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ZION NUCLEAR POWER STATION UNITS 1 and 2

Annual Radiological
Environmental Operating Report

1 January Through 31 December 2014

Prepared By

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Environmental Services



ZIONSOLUTIONS^{LLC}
An Energy Solutions Company

Zion Nuclear Power Station
Zion, IL 60099

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I. Summary and Conclusions

This report on the Radiological Environmental Monitoring Program conducted for the Zion Nuclear Power Station (ZNPS) by ZionSolutions (ZS) covers the period 1 January 2014 through 31 December 2014. During that time period, 592 analyses were performed on 528 samples. In assessing all the data gathered for this report and comparing these results with preoperational data, it was concluded that the operation of ZNPS had no adverse radiological impact on the environment.

Public water samples were analyzed for concentrations of gross beta, tritium and gamma emitting nuclides. No fission or activation products were detected. Gross beta activities detected were consistent with those detected in previous years.

Fish (commercially and recreationally important species) and sediment samples were analyzed for concentrations of gamma emitting nuclides. No Cs-137 activity was detected in fish or sediment samples. No plant produced fission or activation products were found in fish or sediment.

Air particulate samples were analyzed for concentrations of gross beta and gamma emitting nuclides. No fission or activation products were detected.

Environmental gamma radiation measurements were performed quarterly using thermoluminescent dosimeters.

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II. Introduction

The Zion Nuclear Power Station (ZNPS), consisting of two 1,100 MWT pressurized water reactor was owned and operated by Exelon Corporation, is located in Zion, Illinois adjacent to Lake Michigan. Unit No. 1 went critical in December 1973. Unit No. 2 went critical in September 1974. The plant permanently ceased operation in January of 1998 and has been permanently defueled. The site is located in northeast Illinois on the western shore of Lake Michigan, approximately 50 miles north of Chicago, Illinois.

This report covers those analyses performed by Teledyne Brown Engineering (TBE), Mirion Technologies and Environmental Inc. (Midwest Labs) on samples collected during the period 1 January 2014 through 31 December 2014.

A. Objective of the REMP

The objectives of the REMP are to:

1. Provide data on measurable levels of radiation and radioactive materials in the site environs.
2. Evaluate the relationship between quantities of radioactive material released from the plant and resultant radiation doses to individuals from principal pathways of exposure.

B. Implementation of the Objectives

The implementation of the objectives is accomplished by:

1. Identifying significant exposure pathways.
2. Establishing baseline radiological data of media within those pathways.
3. Continuously monitoring those media before and during Station operation to assess Station radiological effects (if any) on man and the environment.

III. Program Description

A. Sample Collection

Samples for the ZNPS REMP were collected for ZS by Environmental Inc. (Midwest Labs). This section describes the general collection methods used by Environmental Inc. (Midwest Labs) to obtain environmental

samples for the ZNPS REMP in 2014. Sample locations and descriptions can be found in Table B-1 and Figures B-1 and B-2, Appendix B. The sampling methods used by Environmental Inc. (Midwest Labs) are listed in Table B-2.

Aquatic Environment

The aquatic environment was evaluated by performing radiological analyses on samples of public water, fish and sediment. Two gallon water samples were collected monthly from four public water locations (Z-14, Z-15, Z-16 and Z-18). Control locations were Z-14 and Z-18. All samples were collected in new unused plastic bottles, which were rinsed at least twice with source water prior to collection. Fish samples comprising the flesh of common carp, chinook salmon, lake trout, longnose sucker, burbot and largemouth bass were collected semiannually at two locations, Z-26 and Z-27. Sediment samples composed of recently deposited substrate were collected at one location semiannually, Z-25.

Atmospheric Environment

The atmospheric environment was evaluated by performing radiological analyses on samples of air particulates. Airborne particulate samples were collected and analyzed weekly at four locations (Z-01, Z-02, Z-03, and Z-13). The control location was Z-13. Airborne particulate samples were obtained at each location, using a vacuum pump with glass fiber filters attached. The pumps were run continuously and sampled air at the rate of approximately one cubic foot per minute. The filters were replaced weekly and sent to the laboratory for analysis.

Terrestrial Environment

The terrestrial environment was evaluated by performing radiological analyses on food product samples. Food products were collected annually in September at three locations (Z-Control, Z-Quad 3 and Z-Quad 4). The control location was Z-Control. Various types of samples were collected and placed in new unused plastic bags and sent to the laboratory for analysis.

Ambient Gamma Radiation

Direct radiation measurements were made using 2 CaF 200 and 2 LiF 100 LiF 4-chip Harshaw thermoluminescent dosimeters (TLD). Each location consisted of 2 TLD sets. The TLD locations were placed on and around the ZNPS site at the following locations:

Inner Ring: Z-101, Z-102, Z-103, Z-104, Z-105, Z-106, Z-107, Z-108, Z-110, Z-111, Z-112, Z-113, Z-114, and Z-115

Other: Z-01, Z-02, Z-03

ISFSI Inner Ring: Z-121, Z-122, Z-123, Z-124, Z-125

Outer Ring: Z-209, Z-211, Z-212, Z-213, Z-214, Z-215, Z-216

Control: Z-13

The specific TLD locations were determined by the following criteria:

1. The presence of relatively dense population;
2. Site meteorological data taking into account distance and elevation for each of the sixteen–22 1/2 degree sectors around the site, where estimated annual dose from ZNPS, if any, would be most significant;
3. On hills free from local obstructions and within sight of the vents (where practical);
4. And near the closest dwelling to the vents in the prevailing downwind direction.

(Two TLDs – each comprised of two CaF_2 200 and 2 LiF 100 LiF 4-chip thermoluminescent phosphors enclosed in plastic – were placed at each location approximately four to eight feet above ground level. The TLDs were exchanged quarterly and sent to Mirion Technologies for analysis.

B. Sample Analysis

This section describes the general analytical methodologies used by TBE and Environmental Inc. (Midwest Labs) to analyze the environmental samples for radioactivity for the ZNPS REMP in 2014. The analytical procedures used by the laboratories are listed in Table B-2.

In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of beta emitters in public water and air particulates.
2. Concentrations of gamma emitters in public water, air particulates, fish, and sediment.

3. Concentrations of tritium in public water.
4. Ambient gamma radiation levels at various site environs.

C. Data Interpretation

The radiological and direct radiation data collected prior to Zion Nuclear Power Station becoming operational were used as a baseline with which these operational data were compared. For the purpose of this report, Zion Nuclear Power Station was considered operational at initial criticality. In addition, data was compared to previous years' operational data for consistency and trending. Several factors were important in the interpretation of the data:

1. Lower Limit of Detection and Minimum Detectable Concentration

The lower limit of detection (LLD) is defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD is intended as a before the fact estimate of a system (including instrumentation, procedure and sample type) and not as an after the fact criteria for the presence of activity. All analyses were designed to achieve the required ZNPS detection capabilities for environmental sample analysis.

The minimum detectable concentration (MDC) is defined above with the exception that the measurement is an after the fact estimate of the presence of activity.

2. Net Activity Calculation and Reporting of Results

Net activity for a sample was calculated by subtracting background activity from the sample activity. Since the REMP measures extremely small changes in radioactivity in the environment, background variations may result in sample activity being lower than the background activity affecting a negative number. An MDC was reported in all cases where positive activity was not detected.

Gamma spectroscopy results for each type of sample were grouped as follows:

For public water, sediment and air particulates 11 nuclides, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, Cs-134, Cs-137, Ba-140, and La-140 were reported.

Means and standard deviations of the results were calculated. The standard deviations represent the variability of measured results for different samples rather than single analysis uncertainty.

D. Program Exceptions

For 2014 the ZNPS REMP had a sample recovery rate in excess of 99%. Sample anomalies and missed samples are listed in the tables below:

Table D-1 LISTING OF SAMPLE ANOMALIES

Sample Type	Location Code	Collection Date	Reason
TLD	Z-214-1,-2	01/03/14	TLDs not exchanged due to unsafe conditions; returned to Station.
PW	Z-14	05/21/14	Water plant closed for repairs; sample collected 05/22/14.
TLD	Z-103-1,-2 Z-104-1,-2	06/04/14	Collected unable to check due to Z-safety issue; demolition at locations. Station will check.
TLD	Z-103-1,-2 Z-104-1,-2	07/02/14	Collected unable to check due to Z-safety issue; demolition at locations. Station will check.
PW	Z-16	12/23/14	Pump not operating; sample taken from "raw" water setting tank.
PW	Z-16	12/31/14	Pump not operating; sample taken from "raw" water setting tank.

Table D-2 LISTING OF MISSED SAMPLES

Sample Type	Location Code	Collection Date	Reason
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There were no missed samples in 2014.

Each program exception was reviewed to understand the causes of the program exception. Sampling and maintenance errors were reviewed with the personnel involved to prevent recurrence. Occasional equipment breakdowns and power outages were unavoidable.

The overall sample recovery rate indicates that the appropriate procedures and equipment are in place to assure reliable program implementation.

E. Program Changes

There were no program changes in 2014.

IV. Results and Discussion

A. Aquatic Environment

1. Public Water

Samples were taken weekly and composited monthly at four locations (Z-14, Z-15, Z-16 and Z-18). The following analyses were performed.

Gross Beta

Samples from all locations were analyzed for concentrations of gross beta (Table C-I.1, Appendix C). Gross beta was detected in 34 of 48 samples. The values ranged from 2.1 pCi/l to 4.3 pCi/l. Concentrations detected were consistent with those detected in previous years (Figures C-1 and C-2, Appendix C).

Tritium

Quarterly composites of weekly collections were analyzed for tritium activity (Table C-I.2, Appendix C). No tritium was detected and the LLD was met (Figures C-3 and C-4, Appendix C).

Gamma Spectrometry

Samples from both locations were analyzed for gamma emitting nuclides (Table C-I.3, Appendix C). No nuclides were detected and all required LLDs were met.

2. Fish

Fish samples comprised of common carp, chinook salmon, lake trout, burbot, and smallmouth bass were collected at two locations (Z-26 and Z-27) semiannually. The following analysis was performed:

Gamma Spectrometry

The edible portion of fish samples from both locations was analyzed for gamma emitting nuclides (Table C–II.1, Appendix C). No nuclides were detected and all required LLDs were met.

3. Sediment

Aquatic sediment samples were collected at one location (Z-25) semiannually. The following analysis was performed:

Gamma Spectrometry

Sediment samples from Z-25 were analyzed for gamma emitting nuclides (Table C–III.1, Appendix C). No nuclides were detected and all required LLDs were met.

B. Atmospheric Environment

1. Airborne

a. Air Particulates

Continuous air particulate samples were collected from three locations on a weekly basis. The three locations were within the ZNPS site boundary (Z-01, Z-02 and Z-03). The following analyses were performed:

Gross Beta

Weekly samples were analyzed for concentrations of beta emitters (Table C–IV.1 and C–IV.2, Appendix C). Detectable gross beta activity was observed at all locations. Comparison of results among the three groups aid in determining the effects, if any, resulting from the operation of ZNPS. The results from the On-Site locations ranged from 6 E-3 pCi/m^3 to 30 E-3 pCi/m^3 with a mean of 16 E-3 pCi/m^3 . The results from the Control location ranged from 7 E-3 pCi/m^3 to 29 E-3 pCi/m^3 with a mean of 17 E-3 pCi/m^3 . Comparison of the 2014 air particulate data with previous years data indicate no effects from the operation of ZNPS. Concentrations detected were consistent with those detected in previous years.

Gamma Spectrometry

Weekly samples were composited quarterly and analyzed for gamma emitting nuclides (Table C–IV.3, Appendix C). No nuclides were detected and all required LLDs were met.

C. Terrestrial Environment

2. Food Product

Food product samples were collected at three locations (Z-Control, Z-Quad 3 and Z-Quad 4) when available. The following analysis was performed:

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides (Table C–V.1, Appendix C). No nuclides were detected and all required LLDs were met.

D. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing Harshaw (CaF and LiF) thermoluminescent dosimeters. Sixty TLD locations were established around the site. Results of TLD measurements are listed in Tables C–VI.1 to C–VI.3, Appendix C.

Most TLD measurements were below 25 mR/quarter, with a range of 17 mR/quarter to 104 mR/quarter.

E. Land Use Survey

A Land Use Census conducted during August 2014 around the Zion Nuclear Power Station (ZNPS) was performed by Environmental Inc. (Midwest Labs) for ZS to comply with Chapter 3 of the Zion Offsite Dose Calculation Manual. The purpose of the survey was to document the nearest resident, milk producing animal and garden of greater than 500 ft₂ in each of the sixteen 22 ½ degree sectors around the site. The results of this survey are summarized below.

Distance in Miles from ZS			
Sector	Residence Miles	Garden Miles	Milk Farm Miles
N	2.5	3.4	>10
NNE	-	-	-
NE	-	-	-
ENE	-	-	-
E	-	-	-
ESE	-	-	-
SE	-	-	-
SSE	-	-	-
S	-	-	-
SSW	1.9	>10	>10
SW	1.1	4.8	>10
WSW	1.0	3.0	>10
W	1.1	2.9	>10
WNW	1.0	2.7	>10
NW	1.0	3.2	>10
NNW	1.3	3.5	>10

F. Errata Data

There is no errata data for 2014.

G. Summary of Results – Inter-Laboratory Comparison Program

The primary and secondary laboratories analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation and water matrices for (Appendix D). The PE samples, supplied by Analytics Inc., Environmental Resource Associates (ERA) and DOE's Mixed Analyte Performance Evaluation Program (MAPEP), were evaluated against the following pre-set acceptance criteria:

1. Analytics Evaluation Criteria

Analytics' evaluation report provides a ratio of laboratory results and Analytics' known value. Since flag values are not assigned by Analytics, TBE-ES evaluates the reported ratios based on internal QC requirements, which are based on the DOE MAPEP criteria.

2. ERA Evaluation Criteria

ERA's evaluation report provides an acceptance range for control and warning limits with associated flag values. ERA's acceptance limits are established per the USEPA, National Environmental Laboratory Accreditation Conference (NELAC), state specific

performance testing (PT) program requirements or ERA's SOP for the Generation of Performance Acceptance Limits, as applicable. The acceptance limits are either determined by a regression equation specific to each analyte or a fixed percentage limit promulgated under the appropriate regulatory document.

3. DOE Evaluation Criteria

MAPEP's evaluation report provides an acceptance range with associated flag values.

The MAPEP defines three levels of performance: Acceptable (flag = "A"), Acceptable with Warning (flag = "W"), and Not Acceptable (flag = "N"). Performance is considered acceptable when a mean result for the specified analyte is $\pm 20\%$ of the reference value. Performance is acceptable with warning when a mean result falls in the range from $\pm 20\%$ to $\pm 30\%$ of the reference value (i.e., $20\% < \text{bias} < 30\%$). If the bias is greater than 30%, the results are deemed not acceptable.

In reviewing our environmental inter-laboratory crosscheck programs, we identified 1) duplication of efforts on some matrices and isotopes and 2) that we are performing crosscheck samples on some matrices and isotopes that we do not perform for clients. Since the DOE MAPEP is designed to evaluate the ability of analytical facilities to correctly analyze for radiological constituents representative of those at DOE sites, the needed changes were made to the MAPEP program. Therefore, the following isotopes were removed from the MAPEP program:

Soil – gamma – will be provided by Analytics twice per year, starting in 2015. For 2014, one soil gamma is provided by MAPEP, the 2nd soil gamma is provided by Analytics.

AP – gamma – is currently provided by Analytics.

Water – gamma, H-3, Sr-90, uranium, gross alpha and gross beta currently provided by ERA.

MAPEP evaluates non-reported (NR) analyses as failed if they were reported in the previous series.

For the TBE laboratory, 163 out of 169 analyses performed met the specified acceptance criteria. Six analyses (Ni-63, K-40 and I-131 in water, and two Sr-90s and one Gross Alpha in AP samples) did not meet the specified acceptance criteria for the following reasons:

1. Teledyne Brown Engineering's MAPEP March 2014 Ni-63 in water result of 32.7 ± 1.69 Bq/L was overlooked when reporting the data

but would have passed the acceptance range of 23.9 – 44.2 Bq/L.
NCR 14-04

2. Teledyne Brown Engineering's MAPEP March 2014 K-40 in water result of 1.63 ± 2.49 Bq/L was overlooked when reporting the data but would have passed the false positive test. NCR 14-04
3. Teledyne Brown Engineering's ERA November 2014 I-131 in water result of 15.8 pCi/L was lower than the known value of 20.3 pCi/L, failing below the lower acceptance limit of 16.8. The result was evaluated as failed with a found to known ratio of 0.778. No cause could be found for the slightly low result. All ERA I-131 evaluations since 2004 have been acceptable. NCR 14-08
4. Teledyne Brown Engineering's MAPEP March 2014 Sr-90 in AP result of 0.822 Bq/sample was lower than the known value of 1.18 Bq/sample, falling below the lower acceptance limit of 0.83 Bq/sample. The rerun result was still low, but fell within the lower acceptance range of 0.836. The rerun result was statistically the same number as the original result. No cause could be found for the slightly low results. NCR 14-04
5. Teledyne Brown Engineering's MAPEP September 2014 Sr-90 in AP result of 0.310 Bq/sample was lower than the known value of 0.703 Bq/sample. The gravimetric yield of 117% was very high (we normally see yields of 60% to 70%) and could account for the low activity. NCR 14-09
6. Teledyne Brown Engineering's MAPEP September 2014 Gr-Alpha in AP result of 0.153 Bq/sample was lower than the known value of 0.53 Bq/sample. The AP sample was counted on the wrong side. The AP was flipped over and recounted with acceptable results. NCR 14-09

For the EIML laboratory, 85 of 90 analyses met the specified acceptance criteria. Five analyses (Water – Pu-238, Pu-239, Fe-55; AP – Co-57; Soil – Cs134) did not meet the specified acceptance criteria for the following reasons:

1. Environmental Inc., Midwest Laboratory's MAPEP February 2014 water Pu-238 result of 1.28 Bq/L was higher than the known value of 0.83 Bq/L, exceeding the upper control limit of 1.08 Bq/L. The high bias on the plutonium was traced to contamination from a newly purchased standard. The result of the reanalysis with the new tracer was 0.68 Bq/L, which fell within the acceptance criteria.
2. Environmental Inc., Midwest Laboratory's MAPEP February 2014 water Pu-239/240 result of 0.91 Bq/L was higher than the known

value of 0.68 Bq/L, exceeding the upper control limit of 0.88 Bq/L. The high bias on the plutonium was traced to contamination from a newly purchased standard. The result of reanalysis with the new tracer was 0.66 Bq/L, which fell within the acceptance criteria.

3. Environmental Inc., Midwest Laboratory's MAPEP February 2014 AP Co-57 result of 1.60 ± 0.05 Bq/total sample failed the false positive test. Interference from the Eu-152 resulted in the misidentification of Co-57.
4. Environmental Inc., Midwest Laboratory's MAPEP February 2014 soil Cs-134 result of 6.10 ± 1.80 Bq/kg failed the false positive test. Long sample counting time lead to interference from naturally occurring Bi-214 in the sample matrix with a close spectral energy.
5. Environmental Inc., Midwest Laboratory's MAPEP August 2014 water Fe-55 result of 55.10 ± 14.80 Bq/L was higher than the known value of 31.50 Bq/L, exceeding the upper control limit of 41.00 Bq/L. The result of the reanalysis of Fe-55 was 32.63 ± 16.30 Bq/L, which fell within the acceptance criteria.

The Inter-Laboratory Comparison Program provides evidence of "in control" counting systems and methods, and that the laboratories are producing accurate and reliable data.

