.23	0.09	0.23	0.19	0.14	0.05	1.81			1.81					
3 SS	0.00	0.00	0.09	0.00	0.00	0.00	0.05	0.05	0.14	0.00	0.28	0.37	0.23	0.60	0.28	0.14	2.23			2.23					
MS	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.05	0.09	0.23	0.23	0.09	0.05	0.05	0.97			0.97					
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.05	0.00	0.00	0.00	0.32	0.09	0.00	0.00	0.56							0.56	5.65
EU	0.00	0.00	0.05	0.00	0.00	0.00	0.19	0.05	0.00	0.00	0.09	0.14	0.05	0.05	0.00	0.00	0.60	0.60							
MU	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.05	0.09	0.05	0.09	0.00	0.42	0.42							
4 SU	0.09	0.28	0.05	0.00	0.09	0.14	0.09	0.09	0.05	0.23	0.23	0.32	0.14	0.37	0.19	0.09	2.46			2.46					
- N	0.19	0.37	0.19	0.14	0.14	0.19	0.14	0.46	0.97	1.86	1.16	1.53	1.90	1.72	1.67	0.42	13.05			13.05					
7 SS	0.19	0.05	0.05	0.05	0.09	0.19	0.05	0.32	0.88	0.70	0.56	0.93	1.44	1.72	1.16	0.37	8.73			8.73					
MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.42	0.09	0.28	0.32	0.60	0.74	0.09	0.00	2.60			2.60					
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.05	0.05	0.09	0.60	0.56	0.00	0.00	1.53							1.53	29.39
EU	0.00	0.37	0.37	0.19	0.00	0.00	0.32	0.32	0.00	0.00	0.19	0.97	1.02	1.02	1.02	0.19	5.99	5.99							
MU	0.05	0.09	0.05	0.05	0.00	0.00	0.09	0.09	0.00	0.14	0.09	0.42	0.14	0.37	0.46	0.23	2.27	2.27							
8 SU	0.05	0.19	0.09	0.05	0.00	0.05	0.05	0.32	0.09	0.32	0.23	0.46	0.19	0.32	0.56	0.14	3.11			3.11					
- N	0.88	1.39	0.65	0.28	0.23	0.37	0.23	1.72	1.16	1.16	2.00	2.92	5.43	3.20	1.86	2.46	25.95			25.95					
1 SS	0.14	0.23	0.05	0.00	0.23	0.14	0.05	0.23	0.51	0.65	0.19	0.42	0.65	0.46	0.46	0.00	4.41			4.41					
2 MS	0.00	0.00	0.00	0.00	0.05	0.05	0.00	0.14	0.28	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.56			0.56					
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05							0.05	42.34
EU	0.14	0.23	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.42	0.46	0.23	0.32	0.00	2.27	2.27							
1 MU	0.14	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.14	0.23	0.23	0.14	0.05	0.00	1.02	1.02							
3 SU	0.19	0.09	0.23	0.14	0.00	0.00	0.00	0.14	0.05	0.23	0.19	0.14	0.19	0.05	0.19	0.00	1.81			1.81					
- N	0.42	0.93	1.30	0.09	0.23	0.05	0.09	1.30	0.79	2.37	1.58	1.16	1.16	0.97	0.70	0.65	13.79			13.79					
1 SS	0.00	0.00	0.00	0.00	0.05	0.05	0.00	0.05	0.09	0.09	0.32	0.00	0.00	0.00	0.00	0.00	0.65			0.65					
8 MS	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.19	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32			0.32					
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14							0.14	20.01

**TABLE 7**  
continued

Zion Nuclear Station  
35 ft. Wind Speed and Direction

January-March, 2014  
250Ft-33Ft Delta-T (F)

SPEED CLASS	WIND DIRECTION CLASSES																STABILITY CLASSES								
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	EU	MU	SU	N	SS	MS	ES	TOTAL
EU	0.05	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.37	0.37								
1 MU	0.05	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.19	0.19								
9 SU	0.05	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.09	0.00	0.00	0.00	0.32			0.32						
- N	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.09	0.65	0.19	0.00	0.00	0.00	1.58				1.58					
2 SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00				
4 MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09						0.09			
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00		
																									2.55
EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00								
G MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00						
T SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00					
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.05					0.05				
2 SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00			
4 MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00		
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00								0.00	
																									0.05
TOT	2.79	4.41	3.62	1.02	1.16	1.30	1.44	6.27	6.27	8.40	9.05	11.88	15.32	13.00	9.29	4.78	100.00	9.24	3.90	7.80	56.22	16.02	4.55	2.27	100.00

Wind Direction by Stability

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	-STABILITY CLASSES-
0.19	0.60	0.65	0.19	0.00	0.00	0.51	0.37	0.00	0.00	0.56	1.81	1.53	1.30	1.35	0.19	9.24	Extremely Unstable
0.23	0.19	0.09	0.05	0.00	0.00	0.09	0.14	0.00	0.19	0.28	0.79	0.46	0.56	0.60	0.23	3.90	Moderately Unstable
0.37	0.56	0.46	0.19	0.09	0.19	0.19	0.56	0.19	0.79	0.79	1.02	0.51	0.74	0.93	0.23	7.80	Slightly Unstable
1.67	2.74	2.23	0.56	0.65	0.60	0.51	3.99	3.16	5.80	5.66	5.90	8.73	6.08	4.36	3.57	56.22	Neutral
0.32	0.28	0.19	0.05	0.37	0.37	0.14	0.65	1.62	1.44	1.35	1.72	2.32	2.79	1.90	0.51	16.02	Slightly Stable
0.00	0.05	0.00	0.00	0.05	0.14	0.00	0.46	0.88	0.14	0.37	0.56	0.84	0.88	0.14	0.05	4.55	Moderately Stable
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.42	0.05	0.05	0.09	0.93	0.65	0.00	0.00	2.27	Extremely Stable

Wind Direction by Wind Speed

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	-WIND SPEED CLASSES-
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	CALM
0.00	0.09	0.23	0.05	0.05	0.00	0.14	0.19	0.56	0.37	0.60	0.70	1.02	0.97	0.46	0.23	5.66	< 3.5 mph
0.46	0.74	0.32	0.19	0.32	0.51	0.46	1.02	2.51	2.92	2.41	3.39	4.83	5.20	3.20	0.88	29.39	3.6 - 7.5 mph
1.11	2.27	1.21	0.56	0.51	0.60	0.74	2.83	2.09	2.27	2.69	5.20	7.43	5.43	4.36	3.02	42.34	7.6 - 12.5 mph
0.88	1.30	1.72	0.23	0.28	0.19	0.09	1.67	1.11	2.74	2.51	1.95	2.04	1.39	1.25	0.65	20.01	12.6 - 18.5 mph
0.32	0.00	0.14	0.00	0.00	0.00	0.00	0.56	0.00	0.09	0.79	0.65	0.00	0.00	0.00	0.00	2.55	18.6 - 24.5 mph
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05	> 24.5 mph



**TABLE 8**

Zion Nuclear Station  
35 ft. Wind Speed and Direction

April-June, 2014  
250Ft-33Ft Delta-T (F)