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

**TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR
THE ZION NUCLEAR POWER STATION, 2014**

Name of Facility: ZION Location of Facility: ZION IL				DOCKET NUMBER: 50-295 & 50-304 2014 REPORTING PERIOD: ANNUAL				
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR	CONTROL	LOCATION WITH HIGHEST ANNUAL MEAN (M)		
				LOCATIONS MEAN (M) (F) RANGE	LOCATION MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
PUBLIC WATER (PCI/LITER)	GR-B	48	4	2.8 (27/36) (2.1/4.3)	3.3 (7/12) (2.6/4.1)	3.3 (7/12) (2.6/4.1)	Z-18 CONTROL LAKE FOREST WATER WORKS 12.9 MILES S OF SITE	0
	H-3	16	200	<LLD	<LLD	-		0
	GAMMA MN-54	48	15	<LLD	<LLD	-		0
	CO-58		15	<LLD	<LLD	-		0
	FE-59		30	<LLD	<LLD	-		0
	CO-60		15	<LLD	<LLD	-		0
	ZN-65		30	<LLD	<LLD	-		0
	NB-95		15	<LLD	<LLD	-		0
	ZR-95		15	<LLD	<LLD	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

**TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR
THE ZION NUCLEAR POWER STATION, 2014**

Name of Facility: ZION Location of Facility: ZION IL				DOCKET NUMBER: 50-295 & 50-304 2014 REPORTING PERIOD: ANNUAL				
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR	CONTROL	LOCATION WITH HIGHEST ANNUAL MEAN (M)		
				LOCATIONS MEAN (M) (F) RANGE	LOCATION MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
PUBLIC WATER (PCI/LITER)	CS-134		15	<LLD	<LLD	-		0
	CS-137		18	<LLD	<LLD	-		0
	BA-140		NA	<LLD	<LLD	-		0
	LA-140		NA	<LLD	<LLD	-		0
FISH (PCI/KG WET)	GAMMA MN-54	8	130	<LLD	NA	-		0
	CO-58		130	<LLD	NA	-		0
	FE-59		260	<LLD	NA	-		0
	CO-60		130	<LLD	NA	-		0
	ZN-65		260	<LLD	NA	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

**TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR
THE ZION NUCLEAR POWER STATION, 2014**

Name of Facility: ZION Location of Facility: ZION IL				DOCKET NUMBER: 50-295 & 50-304 2014 REPORTING PERIOD: ANNUAL				
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR	CONTROL	LOCATION WITH HIGHEST ANNUAL MEAN (M)		
				LOCATIONS MEAN (M) (F) RANGE	LOCATION MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
FISH (PCI/KG WET)	NB-95		NA	<LLD	NA	-		0
	ZR-95		NA	<LLD	NA	-		0
	CS-134		100	<LLD	NA	-		0
	CS-137		100	<LLD	NA	-		0
	BA-140		NA	<LLD	NA	-		0
	LA-140		NA	<LLD	NA	-		0
SEDIMENT (PCI/KG DRY)	GAMMA MN-54	2	NA	<LLD	NA	-		0
	CO-58		NA	<LLD	NA	-		0
	FE-59		NA	<LLD	NA	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

**TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR
THE ZION NUCLEAR POWER STATION, 2014**

Name of Facility: ZION Location of Facility: ZION IL				DOCKET NUMBER: 50-295 & 50-304 2014 REPORTING PERIOD: ANNUAL				
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR	CONTROL	LOCATION WITH HIGHEST ANNUAL MEAN (M)		
				LOCATIONS MEAN (M) (F) RANGE	LOCATION MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SEDIMENT (PCI/KG DRY)	CO-60		NA	<LLD	NA	-		0
	ZN-65		NA	<LLD	NA	-		0
	NB-95		NA	<LLD	NA	-		0
	ZR-95		NA	<LLD	NA	-		0
	CS-134		150	<LLD	NA	-		0
	CS-137		180	<LLD	NA	-		0
	BA-140		NA	<LLD	NA	-		0
	LA-140		NA	<LLD	NA	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

**TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR
THE ZION NUCLEAR POWER STATION, 2014**

Name of Facility: ZION Location of Facility: ZION IL				DOCKET NUMBER: 50-295 & 50-304 2014 REPORTING PERIOD: ANNUAL				
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR	CONTROL	LOCATION WITH HIGHEST ANNUAL MEAN (M)		
				LOCATIONS MEAN (M) (F) RANGE	LOCATION MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATE (E-3 PC/CU METER)	GR-B	208	10	16 (156/156) (6/30)	17 (52/52) (7/29)	17 (52/52) (7/29)	Z-13 CONTROL OFFSITE CONTROL 10.0 MILES NW OF SITE	0
	GAMMA MN-54	16	NA	<LLD	<LLD	-		0
	CO-58		NA	<LLD	<LLD	-		0
	FE-59		NA	<LLD	<LLD	-		0
	CO-60		NA	<LLD	<LLD	-		0
	ZN-65		NA	<LLD	<LLD	-		0
	NB-95		NA	<LLD	<LLD	-		0
	ZR-95		NA	<LLD	<LLD	-		0
	CS-134		10	<LLD	<LLD	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

**TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR
THE ZION NUCLEAR POWER STATION, 2014**

Name of Facility: ZION Location of Facility: ZION IL				DOCKET NUMBER: 50-295 & 50-304 2014 REPORTING PERIOD: ANNUAL				
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR	CONTROL	LOCATION WITH HIGHEST ANNUAL MEAN (M)		
				MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATE (E-3 PCI/CU.METER)	CS-137		10	<LLD	<LLD	-		0
	BA-140		NA	<LLD	<LLD	-		0
	LA-140		NA	<LLD	<LLD	-		0
VEGETATION (PCI/KG WET)	GAMMA MN-54	6	NA	<LLD	<LLD	-		0
	CO-58		NA	<LLD	<LLD	-		0
VEGETATION (PCI/KG WET)	FE-59		NA	<LLD	<LLD	-		0
	CO-60		NA	<LLD	<LLD	-		0
	ZN-65		NA	<LLD	<LLD	-		0
	NB-95		NA	<LLD	<LLD	-		0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

**TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR
THE ZION NUCLEAR POWER STATION, 2014**

Name of Facility: ZION Location of Facility: ZION IL				DOCKET NUMBER: 50-295 & 50-304 2014 REPORTING PERIOD: ANNUAL				
MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS	CONTROL LOCATION	LOCATION WITH HIGHEST ANNUAL MEAN (M)		
				MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	ZR-95		NA	<LLD	<LLD	-		0
	CS-134		60	<LLD	<LLD	-		0
	CS-137		80	<LLD	<LLD	-		0
	BA-140		NA	<LLD	<LLD	-		0
	LA-140		NA	<LLD	<LLD	-		0
DIRECT RADIATION (MILLI-ROENTGEN/QTR.)	TLD-QUARTERLY	240	NA	25 (232/232) (17/104)	21 (8/8) (20/24)	70 (4/4) (23/104)	Z-122-1 INDICATOR 0.2 MILES W	0

* THE MEAN AND 2 STANDARD DEVIATION VALUES ARE CALCULATED USING THE POSITIVE VALUES
FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F)

APPENDIX B

LOCATION DESIGNATION, DISTANCE & DIRECTION, AND SAMPLE COLLECTION & ANALYTICAL METHODS

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Zion Nuclear Power Station, 2014

Location	Location Description	Distance & Direction From Site
<u>A. Public Water</u>		
Z-14	Kenosha Water Works (control)	10.0 miles N
Z-15	Lake County Water Works (indicator)	1.4 miles NNW
Z-16	Waukegan Water Works (indicator)	6.1 miles S
Z-18	Lake Forest Water Works (control)	12.9 miles S
<u>B. Air Particulates</u>		
Z-01	Onsite 1 (indicator)	0.3 miles S
Z-02	Onsite 2 (indicator)	0.2 miles W
Z-03	Onsite 3 (indicator)	0.2 miles NNW
Z-13	Offsite Control	10 miles NW
<u>C. Fish</u>		
Z-26	Lake Michigan Nearsite (indicator)	At station
Z-27	Lake Michigan Farsite (indicator)	10.1 miles N
<u>D. Sediment</u>		
Z-25	Lake Michigan, Illinois Beach State Park (indicator)	0.2 miles S
<u>E. Environmental Dosimetry - TLD</u>		
<u>Inner Ring</u>		
Z-101-1 and -2		0.2 miles N
Z-102-1 and -2		0.2 miles NNE
Z-103-1 and -2		0.2 miles NE
Z-104-1 and -2		0.1 miles ENE
Z-105-1 and -2		0.1 miles E
Z-106-1 and -2		0.1 miles ESE
Z-107-1 and -2		0.1 miles SE
Z-108-1 and -2		0.1 miles SSE
Z-110-1 and -2		0.2 miles SSW
Z-111-1 and -2		0.3 miles SW
Z-112-1 and -2		0.7 miles WSW
Z-113-1 and -2		0.6 miles W
Z-114-1 and -2		0.6 miles WNW
Z-115-1 and -2		0.4 miles NW
<u>Other</u>		
Z-01-1 and -2	Onsite 1 (indicator)	0.3 miles S
Z-02-1 and -2	Onsite 2 (indicator)	0.2 miles W
Z-03-1 and -2	Onsite 3 (indicator)	0.2 miles NNW
<u>ISFSI Inner Ring</u>		
Z-121-1 and -2		0.2 miles NNW
Z-122-1 and -2		0.2 miles W
Z-123-1 and -2		0.1 miles WSW
Z-124-1 and -2		0.5 miles SW
Z-125-1 and -2		0.4 miles SSW

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Zion Nuclear Power Station, 2014

Location	Location Description	Distance & Direction From Site
<u>E. Environmental Dosimetry – TLD (continued)</u>		
<u>Outer Ring</u>		
Z-209-1 and -2		5.1 miles S
Z-211-1 and -2		4.7 miles SW
Z-212-1 and -2		5.1 miles WSW
Z-213-1 and -2		5.1 miles W
Z-214-1 and -2		4.6 miles WNW
Z-215-1 and -2		4.0 miles NW
Z-216-1 and -2		3.0 miles NNW
<u>Control</u>		
Z-13-1 and -2		10 miles NW

TABLE B-2: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Zion Nuclear Power Station, 2014

Sample Medium	Analysis	Sampling Method	Analytical Procedure Number
Public Water	Gamma Spectroscopy	Monthly composite from weekly grab samples.	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Public Water	Gross Beta	Monthly composite from weekly grab samples.	TBE, TBE-2008 Gross Alpha and/or gross beta activity in various matrices Env. Inc., W(DS)-01 Determination of gross alpha and/or gross beta in water (dissolved solids or total residue)
Public Water	Tritium	Quarterly composite from weekly grab samples.	TBE, TBE-2011 Tritium analysis in drinking water by liquid scintillation Env. Inc., T-02 Determination of tritium in water (direct method)
Fish	Gamma Spectroscopy	Semi-annual samples collected via electroshocking or other techniques	TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Sediment	Gamma Spectroscopy	Semi-annual grab samples	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
Air Particulates	Gross Beta	One-week composite of continuous air sampling through glass fiber filter paper	TBE, TBE-2008 Gross Alpha and/or gross beta activity in various matrices Env. Inc., AP-02 Determination of gross alpha and/or gross beta in air particulate filters
Air Particulates	Gamma Spectroscopy	Quarterly composite of each station	TBE, TBE-2007 Gamma emitting radioisotope analysis Env. Inc., GS-01 Determination of gamma emitters by gamma spectroscopy
TLD	Thermoluminescence Dosimetry	Quarterly TLDs comprised of two CaF 200 and two LiF 100 LiF 4-chip Harshaw elements.	Mirion Technologies

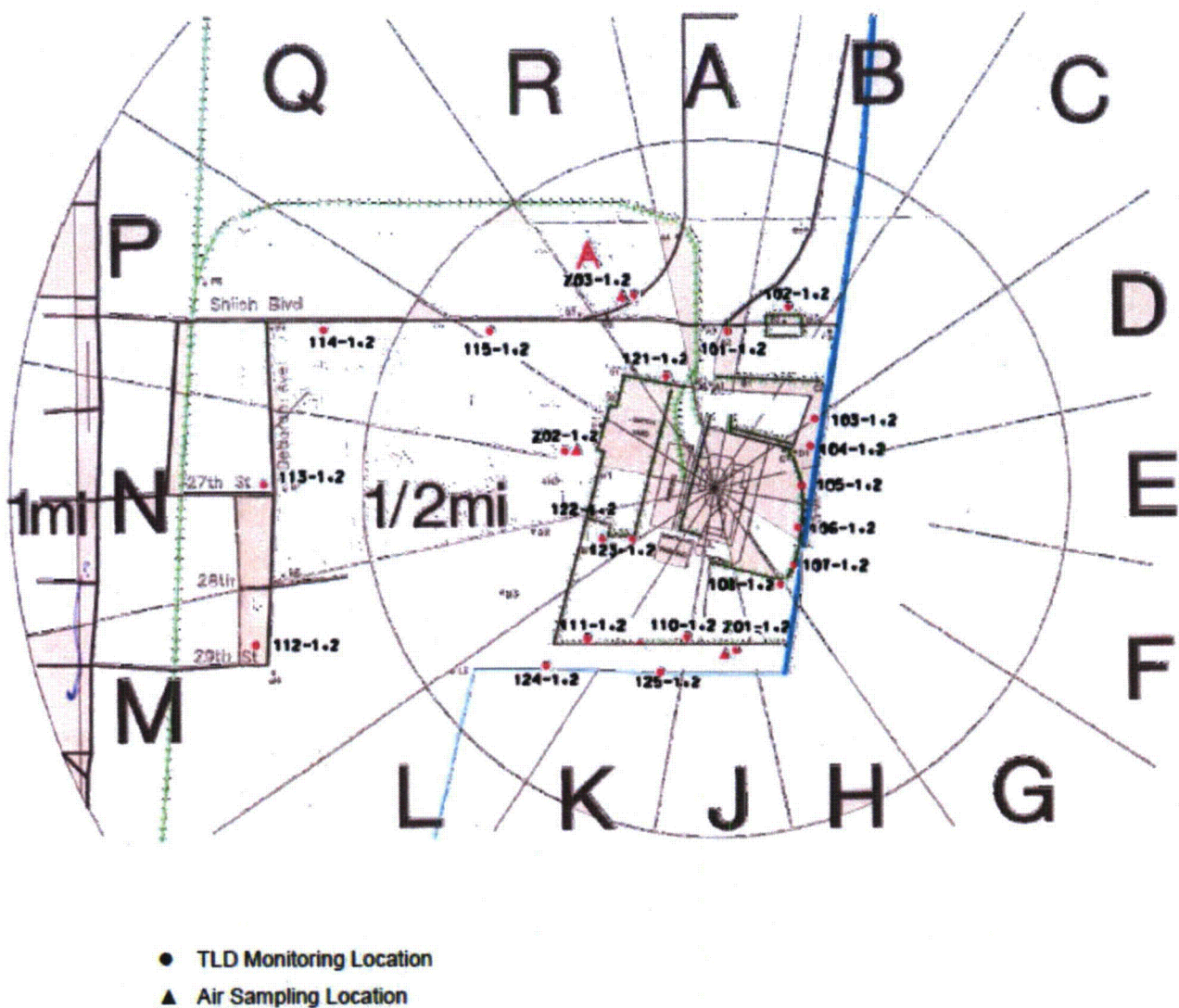


Figure B-1
Inner Ring TLD and Fixed Air Sampler Locations of the Zion Nuclear Power Station, 2014

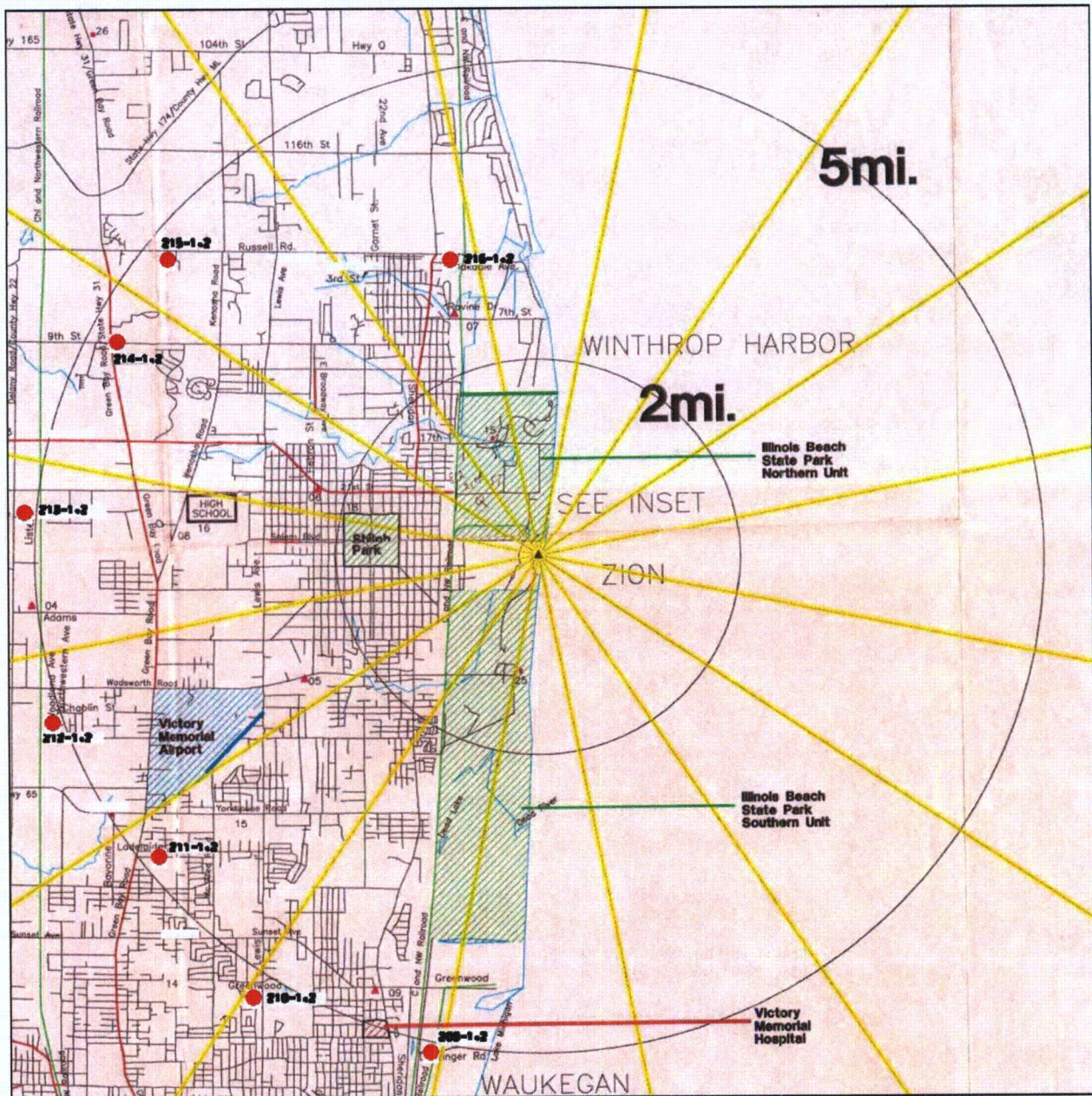


Figure B-2
Outer Ring TLD and Fixed Air Sampler Locations of the Zion Nuclear Power Station, 2014

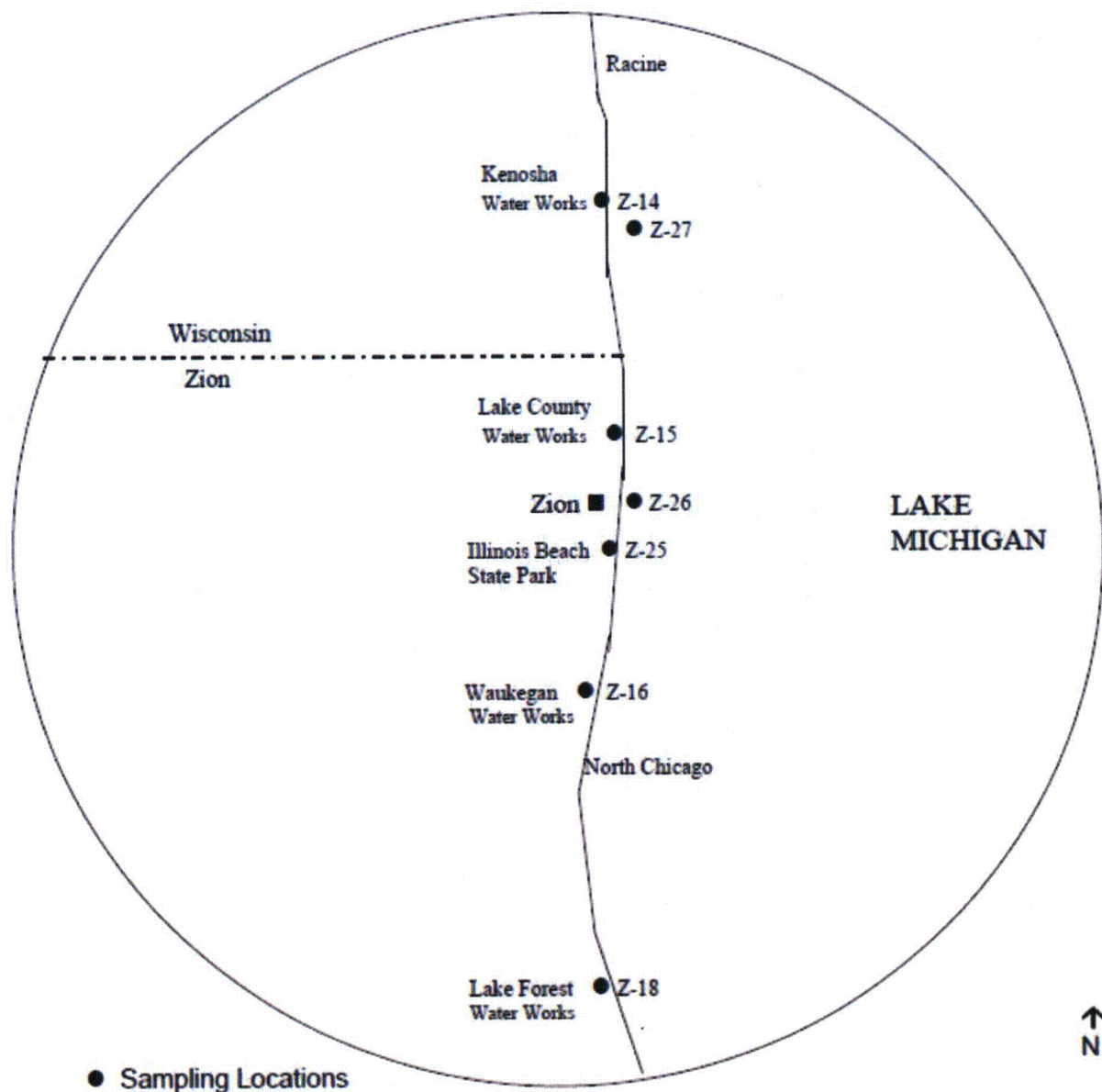


Figure B-3
Fish, Water and Sediment Sampling Locations of the Zion Nuclear Power Station, 2014