Number of Observations = 2169  
Values are Percent Occurrence

SPEED CLASS	WIND DIRECTION CLASSES															TOTAL	STABILITY CLASSES							TOTAL
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW		NNW	EU	MU	SU	N	SS	MS	
C	0.00																	0.00	0.00					0.00
A	0.00																	0.00	0.00					0.00
L	0.00																	0.00	0.00					0.00
M	0.00																	0.00	0.00					0.00
E	0.00																	0.00	0.00					0.00
1	0.00																	0.00	0.00					0.00
- N	0.00																	0.00	0.00					0.00
3	0.00																	0.00	0.00					0.00
M	0.00																	0.00	0.00					0.00
E	0.00																	0.00	0.00					0.00
4	0.00																	0.00	0.00					0.00
- N	0.00																	0.00	0.00					0.00
7	0.00																	0.00	0.00					0.00
M	0.00																	0.00	0.00					0.00
E	0.00																	0.00	0.00					0.00
8	0.00																	0.00	0.00					0.00
- N	0.00																	0.00	0.00					0.00
1	0.00																	0.00	0.00					0.00
2	0.00																	0.00	0.00					0.00
E	0.00																	0.00	0.00					0.00
3	0.00																	0.00	0.00					0.00
- N	0.00																	0.00	0.00					0.00
1	0.00																	0.00	0.00					0.00
6	0.00																	0.00	0.00					0.00
E	0.00																	0.00	0.00					0.00
C																						0.18		
1																						14.48		
4																						40.62		
8																						34.81		
3																						9.41		

**TABLE 8**  
continued

Zion Nuclear Station  
35 ft. Wind Speed and Direction

April-June, 2014  
250Ft-33Ft Delta-T (F)

SPEED CLASS	WIND DIRECTION CLASSES																TOTAL	STABILITY CLASSES							TOTAL	
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		EU	MU	SU	N	SS	MS	ES		
EU	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05								
1 MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
9 SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
- N	0.14	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23			0.23						
2 SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05				0.05					
4 MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00				
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00			
																										0.32
EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
6 MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
T SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00					
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00					
2 SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00				
4 MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00			
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00			
																										0.00
TOT	10.42	10.70	7.75	4.66	4.15	3.09	5.03	9.31	10.05	6.09	5.31	6.27	5.49	3.60	3.78	3.46	99.82	11.25	3.69	5.39	31.95	23.79	14.80	8.94	99.82	

Wind Direction by Stability

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	-STABILITY CLASSES-
0.51	2.12	1.48	0.18	0.18	0.14	0.32	0.14	0.00	0.18	1.48	1.80	1.20	0.65	0.65	0.23	11.25	Extremely Unstable
0.28	0.55	0.46	0.14	0.18	0.09	0.28	0.00	0.05	0.09	0.23	0.46	0.55	0.28	0.00	0.05	3.69	Moderately Unstable
1.11	1.06	0.28	0.18	0.28	0.05	0.14	0.32	0.00	0.09	0.28	0.69	0.28	0.14	0.18	0.32	5.39	Slightly Unstable
5.21	4.43	2.95	1.98	1.75	1.01	0.97	1.89	1.29	1.75	1.98	1.61	1.57	0.97	1.24	1.34	31.95	Neutral
2.12	1.80	1.43	1.11	0.65	0.88	1.71	2.81	3.37	2.17	1.20	0.83	0.78	0.97	0.97	0.92	23.79	Slightly Stable
0.97	0.69	0.78	0.83	0.69	0.65	1.06	2.21	3.18	1.20	0.41	0.37	0.41	0.37	0.46	0.46	14.80	Moderately Stable
0.23	0.05	0.37	0.23	0.41	0.28	0.55	1.94	2.17	0.60	0.23	0.51	0.69	0.23	0.28	0.14	8.94	Extremely Stable

Wind Direction by Wind Speed

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	-WIND SPEED CLASSES-
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	C A L M
0.78	1.01	1.29	0.83	0.97	0.83	0.78	0.74	1.01	1.24	0.60	0.83	0.88	0.83	1.06	0.78	14.48	< 3.5 mph
3.60	4.47	3.46	1.98	2.07	1.48	2.90	3.37	4.93	2.63	1.57	1.80	1.80	1.34	1.61	1.61	40.62	3.6 - 7.5 mph
4.75	4.43	2.58	1.06	0.60	0.65	1.29	3.92	3.92	1.80	2.31	2.58	2.07	0.92	1.06	0.88	34.81	7.6 - 12.5 mph
1.11	0.78	0.41	0.78	0.46	0.14	0.05	1.24	0.14	0.41	1.34	1.06	0.74	0.51	0.05	0.18	9.41	12.6 - 18.5 mph
0.18	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	18.6 - 24.5 mph
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	> 24.5 mph



**TABLE 9**  
continued

Zion Nuclear Station  
35 ft. Wind Speed and Direction

July-September, 2014  
250Ft-23Ft Delta-T (F)

SPEED CLASS	WIND DIRECTION CLASSES																STABILITY CLASSES								
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	EU	MU	SU	N	SS	MS	ES	TOTAL
EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
1 MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.14
9 SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00
- N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00
2 SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14							0.14	
4 MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00	
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00	
																									0.14
EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
6 MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00
T SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00
2 SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00
4 MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00
																									0.00
TOT	5.72	6.44	4.81	3.27	3.54	3.95	4.54	7.40	8.35	6.58	10.03	9.26	9.44	5.49	5.72	5.40	99.95	17.70	5.04	7.26	29.54	19.60	14.07	6.76	99.95

Wind Direction by Stability

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	-STABILITY CLASSES-
0.77	2.13	2.72	1.54	1.23	1.41	1.50	0.77	0.09	0.23	0.91	1.41	2.04	0.64	0.27	0.05	17.70	Extremely Unstable
0.45	0.32	0.27	0.23	0.27	0.54	0.23	0.45	0.00	0.27	0.59	0.27	0.54	0.14	0.36	0.09	5.04	Moderately Unstable
0.77	0.73	0.32	0.09	0.32	0.27	0.64	1.32	0.32	0.09	0.59	0.54	0.41	0.18	0.23	0.45	7.26	Slightly Unstable
2.22	2.27	1.04	1.13	1.50	1.23	1.36	3.18	2.09	0.91	3.31	1.41	1.63	1.32	2.27	2.68	29.54	Neutral
1.13	0.91	0.41	0.18	0.18	0.32	0.59	1.54	3.99	2.04	1.50	1.68	1.59	1.32	0.86	1.36	19.60	Slightly Stable
0.32	0.09	0.05	0.09	0.05	0.18	0.18	0.14	1.72	2.59	2.00	2.04	1.59	0.86	1.50	0.64	14.07	Moderately Stable
0.05	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.14	0.45	1.13	1.91	1.63	1.04	0.23	0.14	6.76	Extremely Stable

Wind Direction by Wind Speed

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	-WIND SPEED CLASSES-	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	C A L M	
1.09	0.91	0.68	0.50	0.45	0.91	0.45	0.73	1.41	3.36	2.99	2.86	2.81	1.91	1.59	1.54	24.18	< 3.5 mph	
2.00	2.99	3.40	2.50	2.77	2.68	3.72	2.59	5.31	1.95	3.31	4.45	4.49	2.54	2.59	2.22	49.50	3.6 - 7.5 mph	
2.04	2.18	0.73	0.27	0.32	0.36	0.36	3.54	1.63	1.23	3.18	1.72	2.09	1.00	1.36	1.59	23.59	7.6 - 12.5 mph	
0.59	0.36	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.05	0.54	0.23	0.05	0.05	0.18	0.05	2.50	12.6 - 18.5 mph	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	18.6 - 24.5 mph	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		> 24.5 mph







**TABLE 11**  
continued

Zion Nuclear Station  
35 ft. Wind Speed and Direction

January-December, 2014  
250Ft-33Ft Delta-T (F)

SPEED		WIND DIRECTION CLASSES														STABILITY CLASSES									
CLASS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	EU	MU	SU	N	SS	MS	ES	TOTAL
EU	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.10	0.10							
1 MU	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.05		0.05						
9 SU	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.01	0.09			0.09					
- N	0.10	0.02	0.00	0.00	0.01	0.00	0.00	0.16	0.00	0.02	0.16	0.05	0.00	0.00	0.00	0.07	0.60				0.60				
2 SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05					0.05			
4 MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02						0.02		
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	
																									0.91
EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
6 MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
T SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01				0.01				
2 SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
4 MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	
																									0.01
TOT	5.74	5.84	4.31	2.39	2.42	2.46	3.30	7.73	8.05	7.45	8.57	9.68	11.98	8.31	6.90	4.75	99.94	11.31	4.25	7.05	43.74	19.22	9.16	5.21	99.94

Wind Direction by Stability

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	-STABILITY CLASSES-
0.39	1.33	1.28	0.50	0.40	0.49	0.71	0.38	0.05	0.15	0.82	1.52	1.72	0.76	0.08	0.13	11.31	Extremely Unstable
0.31	0.30	0.21	0.11	0.11	0.18	0.16	0.23	0.05	0.24	0.48	0.47	0.65	0.36	0.26	0.13	4.25	Moderately Unstable
0.70	0.61	0.27	0.11	0.17	0.15	0.25	0.64	0.24	0.37	0.68	0.81	0.76	0.54	0.45	0.30	7.05	Slightly Unstable
3.02	2.55	1.67	1.01	1.12	0.88	1.02	3.55	2.62	3.47	3.86	3.52	5.17	3.75	3.53	2.99	43.74	Neutral
0.93	0.84	0.57	0.37	0.31	0.44	0.69	1.71	2.83	1.88	1.55	1.64	1.76	1.65	1.20	0.85	19.22	Slightly Stable
0.22	0.21	0.21	0.23	0.19	0.25	0.32	0.72	1.59	1.05	0.79	0.84	0.86	0.64	0.62	0.30	9.16	Moderately Stable
0.07	0.01	0.09	0.06	0.10	0.07	0.15	0.50	0.68	0.29	0.39	0.88	1.07	0.62	0.16	0.07	5.21	Extremely Stable

Wind Direction by Wind Speed

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	-WIND SPEED CLASSES-
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	C A L M
0.49	0.53	0.57	0.37	0.38	0.48	0.40	0.47	0.87	1.45	1.27	1.44	1.70	1.24	1.08	0.72	13.46	< 3.5 mph
1.79	2.27	1.91	1.23	1.37	1.34	2.04	2.06	4.11	2.50	2.65	3.55	4.10	3.44	3.01	1.73	39.11	3.6 - 7.5 mph
2.42	2.37	1.25	0.52	0.46	0.56	0.82	3.71	2.73	2.49	3.06	3.38	4.80	3.04	2.30	1.89	35.79	7.6 - 12.5 mph
0.89	0.65	0.54	0.29	0.19	0.08	0.03	1.27	0.23	0.99	1.39	1.13	1.39	0.60	0.50	0.33	10.61	12.6 - 18.5 mph
0.15	0.02	0.03	0.00	0.01	0.00	0.00	0.22	0.01	0.02	0.19	0.16	0.00	0.00	0.00	0.08	0.91	18.6 - 24.5 mph
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	> 24.5 mph



## 5.5 Precipitation

Monthly totals and the maximum 24-hour and maximum 1-hour precipitation amounts are summarized below. The month with the most measured precipitation was June\*. The month with the least measured precipitation was December. The maximum 24-hour total was 1.98" (May) and the maximum 1-hour total was 1.09" (May).

**Table 12**  
**Precipitation Totals (Inches) - 2014**  
**Zion Site**

<u>Month</u>	<u>Total</u>	<u>Maximum 24-hour</u>	<u>Maximum 1-hour</u>
January	1.19*	0.80*	0.19*
February	2.08*	1.57*	0.40*
March	0.97*	0.34*	0.10*
April	3.79	0.95	0.40
May	5.79	1.98	1.09
June	5.81*	1.64*	0.39*
July	1.62	0.57	0.33
August	4.10	1.76	1.00
September	4.01*	1.38*	0.77*
October	3.33	1.22	0.44
November	1.30*	0.83*	0.13*
December	0.54	0.28	0.07
<b>TOTAL:</b>	<b>34.53*</b>		

\* some data are missing – actual precipitation may be under-reported

## 5.6 Doses Resulting from Airborne Releases

The following are the maximum annual calculated cumulative offsite doses resulting from Zion Generating Station airborne releases.

### Zion Generating Station:

#### Unit 1

<u>Dose</u>	<u>Maximum Value</u>	<u>Sector Affected</u>
gamma air <sup>(1)</sup>	0.000 x 10 <sup>-0</sup> mrad	-
beta air <sup>(2)</sup>	0.000 x 10 <sup>-0</sup> mrad	-
whole body <sup>(3)</sup>	3.315 x 10 <sup>-4</sup> mrem	East
skin <sup>(4)</sup>	2.203 x 10 <sup>-4</sup> mrem	East
organ <sup>(5)</sup> (child bone)	3.129 x 10 <sup>-3</sup> mrem	East

#### Unit 2

<u>Dose</u>	<u>Maximum Value</u>	<u>Sector Affected</u>
gamma air <sup>(1)</sup>	0.000 x 10 <sup>-0</sup> mrad	-
beta air <sup>(2)</sup>	0.000 x 10 <sup>-0</sup> mrad	-
whole body <sup>(3)</sup>	3.315 x 10 <sup>-4</sup> mrem	East
skin <sup>(4)</sup>	2.203 x 10 <sup>-4</sup> mrem	East
organ <sup>(5)</sup> (child bone)	3.129 x 10 <sup>-3</sup> mrem	East

- 
- (1) Gamma Air Dose - GASPAR II, NUREG-0597  
 (2) Beta Air Dose - GASPAR II, NUREG-0597  
 (3) Whole Body Dose - GASPAR II, NUREG-0597  
 (4) Skin Dose - GASPAR II, NUREG-0597  
 (5) Inhalation and Food Pathways Dose - GASPAR II, NUREG-0597

# APPENDIX

# Zion Meteorological Calibration

Date: 2-22-14

## POWER SUPPLIES

$+12.000V \pm 0.120V$	$-12.000V \pm 0.120V$
A: <u>+12.035</u> V	A: <u>-12.045</u> V
B: <u>+12.050</u> V	B: <u>-12.004</u> V