APPENDIX C

DATA TABLES AND FIGURES PRIMARY LABORATORY

Table C-I.1**Concentrations of Gross Beta in Public Water Samples
Collected in the Vicinity of Zion Nuclear Power Station, 2014**Results in Units of pCi/liter \pm 2 Sigma

COLLECTION PERIOD	Z-14	Z-15	Z-16	Z-18
01/03/14 - 01/29/14	3.2 \pm 1.5	2.9 \pm 1.5	2.3 \pm 1.4	2.7 \pm 1.5
02/06/14 - 02/26/14	< 2.1	< 2.1	2.7 \pm 1.5	< 2.1
03/05/14 - 03/26/14	< 2.2	< 2.2	< 2.1	< 2.1
04/02/14 - 04/30/14	3.6 \pm 1.6	2.6 \pm 1.5	3.4 \pm 1.6	3.4 \pm 1.5
05/07/14 - 05/28/14	3.1 \pm 1.5 (1)	3.9 \pm 1.4	2.8 \pm 1.4	3.1 \pm 1.4
06/04/14 - 06/25/14	3.7 \pm 1.7	4.3 \pm 1.7	4.0 \pm 1.5	3.6 \pm 1.5
07/02/14 - 07/30/14	2.4 \pm 1.5	< 2.1	2.7 \pm 1.6	< 2.3
08/06/14 - 08/27/14	< 2.0	2.1 \pm 1.4	2.3 \pm 1.4	4.1 \pm 1.5
09/03/14 - 09/24/14	< 2.2	2.6 \pm 1.6	2.4 \pm 1.6	< 2.3
10/01/14 - 10/28/14	2.4 \pm 1.4	2.3 \pm 1.4	2.3 \pm 1.4	2.6 \pm 1.4
11/05/14 - 11/26/14	< 2.2	2.3 \pm 1.5	2.4 \pm 1.5	< 2.2
12/03/14 - 12/31/14	2.5 \pm 1.3	3.0 \pm 1.3	3.1 \pm 1.3 (1)	3.8 \pm 1.4
MEAN	3.0 \pm 1.1	2.9 \pm 1.5	2.7 \pm 1.1	3.3 \pm 1.1

Table C-I.2**Concentrations of Tritium in Public Water Samples
Collected in the Vicinity of Zion Nuclear Power Station, 2014**Results in Units of pCi/liter \pm 2 Sigma

COLLECTION PERIOD	Z-14	Z-15	Z-16	Z-18
01/03/14 - 03/26/14	< 167	< 168	< 167	< 171
04/02/14 - 06/25/14	< 188 (1)	< 190	< 181	< 183
07/02/14 - 09/24/14	< 174	< 173	< 171	< 176
10/01/14 - 12/31/14	< 191	< 190	< 189 (1)	< 192
MEAN	-	-	-	-

THE MEAN AND 2 STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

**Table C-I.3 Concentrations of Gamma Emitters in Public Water Samples
Collected in the Vicinity of Zion Nuclear Power Station, 2014**

Results in Units of pCi/liter \pm 2 Sigma

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Z-14	01/03/14 - 01/29/14	< 4	< 4	< 12	< 5	< 9	< 5	< 10	< 4	< 5	< 46	< 15
	02/06/14 - 02/26/14	< 4	< 4	< 10	< 4	< 8	< 5	< 8	< 3	< 4	< 38	< 12
	03/05/14 - 03/26/14	< 6	< 5	< 13	< 7	< 12	< 7	< 12	< 5	< 5	< 43	< 15
	04/02/14 - 04/30/14	< 4	< 7	< 13	< 5	< 13	< 6	< 12	< 6	< 6	< 51	< 16
	05/07/14 - 05/28/14 (1)	< 6	< 7	< 13	< 7	< 14	< 8	< 13	< 5	< 6	< 60	< 20
	06/04/14 - 06/25/14	< 3	< 3	< 8	< 3	< 6	< 4	< 6	< 3	< 3	< 33	< 8
	07/02/14 - 07/30/14	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 16	< 6
	08/06/14 - 08/27/14	< 4	< 5	< 10	< 7	< 9	< 6	< 8	< 4	< 5	< 55	< 13
	09/03/14 - 09/24/14	< 5	< 5	< 10	< 5	< 10	< 6	< 9	< 5	< 5	< 25	< 11
	10/01/14 - 10/28/14	< 8	< 8	< 19	< 6	< 18	< 8	< 14	< 7	< 6	< 53	< 29
	11/05/14 - 11/26/14	< 4	< 4	< 11	< 5	< 8	< 4	< 7	< 4	< 4	< 45	< 15
	12/03/14 - 01/02/15	< 5	< 8	< 14	< 6	< 14	< 8	< 13	< 7	< 8	< 53	< 15
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-15	01/03/14 - 01/29/14	< 5	< 5	< 14	< 5	< 10	< 6	< 9	< 5	< 5	< 48	< 19
	02/06/14 - 02/26/14	< 6	< 7	< 18	< 7	< 14	< 8	< 14	< 6	< 5	< 55	< 18
	03/05/14 - 03/26/14	< 5	< 6	< 14	< 5	< 12	< 5	< 10	< 5	< 6	< 42	< 7
	04/02/14 - 04/30/14	< 5	< 4	< 12	< 6	< 8	< 6	< 10	< 5	< 5	< 55	< 14
	05/07/14 - 05/28/14	< 5	< 6	< 12	< 4	< 8	< 5	< 12	< 5	< 6	< 57	< 14
	06/04/14 - 06/25/14	< 4	< 6	< 9	< 4	< 8	< 5	< 8	< 4	< 4	< 45	< 14
	07/02/14 - 07/30/14	< 2	< 2	< 6	< 2	< 5	< 3	< 4	< 2	< 2	< 21	< 6
	08/06/14 - 08/27/14	< 7	< 8	< 14	< 6	< 13	< 9	< 14	< 7	< 7	< 77	< 14
	09/03/14 - 09/24/14	< 6	< 7	< 12	< 5	< 13	< 7	< 9	< 5	< 6	< 41	< 11
	10/01/14 - 10/28/14	< 6	< 6	< 16	< 6	< 13	< 7	< 9	< 6	< 6	< 51	< 18
	11/05/14 - 11/26/14	< 4	< 4	< 10	< 4	< 8	< 4	< 9	< 4	< 4	< 39	< 13
	12/03/14 - 12/31/14	< 5	< 5	< 10	< 5	< 9	< 5	< 9	< 5	< 5	< 36	< 9
	MEAN	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-I.3 Concentrations of Gamma Emitters in Public Water Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014

Results in Units of pCi/liter \pm 2 Sigma

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Z-16	01/03/14 - 01/29/14	< 7	< 7	< 16	< 7	< 13	< 7	< 13	< 6	< 7	< 70	< 23
	02/06/14 - 02/26/14	< 5	< 7	< 14	< 6	< 11	< 7	< 10	< 5	< 6	< 61	< 18
	03/05/14 - 03/26/14	< 5	< 5	< 10	< 5	< 7	< 6	< 9	< 5	< 5	< 37	< 13
	04/02/14 - 04/30/14	< 7	< 7	< 17	< 7	< 11	< 7	< 11	< 6	< 7	< 66	< 21
	05/07/14 - 05/28/14	< 7	< 9	< 16	< 6	< 14	< 9	< 11	< 7	< 7	< 67	< 19
	06/04/14 - 06/25/14	< 4	< 4	< 8	< 3	< 7	< 4	< 7	< 3	< 4	< 40	< 11
	07/02/14 - 07/30/14	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 2	< 2	< 19	< 6
	08/06/14 - 08/27/14	< 8	< 9	< 15	< 8	< 14	< 7	< 12	< 7	< 7	< 81	< 27
	09/03/14 - 09/24/14	< 5	< 6	< 12	< 5	< 8	< 6	< 11	< 6	< 6	< 43	< 15
	10/01/14 - 10/28/14	< 6	< 8	< 20	< 7	< 14	< 7	< 13	< 5	< 5	< 66	< 7
	11/05/14 - 11/26/14	< 4	< 4	< 9	< 4	< 7	< 4	< 7	< 4	< 4	< 42	< 11
	12/03/14 - 12/31/14 (1)	< 6	< 6	< 14	< 6	< 11	< 6	< 9	< 5	< 5	< 39	< 14
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-18	01/03/14 - 01/29/14	< 5	< 5	< 13	< 7	< 9	< 6	< 12	< 5	< 6	< 50	< 18
	02/06/14 - 02/26/14	< 5	< 6	< 16	< 7	< 10	< 7	< 12	< 6	< 6	< 51	< 15
	03/05/14 - 03/26/14	< 5	< 5	< 12	< 6	< 11	< 6	< 9	< 5	< 5	< 33	< 11
	04/02/14 - 04/30/14	< 6	< 7	< 12	< 7	< 12	< 7	< 14	< 6	< 7	< 65	< 15
	05/07/14 - 05/28/14	< 7	< 7	< 17	< 6	< 11	< 8	< 13	< 5	< 7	< 55	< 21
	06/04/14 - 06/25/14	< 4	< 4	< 11	< 5	< 9	< 4	< 8	< 3	< 4	< 41	< 15
	07/02/14 - 07/30/14	< 2	< 2	< 5	< 2	< 4	< 2	< 3	< 2	< 2	< 16	< 6
	08/06/14 - 08/27/14	< 3	< 5	< 13	< 5	< 9	< 6	< 8	< 5	< 4	< 44	< 15
	09/03/14 - 09/24/14	< 5	< 5	< 11	< 5	< 10	< 5	< 9	< 6	< 5	< 35	< 11
	10/01/14 - 10/28/14	< 6	< 6	< 15	< 7	< 9	< 8	< 11	< 5	< 5	< 61	< 19
	11/05/14 - 11/26/14	< 3	< 4	< 10	< 4	< 7	< 5	< 7	< 4	< 4	< 43	< 14
	12/03/14 - 12/31/14	< 6	< 6	< 13	< 5	< 10	< 6	< 11	< 5	< 6	< 40	< 15
	MEAN	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-II.1

**Concentrations of Gamma Emitters in Fish Samples
Collected in the Vicinity of Zion Nuclear Power Station, 2014**

Results in Units of pCi/kg Wet \pm 2 sigma

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Z-26												
Common Carp	05/22/14	< 31	< 38	< 77	< 45	< 71	< 29	< 64	< 30	< 32	< 218	< 69
Smallmouth Bass	05/22/14	< 50	< 53	< 112	< 43	< 118	< 59	< 85	< 52	< 60	< 353	< 77
Chinook Salmon	10/01/14	< 37	< 35	< 98	< 44	< 91	< 46	< 84	< 40	< 55	< 470	< 158
Common Carp	10/01/14	< 65	< 66	< 135	< 63	< 131	< 65	< 125	< 57	< 47	< 550	< 183
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-27												
Burbot	05/14/14	< 42	< 53	< 120	< 44	< 101	< 59	< 113	< 48	< 59	< 459	< 145
Lake Trout	05/14/14	< 66	< 73	< 157	< 58	< 144	< 71	< 136	< 57	< 68	< 598	< 221
Burbot	10/22/14	< 75	< 73	< 119	< 73	< 152	< 70	< 127	< 62	< 79	< 642	< 200
Lake Trout	10/22/14	< 61	< 69	< 149	< 62	< 157	< 68	< 132	< 64	< 77	< 613	< 131
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-III.1**Concentrations of Gamma Emitters in Sediment Samples
Collected in the Vicinity of Zion Nuclear Power Station, 2014**Results in Units of pCi/kg Dry \pm 2 sigma

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Z-25	05/21/14	< 35	< 42	< 77	< 35	< 96	< 43	< 68	< 36	< 44	< 267	< 56
	10/08/14	< 35	< 48	< 76	< 38	< 107	< 55	< 84	< 35	< 44	< 370	< 138
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-IV.1

**Concentrations of Gross Beta in Air Particulate Samples
Collected in the Vicinity of Zion Nuclear Power Station, 2014**

Results in Units of E-3 pCi/cu meter \pm 2 Sigma

COLLECTION PERIOD	GROUP I			GROUP II
	Z-01	Z-02	Z-03	Z-13
01/03/14 - 01/08/14	30 \pm 6	28 \pm 6	30 \pm 6	25 \pm 6
01/08/14 - 01/15/14	20 \pm 4	19 \pm 4	22 \pm 5	24 \pm 5
01/15/14 - 01/22/14	20 \pm 4	21 \pm 4	18 \pm 4	20 \pm 4
01/22/14 - 01/29/14	13 \pm 4	12 \pm 4	18 \pm 4	14 \pm 4
01/29/14 - 02/06/14	18 \pm 4	21 \pm 4	18 \pm 4	20 \pm 4
02/06/14 - 02/12/14	24 \pm 5	21 \pm 5	20 \pm 5	17 \pm 4
02/12/14 - 02/19/14	25 \pm 4	19 \pm 4	22 \pm 4	26 \pm 5
02/19/14 - 02/26/14	27 \pm 5	27 \pm 5	27 \pm 5	28 \pm 5
02/26/14 - 03/05/14	21 \pm 4	23 \pm 4	22 \pm 4	29 \pm 5
03/05/14 - 03/13/14	16 \pm 4	20 \pm 4	18 \pm 4	17 \pm 4
03/13/14 - 03/19/14	10 \pm 4	12 \pm 5	12 \pm 5	11 \pm 4
03/19/14 - 03/26/14	15 \pm 4	15 \pm 4	19 \pm 4	17 \pm 4
03/26/14 - 04/02/14	14 \pm 4	18 \pm 4	14 \pm 4	18 \pm 4
04/02/14 - 04/09/14	14 \pm 4	14 \pm 4	17 \pm 4	12 \pm 4
04/09/14 - 04/16/14	14 \pm 4	11 \pm 4	11 \pm 4	14 \pm 4
04/16/14 - 04/23/14	16 \pm 4	22 \pm 4	19 \pm 4	16 \pm 4
04/23/14 - 04/30/14	12 \pm 4	10 \pm 4	14 \pm 4	13 \pm 4
04/30/14 - 05/07/14	6 \pm 3	6 \pm 3	7 \pm 3	7 \pm 3
05/07/14 - 05/14/14	16 \pm 4	15 \pm 4	13 \pm 4	14 \pm 4
05/14/14 - 05/21/14	13 \pm 4	14 \pm 4	13 \pm 4	14 \pm 4
05/21/14 - 05/28/14	16 \pm 4	16 \pm 4	13 \pm 4	18 \pm 4
05/28/14 - 06/04/14	13 \pm 4	11 \pm 4	10 \pm 4	11 \pm 4
06/04/14 - 06/11/14	14 \pm 4	10 \pm 4	10 \pm 4	12 \pm 4
06/11/14 - 06/18/14	14 \pm 4	18 \pm 4	18 \pm 4	15 \pm 4
06/18/14 - 06/25/14	9 \pm 3	10 \pm 3	10 \pm 3	8 \pm 3
06/25/14 - 07/02/14	14 \pm 4	12 \pm 4	14 \pm 4	15 \pm 4
07/02/14 - 07/08/14	15 \pm 4	15 \pm 4	11 \pm 4	12 \pm 4
07/08/14 - 07/16/14	13 \pm 3	13 \pm 3	10 \pm 3	12 \pm 3
07/16/14 - 07/23/14	23 \pm 5	20 \pm 4	16 \pm 4	22 \pm 4
07/23/14 - 07/30/14	15 \pm 4	10 \pm 4	10 \pm 4	15 \pm 4
07/30/14 - 08/06/14	21 \pm 4	16 \pm 4	20 \pm 4	29 \pm 5
08/06/14 - 08/12/14	14 \pm 4	11 \pm 4	13 \pm 4	18 \pm 5
08/12/14 - 08/20/14	17 \pm 4	13 \pm 3	12 \pm 3	15 \pm 4
08/20/14 - 08/27/14	12 \pm 4	13 \pm 4	16 \pm 4	12 \pm 4
08/27/14 - 09/03/14	19 \pm 4	15 \pm 4	14 \pm 4	17 \pm 4
09/03/14 - 09/10/14	18 \pm 4	13 \pm 4	13 \pm 4	19 \pm 5
09/10/14 - 09/17/14	10 \pm 3	6 \pm 2	9 \pm 3	10 \pm 3
09/17/14 - 09/24/14	23 \pm 5	15 \pm 4	20 \pm 4	19 \pm 4
09/24/14 - 10/01/14	19 \pm 4	16 \pm 4	20 \pm 4	25 \pm 5
10/01/14 - 10/08/14	12 \pm 4	13 \pm 4	9 \pm 4	12 \pm 4
10/08/14 - 10/15/14	13 \pm 4	13 \pm 4	12 \pm 4	13 \pm 4
10/15/14 - 10/22/14	12 \pm 4	10 \pm 3	7 \pm 3	12 \pm 4
10/22/14 - 10/28/14	21 \pm 5	15 \pm 5	22 \pm 5	20 \pm 5
10/28/14 - 11/05/14	13 \pm 3	11 \pm 3	13 \pm 4	16 \pm 4
11/05/14 - 11/12/14	15 \pm 4	12 \pm 4	12 \pm 4	17 \pm 4
11/12/14 - 11/19/14	16 \pm 4	13 \pm 4	14 \pm 4	21 \pm 4
11/19/14 - 11/26/14	15 \pm 4	13 \pm 4	16 \pm 4	15 \pm 4
11/26/14 - 12/03/14	27 \pm 5	18 \pm 4	19 \pm 4	23 \pm 5
12/03/14 - 12/10/14	26 \pm 5	30 \pm 5	23 \pm 4	27 \pm 5
12/10/14 - 12/17/14	19 \pm 4	16 \pm 4	16 \pm 4	20 \pm 4
12/17/14 - 12/23/14	22 \pm 5	28 \pm 5	23 \pm 5	25 \pm 5
12/23/14 - 12/31/14	20 \pm 4	15 \pm 4	12 \pm 3	19 \pm 4
MEAN	17 \pm 10	15 \pm 11	16 \pm 10	17 \pm 11

Table C-IV.2

**Monthly and Yearly Mean Values of Gross Beta Concentrations in Air
Particulate Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014**

Results in Units of E-3 pCi/cu meter \pm 2 Sigma

GROUP I - ONSITE LOCATIONS				GROUP II - OFFSITE CONTROL LOCATION			
COLLECTION PERIOD	MIN	MAX	MEAN \pm 2SD	COLLECTION PERIOD	MIN	MAX	MEAN \pm 2SD
01/03/14 - 01/29/14	12	30	21 \pm 12	01/03/14 - 01/29/14	14	24.7	21 \pm 9.9
01/29/14 - 02/26/14	18	27	22 \pm 7	01/29/14 - 02/26/14	17	27.8	23 \pm 10
02/26/14 - 04/02/14	10	23	17 \pm 8	02/26/14 - 04/02/14	11	28.8	18 \pm 13
04/02/14 - 04/30/14	10	22	14 \pm 7	04/02/14 - 04/30/14	12	16	13 \pm 4
04/30/14 - 06/04/14	6	16	12 \pm 7	04/30/14 - 06/04/14	7	18	13 \pm 8
06/04/14 - 07/02/14	9	18	13 \pm 6	06/04/14 - 07/02/14	8	15	13 \pm 6
07/02/14 - 07/30/14	10	23	14 \pm 8	07/02/14 - 07/30/14	12	22	15 \pm 9
07/30/14 - 09/03/14	11	21	15 \pm 6	07/30/14 - 09/03/14	12	29	18 \pm 13
09/03/14 - 10/01/14	6	23	15 \pm 10	09/03/14 - 10/01/14	10	25	18 \pm 12
10/01/14 - 10/28/14	7	22	13 \pm 8	10/01/14 - 10/28/14	12	20	14 \pm 8
10/28/14 - 12/03/14	11	27	15 \pm 8	10/28/14 - 12/03/14	15	23	19 \pm 6
12/03/14 - 12/31/14	12	30	21 \pm 11	12/03/14 - 12/31/14	19	27	23 \pm 8
01/03/14 - 12/31/14	6	30	16 \pm 10	01/03/14 - 12/31/14	7	29	17 \pm 11

Table C-IV.3 Concentrations of Gamma Emitters in Air Particulate Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014

Results in Units of E-3 pCi/cu meter \pm 2 Sigma

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Z-01	01/03/14 - 04/02/14	< 2	< 3	< 7	< 3	< 6	< 3	< 5	< 3	< 3	< 31	< 11
	04/02/14 - 07/02/14	< 2	< 1	< 9	< 3	< 4	< 2	< 3	< 2	< 2	< 54	< 20
	07/02/14 - 10/01/14	< 2	< 2	< 2	< 2	< 2	< 2	< 4	< 1	< 2	< 23	< 10
	10/01/14 - 12/31/14	< 2	< 3	< 8	< 3	< 5	< 3	< 6	< 2	< 2	< 39	< 15
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-02	01/03/14 - 04/02/14	< 4	< 3	< 8	< 4	< 8	< 4	< 7	< 4	< 4	< 36	< 10
	04/02/14 - 07/02/14	< 3	< 3	< 8	< 4	< 4	< 4	< 7	< 3	< 2	< 65	< 33
	07/02/14 - 10/01/14	< 1	< 1	< 4	< 2	< 3	< 1	< 3	< 2	< 1	< 16	< 7
	10/01/14 - 12/31/14	< 2	< 2	< 6	< 2	< 5	< 3	< 6	< 3	< 3	< 40	< 10
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-03	01/03/14 - 04/02/14	< 2	< 2	< 7	< 2	< 5	< 3	< 5	< 2	< 2	< 24	< 10
	04/02/14 - 07/02/14	< 4	< 4	< 8	< 4	< 9	< 5	< 8	< 3	< 3	< 67	< 21
	07/02/14 - 10/01/14	< 2	< 3	< 3	< 3	< 5	< 3	< 4	< 2	< 1	< 29	< 12
	10/01/14 - 12/31/14	< 3	< 3	< 7	< 3	< 5	< 3	< 5	< 2	< 2	< 33	< 12
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-13	01/03/14 - 04/02/14	< 2	< 2	< 4	< 2	< 5	< 2	< 3	< 2	< 2	< 19	< 7
	04/02/14 - 07/02/14	< 3	< 3	< 8	< 2	< 6	< 3	< 6	< 2	< 2	< 63	< 13
	07/02/14 - 10/01/14	< 3	< 3	< 6	< 2	< 5	< 2	< 4	< 3	< 2	< 34	< 12
	10/01/14 - 12/31/14	< 3	< 4	< 10	< 3	< 8	< 5	< 7	< 4	< 4	< 47	< 20
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-V.1