### Signal conditioners and Digital Recorder:

	Signal Conditioner Voltage Out			Digital recorder		Specifications
	AF	AL	AL EQUIV	AF	AL	
	<u>5 ft.</u>					
DP LO	<u>-.015</u> V	<u>-</u> V	<u>-42.4</u> °	<u>-42.43</u> °	<u>-</u> °	AL EQUIV $\pm 0.1^\circ F$
DP HI	<u>.982</u> V	<u>-</u> V	<u>117.12</u> °	<u>117.10</u> °	<u>-</u> °	AL EQUIV $\pm 0.1^\circ F$
DP HI-LO	<u>.997</u> V	<u>-</u> V				1.000V $\pm 0.025V$
	<u>10 ft.</u>					
PRCP LO	<u>.000</u> V	<u>.000</u> V	<u>0.00</u> "	<u>0.00</u> "	<u>-</u> "	0.000V $\pm 0.050V$ AL EQUIV $\pm 0.01"$
PRCP HI	<u>1.007</u> V	<u>1.000</u> V	<u>1.00</u> "	<u>1.00</u> "	<u>-</u> "	1.000V $\pm 0.050V$ AL EQUIV $\pm 0.01"$
	<u>35 ft.</u>					
WS LO	<u>.006</u> V	<u>-</u> V	<u>0.6</u> mph	<u>0.6</u> mph	<u>-</u> mph	0.006V $\pm 0.005V$ AL EQUIV $\pm 0.1$ mph
WS HI	<u>.298</u> V	<u>.300</u> V	<u>30.0</u> mph	<u>30.0</u> mph	<u>-</u> mph	0.300V $\pm 0.005V$ AL EQUIV $\pm 0.1$ mph
WD LO	<u>.001</u> V	<u>-</u> V	<u>.54</u> °	<u>1</u> °	<u>-</u> °	0.000V $\pm 0.005V$ AL EQUIV $\pm 1^\circ$
WD HI	<u>.998</u> V	<u>1.000</u> V	<u>540</u> °	<u>540</u> °	<u>-</u> °	1.000V $\pm 0.005V$ AL EQUIV $\pm 1^\circ$
T LO	<u>.168</u> V	<u>-</u> V	<u>-13.12</u> °	<u>-13.20</u> °	<u>-</u> °	AL EQUIV $\pm 0.1^\circ F$
THI	<u>.948</u> V	<u>-</u> V	<u>111.68</u> °	<u>111.72</u> °	<u>-</u> °	AL EQUIV $\pm 0.1^\circ F$
THI-LO	<u>.780</u> V	<u>-</u> V				0.781V $\pm 0.002V$
	<u>250 ft.</u>					
WS LO	<u>.006</u> V	<u>-</u> V	<u>0.6</u> mph	<u>0.6</u> mph	<u>-</u> mph	0.006V $\pm 0.005V$ AL EQUIV $\pm 0.1$ mph
WS HI	<u>.297</u> V	<u>.300</u> V	<u>30.0</u> mph	<u>30.0</u> mph	<u>-</u> mph	0.300V $\pm 0.005V$ AL EQUIV $\pm 0.1$ mph
WD LO	<u>.001</u> V	<u>-</u> V	<u>.54</u> °	<u>1</u> °	<u>-</u> °	0.000V $\pm 0.005V$ AL EQUIV $\pm 1^\circ$
WD HI	<u>1.000</u> V	<u>-</u> V	<u>540</u> °	<u>540</u> °	<u>-</u> °	1.000V $\pm 0.005V$ AL EQUIV $\pm 1^\circ$
T LO	<u>.158</u> V	<u>-</u> V	<u>-14.72</u> °	<u>-14.67</u> °	<u>-</u> °	AL EQUIV $\pm 0.1^\circ F$
THI	<u>.939</u> V	<u>-</u> V	<u>110.24</u> °	<u>110.30</u> °	<u>-</u> °	AL EQUIV $\pm 0.1^\circ F$
THI-LO	<u>.781</u> V	<u>-</u> V				0.781V $\pm 0.002V$
↑ ZERO	<u>.000</u> V	<u>-</u> V	<u>-10.00</u> °	<u>-10.00</u> °	<u>-</u> °	0.000V $\pm 0.010V$ AL EQUIV $\pm 0.1^\circ F$
ΔT SPAN	<u>.501</u> V	<u>-</u> V	<u>10.04</u> °	<u>10.02</u> °	<u>-</u> °	0.500V $\pm 0.010V$ AL EQUIV $\pm 0.1^\circ F$
ΔT MID	<u>.251</u> V	<u>-</u> V	<u>.04</u> °			0.250V $\pm 0.005$

ADJ 3-5-14

### Zion Meteorological Calibration

Date: 2-22-14

**Dates of Last Wind Sensor Bearing Replacements:**

		<u>35 ft.</u>	<u>250 ft.</u>
(6 mos.)	Wind Speed:	<u>10-28-13</u>	<u>10-28-13</u>
(12 mos.)	Wind Direction:	<u>12-23-13</u>	<u>6-28-13</u>

**TOWER MEASUREMENTS**

Ambient     Ice Bath

Temperatures

	<u>35 ft. Amb.</u>		<u>250 ft. ΔT</u>		<u>5 ft. dew point</u>	
	AF	AL	AF	AL	AF	AL
Measured	<u>27.40</u> °F	<u>-</u> °F	<u>-2.00</u> °F	<u>-</u> °F	<u>6.0</u> °F	<u>-</u> °F
Recorded	<u>27.44</u> °F	<u>-</u> °F	<u>-2.12</u> °F	<u>-</u> °F	<u>8.0</u> °F	<u>-</u> °F
Difference	<u>0.04</u> °F	<u>-</u> °F	<u>0.12</u> °F	<u>-</u> °F	<u>2.0</u> °F	<u>-</u> °F
Specification	±0.5°F		±0.18°F		±2.7°F	

Winds

	<u>35 ft.</u>		<u>250 ft.</u>		<u>Specification</u>
	AF	AL	AF	AL	
WS stall	<u>0.6</u> mph	<u>-</u> mph	<u>0.6</u> mph	<u>-</u> mph	0.6mph ± 0.45mph
Forw. WD	<u>149</u> °	<u>-</u> °	<u>148</u> °	<u>-</u> °	150°/510° ± 5°
Revr. WD	<u>327</u> °	<u>-</u> °	<u>328</u> °	<u>-</u> °	330° ± 5°
Tracking/wear	<u>OK</u>		<u>OK</u>		

**Aspirators:**                      35 ft.                      250 ft.  
   OK                                      OK

Comments:

ADL 3-5-14

# Zion Meteorological Calibration

Date: 2-22-14

Operation of De-ice Heat Lamp System (Aug-Mar): OK

UPS Check: OK

Operation of Rain Gauge: \*

Tips Poured 25 Tips Recorded 25 AFTER MAINTNANCE

Debris screen: In (Out) Installed Removed

Tower Lighting	Good	Fair	Poor	Tower Condition	Good	Fair	Poor
Beacon	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Paint	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Side lights	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Wiring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Flasher	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Shelter condition	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note:

- AF = As Found
- AL = As Left
- = No Change (AF=AL)

Calibration Instruments:

	S/N	Next Cal Due
Psychrometer	MT104	APRIL 2014
Digital multimeter	8980209	EXT 2014
Digital multimeter		
Digital thermometer		

FS = Full Scale

Technicians: MICK MONDIA MIKE MARX

Comments:

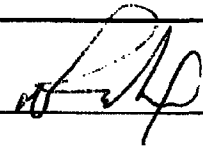
\* REED SWITCH BAD - KEPT SHOOTING OUT. SOME DAYS OK.

ALSO MICROTEL COUNTS DID NOT MATCH DIGI - DIGI WAS OK WHEN

REED SWITCH WASN'T SHOOTED. I REPLACED THE REED SWITCH - NOW OK

CLEARED THE MEMORY IN THE MICROTEL - NOW BOTH MATCH DIGI

AND MICROTEL.

Signature: 

ASL 3-5-14

### System Response Check

Date: 2-26-14

Site: Zion  
System: Microtel

<u>Low Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
<b>Expected Response</b>	10.0 ±0.4	10.0 ±0.4	54 ±2	54 ±2	-24.00 ±0.5	-6.00 ±0.18	-24.0 ±0.5
<b>As Found Response</b>	9.8	9.8	53	53	-24.3	-6.1	-24.3
<b>As Left Response</b>	-	-	-	-	-	-	-

<u>Mid Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
<b>Expected Response</b>	50.0 ±0.4	50.0 ±0.4	270 ±2	270 ±2	40.00 ±0.5	10.00 ±0.18	40.0 ±0.5
<b>As Found Response</b>	49.8	49.8	269	269	39.7	9.9	39.7
<b>As Left Response</b>	-	-	-	-	-	-	-

<u>Full Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
<b>Expected Response</b>	90.0 ±0.4	90.0 ±0.4	486 ±2	486 ±2	104.00 ±0.5	26.00 ±0.18	104.0 ±0.5
<b>As Found Response</b>	89.8	89.8	485	485	103.6	25.9	103.6
<b>As Left Response</b>	-	-	-	-	-	-	-

ASL 3-5-14

### System Response Check

Date: 2-26-14

Site: Zion  
System: Process Computer

<u>Low Scale Check</u>	Y9131 35' WS	Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
<b>Expected Response</b>	10.0 ±0.4	54 ±2	10.0 ±0.4	54 ±2	-24.00 ±0.5	-6.00 ±0.18	0.10 ±0.01
<b>As Found Response</b>	10.1	54.15	10.2	54.35	-23.97	-5.95	.105
<b>As Left Response</b>	-	-	-	-	-	-	-

<u>Mid Scale Check</u>	Y9131 35' WS	Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
<b>Expected Response</b>	50.0 ±0.4	270 ±2	50.0 ±0.4	270 ±2	40.00 ±0.5	10.00 ±0.18	0.50 ±0.01
<b>As Found Response</b>	50.1	269.6	50.2	270.2	39.9	10.08	0.50
<b>As Left Response</b>	-	-	-	-	-	-	-

<u>Full Scale Check</u>	Y9131 35' WS	Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
<b>Expected Response</b>	90.0 ±0.4	486 ±2	90.0 ±0.4	486 ±2	104.00 ±0.5	26.00 ±0.18	0.90 ±0.01
<b>As Found Response</b>	90.12	487.1	90.09	486.31	104.25	26.03	0.90
<b>As Left Response</b>	-	-	-	-	-	-	-

ASZ 3-5-14



# Zion Meteorological Calibration

Date: 6-6-14

## POWER SUPPLIES

+12.000V ± 0.120V	-12.000V ± 0.120V
A: + <u>12.025</u> V	A: - <u>12.036</u> V
B: + <u>12.045</u> V	B: - <u>11.999</u> V

### Signal conditioners and Digital Recorder:

Signal Conditioner Voltage Out			Digital recorder		Specifications	
AF	AL	AL EQUIV	AF	AL	Signal Cond.	Recorder
<u>5 ft.</u>						
DP LO	<u>.016</u> V	- V <u>42.56</u> °	<u>-42.53</u> °	- °		AL EQUIV ± 0.1°F
DP HI	<u>.984</u> V	- V <u>117.44</u> °	<u>117.46</u> °	- °		AL EQUIV ± 0.1°F
DP HI-LO	<u>1.000</u> V	- V			1.000V ± 0.025V	
<u>10 ft.</u>						
PRCP LO	<u>.000</u> V	- V <u>0.00</u> "	<u>0.00</u> "	- "	0.000V ± 0.050V	AL EQUIV ± 0.01"
PRCP HI	<u>.986</u> V	<u>1.000</u> V <u>1.00</u> "	<u>1.00</u> "	- "	1.000V ± 0.050V	AL EQUIV ± 0.01"
<u>35 ft.</u>						
WS LO	<u>.006</u> V	- V <u>0.6</u> mph	<u>0.6</u> mph	- mph	0.006V ± 0.005V	AL EQUIV ± 0.1mph
WS HI	<u>.300</u> V	- V <u>30.0</u> mph	<u>30.0</u> mph	- mph	0.300V ± 0.005V	AL EQUIV ± 0.1mph
WD LO	<u>.002</u> V	- V <u>1.08</u> °	<u>1</u> °	- °	0.000V ± 0.005V	AL EQUIV ± 1°
WD HI	<u>1.000</u> V	- V <u>540</u> °	<u>540</u> °	- °	1.000V ± 0.005V	AL EQUIV ± 1°
T LO	<u>.163</u> V	- V <u>-13.12</u> °	<u>-13.18</u> °	- °		AL EQUIV ± 0.1°F
T HI	<u>.949</u> V	- V <u>111.84</u> °	<u>111.46</u> °	- °		AL EQUIV ± 0.1°F
T HI-LO	<u>.781</u> V	- V			0.781V ± 0.002V	
<u>250 ft.</u>						
WS LO	<u>.006</u> V	- V <u>0.6</u> mph	<u>0.6</u> mph	- mph	0.006V ± 0.005V	AL EQUIV ± 0.1mph
WS HI	<u>.302</u> V	<u>.300</u> V <u>30.0</u> mph	<u>30.0</u> mph	- mph	0.300V ± 0.005V	AL EQUIV ± 0.1mph
WD LO	<u>.000</u> V	- V <u>0</u> °	<u>0</u> °	- °	0.000V ± 0.005V	AL EQUIV ± 1°
WD HI	<u>1.000</u> V	- V <u>540</u> °	<u>540</u> °	- °	1.000V ± 0.005V	AL EQUIV ± 1°
T LO	<u>.158</u> V	- V <u>-14.72</u> °	<u>-14.70</u> °	- °		AL EQUIV ± 0.1°F
T HI	<u>.939</u> V	- V <u>110.24</u> °	<u>110.29</u> °	- °		AL EQUIV ± 0.1°F
T HI-LO	<u>.781</u> V	- V			0.781V ± 0.002V	
T ZERO	<u>.002</u> V	<u>.000</u> V <u>-10.00</u> °	<u>-10.00</u> °	- °	0.000V ± 0.010V	AL EQUIV ± 0.1°F
ΔT SPAN	<u>.501</u> V	<u>.500</u> V <u>10.00</u> °	<u>10.00</u> °	- °	0.500V ± 0.010V	AL EQUIV ± 0.1°F
ΔT MID	<u>.250</u> V	- V <u>0.00</u> °			0.250V ± 0.005	

AD 6-24-14

# Zion Meteorological Calibration

Date: 6-6-14

## Dates of Last Wind Sensor Bearing Replacements:

		<u>35 ft.</u>	<u>250 ft.</u>
(6 mos.)	Wind Speed:	<u>4-15-14</u>	<u>4-8-14</u>
(12 mos.)	Wind Direction:	<u>12-23-13</u>	<u>5-26-14</u>

## TOWER MEASUREMENTS

Ambient     Ice Bath

### Temperatures

	<u>35 ft. Amb.</u>		<u>250 ft. ΔT</u>		<u>5 ft. dew point</u>	
	AF	AL	AF	AL	AF	AL
Measured	<u>64.5</u> °F	<u>—</u> °F	<u>0.3</u> °F	<u>—</u> °F	<u>50.0</u> °F	<u>—</u> °F
Recorded	<u>64.6</u> °F	<u>—</u> °F	<u>0.3</u> °F	<u>—</u> °F	<u>48.0</u> °F	<u>—</u> °F
Difference	<u>0.1</u> °F	<u>—</u> °F	<u>0.0</u> °F	<u>—</u> °F	<u>2.0</u> °F	<u>—</u> °F
Specification	±0.5°F		±0.18°F		±2.7°F	

### Winds

	<u>35 ft.</u>		<u>250 ft.</u>		<u>Specification</u>
	AF	AL	AF	AL	
WS stall	<u>0.6</u> mph	<u>—</u> mph	<u>0.6</u> mph	<u>—</u> mph	0.6mph ± 0.45mph
Forw. WD	<u>150</u> °	<u>—</u> °	<u>149</u> °	<u>—</u> °	150°/510° ± 5°
Revr. WD	<u>331</u> °	<u>—</u> °	<u>330</u> °	<u>—</u> °	330° ± 5°
Tracking/wear	<u>OK</u>		<u>OK</u>		

Aspirators:                      35 ft.                      250 ft.  
    OK                                      OK

Comments:

ASZ 6-24-14

# Zion Meteorological Calibration

Date: 6-6-14

Operation of De-ice Heat Lamp System (Aug-Mar): NA

UPS Check: OK

Operation of Rain Gauge: OK

Tips Poured 5 Tips Recorded 5

Debris screen:  In  Out  Installed  Removed

Tower Lighting	Good	Fair	Poor	Tower Condition	Good	Fair	Poor
Beacon	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Paint	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Side lights	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Wiring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Flasher	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Shelter condition	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Note:

- AF = As Found
- AL = As Left
- = No Change (AF=AL)

Calibration Instruments:

- Psychrometer - S/N - MT107 OCT 2014
- Digital multimeter - S/N - 931202DB MAY 2015
- Digital multimeter - S/N - \_\_\_\_\_
- Digital thermometer - S/N - \_\_\_\_\_

Next Cal Due

FS = Full Scale

Technicians: HEATHER CARMONA, MIKE MONDIA, MIKE MARX

Comments:

ANTS INSIDE MET Shelter - AF

Called Roger Boyce he said he will look into it.