**CONCENTRATIONS OF GAMMA EMITTERS IN VEGETATION SAMPLES
COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2014**

RESULTS IN UNITS OF PC/KG WET \pm 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Z-CONTROL												
Lettuce & cauliflower leaves	09/11/14	< 4	< 5	< 13	< 5	< 11	< 5	< 9	< 4	< 5	< 37	< 11
Potato & sweet potato	09/11/14	< 2	< 3	< 6	< 4	< 6	< 3	< 4	< 2	< 3	< 23	< 5
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-QUAD 3												
Kohlrabi & potatoes	09/11/14	< 4	< 4	< 11	< 4	< 10	< 5	< 8	< 4	< 4	< 37	< 9
Lettuce & red cabbage	09/11/14	< 11	< 12	< 29	< 11	< 24	< 13	< 22	< 11	< 12	< 93	< 24
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-QUAD 4												
Broccoli & sweet potato & potato & leek	09/11/14	< 5	< 7	< 12	< 11	< 9	< 5	< 10	< 4	< 5	< 56	< 10
Cabbage & cauliflower leaves	09/11/14	< 9	< 13	< 29	< 15	< 24	< 12	< 23	< 10	< 10	< 104	< 29
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-VI.1 Quarterly TLD Results for Zion Nuclear Power Station, 2014

Results in Units of Milli-Roentgen/Quarter \pm 2 Standard Deviations

STATION CODE	MEAN \pm 2 S.D.	JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC
Z-01-1	30 \pm 10	23	31	35	29
Z-01-2	31 \pm 13	23	31	39	30
Z-02-1	21 \pm 5	24	22	20	18
Z-02-2	20 \pm 3	20	21	19	18
Z-03-1	20 \pm 1	20	19	20	19
Z-03-2	19 \pm 3	21	18	18	18
Z-13-1	21 \pm 4	20	24	20	20
Z-13-2	21 \pm 4	20	24	20	20
Z-101-1	19 \pm 2	20	19	18	18
Z-101-2	19 \pm 4	22	19	17	18
Z-102-1	22 \pm 4	24	24	20	21
Z-102-2	22 \pm 5	22	25	19	20
Z-103-1	20 \pm 1	20	20 (1)	19	20
Z-103-2	20 \pm 5	20	24 (1)	18	19
Z-104-1	19 \pm 3	21	20 (1)	17	19
Z-104-2	21 \pm 3	20	23 (1)	20	19
Z-105-1	20 \pm 3	22	20	19	18
Z-105-2	19 \pm 2	20	19	18	18
Z-106-1	20 \pm 2	20	21	19	19
Z-106-2	20 \pm 5	20	23	18	18
Z-107-1	22 \pm 5	21	25	21	19
Z-107-2	21 \pm 3	21	22	20	19
Z-108-1	23 \pm 3	21	25	23	22
Z-108-2	23 \pm 5	21	26	21	22
Z-110-1	29 \pm 10	26	30	25	36
Z-110-2	40 \pm 40	24	31	69	36
Z-111-1	34 \pm 46	19	25	68	24
Z-111-2	24 \pm 4	21	23	25	26
Z-112-1	21 \pm 5	21	24	19	19
Z-112-2	20 \pm 2	21	21	20	19
Z-113-1	20 \pm 4	20	19	19	23
Z-113-2	19 \pm 2	19	20	20	18
Z-114-1	21 \pm 4	20	24	19	21
Z-114-2	21 \pm 3	20	23	20	19
Z-115-1	22 \pm 3	23	23	20	20
Z-115-2	21 \pm 5	23	23	18	20
Z-121-1	20 \pm 3	21	20	18	20
Z-121-2	21 \pm 3	20	23	22	20
Z-122-1	70 \pm 68	23	79	73	104
Z-122-2	61 \pm 54	25	63	64	90
Z-123-1	52 \pm 45	25	44	78	59
Z-123-2	49 \pm 49	23	41	82	51
Z-124-1	21 \pm 3	21	22	19	23
Z-124-2	20 \pm 1	19	20	20	19

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VI.1 Quarterly TLD Results for Zion Nuclear Power Station, 2014

Results in Units of Milli-Roentgen/Quarter \pm 2 Standard Deviations

STATION CODE	MEAN \pm 2 S.D.	JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC
Z-125-1	23 \pm 6	19	24	25	25
Z-125-2	23 \pm 6	19	24	26	21
Z-209-1	21 \pm 1	20	21	20	21
Z-209-2	21 \pm 6	22	25	19	19
Z-211-1	24 \pm 4	23	26	25	21
Z-211-2	25 \pm 5	25	28	25	22
Z-212-1	25 \pm 4	26	27	23	23
Z-212-2	26 \pm 5	28	27	24	23
Z-213-1	26 \pm 6	24	29	27	23
Z-213-2	25 \pm 6	27	28	21	25
Z-214-1	24 \pm 4	24 (1)	27	23	23
Z-214-2	24 \pm 4	23 (1)	27	23	22
Z-215-1	25 \pm 5	23	27	26	22
Z-215-2	25 \pm 5	24	28	24	22
Z-216-1	21 \pm 3	21	23	20	20
Z-216-2	21 \pm 2	21	21	20	22

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VI.2 Mean Quarterly TLD Results for Inner Ring, ISFSI Inner Ring, Other, Outer Ring, and Control Locations For Zion Nuclear Power Station, 2014

Results in Units of Milli-Roentgen/Quarter \pm 2 Standard Deviation of the Station Data

COLLECTION PERIOD	INNER RING \pm 2 S.D.	OUTER RING	OTHER	CONTROL	ISFSI INNER RING
JAN-MAR	21 \pm 3	24 \pm 5	22 \pm 3	20 \pm 0	22 \pm 5
APR-JUN	23 \pm 6	26 \pm 5	24 \pm 12	24 \pm 0	36 \pm 41
JUL-SEP	23 \pm 26	23 \pm 5	25 \pm 19	20 \pm 0	43 \pm 55
OCT-DEC	21 \pm 9	22 \pm 3	22 \pm 12	20 \pm 0	43 \pm 64

Table C-VI.3 Summary of the Ambient Dosimetry Program for Zion Nuclear Power Station, 2014

Results in Units of Milli-Roentgen/Quarter

LOCATION	SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN \pm 2 S.D.
INNER RING	112	17	69	22 \pm 14
OUTER RING	56	19	29	24 \pm 5
OTHER	24	18	39	23 \pm 12
CONTROL	8	20	24	21 \pm 4
ISFSI INNER RING	40	18	104	36 \pm 48

INNER RING STATIONS - Z-101-1, Z-101-2, Z-102-1, Z-102-2, Z-103-1, Z-103-2, Z-104-1, Z-104-2, Z-105-1, Z-105-2, Z-106-1, Z-106-2, Z-107-1, Z-107-2, Z-108-1, Z-108-2, Z-110-1, Z-110-2, Z-111-1, Z-111-2, Z-112-1, Z-112-2, Z-113-1, Z-113-2, Z-114-1, Z-114-2, Z-115-1, Z-115-2

OUTER RING STATIONS - Z-209-1, Z-209-2, Z-211-1, Z-211-2, Z-212-1, Z-212-2, Z-213-1, Z-213-2, Z-214-1, Z-214-2, Z-215-1, Z-215-2, Z-216-1, Z-216-2

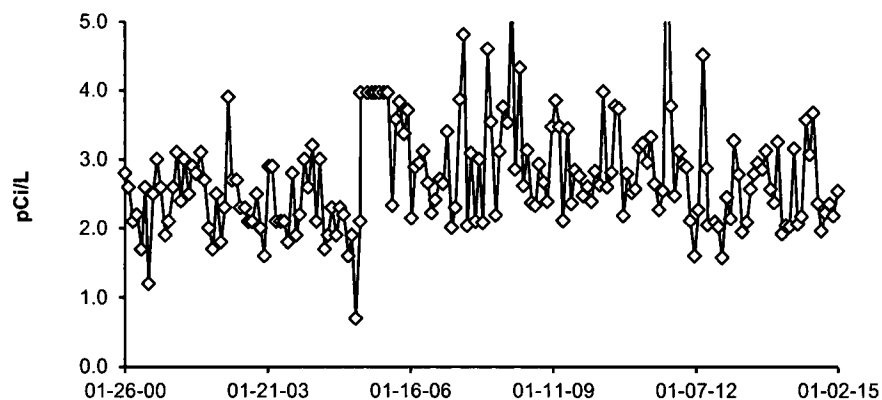
OTHER STATIONS - Z-01-1, Z-01-2, Z-02-1, Z-02-2, Z-03-1, Z-03-2

CONTROL STATIONS - Z-13-1, Z-13-2

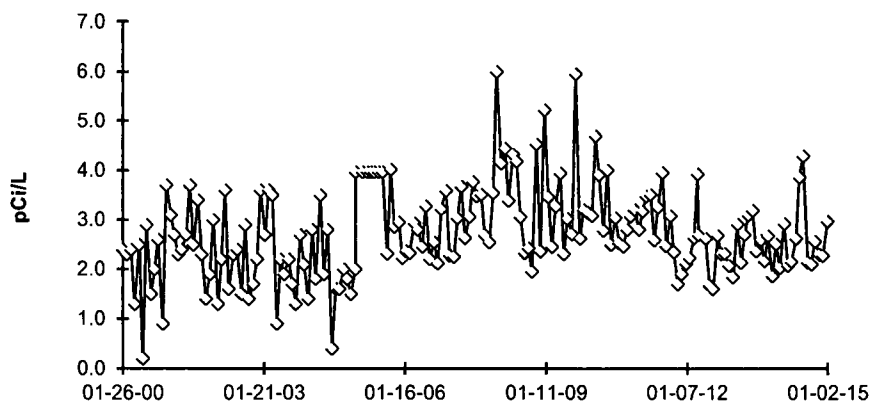
ISFSI INNER RING STATIONS - Z-121-1, Z-121-2, Z-122-1, Z-122-2, Z-123-1, Z-123-2, Z-124-1, Z-124-2, Z-125-1, Z-125-2

FIGURE C-1
PUBLIC WATER - GROSS BETA - STATIONS Z-14 AND
Z-15 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2014

Z-14 (C) Kenosha Water Works



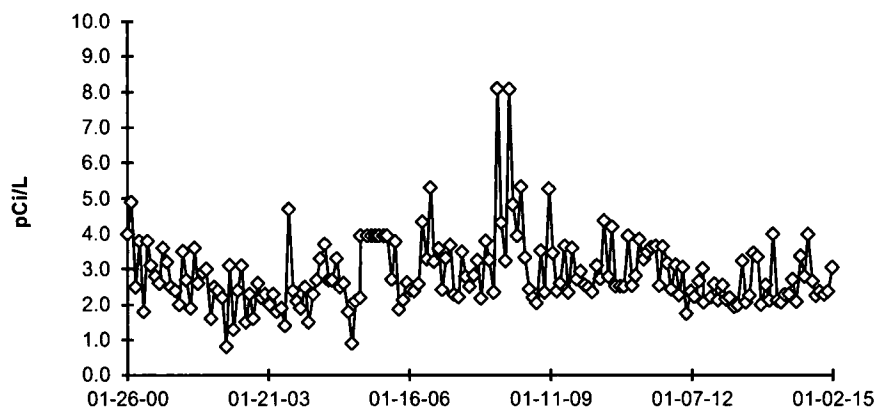
Z-15 Lake County Water Works



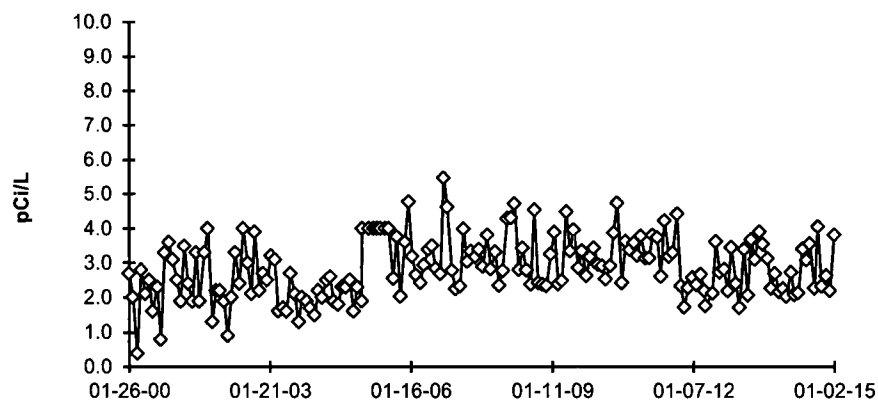
DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

FIGURE C-2
PUBLIC WATER - GROSS BETA - STATIONS Z-16 AND
Z-18 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2014

Z-16 Waukegan Water Works



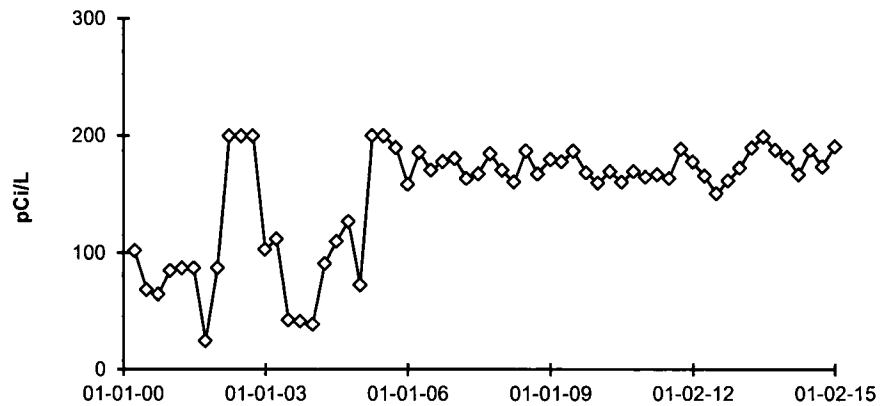
Z-18 (C) Lake Forest Water Works



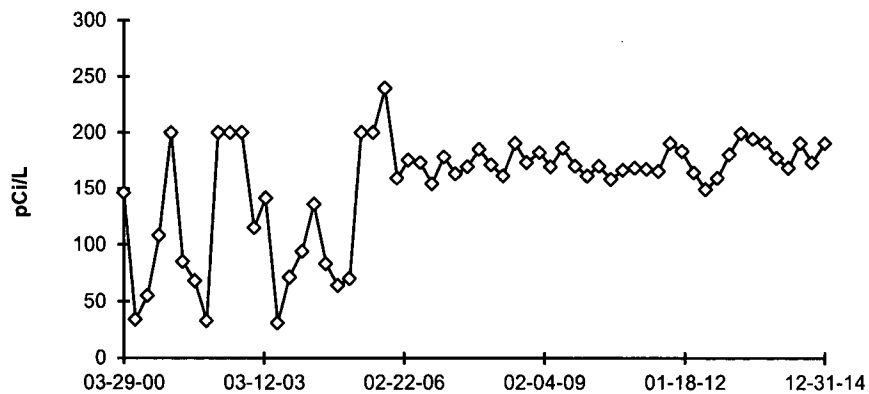
DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

FIGURE C-3 **PUBLIC WATER - TRITIUM - STATION Z-14 AND Z-15** **COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2014**

Z-14 (C) Kenosha Water Works



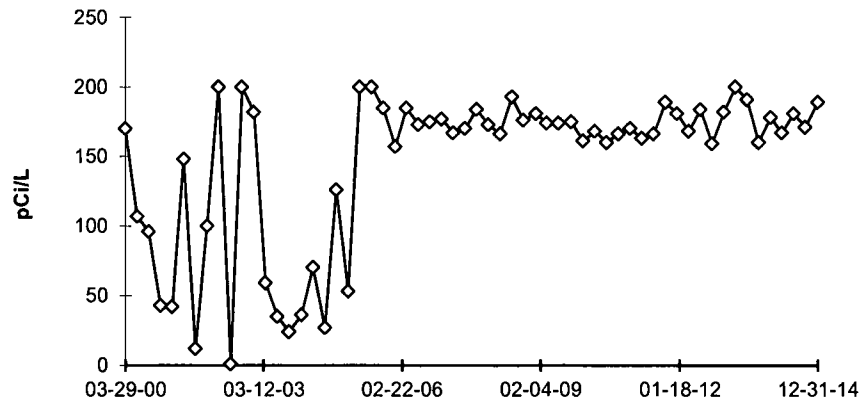
Z-15 Lake County Water Works



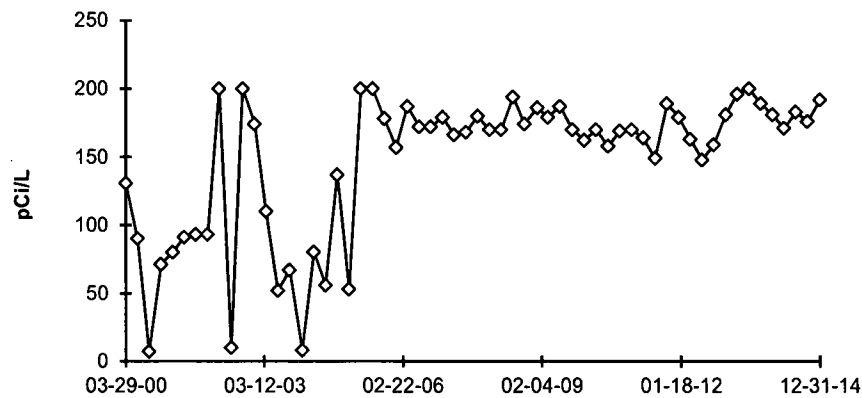
DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

FIGURE C-4
PUBLIC WATER - TRITIUM - STATION Z-16 AND Z-18
COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2014

Z-16 Waukegan Water Works



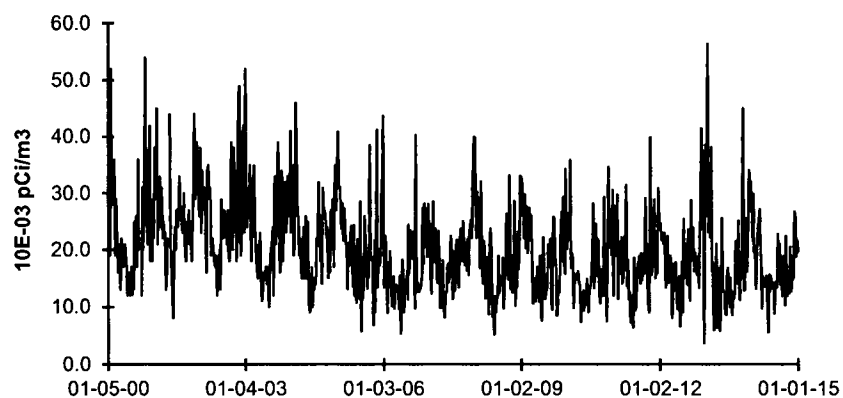
Z-18 (C) Lake Forest Water Works



DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

FIGURE C-5
AIR PARTICULATES - GROSS BETA - STATIONS Z-01 AND
Z-02 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2014