Signature: [Signature]

ADL 6-24-14

### System Response Check

Date: 6-2-14

Site: Zion  
System: Microtel

<u>Low Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
Expected Response	10.0 ±0.4	10.0 ±0.4	54 ±2	54 ±2	-24.00 ±0.5	-6.00 ±0.18	-24.0 ±0.5
As Found Response	9.9	9.9	54	54	-24.1	-6.0	-24.1
As Left Response	—	—	—	—	—	—	—

<u>Mid Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
Expected Response	50.0 ±0.4	50.0 ±0.4	270 ±2	270 ±2	40.00 ±0.5	10.00 ±0.18	40.0 ±0.5
As Found Response	49.9	50.0	270	270	39.9	10.0	39.9
As Left Response	—	—	—	—	—	—	—

<u>Full Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
Expected Response	90.0 ±0.4	90.0 ±0.4	486 ±2	486 ±2	104.00 ±0.5	26.00 ±0.18	104.0 ±0.5
As Found Response	89.9	89.9	485	485	103.8	25.9	103.8
As Left Response	—	—	—	—	—	—	—

ASZ 6-24-14

## System Response Check

Date: 6-6-14Site: Zion  
System: Process Computer

<u>Low Scale Check</u>	Y9131 35' WS	Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
<b>Expected Response</b>	10.0 ±0.4	54 ±2	10.0 ±0.4	54 ±2	-24.00 ±0.5	-6.00 ±0.18	0.10 ±0.01
<b>As Found Response</b>	10.05	53.86	9.84	54.09	-23.91	-6.048	0.099
<b>As Left Response</b>	-	-	-	-	-	-	-

<u>Mid Scale Check</u>	Y9131 35' WS	Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
<b>Expected Response</b>	50.0 ±0.4	270 ±2	50.0 ±0.4	270 ±2	40.00 ±0.5	10.00 ±0.18	0.50 ±0.01
<b>As Found Response</b>	50.11	270.2	49.95	270.6	40.11	9.97	0.498
<b>As Left Response</b>	-	-	-	-	-	-	-

<u>Full Scale Check</u>	Y9131 35' WS	Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
<b>Expected Response</b>	90.0 ±0.4	486 ±2	90.0 ±0.4	486 ±2	104.00 ±0.5	26.00 ±0.18	0.90 ±0.01
<b>As Found Response</b>	90.18	486.8	90.13	487.31	104.19	26.03	0.90
<b>As Left Response</b>	-	-	-	-	-	-	-

ASL 6-24-14

**Zion Meteorological Calibration**

Date: 10-1-14

**POWER SUPPLIES**

$+12.000V \pm 0.120V$	$-12.000V \pm 0.120V$
A: <u>+12.030</u> V	A: <u>-12.039</u> V
B: <u>+12.046</u> V	B: <u>-11.999</u> V

**Signal conditioners and Digital Recorder:**

	Signal Conditioner Voltage Out			Digital recorder		Specifications	
	AF	AL	AL EQUIV	AF	AL	Signal Cond.	Recorder
<u>5 ft.</u>							
DP LO	<u>-.014</u> V	<u>-</u> V	<u>-42.24</u> °	<u>-42.21</u> °	<u>-</u> °		AL EQUIV $\pm 0.1^\circ F$
DP HI	<u>.985</u> V	<u>-</u> V	<u>117.6</u> °	<u>117.65</u> °	<u>-</u> °		AL EQUIV $\pm 0.1^\circ F$
DP HI-LO	<u>.999</u> V	<u>-</u> V				$1.000V \pm 0.025V$	
<u>10 ft.</u>							
PRCP LO	<u>.000</u> V	<u>-</u> V	<u>0.00</u> "	<u>0.00</u> "	<u>-</u> "	$0.000V \pm 0.050V$	AL EQUIV $\pm 0.01"$
PRCP HI	<u>.997</u> V	<u>1.000</u> V	<u>1.00</u> "	<u>1.00</u> "	<u>-</u> "	$1.000V \pm 0.050V$	AL EQUIV $\pm 0.01"$
<u>35 ft.</u>							
WS LO	<u>.005</u> V	<u>.006</u> V	<u>0.6</u> mph	<u>0.6</u> mph	<u>-</u> mph	$0.006V \pm 0.005V$	AL EQUIV $\pm 0.1$ mph
WS HI	<u>.300</u> V	<u>-</u> V	<u>30.0</u> mph	<u>30.0</u> mph	<u>-</u> mph	$0.300V \pm 0.005V$	AL EQUIV $\pm 0.1$ mph
WD LO	<u>.005</u> V	<u>.000</u> V	<u>0</u> °	<u>0</u> °	<u>-</u> °	$0.000V \pm 0.005V$	AL EQUIV $\pm 1^\circ$
WD HI	<u>.997</u> V	<u>1.000</u> V	<u>540</u> °	<u>540</u> °	<u>-</u> °	$1.000V \pm 0.005V$	AL EQUIV $\pm 1^\circ$
T LO	<u>.167</u> V	<u>-</u> V	<u>-13.28</u> °	<u>-13.28</u> °	<u>-</u> °		AL EQUIV $\pm 0.1^\circ F$
T HI	<u>.948</u> V	<u>-</u> V	<u>111.68</u> °	<u>111.71</u> °	<u>-</u> °		AL EQUIV $\pm 0.1^\circ F$
T HI-LO	<u>.781</u> V	<u>-</u> V				$0.781V \pm 0.002V$	
<u>250 ft.</u>							
VS LO	<u>.006</u> V	<u>-</u> V	<u>0.6</u> mph	<u>0.6</u> mph	<u>-</u> mph	$0.006V \pm 0.005V$	AL EQUIV $\pm 0.1$ mph
VS HI	<u>.295</u> V	<u>.300</u> V	<u>30.0</u> mph	<u>30.0</u> mph	<u>-</u> mph	$0.300V \pm 0.005V$	AL EQUIV $\pm 0.1$ mph
VD LO	<u>.000</u> V	<u>-</u> V	<u>0</u> °	<u>0</u> °	<u>-</u> °	$0.000V \pm 0.005V$	AL EQUIV $\pm 1^\circ$
VD HI	<u>1.000</u> V	<u>-</u> V	<u>540</u> °	<u>540</u> °	<u>-</u> °	$1.000V \pm 0.005V$	AL EQUIV $\pm 1^\circ$
VO LO	<u>.158</u> V	<u>-</u> V	<u>-14.72</u> °	<u>-14.66</u> °	<u>-</u> °		AL EQUIV $\pm 0.1^\circ F$
VO HI	<u>.940</u> V	<u>-</u> V	<u>110.40</u> °	<u>110.40</u> °	<u>-</u> °		AL EQUIV $\pm 0.1^\circ F$
VO HI-LO	<u>.782</u> V	<u>-</u> V				$0.781V \pm 0.002V$	
VRO	<u>.000</u> V	<u>-</u> V	<u>-10.00</u> °	<u>-10.00</u> °	<u>-</u> °	$0.000V \pm 0.010V$	AL EQUIV $\pm 0.1^\circ F$
VSPAN	<u>.504</u> V	<u>-</u> V	<u>10.04</u> °	<u>10.06</u> °	<u>-</u> °	$0.500V \pm 0.010V$	AL EQUIV $\pm 0.1^\circ F$
V MID	<u>.250</u> V	<u>-</u> V	<u>-</u> °			$0.250v \pm 0.005$	

AD-11-11-14

### Zion Meteorological Calibration

Date: 10-1-14

**Dates of Last Wind Sensor Bearing Replacements:**

		<u>35 ft.</u>	<u>250 ft.</u>
(6 mos.)	Wind Speed:	<u>10-1-14</u>	<u>10-1-14</u>
(12 mos.)	Wind Direction:	<u>11-23-13</u>	<u>5-26-14</u>

**TOWER MEASUREMENTS**

Ambient     Ice Bath

Temperatures

	<u>35 ft. Amb.</u>		<u>250 ft. ΔT</u>		<u>5 ft. dew point</u>	
	AF	AL	AF	AL	AF	AL
Measured	<u>58.25</u> °F	<u>—</u> °F	<u>-1.75</u> °F	<u>—</u> °F	<u>51</u> °F	<u>—</u> °F
Recorded	<u>58.25</u> °F	<u>—</u> °F	<u>-1.81</u> °F	<u>—</u> °F	<u>51.09</u> °F	<u>—</u> °F
Difference	<u>0.0</u> °F	<u>—</u> °F	<u>0.06</u> °F	<u>—</u> °F	<u>.09</u> °F	<u>—</u> °F
Specification	±0.5°F		±0.18°F		±2.7°F	

Winds

	<u>35 ft.</u>		<u>250 ft.</u>		<u>Specification</u>
	AF	AL	AF	AL	
WS stall	<u>0.6</u> mph	<u>0.6</u> mph	<u>0.6</u> mph	<u>0.6</u> mph	0.6mph ± 0.45mph
Forw. WD	<u>150</u> °	<u>—</u> °	<u>158</u> °	<u>150</u> °	150°/510° ± 5°
Revr. WD	<u>330</u> °	<u>—</u> °	<u>338</u> °	<u>330</u> °	330° ± 5°
Tracking/wear	<u>OK</u>		<u>OK</u>		

**Aspirators:**                      35 ft.                      250 ft.  
    OK                                      OK

**Comments:**

35ft. WS

250ft WS

Removed: MT0065

Removed: MT0023

Installed: MT0126

Installed: MT0112

\* Changed 2 heat lamps at 35ft.

\* changed 3 heat lamps at 250ft but  
 need to repair 2 sockets

ADZ 11-11-14

# Zion Meteorological Calibration

Date: 10-1-14

Operation of De-ice Heat Lamp System (Aug-Mar): \* See Comments Page 2

UPS Check: OK

Operation of Rain Gauge: OK

Tips Poured 5 Tips Recorded 5

Debris screen: In Out Installed Removed

Tower Lighting	Good	Fair	Poor	Tower Condition	Good	Fair	Poor
Beacon	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Paint	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Side lights	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Wiring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Flasher	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Shelter condition	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Note:

- AF = As Found
- AL = As Left
- = No Change (AF=AL)

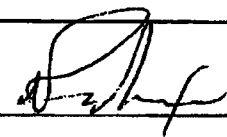
Calibration Instruments:

	Next Cal Due
Psychrometer - S/N - <u>71</u>	<u>OCT 2014</u>
Digital multimeter - S/N - <u>93120208</u>	<u>MAY 2015</u>
Digital multimeter - S/N - _____	_____
Digital thermometer - S/N - _____	_____

FS = Full Scale

Technicians: HEATHER (ANGUS) MIKE WART

Comments:

Signature: 

ASZ 11-11-14



### System Response Check

Date: 10-1-14

Site: Zion  
System: Microtel

<u>Low Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
<b>Expected Response</b>	10.0 ±0.4	10.0 ±0.4	54 ±2	54 ±2	-24.00 ±0.5	-6.00 ±0.18	-24.0 ±0.5
<b>As Found Response</b>	9.9	9.9	54	54	-24.2	-6.1	-24.1
<b>As Left Response</b>	—	—	—	—	—	—	—

<u>Mid Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
<b>Expected Response</b>	50.0 ±0.4	50.0 ±0.4	270 ±2	270 ±2	40.00 ±0.5	10.00 ±0.18	40.0 ±0.5
<b>As Found Response</b>	49.9	49.9	269	269	39.7	9.9	39.8
<b>As Left Response</b>	—	—	—	—	—	—	—

<u>Full Scale Check</u>	35' WS	250' WS	35' WD	250' WD	35' T	250' ΔT	5' DP
<b>Expected Response</b>	90.0 ±0.4	90.0 ±0.4	486 ±2	486 ±2	104.00 ±0.5	26.00 ±0.18	104.0 ±0.5
<b>As Found Response</b>	89.9	89.9	485	485	103.8	26.0	103.8
<b>As Left Response</b>	—	—	—	—	—	—	—

ASL 11-11-14

## System Response Check

Date: 10-1-14

Site: Zion

System: Process Computer

<u>Low Scale Check</u>	Y9131 35' WS	Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	* Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
Expected Response	10.0 ±0.4	* 54 ±2	10.0 ±0.4	54 ±2	-24.00 ±0.5	-6.00 ±0.18	0.10 ±0.01
As Found Response	10.04	53.82	9.83	53.93	-24.14	-5.92	0.104
As Left Response	—	54.04	—	—	23.82	—	—

<u>Mid Scale Check</u>	Y9131 35' WS	* Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	* Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
Expected Response	50.0 ±0.4	270 ±2	50.0 ±0.4	270 ±2	40.00 ±0.5	10.00 ±0.18	0.50 ±0.01
As Found Response	50.10	263.6	50.13	269.54	38.15	10.00	.505
As Left Response	—	269.8	—	—	40.04	—	—

<u>Full Scale Check</u>	Y9131 35' WS	* Y9132 35' WD	Y9135 250' WS	Y9136 250' WD	* Y9137 35' T	Y9138 250' ΔT	Y9140 Precipitation
Expected Response	90.0 ±0.4	486 ±2	90.0 ±0.4	486 ±2	104.00 ±0.5	26.00 ±0.18	0.90 ±0.01
As Found Response	90.08	455	90.23	486.04	99.65	25.99	0.901
As Left Response	—	485.79	—	—	104.02	—	—

\* Y9132 + Y9137 NEEDED New CURRENT CARDS

PSL 11-11-14

ZionSolutions LLC

ZS-2015-0055: Zion Station Radioactive Effluent Release Report for 2014

Attachment 6 - Errata data

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There are no errata corrections from prior years reports in 2014

Attachment 7 - Changes to Zion Station Liquid Radwaste System

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Summary: Changes to the ODCM to support the design changes to the liquid radwaste system were performed in 2013. These design changes were submitted in the 2013 Annual Radioactive Effluent Release Report. The physical changes to the system were implemented in 2014.

The changes made to the system utilize most of the in-place piping and tanks, two pillow tanks have been installed to support processing of liquid waste through the pre-existing filters and demineralizers. There are no changes made to the methodology or equipment used to reduce radioactive effluent concentration in liquid effluent. Figure 1 shows the simplified one line diagram of the system.