Z-01 Onsite No. 1, Southside



Z-02 Onsite No. 2, Westside

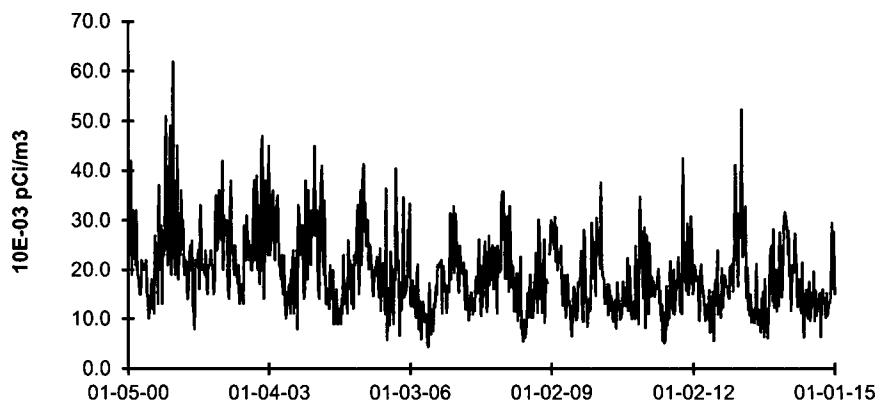
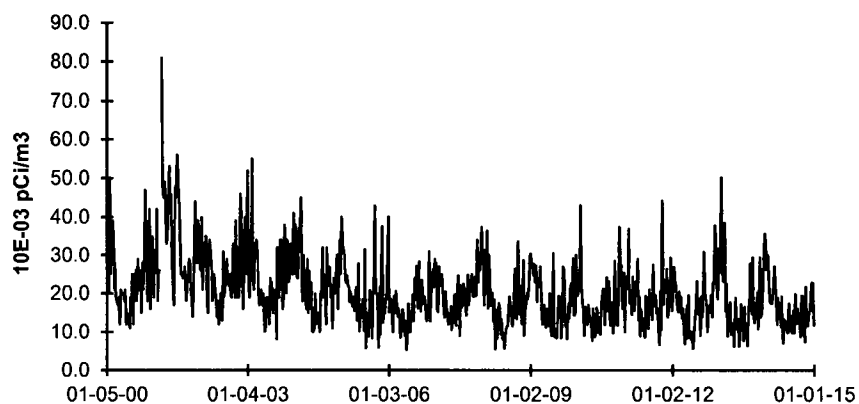
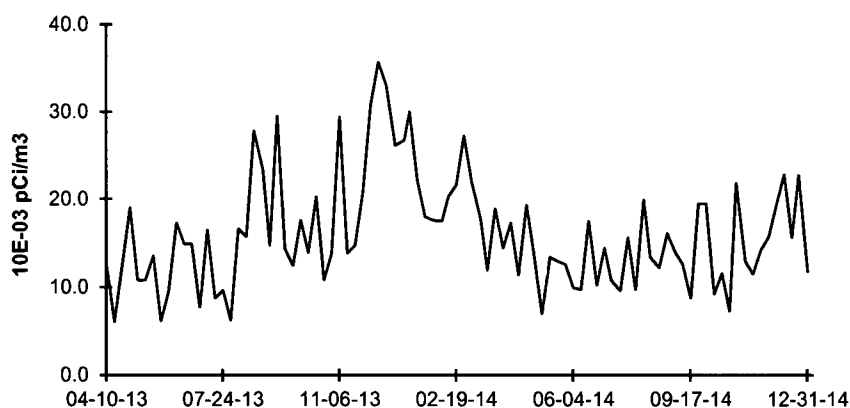


FIGURE C-6
AIR PARTICULATES - GROSS BETA - STATIONS Z-03 AND
Z-13 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2014

Z-03 Onsite No. 3, Northside



Z-13 Offsite Control



APPENDIX D

INTER-LABORATORY COMPARISON PROGRAM

TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2014
(PAGE 1 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
March 2014	E10854	Milk	Sr-89	pCi/L	95.1	91.7	1.04	A
			Sr-90	pCi/L	10.9	15.1	0.72	W
	E10855	Milk	I-131	pCi/L	96.6	98.5	0.98	A
			Ce-141	pCi/L	112	119	0.94	A
			Cr-51	pCi/L	449	491	0.91	A
			Cs-134	pCi/L	186	210	0.89	A
			Cs-137	pCi/L	250	253	0.99	A
			Co-58	pCi/L	248	268	0.93	A
			Mn-54	pCi/L	292	297	0.98	A
			Fe-59	pCi/L	230	219	1.05	A
			Zn-65	pCi/L	312	323	0.97	A
			Co-60	pCi/L	321	337	0.95	A
	E10857	AP	Ce-141	pCi	53.0	53.9	0.98	A
			Cr-51	pCi	232	223	1.04	A
			Cs-134	pCi	100	95.3	1.05	A
			Cs-137	pCi	122	115	1.06	A
			Co-58	pCi	122	121	1.01	A
			Mn-54	pCi	135	135	1.00	A
			Fe-59	pCi	111	99.3	1.12	A
			Zn-65	pCi	140	147	0.95	A
			Co-60	pCi	187	153	1.22	W
	E10856	Charcoal	I-131	pCi	74.1	76.4	0.97	A
	E10858	Water	Fe-55	pCi/L	2090	1760	1.19	A
June 2014	E10913	Milk	Sr-89	pCi/L	85.9	91.3	0.94	A
			Sr-90	pCi/L	13.8	14.5	0.95	A
	E10914	Milk	I-131	pCi/L	86.5	90.9	0.95	A
			Ce-141	pCi/L	111	124	0.90	A
			Cr-51	pCi/L	255	253	1.01	A
			Cs-134	pCi/L	147	162	0.91	A
			Cs-137	pCi/L	123	120	1.03	A
			Co-58	pCi/L	105	112	0.94	A
			Mn-54	pCi/L	155	156	0.99	A
			Fe-59	pCi/L	106	102	1.04	A
			Zn-65	pCi/L	251	252	1.00	A
			Co-60	pCi/L	218	224	0.97	A
	E10916	AP	Ce-141	pCi	95.1	92.6	1.03	A
			Cr-51	pCi	215	190	1.13	A
			Cs-134	pCi	122	122	1.00	A
			Cs-137	pCi	95.1	89.8	1.06	A
			Co-58	pCi	88.7	84.1	1.05	A
			Mn-54	pCi	115	116	0.99	A
			Fe-59	pCi	72.6	76.7	0.95	A
			Zn-65	pCi	193	189	1.02	A
			Co-60	pCi	179	168	1.07	A
	E10915	Charcoal	I-131	pCi	85.6	85.2	1.00	A
	E10917	Water	Fe-55	pCi/L	1680	1810	0.93	A

TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2014
(PAGE 2 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
September 2014	E10946	Milk	Sr-89	pCi/L	90.7	96.9	0.94	A
			Sr-90	pCi/L	14.0	16.4	0.85	A
	E10947	Milk	I-131	pCi/L	92.0	97.6	0.94	A
			Ce-141	pCi/L	117	126	0.93	A
			Cr-51	pCi/L	281	288	0.98	A
			Cs-134	pCi/L	141	158	0.89	A
			Cs-137	pCi/L	186	193	0.96	A
			Co-58	pCi/L	137	143	0.96	A
			Mn-54	pCi/L	138	142	0.97	A
			Fe-59	pCi/L	162	158	1.03	A
			Zn-65	pCi/L	75.2	73.0	1.03	A
			Co-60	pCi/L	286	297	0.96	A
	E10949	AP	Ce-141	pCi	97.8	82.1	1.19	A
			Cr-51	pCi	212	188	1.13	A
			Cs-134	pCi	106	103	1.03	A
			Cs-137	pCi	131	126	1.04	A
			Co-58	pCi	85.7	93.0	0.92	A
			Mn-54	pCi	92.8	92.3	1.01	A
			Fe-59	pCi	113	103	1.10	A
			Zn-65	pCi	53.2	47.5	1.12	A
			Co-60	pCi	202	193	1.05	A
	E10948	Charcoal	I-131	pCi	83.9	89.8	0.93	A
	E10950	Water	Fe-55	pCi/L	2010	1720	1.17	A
	E10951	Soil	Ce-141	pCi/g	0.208	0.186	1.12	A
			Cr-51	pCi/g	0.398	0.425	0.94	A
			Cs-134	pCi/g	0.216	0.233	0.93	A
			Cs-137	pCi/g	0.398	0.365	1.09	A
			Co-58	pCi/g	0.197	0.211	0.93	A
			Mn-54	pCi/g	0.242	0.209	1.16	A
			Fe-59	pCi/g	0.238	0.233	1.02	A
			Zn-65	pCi/g	0.117	0.108	1.08	A
			Co-60	pCi/g	0.447	0.438	1.02	A
December 2014	E11078	Milk	Sr-89	pCi/L	85.7	95.7	0.90	A
			Sr-90	pCi/L	12.9	15.6	0.83	A
	E11079	Milk	I-131	pCi/L	85.9	95.1	0.90	A
			Ce-141	pCi/L	205	219	0.94	A
			Cr-51	pCi/L	402	406	0.99	A
			Cs-134	pCi/L	156	164	0.95	A
			Cs-137	pCi/L	194	198	0.98	A
			Co-58	pCi/L	122	130	0.94	A
			Mn-54	pCi/L	220	225	0.98	A
			Fe-59	pCi/L	183	175	1.05	A
			Zn-65	pCi/L	287	297	0.97	A
			Co-60	pCi/L	224	235	0.95	A

TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2014
(PAGE 3 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
December 2014	E11081	AP	Ce-141	pCi	96.4	102	0.95	A
			Cr-51	pCi	171	190	0.90	A
			Cs-134	pCi	73.1	76.9	0.95	A
			Cs-137	pCi	99.0	92.6	1.07	A
			Co-58	pCi	57.5	60.8	0.95	A
			Mn-54	pCi	107	105	1.02	A
			Fe-59	pCi	74.2	81.6	0.91	A
			Zn-65	pCi	144	139	1.04	A
			Co-60	pCi	114	110	1.04	A
	E11080	Charcoal	I-131	pCi	93.5	98.2	0.95	A
	E11082	Water	Fe-55	pCi/L	1760	1970	0.89	A

(a) Teledyne Brown Engineering reported result.

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

(c) Ratio of Teledyne Brown Engineering to Analytics results.

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

TABLE D-2 **ERA ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**
TELEDYNE BROWN ENGINEERING, 2014
(PAGE 1 OF 1)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Limits	Evaluation (c)
May 2014	RAD-97	Water	Sr-89	pCi/L	38.25	36.7	27.5 - 43.6	A
			Sr-90	pCi/L	24.65	26.5	19.2 - 30.9	A
			Ba-133	pCi/L	89.1	87.9	74.0 - 96.7	A
			Cs-134	pCi/L	45.55	44.3	35.5 - 48.7	A
			Cs-137	pCi/L	91.15	89.1	80.2 - 101	A
			Co-60	pCi/L	65.10	64.2	57.8 - 73.1	A
			Zn-65	pCi/L	244	235	212 - 275	A
			Gr-A	pCi/L	45.65	61.0	31.9 - 75.8	A
			Gr-B	pCi/L	27.95	33.0	21.4 - 40.7	A
			I-131	pCi/L	23.75	25.7	21.3 - 30.3	A
			U-Nat	pCi/L	9.61	10.2	7.95 - 11.8	A
			H-3	pCi/L	8435	8770	7610 - 9650	A
	MRAD-20	Filter	Gr-A	pCi/filter	28.0	46.0	15.4 - 71.4	A
November 2014	RAD-99	Water	Sr-89	pCi/L	30.4	31.4	22.8 - 38.1	A
			Sr-90	pCi/L	18.6	21.8	15.6 - 25.7	A
			Ba-133	pCi/L	46.8	49.1	40.3 - 54.5	A
			Cs-134	pCi/L	88.0	89.8	73.7 - 98.8	A
			Cs-137	pCi/L	99.0	98.8	88.9 - 111	A
			Co-60	pCi/L	92.5	92.1	82.9 - 104	A
			Zn-65	pCi/L	325	310	279 - 362	A
			Gr-A	pCi/L	29.9	37.6	19.4 - 48.1	A
			Gr-B	pCi/L	27.5	27.4	17.3 - 35.3	A
			I-131	pCi/L	15.8	20.3	16.8 - 24.4	N (1)
			U-Nat	pCi/L	5.74	5.80	4.34 - 6.96	A
			H-3	pCi/L	6255	6880	5940 - 7570	A
	MRAD-21	Filter	Gr-A	pCi/filter	27.3	36.9	12.4 - 57.3	A

(1) The **Iodine-131** was evaluated as failed with a ratio of 0.778. No cause could be found for the slightly low activity. TBE would evaluate this as acceptable with warning. A rerun was not possible due to I-131 decay. All ERA Iodine-131 evaluations since 2004 have been acceptable. NCR 14-08

(a) Teledyne Brown Engineering reported result.

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

(c) ERA evaluation: A=acceptable. Reported result falls within the Warning Limits. NA=not acceptable. Reported result falls outside of the Control Limits. CE=check for Error. Reported result falls within the Control Limits and outside of the Warning Limit.

TABLE D-3

DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
TELEDYNE BROWN ENGINEERING, 2014

(PAGE 1 OF 2)

Month/Year	Identification Number	Media	Nuclide*	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
March 2014	14-MaW30	Water	Am-241	Bq/L	0.764	0.720	0.504 - 0.936	A
			Cs-134	Bq/L	20.7	23.1	16.2 - 30.0	A
			Cs-137	Bq/L	28.0	28.9	20.2 - 37.6	A
			Co-57	Bq/L	26.5	27.5	19.3 - 35.8	A
			Co-60	Bq/L	15.6	16.0	11.2 - 20.8	A
			H-3**	Bq/L	NR	321	225 - 417	N (3)
			Mn-54	Bq/L	13.5	13.9	9.7 - 18.1	A
			Ni-63	Bq/L	NR	34.0	23.8 - 44.2	N (3)
			Pu-238	Bq/L	0.911	0.828	0.580 - 1.076	
			Pu-239/240	Bq/L	0.751	0.676	0.473 - 0.879	
			K-40	Bq/L	NR		(1)	N (3)
			Sr-90**	Bq/L	NR	8.51	5.96 - 11.06	N (3)
			U-234/233**	Bq/L	NR	0.225	0.158 - 0.293	N (3)
			U-238**	Bq/L	NR	1.45	1.02 - 1.89	N (3)
			Zn-65	Bq/L	-0.201		(1)	A
	14-MaS30	Soil	Cs-134	Bq/kg	2.02		(1)	A
			Cs-137	Bq/kg	1300	1238	867 - 1609	A
			Co-57	Bq/kg	1069	966	676 - 1256	A
			Co-60	Bq/kg	1.32	1.22	(2)	A
			Mn-54	Bq/kg	1510	1430	1001 - 1859	A
			K-40	Bq/kg	669	622	435 - 809	A
			Sr-90	Bq/kg	4.14		(1)	A
			Zn-65	Bq/kg	763	695	487 - 904	A
	14-RdF30	AP	Cs-134**	Bq/sample	NR	1.91	1.34 - 2.48	N (3)
			Cs-137**	Bq/sample	NR	1.76	1.23 - 2.29	N (3)
			Co-57**	Bq/sample	NR		(1)	N (3)
			Co-60**	Bq/sample	NR	1.39	0.97 - 1.81	N (3)
			Mn-54**	Bq/sample	NR		(1)	N (3)
			Sr-90	Bq/sample	0.8220	1.18	0.83 - 1.53	N (3)
			Zn-65**	Bq/sample	NR		(1)	N (3)
	14-GrF30	AP	Gr-A	Bq/sample	0.606	1.77	0.53 - 3.01	A
			Gr-B	Bq/sample	0.7507	0.77	0.39 - 1.16	A
	14-RdV30	Vegetation	Cs-134	Bq/sample	5.96	6.04	4.23 - 7.85	A
			Cs-137	Bq/sample	5.06	4.74	3.32 - 6.16	A
			Co-57	Bq/sample	11.8	10.1	7.1 - 13.1	A
			Co-60	Bq/sample	7.34	6.93	4.85 - 9.01	A
			Mn-54	Bq/sample	8.95	8.62	6.03 - 11.21	A
			Sr-90	Bq/sample	1.23	1.46	1.02 - 1.90	A
			Zn-65	Bq/sample	8.91	7.86	5.50 - 10.22	A

TABLE D-3 **DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)**
TELEDYNE BROWN ENGINEERING, 2014
(PAGE 2 OF 2)

Month/Year	Identification Number	Media	Nuclide*	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
September 2014	14-MaW31	Water	Am-241	Bq/L	0.705	0.88	0.62 - 1.14	A
			Cs-134***	Bq/L	NR		(1)	N (4)
			Cs-137***	Bq/L	NR	18.4	12.9 - 23.9	N (4)
			Co-57***	Bq/L	NR	24.7	17.3 - 32.1	N (4)
			Co-60***	Bq/L	NR	12.4	8.7 - 16.1	N (4)
			Mn-54***	Bq/L	NR	14.0	9.8 - 18.2	N (4)
			Ni-63	Bq/L	24.07	24.6	17.2 - 32.0	A
			Pu-238	Bq/L	0.591	0.618	0.433 - 0.803	A
			Pu-239/240	Bq/L	0.0153	0.0048	(2)	A
			K-40***	Bq/L	NR	161	113 - 209	N (4)
			Zn-65***	Bq/L	NR	10.9	7.6 - 14.2	N (4)
	14-MaS31	Soil	Cs-134***	Bq/kg	NR	622	435 - 809	N (4)
			Cs-137***	Bq/kg	NR		(1)	N (4)
			Co-57***	Bq/kg	NR	1116	781 - 1451	N (4)
			Co-60***	Bq/kg	NR	779	545 - 1013	N (4)
			Mn-54***	Bq/kg	NR	1009	706 - 1312	N (4)
			K-40***	Bq/kg	NR	824	577 - 1071	N (4)
			Sr-90	Bq/kg	694	858	601 - 1115	A
			Zn-65***	Bq/kg	NR	541	379 - 703	N (4)
	14-RdF31	AP	Sr-90	Bq/sample	0.310	0.703	0.492 - 0.914	N (4)
	14-GrF31	AP	Gr-A	Bq/sample	0.153	0.53	0.16 - 0.90	N (4)
			Gr-B	Bq/sample	0.977	1.06	0.53 - 1.59	A
September 2014	14-RdV31	Vegetation	Cs-134	Bq/sample	7.31	7.38	5.17 - 9.59	A
			Cs-137	Bq/sample	8.93	8.14	5.70 - 10.58	A
			Co-57	Bq/sample	10.8	9.2	6.4 - 12.0	A
			Co-60	Bq/sample	6.31	6.11	4.28 - 7.94	A
			Mn-54	Bq/sample	7.76	7.10	4.97 - 9.23	A
			Sr-90	Bq/sample	0.738	0.85	0.60 - 1.11	A
			Zn-65	Bq/sample	7.16	6.42	4.49 - 8.35	A

* The MAPEP cross check isotope list has been reduced due to duplication of effort or analysis not being performed for clients.

** These nuclides are no longer part of the TBE cross check program due to duplication of effort or analysis not being performed for clients. MAPEP evaluates non-reported analyses as failed if they were reported in the previous series.

*** All future gamma cross check samples for these isotopes will be provided by Analytics.

(1) False positive test.

(2) Sensitivity evaluation.

(3) **Water, Ni-63** overlooked when reporting, but the result of 32.7 +/- 1.69 would have passed the acceptance criteria. NCR 14-04

Water, the non-detected **K-40** was overlooked when reporting, but would have passed the false positive test. NCR 14-04

AP, Sr-90 rerun was within the low range of the acceptance criteria. The original and rerun results were statistically the same. No cause could be identified for the slightly low Sr-90 activity. NCR 14-04

For non reported (NR) analyses, MAPEP evaluates as failed if they were reported in the previous series. NCR 14-04

(4) **AP, Sr-90** gravimetric yield was very high at 117%. Could indicate larger than normal amounts of calcium in the AP. A second fuming HNO₃ separation would be required to remove the excess calcium. NCR 14-09

AP, Gr-Alpha was counted on the wrong side. When flipped over and recounted the results were acceptable. NCR 14-09

For non reported (NR) analyses, MAPEP evaluates as failed if they were reported in the previous series. NCR 14-09

(a) Teledyne Brown Engineering reported result.

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

(c) DOE/MAPEP evaluation: A=acceptable, W=acceptable with warning, N=not acceptable.

TABLE D-4

ERA (a) STATISTICAL SUMMARY PROFICIENCY TESTING PROGRAM^a
ENVIRONMENTAL, INC., 2014

(Page 1 of 1)

Lab Code	Date	Analysis	Concentration (pCi/L)		Control Limits	Acceptance
			Laboratory Result b	ERA Result c		
ERW-1384	04/07/14	Sr-89	40.29 ± 5.76	36.70	27.50 - 43.60	Pass
ERW-1384	04/07/14	Sr-90	24.08 ± 2.35	26.50	19.20 - 30.90	Pass
ERW-1385	04/07/14	Ba-133	78.23 ± 3.93	87.90	74.00 - 96.70	Pass
ERW-1385	04/07/14	Co-60	62.75 ± 3.53	64.20	57.80 - 73.10	Pass
ERW-1385	04/07/14	Cs-134	44.97 ± 3.99	44.30	35.50 - 48.70	Pass
ERW-1385	04/07/14	Cs-137	88.54 ± 4.93	89.10	80.20 - 101.00	Pass
ERW-1385	04/07/14	Zn-65	249.1 ± 10.44	235.0	212.0 - 275.0	Pass
ERW-1388	04/07/14	Gr. Alpha	56.70 ± 2.47	61.00	31.90 - 75.80	Pass
ERW-1388	04/07/14	Gr. Beta	32.10 ± 1.20	33.00	21.40 - 40.70	Pass
ERW-1391	04/07/14	I-131	25.52 ± 1.12	25.70	21.30 - 30.30	Pass
ERW-1394	04/07/14	Uranium	10.76 ± 0.74	10.20	7.95 - 11.80	Pass
ERW-1397	04/07/14	H-3	8982 ± 279	8770	7610 - 9650	Pass
ERW-5382	10/06/14	Sr-89	29.40 ± 5.32	31.40	22.80 - 38.10	Pass
ERW-5382	10/06/14	Sr-90	19.19 ± 1.85	21.80	15.60 - 25.70	Pass
ERW-5385	10/06/14	Ba-133	43.54 ± 4.54	49.10	40.30 - 54.50	Pass
ERW-5385	10/06/14	Cs-134	81.95 ± 7.49	89.80	73.70 - 98.80	Pass
ERW-5385	10/06/14	Cs-137	95.76 ± 5.50	98.80	88.90 - 111.00	Pass
ERW-5385	10/06/14	Co-60	90.25 ± 2.77	92.10	82.90 - 104.00	Pass
ERW-5385	10/06/14	Zn-65	327.4 ± 23.3	310.00	279.0 - 362.0	Pass
ERW-5388	10/06/14	Gr. Alpha	30.88 ± 8.05	37.60	19.40 - 46.10	Pass
ERW-5388	10/06/14	G. Beta	20.47 ± 4.75	27.40	17.30 - 35.30	Pass
ERW-5392	10/06/14	I-131	19.58 ± 2.35	20.30	16.80 - 24.40	Pass
ERW-5394	10/06/14	Uranium	5.51 ± 0.37	5.80	4.34 - 6.96	Pass
ERW-5397	10/06/14	H-3	6876 ± 383	6880	5940 - 7570	Pass

a Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing in drinking water conducted by Environmental Resources Associates (ERA).

b Unless otherwise indicated, the laboratory result is given as the mean ± standard deviation for three determinations.

c Results are presented as the known values, expected laboratory precision (1 sigma, 1 determination) and control limits as provided by ERA.