Overview of system operation: Liquid radwaste is stored in the 498,000 gallon Refueling Water Storage Tank (RWST) (pre-existing). From the RWST, the liquid is transferred to one of three 128,000 gallon Hold Up Tanks (HUT)(pre-existing). When a batch release is desired to be performed, water from the HUTs are pumped to one of two 25,000 gallon pillow tanks (newly constructed). Once in the pillow tanks, water is sent through the charcoal filters and demineralizers to reduce the effluent concentration and other particulates that may be present in the water. Demineralizer inlet and outlet sampling is performed to test the effectiveness of the demineralizer and predict when filters and resins will need to be changed. If desired, from the pillow tanks, water may be sent through the demineralizers multiple times. After sending the water through the demineralizers, the water is then sent to one of two 25,000 gallon Lake Release Tanks (LRT) (pre-existing and previously named Boric Acid Tanks). Water in the LRTs is then recirculated 3 times within a 12 hour period per ANSI standards for representative sampling. A sample is drawn, isotopically analyzed and stored for quarterly composites from an offsite laboratory. The analyzed samples include hard to detect nuclides that may be present scaled into the isotopic mixture and the results of the analysis compared with effluent release limits per 10CFR20 table 2 column 2 prior to release. If the water fails the comparison, it is sent back to the RWST for re-processing. Satisfactory results allow for the discharge of the liquid. The liquid effluent monitor is verified functional and water is discharged at the rate calculated based on dilution flow into the effluent discharge piping (pre-existing). If the liquid effluent monitor alarms, the downstream valve closes to stop the release prior to reaching the discharge point and a notification is sent to the guard-it dialer notifying operations personnel of the event.

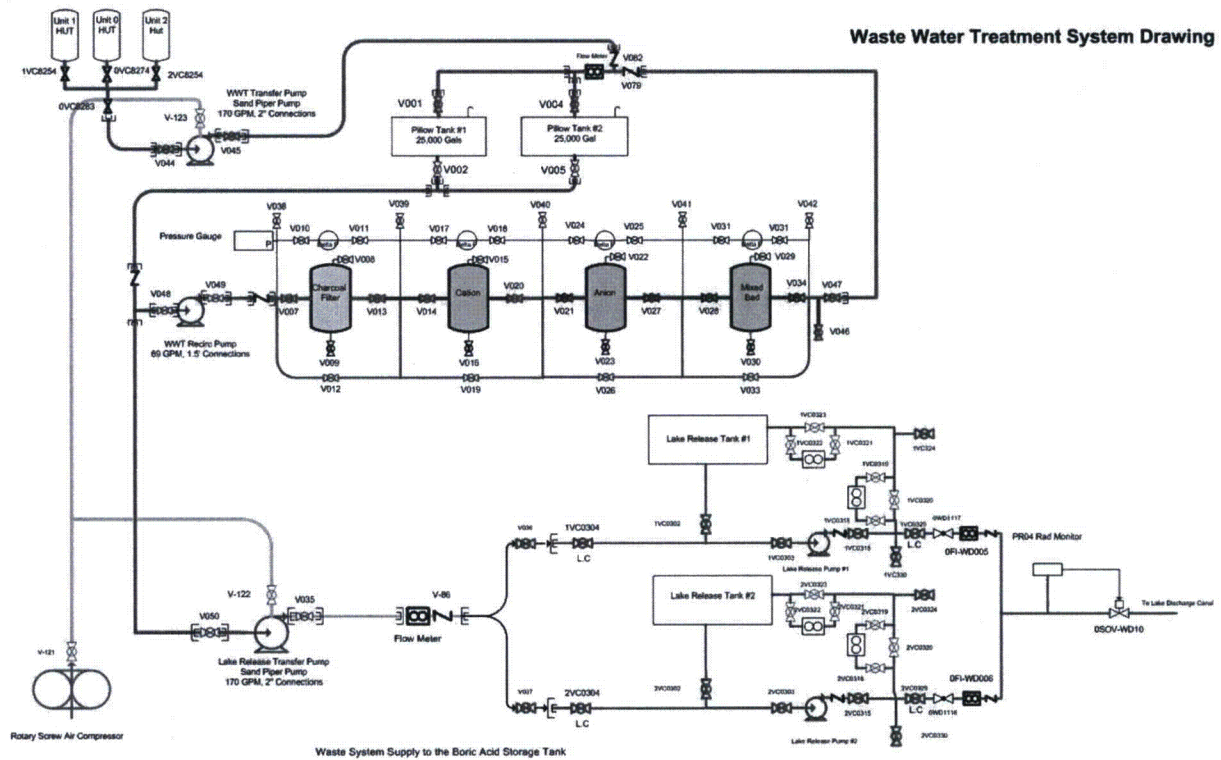


Figure 1

All applicable changes have been evaluated in accordance with 10CFR 50.59 by ANSI qualified technical review personnel. Doses to members of the public have been evaluated during system design to ensure that the system continues to maintain doses to the public and workers are as low as reasonably attainable and well within limits.

Attachment 8 – Station Review and Reason for  
inoperable monitor surveillances conducted > 30 days.

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Station Review

Date: 12/3/14

To: Station Review Committee

Subject: 2RIA-PR49 Channel 1,5 Inoperable >30 days per ODCM Table 12.2-3 Surveillance 10, 11

Supporting Documentation: TR-032-2014

After an exhaustive search was performed, it is determined the SPING monitor being used to monitor effluent from Unit 2 vent stack is unable to be repaired due to repair parts no longer available. The SPING unit being in place as 2RIA-PR49 is no longer manufactured by Eberline and no repair parts are supported. The SPING unit that was in use for Unit 1 vent stack parts had already been salvaged and used for repairs in the past. Other stations have been contacted for salvage parts and various parts dealers have been contacted for the parts to repair the SPING unit. None were found. To have an effluent radiation monitor built to the design required, manufacturers ask for an 18 month lead time to build an effluent monitor for Zion Station. TR-032-2014 has determined that installing an AMS-4 such as the one in Unit 1 will meet the requirement for gaseous effluent radiation monitoring, and this system can be installed within 4 weeks; however, Zion will exceed the 30 days prescribed to restore normal effluent monitoring and this station review satisfies the ODCM requirement to determine the course of action to restore effluent monitoring.

Channel 1 particulate: This change was previously evaluated and will be established by using an AMS-4 similar to the operation of 1RIA-PR49 that is currently in place. This change will be implemented now instead of after all fuel is removed from Spent Fuel Pool.

Channel 5 noble gas: Several alternate methods of re-establishing continuous noble gas monitoring were examined. Each of the three alternate methods required an engineering change, and physical reconfiguration of one form or another to establish a suitable monitoring flowpath. Two of the methods for noble gas monitoring would require evaluation time that would place the timeline of re-establishing noble gas monitoring past January 31, 2015 or later and thus the method presented here is the only reasonable method of re-establishing continuous noble gas monitoring while fuel is still present.

Technical Review summary of Channel 5 noble gas method: Engineers of Thermo-Scientific were contacted to determine if the AMS-4 particulate monitor could also be used to monitor noble gas concurrently with particulate. The contact personnel responded that it was possible, using correction factors and efficiencies for Kr-85 instead of Sr-90. The alarm setpoint will be extremely low since the detector volume is setup for particulate. However this is feasible since there has been less than minimum detectable particulate effluent. This single setpoint based on noble gas will also satisfy the particulate alarm setpoint. Once all fuel is removed, the setpoint can be changed to reflect only the particulate setpoint.

The Station Review Committee concurred with the proposed corrective actions. Corrective actions were completed on December 29, 2014 and the Unit 2 vent stack effluent radiation monitor was placed back in service.