TABLE D-5

DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
ENVIRONMENTAL, INC., 2014

(Page 1 of 2)

Lab Code b	Date	Analysis	Laboratory result	Concentration a		Acceptance
				Known Activity	Control Limits c	
MAW-1140	02/01/14	Gr. Alpha	0.77 ± 0.06	0.85	0.26 - 1.44	Pass
MAW-1140	02/01/14	Gr. Beta	4.31 ± 0.08	4.19	2.10 - 6.29	Pass
MAW-1184	02/01/14	Fe-55	0.40 ± 3.20	0.00	-0.01 - 2.00	Pass
MAW-1184	02/01/14	H-3	345.10 ± 10.60	321.00	225.00 - 417.00	Pass
MAW-1184	02/01/14	Ni-63	32.40 ± 3.20	34.00	23.80 - 44.20	Pass
MAW-1184	02/01/14	Pu-238	1.28 ± 0.12	0.83	0.58 - 1.08	Fail (1)
MAW-1184	02/01/14	Pu-239/240	0.91 ± 0.10	0.68	0.47 - 0.88	Fail (1)
MAW-1184	02/01/14	Sr-90	7.00 ± 0.70	8.51	5.96 - 11.06	Pass
MAW-1184	02/01/14	U-233/234	0.20 ± 0.07	0.23	0.16 - 0.29	Pass
MAW-1184	02/01/14	U-238	1.25 ± 0.18	1.45	1.02 - 1.89	Pass
MAW-1184	02/01/14	Co-57	27.86 ± 0.38	27.50	19.30 - 35.80	Pass
MAW-1184	02/01/14	Co-60	15.99 ± 0.27	16.00	11.20 - 20.80	Pass
MAW-1184	02/01/14	Cs-134	21.85 ± 0.54	23.10	16.20 - 30.00	Pass
MAW-1184	02/01/14	Cs-137	28.74 ± 0.49	28.90	20.20 - 37.60	Pass
MAW-1184	02/01/14	K-40	1.80 ± 2.00	0.00	0.00 - 10.00	Pass
MAW-1184	02/01/14	Mn-54	14.06 ± 0.40	13.90	9.70 - 18.10	Pass
MAW-1184	02/01/14	Zn-65	0.00 ± 0.19	0.00	-0.01 - 0.00	Pass
MAVE-1148	02/01/14	Co-57	11.63 ± 0.19	10.10	7.10 - 13.10	Pass
MAVE-1148	02/01/14	Co-60	7.28 ± 0.18	6.93	4.85 - 9.01	Pass
MAVE-1148	02/01/14	Cs-134	6.29 ± 0.29	6.04	4.23 - 7.85	Pass
MAVE-1148	02/01/14	Cs-137	5.18 ± 0.20	4.74	3.32 - 6.16	Pass
MAVE-1148	02/01/14	Mn-54	9.22 ± 0.26	8.62	6.03 - 11.21	Pass
MAVE-1148	02/01/14	Zn-65	8.59 ± 0.40	7.86	5.50 - 10.22	Pass
MAAP-1151	02/01/14	Co-57	1.60 ± 0.05	0.00	NA	Fail (2)
MAAP-1151	02/01/14	Co-60	1.38 ± 0.08	1.39	0.97 - 1.81	Pass
MAAP-1151	02/01/14	Cs-134	1.75 ± 0.11	1.91	1.34 - 2.48	Pass
MAAP-1151	02/01/14	Cs-137	1.81 ± 0.10	1.76	1.23 - 2.29	Pass
MAAP-1151	02/01/14	Mn-54	0.01 ± 0.03	0.00	NA	Pass
MAAP-1151	02/01/14	Zn-65	-0.24 ± 0.09	0.00	-0.50 - 1.00	Pass
MAAP-1151	02/01/14	Sr-90	1.11 ± 0.14	1.18	0.83 - 1.53	Pass
MAAP-1154	02/01/14	Gr. Alpha	0.56 ± 0.06	1.77	0.53 - 3.01	Pass
MAAP-1154	02/01/14	Gr. Beta	0.98 ± 0.06	0.77	0.39 - 1.16	Pass
MASO-1146	02/01/14	Ni-63	4.80 ± 15.30	0.00	NA	Pass
MASO-1146	02/01/14	Co-57	1064.50 ± 3.60	966.00	676.00 - 1256.00	Pass
MASO-1146	02/01/14	Co-60	1.70 ± 0.50	1.22	(3)	Pass
MASO-1146	02/01/14	Cs-134	6.10 ± 1.80	0.00	NA	Fail (4)
MASO-1146	02/01/14	Cs-137	1364.30 ± 5.30	1238.00	867.00 - 1609.00	Pass
MASO-1146	02/01/14	K-40	728.90 ± 15.90	622.00	435.00 - 809.00	Pass
MASO-1146	02/01/14	Mn-54	1588.00 ± 6.00	1430.00	1001.00 - 1859.00	Pass
MASO-1146	02/01/14	Zn-65	763.50 ± 6.80	695.00	487.00 - 904.00	Pass
MASO-1146	02/01/14	Sr-90	1.23 ± 1.37	0.00	NA	Pass

TABLE D-5 **DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)**
ENVIRONMENTAL, INC., 2014
(Page 2 of 2)

Lab Code b	Date	Analysis	Laboratory result	Concentration a		Acceptance
				Known Activity	Control Limits c	
MASO-4439	08/01/14	Ni-63	771.62 ± 23.29	980.00	686.00 - 1274.00	Pass
MASO-4439	08/01/14	Sr-90	778.34 ± 17.82	858.00	601.00 - 1115.00	Pass
MASO-4439	08/01/14	Cs-134	520.60 ± 7.09	622.00	435.00 - 809.00	Pass
MASO-4439	08/01/14	Co-57	1135.00 ± 7.40	1116.00	781.00 - 1451.00	Pass
MASO-4439	08/01/14	Co-60	768.20 ± 7.70	779.00	545.00 - 1013.00	Pass
MASO-4439	08/01/14	Mn-54	1050.70 ± 12.60	1009.00	706.00 - 1312.00	Pass
MASO-4439	08/01/14	Zn-65	407.89 ± 15.03	541.00	379.00 - 703.00	Pass
MAW-4431	08/01/14	Am-241	0.79 ± 0.08	0.88	0.62 - 1.14	Pass
MAW-4431	08/01/14	Cs-137	18.62 ± 0.54	18.40	12.90 - 23.90	Pass
MAW-4431	08/01/14	Co-57	24.85 ± 0.42	24.70	17.30 - 32.10	Pass
MAW-4431	08/01/14	Co-60	12.27 ± 0.38	12.40	8.70 - 16.10	Pass
MAW-4431	08/01/14	H-3	207.20 ± 10.60	208.00	146.00 - 270.00	Pass
MAW-4431	08/01/14	Fe-55	55.10 ± 14.80	31.50	22.10 - 41.00	Fail (5)
MAW-4431	08/01/14	Mn-54	14.36 ± 0.53	14.00	9.80 - 18.20	Pass
MAW-4431	08/01/14	Zn-65	11.46 ± 0.78	10.90	7.60 - 14.20	Pass
MAW-4493	08/01/14	Gr. Alpha	0.93 ± 0.07	1.40	0.42 - 2.38	Pass
MAW-4493	08/01/14	Gr. Beta	6.31 ± 1.35	6.50	3.25 - 9.75	Pass
MAAP-4433	08/01/14	Sr-90	0.74 ± 0.10	0.70	0.49 - 0.91	Pass
MAAP-4444	08/01/14	Sr-89	7.82 ± 0.52	9.40	6.60 - 12.20	Pass
MAAP-4444	08/01/14	Sr-90	0.76 ± 0.10	0.76	0.53 - 0.99	Pass
MAVE-4436	08/01/14	Cs-134	7.49 ± 0.18	7.38	5.17 - 9.59	Pass
MAVE-4436	08/01/14	Co-57	11.20 ± 0.19	9.20	6.40 - 12.00	Pass
MAVE-4436	08/01/14	Co-60	6.84 ± 0.17	6.11	4.28 - 7.94	Pass
MAVE-4436	08/01/14	Mn-54	8.11 ± 0.26	7.11	4.97 - 9.23	Pass
MAVE-4436	08/01/14	Zn-65	7.76 ± 0.43	6.42	4.49 - 8.35	Pass

^a Results are reported in units of Bq/kg (soil), Bq/L (water) or Bq/total sample (filters, vegetation).

^b Laboratory codes as follows: MAW (water), MAAP (air filter), MASO (soil), MAVE (vegetation).

^c MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP. A known value of "zero" indicates an analysis was included in the testing series as a "false positive". MAPEP does not provide control limits.

(1) The high bias on the plutonium crosscheck samples was traced to contamination from a newly purchased standard.

The results of reanalysis with replacement tracer purchased from NIST:

MAW-1184 Pu-238	0.68 ± 0.10	Bq / L
MAW-1184 Pu-239/240	0.66 ± 0.10	Bq / L

(2) Interference from Eu-152 resulted in misidentification of Co-57.

(3) Provided in the series for "sensitivity evaluation". MAPEP does not provide control limits.

(4) False positive test. Long sample counting time lead to interference from naturally occurring Bi-214 in sample matrix with a close spectral energy.

(5) Result of reanalysis Fe-55 32.63 ± 16.30 Bq/L

APPENDIX E

EFFLUENT DATA

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INTRODUCTION

Units 1 and 2 of the Zion Station, located in Zion, Illinois adjacent to Lake Michigan, are 1100 MWe (3520 MWt) Westinghouse pressurized water reactors. The plant permanently ceased operation in February of 1998 and has been permanently defueled.

The station was designed to keep releases to the environment at levels below those specified in the regulations. Historical data has been established that Zion, as a fully operational facility, did not contribute appreciable doses to the surrounding public. Sampling results for 2014 showed minimal releases above background for a variety of monitored pathways, e.g. water, vegetation, air samples and TLIV.

Liquid effluents from Zion Station are released to Lake Michigan in controlled batches after radioassay of each batch and continuously through a monitored pathway. There are no routine noble gas releases. Due to decay, iodine is no longer present. The only noble gas that remains is Kr-85 captured in the spent fuel assemblies stored in the fuel pool in the fuel building. The results of effluent analyses are summarized on a monthly basis and reported to the Nuclear Regulatory Commission as required per Technical Specifications. Airborne concentrations of noble gases and particulate radioactivity in offsite areas are calculated using effluent and meteorological data.

Currently Zion Station is undergoing decommissioning. During the decommissioning process, containerized waste is temporarily maintained at designated locations onsite. The designated locations are located in a manner to minimize the direct radiation exposure to the public at or near the site boundary.

Environmental monitoring was conducted by sampling at indicator and control (background) locations in the vicinity of the Zion Station to measure changes in radiation or radioactivity levels that may be attributable to the station. If significant changes attributable to Zion Station are measured, these changes are correlated with effluent releases or direct radiation from containerized waste.

ISFSI operations were conducted in 2014 which attributed direct radiation dose in the form of gamma and neutron to members of the public. The results of the calculated dose from direct radiation from the ISFSI has been calculated and included in this report. In addition to the dose contributed to members of the public. A special case exists for members of the public working onsite in the switchyard area. Switchyard worker dose results are also included in this report.

SUMMARY

Gaseous, liquid and solid waste effluents for the period contributed to only a small fraction of the Station Technical Specification limits. Calculations of environmental concentrations based on effluent and meteorological data for the period indicate that consumption by the public of radionuclides attributable to the Zion Station does not exceed regulatory limits. Radiation exposure from direct radiation from containerized waste at the site boundary represented the critical pathway for the period with a maximum individual total body dose estimated to be $1.30\text{E}+01$ mrem for the year, where a factor to analyze exposure based on habits of the real individual of $7.50\text{E}-01$ was applied. The assessment of radiation doses is performed in accordance with the Zion Station Offsite Dose Calculation Manual (ODCM). The results of analysis confirm that the station is operating in compliance with 10CFR50 Appendix 1, 10CFR20, 10CFR72 and 40CFR190.

1.0 EFFLUENTS

1.1 Gaseous Effluents to the Atmosphere

Measured concentrations and isotopic composition of noble gases and particulate radioactivity released to the atmosphere were monitored during the year. A total of 0.00E+00 microcuries of fission and activation gases was released with a maximum average release rate of 0.00E+00 $\mu\text{Ci/sec}$ during any one quarter period.

A total of 4.05E-5 curies of beta-gamma emitters was released as airborne particulate matter with a maximum average quarterly release rate of 5.10E-06 $\mu\text{Ci/sec}$. Alpha-emitting radionuclides were less than measurable detection limits. 1.06E-01 curies of tritium were released with a maximum average quarterly release rate of 5.84E-03 $\mu\text{Ci/sec}$.

1.2 Liquids Released to Lake Michigan

A total of 1.82E+07 liters of liquid waste containing 3.69E-02 curies of fission and activation products, 1.06E+00 curies of tritium, and 1.57E-06 Ci of Alpha was discharged from the station via an approved pathway after dilution with a total of 4.97E+09 liters of water. These wastes were released at a maximum quarterly average concentration of 1.62E-07 $\mu\text{Ci/ml}$. Monthly release estimates and principal radionuclides in liquid effluents are reported in the Zion Nuclear Power Station Radioactive Effluent Report for 2014.

2.0 SOLID RADIOACTIVE WASTE

There were 63 solid radioactive waste shipments in 2014. For more detail, refer to the Zion Station 2014 Annual Radioactive Effluent Release Report.

3.0 DOSE TO MAN

3.1 Gaseous Effluent Pathways

Table 3.1-1 summarizes the doses resulting from releases of airborne radioactivity via the different exposure pathways.

3.1.1 Gaseous Releases

3.1.1.1 Gamma Dose Rates

Offsite Gamma air and whole (total) body dose rates are shown in Table 3.1-1 and were calculated based on measured release rates, isotopic composition of the gases, and meteorological data for the period. Based on measured effluents and average meteorological data, the maximum total body dose to an individual would be 6.86E-04 mrem (child) for the year (Table 3.5-1), with an occupancy or shielding factor of 0.7 included. The maximum gamma air dose was 0.00E+00 mrad based on measured effluents and average meteorological data (Table 3.5-1).

3.1.1.2 Beta Air and Skin Dose Rates

The range of beta particles in air is relatively small (on the order of a few meters or less); consequently, plumes of gaseous effluents may be considered "infinite" for purpose of calculating the dose from beta radiation incident on the skin. However, the actual dose to sensitive skin tissues is difficult to calculate due to the effect of the beta particle energies, thickness of inert skin and clothing covering sensitive tissues. For purposes of this report the skin is taken to have a density thickness of 7.0 mg/cm² and an occupancy factor of 1.0 is used. The skin dose from beta and gamma radiation for the year 0.00E+00 mrem based on measured effluents and average meteorological data (Table 3.5-1).

The maximum offsite beta air dose for the year was 0.00E+00 mrad based on measured effluents and average meteorological data (Table 3.5-1).

3.1.2 Radioactive Iodine

The human thyroid exhibits a significant capacity to

concentrate ingested or inhaled iodine. The radioiodine, I-131, released during routine operation of the station, may be made available to man resulting in a dose to the thyroid. The principal pathway of interest for this radionuclide is ingestion of radioiodine in milk. As Zion Station is not operational and I-131 has decayed away, the maximum offsite concentration is estimated to be zero, as expected.

3.1.3 Dose to Thyroid

The hypothetical thyroid dose to a maximum exposed individual living near the station via ingestion of milk was calculated. As Zion Station is not operational and I-131 has decayed away, the maximum offsite concentration is estimated to be zero, as expected.

3.2 Liquid Effluent Pathways

The three principal pathways through the aquatic environment for potential doses to man from liquid waste are ingestion of potable water, eating aquatic foods, and exposure while on the shoreline. Not all of these pathways are significant or applicable at a given time but a reasonable approximation of the dose can be made by adjusting the dose formula for season of the year or type and degree of use of the aquatic environment. NRC developed equations* were used to calculate the doses to the whole body, lower GI tracts, thyroid, bone, skin; specific parameters for use in the equations are given in the Zion Station Offsite Dose Calculation Manual. The maximum whole body dose (total body) for the year was 1.95E-01 mrem and no organ dose exceeded 2.87E-01 mrem (Table 3.2-1).

*Nuclear Regulatory Commission, Regulatory Guide 1.109 (Rev. 1) distributions of the wind direction for the 250' level and wind speed class by atmospheric stability class determined from the temperature difference between the 250' and 35' levels. Data recovery for these measurements was 99.6% during 2014 (Table 3.5-1).

3.3 Direct Radiation

During the period January to December 2014, Zion Station during decommissioning has stored containerized radioactive waste combined with direct radiation from the ISFSI (including gamma plus neutron) that contributed a total of $1.30\text{E}+00$ mrem to the whole body of a maximally exposed individual at site boundary taking into account the occupancy factor of $7.50\text{E}-01$ calculated in Zion Station ES&H Technical Support Document (TSD) 13-009 "Member of the Public Dose from All Onsite Sources." The maximally exposed member of the public working in the switchyard onsite was calculated to receive $5.21\text{E}+01$ mrem to the whole body at the south switchyard boundary. This value takes into account the occupancy factor of $2.38\text{E}-01$ as described in ES&H TSD 13-009 referenced above.

3.4 Assessment of Dose to Member of Public

During the period January to December, 2014, Zion Station did not exceed the below limits as shown in Table 3.1-1 and Table 3.2-1 (based on yearly average meteorological data), and Table 3.3 (based on TLD results):

- The RETS limits on dose or dose commitment to an individual due to radioactive materials in liquid effluents from each reactor unit (3 mrem to the whole body or 10 mrem to any organ during any calendar year).
- The RETS limits on air dose in noble gases released in gaseous effluents to a member of the public from each reactor unit (10 mrad for gamma radiation or 20 mrad for beta radiation during any calendar year).
- The RETS limits on dose to a member of the public due to iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released from each reactor unit (15 mrem to any organ during any calendar year).
- The 10CFR20 limit on Total Effective Dose Equivalent to individual members of the public (100 mrem).
- The 10CFR72.104 limit on Total Effective Dose Equivalent to individual members of the public from combined effluents and radioactive material including ISFSI (25 mrem).

4.0 SITE METEOROLOGY

A summary of the site meteorological measurements taken during each calendar quarter of the year is given in Appendix 11. The data are presented as cumulative joint frequency

APPENDIX E-1

DATA TABLES AND FIGURES

Table 3.1-1
Maximum Dose Resulting from Airborne Releases
Zion Station 2014

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.						

Table 3.1-1(continued)
Maximum Dose Resulting from Airborne Releases
Zion Station 2014

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		<LLD	<LLD	<LLD	<LLD	<LLD
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.						

Table 3.1-1(continued)
Maximum Dose Resulting from Airborne Releases
Zion Station 2014

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

Table 3.1-1(continued)
Maximum Dose Resulting from Airborne Releases
Zion Station 2014

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

Table 3.2-1
Maximum dose Resulting from Liquid Effluents
Zion Station 2014

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

Table 3.2-1 (continued)
Maximum dose Resulting from Liquid Effluents
Zion Station 2014

LIQUID EFFLUENTS - BATCH MODE (Unit 1 & 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

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

Table 3.2-1 (continued)
Maximum dose Resulting from Liquid Effluents
Zion Station 2014

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

Table 3.2-1 (continued)
Maximum dose Resulting from Liquid Effluents
Zion Station 2014

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

Table 3.3-1
Maximum Dose Resulting from Direct Radiation
Zion Station 2014

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

Table 3.4-1
ZION STATION
2014
Unit 1
10CFR20 Compliance Assessment

1. 10CFR 20.1301 (a) (1) Compliance

Total Effective Dose Equivalent **4.00E+00 mrem/year**

10 CFR 20.1301 (a) (1) limit **100 mrem/year**

% of the limit **4.00E+00%**

2. Compliance Summary 10CFR20

	1 st Qtr.	2 nd Qtr.	3 rd Qtr.	4 th Qtr	% of Limit
TEDE	2.23E-01	7.77E-01	1.97E+00	1.03E+00	4.00E+00%

Table 3.4-1(continued)
ZION STATION
2014
Unit 2
10CFR20 Compliance Assessment

1. 10CFR 20.1301 (a) (1) Compliance

Total Effective Dose Equivalent 4.00E+00 mrem/year

10 CFR 20.1301 (a) (1) limit 100 mrem/year

% of the limit 4.00E+00%

2. Compliance Summary 10CFR20

	1 st Qtr.	2 nd Qtr.	3 rd Qtr.	4 th Qtr	% of Limit
TEDE	2.23E-01	7.77E-01	1.97E+00	1.03E+00	4.00E+00%

Table 3.4-1(continued)
ZION STATION
2014
Switchyard
10CFR20 Compliance Assessment

1. 10CFR 20.1301 (a) (1) Compliance

Total Effective Dose Equivalent 5.21E+01 mrem/year

10 CFR 20.1301 (a) (1) limit 100 mrem/year

% of the limit 5.21E+01%

2. Compliance Summary 10CFR20

	1 st Qtr.	2 nd Qtr.	3 rd Qtr.	4 th Qtr	% of Limit
TEDE	7.15E-01	1.38E+01	1.58E+01	2.17E+01	5.21E+01%

Table 3.5-1

Doses Resulting from Airborne Releases

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

Unit 1:

<u>Dose</u>	<u>Maximum Value</u>	<u>Sector Affected</u>
gamma air ⁽¹⁾	0.00E+00 mrad	
beta air ⁽²⁾	0.00E+00 mrad	
whole body ⁽³⁾	3.43E-04 mrem	East
skin ⁽⁴⁾	2.28E-04 mrem	East
organ ⁽⁵⁾ (child bone)	3.70E-04 mrem	East

Unit 2:

<u>Dose</u>	<u>Maximum Value</u>	<u>Sector Affected</u>
gamma air ⁽¹⁾	0.00E+00 mrad	
beta air ⁽²⁾	0.00E+00 mrad	
whole body ⁽³⁾	3.43E-04 mrem	East
skin ⁽⁴⁾	2.28E-04 mrem	East
organ ⁽⁵⁾ (child liver)	3.70E-04 mrem	East

Data recovery: 99.6%

(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 F

METEOROLOGICAL DATA

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	0	3	1	0	4
NNE	0	0	8	5	0	0	13
NE	0	1	8	4	1	0	14
ENE	0	0	4	0	0	0	4
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	4	7	0	0	0	11
SSE	0	1	7	0	0	0	8
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	2	4	6	0	0	12
WSW	0	3	21	9	6	0	39
W	0	1	22	10	0	0	33
WNW	0	1	22	5	0	0	28
NW	0	0	22	7	0	0	29
NNW	0	0	4	0	0	0	4
Variable	0	0	0	0	0	0	0
Total	0	13	129	49	8	0	199

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	1	3	1	0	5
NNE	0	1	2	1	0	0	4
NE	0	0	1	0	1	0	2
ENE	0	0	1	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	2	0	0	0	2
SSE	0	1	2	0	0	0	3
S	0	0	0	0	0	0	0
SSW	0	0	3	1	0	0	4
SW	0	1	2	3	0	0	6
WSW	0	1	9	5	2	0	17
W	0	2	3	5	0	0	10
WNW	0	1	8	3	0	0	12
NW	0	2	10	1	0	0	13
NNW	0	0	5	0	0	0	5
Variable	0	0	0	0	0	0	0
Total	0	9	49	22	4	0	84

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	2	1	4	1	0	8
NNE	0	6	4	2	0	0	12
NE	1	1	2	5	1	0	10
ENE	0	0	1	3	0	0	4
E	0	2	0	0	0	0	2
ESE	0	3	1	0	0	0	4
SE	1	2	1	0	0	0	4
SSE	0	2	7	3	0	0	12
S	0	1	2	1	0	0	4
SSW	0	5	7	5	0	0	17
SW	0	5	5	4	3	0	17
WSW	0	7	10	3	2	0	22
W	0	3	4	4	0	0	11
WNW	0	8	7	1	0	0	16
NW	0	4	12	4	0	0	20
NNW	0	2	3	0	0	0	5
Variable	0	0	0	0	0	0	0
Total	2	53	67	39	7	0	168

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014
 Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
 Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	4	19	9	4	0	36
NNE	1	8	30	20	0	0	59
NE	2	4	14	28	0	0	48
ENE	1	3	6	2	0	0	12
E	1	3	5	5	0	0	14
ESE	0	4	8	1	0	0	13
SE	1	3	5	2	0	0	11
SSE	1	10	37	28	10	0	86
S	5	21	25	17	0	0	68
SSW	7	40	25	51	2	0	125
SW	5	25	43	34	14	1	122
WSW	2	33	63	25	4	0	127
W	5	41	117	25	0	0	188
WNW	4	37	69	21	0	0	131
NW	3	36	40	15	0	0	94
NNW	1	9	53	14	0	0	77
Variable	0	0	0	0	0	0	0
Total	39	281	559	297	34	1	1211

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014
 Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
 Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	4	3	0	0	0	7
NNE	0	1	5	0	0	0	6
NE	2	1	1	0	0	0	4
ENE	0	1	0	0	0	0	1
E	0	2	5	1	0	0	8
ESE	0	4	3	1	0	0	8
SE	1	1	1	0	0	0	3
SSE	1	7	5	1	0	0	14
S	3	19	11	2	0	0	35
SSW	0	15	14	2	0	0	31
SW	6	12	4	7	0	0	29
WSW	8	20	9	0	0	0	37
W	5	31	14	0	0	0	50
WNW	13	37	10	0	0	0	60
NW	6	25	10	0	0	0	41
NNW	3	8	0	0	0	0	11
Variable	0	0	0	0	0	0	0
Total	48	188	95	14	0	0	345

Hours of calm in this stability class: 3
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	0	0	0	0	0
NNE	1	0	0	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	1	0	0	0	1
ESE	0	0	1	2	0	0	3
SE	0	0	0	0	0	0	0
SSE	0	1	3	4	2	0	10
S	3	9	6	1	0	0	19
SSW	1	2	0	0	0	0	3
SW	2	6	0	0	0	0	8
WSW	5	7	0	0	0	0	12
W	5	13	0	0	0	0	18
WNW	2	16	1	0	0	0	19
NW	1	2	0	0	0	0	3
NNW	1	0	0	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	21	56	12	7	2	0	98

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	2	0	0	0	0	0	2
S	1	4	1	3	0	0	9
SSW	0	1	0	0	0	0	1
SW	0	1	0	0	0	0	1
WSW	0	2	0	0	0	0	2
W	7	13	0	0	0	0	20
WNW	2	12	0	0	0	0	14
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	12	33	1	3	0	0	49

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	0	0	0	2	2
NNE	0	0	2	10	3	0	15
NE	0	0	5	5	2	2	14
ENE	0	0	3	1	0	0	4
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	1	5	9	1	0	16
SSE	0	0	1	1	0	0	2
S	0	0	1	0	0	0	1
SSW	0	0	0	0	0	0	0
SW	0	0	1	3	2	0	6
WSW	0	0	4	17	8	8	37
W	0	0	8	21	8	2	39
WNW	0	0	8	12	5	0	25
NW	0	0	6	17	9	0	32
NNW	0	0	1	5	0	0	6
Variable	0	0	0	0	0	0	0
Total	0	1	45	101	38	14	199

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	0	1	2	1	4
NNE	0	0	1	2	2	0	5
NE	0	0	0	1	0	1	2
ENE	0	0	1	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	1	2	0	0	3
SSE	0	0	2	0	0	0	2
S	0	0	0	0	0	0	0
SSW	0	0	0	3	1	0	4
SW	0	0	0	1	1	0	2
WSW	0	1	1	6	5	2	15
W	0	1	2	5	6	1	15
WNW	0	0	4	5	2	1	12
NW	0	1	6	5	2	0	14
NNW	0	0	1	4	0	0	5
Variable	0	0	0	0	0	0	0
Total	0	3	19	35	21	6	84

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	3	0	0	3	2	8
NNE	1	1	4	4	1	1	12
NE	0	0	2	2	3	4	11
ENE	0	0	1	0	1	2	4
E	0	2	0	0	0	0	2
ESE	0	4	0	0	0	1	5
SE	0	1	4	3	1	0	9
SSE	0	0	3	0	0	0	3
S	0	1	2	0	4	0	7
SSW	0	0	4	5	3	0	12
SW	0	4	5	4	4	3	20
WSW	0	5	5	4	4	3	21
W	0	2	1	5	4	1	13
WNW	0	6	2	6	2	0	16
NW	0	2	3	9	2	1	17
NNW	0	1	3	3	0	1	8
Variable	0	0	0	0	0	0	0
Total	1	32	39	45	32	19	168

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014
 Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
 Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	3	8	7	6	25
NNE	0	2	9	25	15	15	66
NE	0	3	6	15	26	4	54
ENE	0	1	2	6	2	1	12
E	1	3	3	4	3	1	15
ESE	0	2	3	6	2	0	13
SE	0	1	6	7	9	6	29
SSE	0	5	14	26	22	3	70
S	0	4	14	18	19	9	64
SSW	0	14	31	14	33	19	111
SW	0	6	18	39	24	22	109
WSW	0	7	24	56	19	25	131
W	3	6	13	80	60	5	167
WNW	0	8	24	66	30	14	142
NW	0	4	31	37	25	8	105
NNW	0	2	16	47	16	4	85
Variable	0	0	0	0	0	0	0
Total	4	69	217	454	312	142	1198

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 13
 Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	3	9	0	0	13
NNE	0	2	1	4	1	1	9
NE	2	0	1	2	0	0	5
ENE	0	1	0	0	1	0	2
E	0	0	1	1	5	0	7
ESE	0	0	0	6	1	1	8
SE	0	0	2	1	1	0	4
SSE	1	1	9	3	2	1	17
S	0	5	6	6	7	1	25
SSW	0	4	8	13	7	1	33
SW	1	2	11	9	7	2	32
WSW	0	5	15	14	1	0	35
W	1	1	12	14	5	0	33
WNW	0	0	10	22	5	0	37
NW	1	7	12	38	3	0	61
NNW	0	3	12	12	0	0	27
Variable	0	0	0	0	0	0	0
Total	6	32	103	154	46	7	348

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	1	0	0	0	2
NNE	0	1	0	0	0	0	1
NE	0	1	0	0	0	0	1
ENE	0	0	0	0	0	0	0
E	1	0	0	0	0	0	1
ESE	0	0	0	0	0	4	4
SE	0	0	0	0	0	0	0
SSE	0	1	2	4	0	6	13
S	0	0	2	4	1	4	11
SSW	0	0	7	7	0	0	14
SW	0	0	2	1	0	0	3
WSW	0	2	1	1	0	0	4
W	0	2	1	5	0	0	8
WNW	0	2	11	1	1	0	15
NW	0	1	5	6	1	0	13
NNW	0	0	3	5	0	0	8
Variable	0	0	0	0	0	0	0
Total	1	11	35	34	3	14	98

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: January - March 2014

Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	1	1	0	0	0	3
NNE	1	0	0	0	0	0	1
NE	1	0	0	0	0	0	1
ENE	0	0	0	0	0	0	0
E	1	0	0	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	0	1	0	0	0	0	1
SSE	0	1	0	1	0	0	2
S	0	0	3	5	0	3	11
SSW	0	1	0	0	1	0	2
SW	0	2	0	0	0	0	2
WSW	0	0	0	0	0	0	0
W	0	1	1	1	0	0	3
WNW	0	0	5	0	0	0	5
NW	0	0	4	4	0	0	8
NNW	0	0	2	7	0	0	9
Variable	0	0	0	0	0	0	0
Total	4	7	16	18	1	3	49

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	2	2	6	1	0	11
NNE	0	4	31	11	0	0	46
NE	0	6	25	1	0	0	32
ENE	0	1	3	0	0	0	4
E	0	3	0	1	0	0	4
ESE	0	3	0	0	0	0	3
SE	0	0	6	1	0	0	7
SSE	0	0	2	1	0	0	3
S	0	0	0	0	0	0	0
SSW	0	0	2	2	0	0	4
SW	0	4	14	14	0	0	32
WSW	0	2	23	14	0	0	39
W	0	2	17	7	0	0	26
WNW	0	0	7	7	0	0	14
NW	0	4	10	0	0	0	14
NNW	0	0	4	1	0	0	5
Variable	0	0	0	0	0	0	0
Total	0	31	146	66	1	0	244

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 2

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	2	3	0	0	6
NNE	0	1	11	0	0	0	12
NE	0	6	3	1	0	0	10
ENE	0	2	1	0	0	0	3
E	0	4	0	0	0	0	4
ESE	0	0	2	0	0	0	2
SE	0	6	0	0	0	0	6
SSE	0	0	0	0	0	0	0
S	0	0	1	0	0	0	1
SSW	0	0	1	1	0	0	2
SW	0	0	5	0	0	0	5
WSW	0	1	8	1	0	0	10
W	0	3	8	1	0	0	12
WNW	0	3	3	0	0	0	6
NW	0	0	0	0	0	0	0
NNW	0	0	1	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	0	27	46	7	0	0	80

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 3

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	3	17	4	0	0	24
NNE	0	14	6	3	0	0	23
NE	1	3	2	0	0	0	6
ENE	1	2	1	0	0	0	4
E	0	4	1	1	0	0	6
ESE	0	0	1	0	0	0	1
SE	0	2	1	0	0	0	3
SSE	0	4	1	2	0	0	7
S	0	0	0	0	0	0	0
SSW	0	0	0	2	0	0	2
SW	0	1	2	3	0	0	6
WSW	0	2	12	1	0	0	15
W	0	2	2	2	0	0	6
WNW	0	0	2	1	0	0	3
NW	0	2	2	0	0	0	4
NNW	0	1	6	0	0	0	7
Variable	0	0	0	0	0	0	0
Total	2	40	56	19	0	0	117

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 1

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014
 Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
 Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	41	57	11	3	0	113
NNE	8	45	40	3	0	0	96
NE	6	39	16	3	0	0	64
ENE	4	17	10	12	0	0	43
E	7	15	8	7	1	0	38
ESE	5	10	5	2	0	0	22
SE	1	14	6	0	0	0	21
SSE	1	12	16	11	1	0	41
S	2	16	9	1	0	0	28
SSW	0	7	27	4	0	0	38
SW	0	10	21	12	0	0	43
WSW	0	18	10	7	0	0	35
W	1	12	15	6	0	0	34
WNW	1	11	6	3	0	0	21
NW	5	13	8	1	0	0	27
NNW	2	18	7	2	0	0	29
Variable	0	0	0	0	0	0	0
Total	44	298	261	85	5	0	693

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 6
 Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	4	20	22	0	0	0	46
NNE	8	25	6	0	0	0	39
NE	10	12	5	4	0	0	31
ENE	7	9	3	5	0	0	24
E	3	9	1	1	0	0	14
ESE	6	11	2	0	0	0	19
SE	8	19	10	0	0	0	37
SSE	3	23	30	5	0	0	61
S	6	38	26	2	1	0	73
SSW	8	32	7	0	0	0	47
SW	4	16	6	0	0	0	26
WSW	1	14	3	0	0	0	18
W	3	11	3	0	0	0	17
WNW	5	14	2	0	0	0	21
NW	8	11	2	0	0	0	21
NNW	7	12	1	0	0	0	20
Variable	2	0	0	0	0	0	2
Total	93	276	129	17	1	0	516

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 2

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	8	10	3	0	0	0	21
NNE	5	8	2	0	0	0	15
NE	6	7	4	0	0	0	17
ENE	5	9	4	0	0	0	18
E	8	5	2	0	0	0	15
ESE	5	5	3	1	0	0	14
SE	5	14	4	0	0	0	23
SSE	5	12	25	6	0	0	48
S	9	32	28	0	0	0	69
SSW	11	14	1	0	0	0	26
SW	5	2	2	0	0	0	9
WSW	8	0	0	0	0	0	8
W	5	4	0	0	0	0	9
WNW	8	0	0	0	0	0	8
NW	7	2	1	0	0	0	10
NNW	6	3	0	1	0	0	10
Variable	0	1	0	0	0	0	1
Total	106	128	79	8	0	0	321

Hours of calm in this stability class: 1

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	4	1	0	0	0	0	5
NNE	1	0	0	0	0	0	1
NE	5	2	1	0	0	0	8
ENE	1	3	1	0	0	0	5
E	3	5	1	0	0	0	9
ESE	2	3	1	0	0	0	6
SE	3	8	1	0	0	0	12
SSE	7	22	11	2	0	0	42
S	5	21	21	0	0	0	47
SSW	8	4	1	0	0	0	13
SW	4	1	0	0	0	0	5
WSW	9	2	0	0	0	0	11
W	10	5	0	0	0	0	15
WNW	4	1	0	0	0	0	5
NW	3	3	0	0	0	0	6
NNW	2	1	0	0	0	0	3
Variable	1	0	0	0	0	0	1
Total	72	82	38	2	0	0	194

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	0	0	4	6	10
NNE	0	1	17	26	4	0	48
NE	0	2	13	3	3	0	21
ENE	0	0	3	6	0	0	9
E	0	0	7	2	0	0	9
ESE	0	2	0	0	0	0	2
SE	0	0	1	1	1	3	6
SSE	0	0	0	3	0	0	3
S	0	0	0	1	0	0	1
SSW	0	0	1	1	1	0	3
SW	0	0	4	12	6	1	23
WSW	0	0	8	21	10	9	48
W	0	0	6	10	7	1	24
WNW	0	0	2	5	8	3	18
NW	0	0	3	9	1	0	13
NNW	0	0	1	4	1	0	6
Variable	0	0	0	0	0	0	0
Total	0	5	66	104	46	23	244

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 2

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	2	4	0	1	7
NNE	0	1	10	5	1	0	17
NE	0	1	2	0	1	0	4
ENE	0	0	1	0	0	0	1
E	0	1	2	1	0	0	4
ESE	0	0	1	0	0	0	1
SE	0	5	1	0	0	0	6
SSE	0	1	1	0	0	0	2
S	0	0	0	1	0	0	1
SSW	0	0	0	1	1	0	2
SW	0	0	0	3	0	0	3
WSW	0	0	2	6	2	0	10
W	0	0	4	6	5	0	15
WNW	0	0	2	3	0	0	5
NW	0	0	2	0	0	0	2
NNW	0	0	0	1	0	0	1
Variable	0	0	0	0	0	0	0
Total	0	9	30	31	10	1	81

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 2

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	7	8	2	2	19
NNE	0	5	8	6	1	0	20
NE	0	1	2	1	4	0	8
ENE	0	2	4	1	0	0	7
E	0	1	1	0	1	0	3
ESE	0	2	2	0	0	0	4
SE	0	0	2	1	2	0	5
SSE	0	2	2	0	0	0	4
S	0	0	0	1	0	0	1
SSW	0	0	0	0	2	0	2
SW	0	0	0	3	1	0	4
WSW	0	0	4	10	2	1	17
W	0	0	3	2	0	1	6
WNW	0	0	0	2	1	0	3
NW	0	0	3	2	0	0	5
NNW	0	0	2	5	1	0	8
Variable	0	0	0	0	0	0	0
Total	0	13	40	42	17	4	116

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 2

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014
 Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
 Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	13	15	41	20	9	98
NNE	1	14	36	34	11	1	97
NE	0	18	18	15	4	1	56
ENE	0	8	14	13	6	2	43
E	0	11	10	10	7	11	49
ESE	1	8	6	4	4	1	24
SE	1	9	6	11	4	3	34
SSE	0	4	7	17	8	3	39
S	0	1	11	5	2	0	19
SSW	0	2	8	12	11	1	34
SW	0	0	11	26	6	7	50
WSW	0	0	10	16	9	2	37
W	0	0	11	15	10	1	37
WNW	0	0	2	8	4	1	15
NW	0	4	11	6	0	0	21
NNW	3	7	5	12	8	0	35
Variable	0	0	0	0	0	0	0
Total	6	99	181	245	114	43	688

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 11
 Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	4	6	11	5	1	28
NNE	0	11	20	20	5	0	56
NE	1	9	7	4	0	6	27
ENE	0	9	4	3	4	2	22
E	1	7	6	2	2	3	21
ESE	1	14	9	2	1	0	27
SE	2	11	19	14	1	8	55
SSE	0	7	15	26	16	7	71
S	0	2	10	28	8	4	52
SSW	1	2	7	23	2	0	35
SW	0	3	6	22	1	0	32
WSW	1	4	3	12	0	0	20
W	0	2	4	13	0	0	19
WNW	0	0	8	13	0	0	21
NW	0	1	2	10	0	0	13
NNW	0	1	2	7	0	0	10
Variable	0	0	0	0	0	0	0
Total	8	87	128	210	45	31	509

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 9

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	5	4	0	0	10
NNE	0	6	10	6	1	0	23
NE	0	9	6	0	0	1	16
ENE	1	4	4	1	1	2	13
E	1	3	5	5	2	1	17
ESE	1	3	6	0	3	2	15
SE	1	9	13	7	2	7	39
SSE	1	5	6	18	20	9	59
S	2	3	14	21	13	1	54
SSW	1	3	16	11	0	0	31
SW	0	1	2	3	1	0	7
WSW	0	2	2	1	1	0	6
W	1	1	5	1	0	0	8
WNW	0	0	0	3	0	0	3
NW	0	2	1	0	0	0	3
NNW	0	2	1	7	1	0	11
Variable	0	0	0	0	0	0	0
Total	9	54	96	88	45	23	315

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 7

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: April - June 2014

Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	1	4	0	0	0	6
NNE	0	3	1	0	0	0	4
NE	0	2	0	0	0	0	2
ENE	0	2	1	0	0	0	3
E	0	0	1	0	1	0	2
ESE	0	2	0	2	0	1	5
SE	0	2	4	3	4	2	15
SSE	0	5	13	13	5	5	41
S	0	5	27	21	7	0	60
SSW	1	3	9	7	3	0	23
SW	1	3	9	5	0	0	18
WSW	0	1	3	1	0	0	5
W	1	0	1	2	0	0	4
WNW	0	1	1	0	0	0	2
NW	0	1	0	0	0	0	1
NNW	0	1	1	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	4	32	75	54	20	8	193

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 1

Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	11	5	0	0	17
NNE	0	18	28	1	0	0	47
NE	0	52	8	0	0	0	60
ENE	0	30	4	0	0	0	34
E	1	26	0	0	0	0	27
ESE	0	28	3	0	0	0	31
SE	0	30	3	0	0	0	33
SSE	0	6	11	0	0	0	17
S	0	1	1	0	0	0	2
SSW	0	1	3	1	0	0	5
SW	0	5	10	5	0	0	20
WSW	0	15	13	3	0	0	31
W	0	20	25	0	0	0	45
WNW	0	3	10	1	0	0	14
NW	0	4	1	1	0	0	6
NNW	0	0	1	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	1	240	132	17	0	0	390

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	2	7	1	0	0	10
NNE	0	4	3	0	0	0	7
NE	1	5	0	0	0	0	6
ENE	0	5	0	0	0	0	5
E	0	5	1	0	0	0	6
ESE	3	7	2	0	0	0	12
SE	0	5	0	0	0	0	5
SSE	0	2	8	0	0	0	10
S	0	0	0	0	0	0	0
SSW	0	2	4	0	0	0	6
SW	0	1	10	2	0	0	13
WSW	0	2	3	1	0	0	6
W	1	5	6	0	0	0	12
WNW	0	0	3	0	0	0	3
NW	0	5	2	1	0	0	8
NNW	0	0	2	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	5	50	51	5	0	0	111

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	7	8	1	0	0	17
NNE	2	5	7	2	0	0	16
NE	1	5	1	0	0	0	7
ENE	0	2	0	0	0	0	2
E	3	4	0	0	0	0	7
ESE	1	4	1	0	0	0	6
SE	0	12	2	0	0	0	14
SSE	1	14	14	0	0	0	29
S	0	4	3	0	0	0	7
SSW	0	1	1	0	0	0	2
SW	0	6	7	0	0	0	13
WSW	0	1	10	1	0	0	12
W	1	4	3	1	0	0	9
WNW	0	1	3	0	0	0	4
NW	0	1	3	1	0	0	5
NNW	1	4	5	0	0	0	10
Variable	0	0	0	0	0	0	0
Total	11	75	68	6	0	0	160

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014
 Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
 Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	7	21	16	5	0	0	49
NNE	9	29	10	2	0	0	50
NE	7	9	7	0	0	0	23
ENE	7	16	2	0	0	0	25
E	4	23	6	0	0	0	33
ESE	9	16	2	0	0	0	27
SE	6	23	1	0	0	0	30
SSE	4	24	34	8	0	0	70
S	7	31	8	0	0	0	46
SSW	2	7	11	0	0	0	20
SW	5	26	37	5	0	0	73
WSW	2	19	10	0	0	0	31
W	5	21	10	0	0	0	36
WNW	4	20	5	0	0	0	29
NW	7	20	22	1	0	0	50
NNW	6	27	25	1	0	0	59
Variable	0	0	0	0	0	0	0
Total	91	332	206	22	0	0	651

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	11	11	2	1	0	0	25
NNE	8	9	0	3	0	0	20
NE	5	4	0	0	0	0	9
ENE	3	1	0	0	0	0	4
E	2	2	0	0	0	0	4
ESE	5	2	0	0	0	0	7
SE	3	9	1	0	0	0	13
SSE	9	10	11	1	3	0	34
S	12	58	18	0	0	0	88
SSW	22	16	7	0	0	0	45
SW	6	21	6	0	0	0	33
WSW	7	28	2	0	0	0	37
W	18	15	2	0	0	0	35
WNW	11	17	1	0	0	0	29
NW	8	10	1	0	0	0	19
NNW	13	15	2	0	0	0	30
Variable	0	0	0	0	0	0	0
Total	143	228	53	5	3	0	432

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	4	2	1	0	0	0	7
NNE	1	1	0	0	0	0	2
NE	1	0	0	0	0	0	1
ENE	1	1	0	0	0	0	2
E	0	1	0	0	0	0	1
ESE	2	2	0	0	0	0	4
SE	0	3	1	0	0	0	4
SSE	2	1	0	0	0	0	3
S	11	22	5	0	0	0	38
SSW	41	15	1	0	0	0	57
SW	35	9	0	0	0	0	44
WSW	28	17	0	0	0	0	45
W	14	21	0	0	0	0	35
WNW	7	12	0	0	0	0	19
NW	15	17	1	0	0	0	33
NNW	11	3	0	0	0	0	14
Variable	1	0	0	0	0	0	1
Total	174	127	9	0	0	0	310

Hours of calm in this stability class: 3

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	0	0	0	0	0	1
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	1	0	0	0	0	0	1
SSE	0	0	0	0	0	0	0
S	1	1	1	0	0	0	3
SSW	9	1	0	0	0	0	10
SW	20	5	0	0	0	0	25
WSW	26	16	0	0	0	0	42
W	23	13	0	0	0	0	36
WNW	20	3	0	0	0	0	23
NW	5	0	0	0	0	0	5
NNW	3	0	0	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	109	39	1	0	0	0	149

Hours of calm in this stability class: 2

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	4	6	5	1	17
NNE	0	10	25	23	1	0	59
NE	0	9	37	1	0	0	47
ENE	0	14	20	0	0	0	34
E	0	18	5	0	0	0	23
ESE	0	15	9	6	0	0	30
SE	0	2	32	7	0	0	41
SSE	0	2	9	1	0	0	12
S	0	0	2	2	0	0	4
SSW	0	0	1	3	0	0	4
SW	0	1	9	8	2	0	20
WSW	0	4	11	7	7	0	29
W	0	4	21	20	3	0	48
WNW	0	1	7	5	2	0	15
NW	0	0	2	2	1	0	5
NNW	0	0	1	1	0	0	2
Variable	0	0	0	0	0	0	0
Total	0	81	195	92	21	1	390

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	2	2	5	2	0	11
NNE	0	2	2	2	0	0	6
NE	1	3	3	0	0	0	7
ENE	1	4	0	0	0	0	5
E	0	2	2	1	0	0	5
ESE	0	5	1	2	0	0	8
SE	0	6	3	3	0	0	12
SSE	0	0	4	1	0	0	5
S	0	0	0	2	0	0	2
SSW	0	0	2	2	0	0	4
SW	0	1	3	9	2	0	15
WSW	0	0	1	2	2	0	5
W	0	4	4	5	2	0	15
WNW	0	0	0	2	0	0	2
NW	0	2	2	2	1	0	7
NNW	0	0	1	1	0	0	2
Variable	0	0	0	0	0	0	0
Total	2	31	30	39	9	0	111

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	3	5	7	0	1	16
NNE	2	2	5	7	0	2	18
NE	1	3	2	1	0	0	7
ENE	0	0	0	0	0	0	0
E	0	4	1	0	0	0	5
ESE	1	2	3	1	0	0	7
SE	0	7	5	6	0	0	18
SSE	0	8	14	5	0	0	27
S	0	1	1	2	1	0	5
SSW	0	0	1	1	0	0	2
SW	0	2	6	4	2	0	14
WSW	0	0	2	6	4	0	12
W	1	0	5	2	1	0	9
WNW	0	0	1	2	2	0	5
NW	0	1	0	2	2	0	5
NNW	0	1	5	4	0	0	10
Variable	0	0	0	0	0	0	0
Total	5	34	56	50	12	3	160

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014
 Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
 Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	3	7	12	16	14	2	54
NNE	2	3	21	14	1	0	41
NE	4	8	3	7	0	0	22
ENE	0	10	13	2	0	0	25
E	1	8	11	6	2	0	28
ESE	3	18	7	6	1	0	35
SE	1	8	7	13	0	0	29
SSE	1	20	28	22	8	3	82
S	2	4	12	15	4	0	37
SSW	1	0	5	7	2	0	15
SW	0	3	24	32	11	1	71
WSW	0	4	14	17	3	0	38
W	1	3	14	18	3	0	39
WNW	1	3	10	13	2	1	30
NW	0	6	12	26	10	0	54
NNW	1	4	9	37	0	0	51
Variable	0	0	0	0	0	0	0
Total	21	109	202	251	61	7	651

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	5	11	9	1	0	26
NNE	1	4	9	0	0	4	18
NE	3	5	8	0	0	0	16
ENE	0	3	0	0	0	0	3
E	0	5	3	0	0	0	8
ESE	5	9	3	2	0	0	19
SE	2	5	4	9	0	0	20
SSE	1	10	15	19	0	4	49
S	1	4	23	24	12	0	64
SSW	0	6	14	16	2	0	38
SW	2	6	18	18	2	0	46
WSW	0	2	15	20	1	0	38
W	1	7	10	10	1	0	29
WNW	0	4	9	12	2	0	27
NW	2	2	7	5	0	0	16
NNW	0	3	2	9	1	0	15
Variable	0	0	0	0	0	0	0
Total	18	80	151	153	22	8	432

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	3	6	6	0	0	16
NNE	0	4	2	1	0	0	7
NE	2	11	1	0	0	0	14
ENE	0	3	2	0	0	0	5
E	0	1	4	0	0	0	5
ESE	0	1	1	0	0	0	2
SE	2	4	1	2	0	0	9
SSE	3	4	25	5	0	0	37
S	0	2	29	26	4	1	62
SSW	0	6	17	8	1	0	32
SW	2	2	11	11	0	0	26
WSW	0	4	5	16	0	0	25
W	0	2	3	16	0	0	21
WNW	0	1	11	11	0	0	23
NW	1	1	3	11	1	0	17
NNW	0	3	1	7	0	0	11
Variable	0	0	0	0	0	0	0
Total	11	52	122	120	6	1	312

Hours of calm in this stability class: 1

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: July - September 2014

Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	3	5	0	0	0	0	8
NNE	0	6	0	0	0	0	6
NE	0	2	0	0	0	0	2
ENE	0	1	0	0	0	0	1
E	1	0	1	0	0	0	2
ESE	1	2	1	0	0	0	4
SE	1	3	3	0	0	0	7
SSE	0	5	5	0	0	0	10
S	1	6	7	3	0	0	17
SSW	0	3	12	6	0	0	21
SW	0	2	11	17	0	0	30
WSW	1	2	6	9	2	0	20
W	0	1	3	3	0	0	7
WNW	0	5	4	1	0	0	10
NW	0	0	2	0	0	0	2
NNW	0	1	2	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	8	44	57	39	2	0	150

Hours of calm in this stability class: 1

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 0

Zion Nuclear Station

Period of Record: October - December 2014

Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	1	0	0	0	2
NNE	0	5	5	0	0	0	10
NE	0	3	3	0	0	0	6
ENE	0	2	0	0	0	0	2
E	0	3	1	0	0	0	4
ESE	0	8	1	0	0	0	9
SE	0	9	2	0	0	0	11
SSE	0	1	4	0	0	0	5
S	0	0	2	0	0	0	2
SSW	0	0	4	0	0	0	4
SW	0	0	8	0	0	0	8
WSW	0	4	14	6	0	0	24
W	0	6	20	20	0	0	46
WNW	0	1	7	2	0	0	10
NW	0	5	4	1	0	0	10
NNW	0	1	0	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	0	49	76	29	0	0	154

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014

Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	4	2	0	0	6
NNE	0	2	1	0	0	0	3
NE	0	0	0	0	0	0	0
ENE	0	0	1	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	1	1	0	0	0	2
SE	0	0	1	0	0	0	1
SSE	0	1	5	1	0	0	7
S	0	0	3	0	0	0	3
SSW	0	2	6	1	0	0	9
SW	0	3	10	5	0	0	18
WSW	0	2	5	1	0	0	8
W	0	2	11	10	0	0	23
WNW	0	1	9	0	0	0	10
NW	0	1	1	0	0	0	2
NNW	0	0	3	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	0	15	61	20	0	0	96

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014

Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	5	4	3	0	0	12
NNE	0	2	0	0	0	0	2
NE	0	0	0	1	0	0	1
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	2	0	0	0	2
SE	1	0	0	0	0	0	1
SSE	0	1	3	4	0	0	8
S	1	2	6	1	0	0	10
SSW	0	3	5	3	0	0	11
SW	0	7	14	2	0	0	23
WSW	0	6	11	5	0	0	22
W	0	10	23	7	0	0	40
WNW	0	6	18	0	0	0	24
NW	0	2	6	2	0	0	10
NNW	0	0	2	1	1	0	4
Variable	0	0	0	0	0	0	0
Total	2	44	94	29	1	0	170

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014
 Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
 Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	16	30	17	2	0	66
NNE	1	6	5	4	2	0	18
NE	1	3	7	0	0	0	11
ENE	1	1	3	3	0	0	8
E	1	4	7	1	0	0	13
ESE	1	6	8	0	0	0	15
SE	2	10	15	0	0	0	27
SSE	3	9	69	29	3	0	113
S	7	39	40	1	0	0	87
SSW	4	26	78	12	0	0	120
SW	10	30	40	19	0	0	99
WSW	7	38	52	17	0	0	114
W	9	51	110	23	0	0	193
WNW	8	60	70	8	0	0	146
NW	11	74	43	9	0	0	137
NNW	3	37	41	9	6	0	96
Variable	0	0	0	0	0	0	0
Total	70	410	618	152	13	0	1263

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014
 Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
 Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	1	2	0	0	0	0	3
NNE	1	4	3	0	0	0	8
NE	1	4	1	0	0	0	6
ENE	1	2	0	0	0	0	3
E	0	0	1	0	0	0	1
ESE	2	0	2	0	0	0	4
SE	2	3	2	0	0	0	7
SSE	1	15	19	5	0	0	40
S	1	29	21	0	0	0	51
SSW	9	22	9	1	0	0	41
SW	6	24	17	0	0	0	47
WSW	6	38	7	0	0	0	51
W	15	33	4	0	0	0	52
WNW	11	21	2	0	0	0	34
NW	14	10	0	0	0	0	24
NNW	4	9	0	0	0	0	13
Variable	0	0	0	0	0	0	0
Total	75	216	88	6	0	0	385

Hours of calm in this stability class: 1
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014

Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	1	0	0	0	0	0	1
SE	0	1	0	0	0	0	1
SSE	1	1	0	0	0	0	2
S	2	11	0	0	0	0	13
SSW	4	2	0	0	0	0	6
SW	2	6	0	0	0	0	8
WSW	4	4	0	0	0	0	8
W	7	6	0	0	0	0	13
WNW	5	5	0	0	0	0	10
NW	1	7	0	0	0	0	8
NNW	0	1	0	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	27	44	0	0	0	0	71

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014
 Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
 Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	1	0	0	0	0	0	1
SW	1	2	0	0	0	0	3
WSW	13	9	0	0	0	0	22
W	14	8	0	0	0	0	22
WNW	3	9	0	0	0	0	12
NW	0	3	0	0	0	0	3
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	32	31	0	0	0	0	63

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014

Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	1	1	1	0	0	3
NNE	0	1	7	3	0	0	11
NE	0	0	3	2	0	0	5
ENE	0	2	0	0	0	0	2
E	0	0	3	0	0	0	3
ESE	0	3	5	3	0	0	11
SE	0	2	6	4	0	0	12
SSE	0	0	1	1	0	0	2
S	0	0	0	2	0	0	2
SSW	0	0	0	4	0	0	4
SW	0	0	1	8	0	0	9
WSW	0	2	7	3	7	0	19
W	0	0	9	12	19	1	41
WNW	0	0	2	7	1	0	10
NW	0	0	7	1	1	0	9
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	11	52	51	28	1	143

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 11

Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014
 Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
 Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	1	2	2	0	5
NNE	0	0	3	0	0	0	3
NE	0	0	0	0	0	0	0
ENE	0	0	1	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	1	0	0	1	0	2
SE	0	0	3	2	0	0	5
SSE	0	0	1	2	0	0	3
S	0	1	1	2	0	0	4
SSW	0	1	3	4	1	0	9
SW	0	0	4	6	4	1	15
WSW	0	0	4	4	5	0	13
W	0	1	2	9	4	1	17
WNW	0	0	1	5	2	0	8
NW	0	0	3	1	0	0	4
NNW	0	0	2	2	0	0	4
Variable	0	0	0	0	0	0	0
Total	0	4	29	39	19	2	93

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 3
 Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014

Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	5	3	3	0	11
NNE	0	0	1	0	0	0	1
NE	0	0	0	0	1	0	1
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	1	1	0	0	2
SE	0	1	1	1	0	0	3
SSE	0	0	1	2	3	0	6
S	0	2	1	6	1	0	10
SSW	0	2	1	6	2	0	11
SW	0	3	8	10	2	0	23
WSW	0	5	2	6	2	3	18
W	0	2	9	16	7	0	34
WNW	0	1	8	16	3	0	28
NW	0	0	2	3	4	0	9
NNW	0	0	1	2	0	2	5
Variable	0	0	0	0	0	0	0
Total	0	16	41	72	28	5	162

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 8

Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014
 Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
 Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	2	10	13	20	11	56
NNE	0	1	5	4	4	2	16
NE	1	1	3	8	0	0	13
ENE	1	1	0	5	1	0	8
E	1	0	1	6	4	0	12
ESE	0	0	5	9	1	0	15
SE	0	4	8	38	12	0	62
SSE	0	2	7	37	25	5	76
S	1	7	21	50	13	0	92
SSW	0	7	26	70	26	1	130
SW	1	8	28	27	20	1	85
WSW	3	12	24	46	23	8	116
W	2	4	34	69	41	1	151
WNW	1	10	52	64	27	0	154
NW	3	7	50	63	18	5	146
NNW	0	5	24	55	2	11	97
Variable	0	0	0	0	0	0	0
Total	14	71	298	564	237	45	1229

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 34
 Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014
 Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
 Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	5	7	3	0	0	15
NNE	0	4	2	1	2	0	9
NE	0	1	2	4	0	0	7
ENE	0	0	0	1	0	0	1
E	0	1	0	1	0	0	2
ESE	0	0	0	4	3	0	7
SE	0	1	5	5	3	0	14
SSE	0	1	3	12	12	5	33
S	0	2	8	28	7	0	45
SSW	1	5	11	25	1	0	43
SW	0	1	16	11	12	0	40
WSW	0	3	13	21	2	0	39
W	1	6	15	24	2	0	48
WNW	0	1	13	13	5	0	32
NW	0	7	10	4	0	0	21
NNW	1	2	6	0	0	0	9
Variable	0	0	0	0	0	0	0
Total	3	40	111	157	49	5	365

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 21
 Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014

Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)

Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	0	1	2	0	0	3
NNE	0	2	0	0	0	0	2
NE	0	0	1	0	0	0	1
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	1	0	0	1
SE	0	2	1	0	0	0	3
SSE	1	0	1	1	0	0	3
S	0	0	6	10	0	0	16
SSW	0	1	4	2	0	0	7
SW	0	0	3	2	0	0	5
WSW	0	3	2	4	0	0	9
W	0	0	2	2	0	0	4
WNW	0	1	1	3	0	0	5
NW	0	0	2	3	0	0	5
NNW	0	1	1	5	0	0	7
Variable	0	0	0	0	0	0	0
Total	1	10	25	35	0	0	71

Hours of calm in this stability class: 0

Hours of missing wind measurements in this stability class: 0

Hours of missing stability measurements in all stability classes: 5

Zion Nuclear Station

Period of Record: October - December 2014
 Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
 Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph)						Total
	1-3	4-7	8-12	13-18	19-24	> 24	
N	0	3	0	2	0	0	5
NNE	2	1	0	0	0	0	3
NE	0	3	0	0	0	0	3
ENE	0	1	0	0	0	0	1
E	1	0	0	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	1	1	0	0	0	0	2
SSE	1	0	3	0	0	0	4
S	0	0	2	1	0	0	3
SSW	1	2	4	1	0	0	8
SW	0	1	3	0	0	0	4
WSW	1	3	4	6	0	0	14
W	1	2	0	0	0	0	3
WNW	1	1	1	0	0	0	3
NW	0	2	3	1	0	0	6
NNW	0	3	0	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	9	23	20	11	0	0	63

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 5

APPENDIX G

ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

Docket No: 50-295
50-304

ZION NUCLEAR POWER STATION UNITS 1 and 2

Annual Radiological
Groundwater Protection Program Report

1 January Through 31 December 2014

Prepared By

Teledyne Brown Engineering
Environmental Services



Zion Nuclear Power Station
Zion, IL 60099

May 2015

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Appendices

Appendix A Location and Direction

Tables

Table A-1 Radiological Groundwater Protection Program - Sampling Locations and Distance, Zion Nuclear Power Station, 2014

Figures

Figure A-1 Radiological Groundwater Protection Program Groundwater and Surface Water Locations of the Zion Nuclear Power Station, 2014

Appendix B Data Tables

Tables

Table B-I.1 Concentrations of Tritium, Strontium, Gross Alpha and Gross Beta in Groundwater Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014.

Table B-I.2 Concentrations of Gamma Emitters in Groundwater Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014.

Table B-I.3 Concentrations of Iron-55 and Nickel-63 in Groundwater Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014.

Table B-II.1 Concentrations of Tritium, Strontium, Gross Alpha and Gross Beta in Surface Water Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014.

Table B-II.2 Concentrations of Gamma Emitters in Surface Water Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014.

Table B-II.3 Concentrations of Iron-55 and Nickel-63 in Surface Water Samples Collected in the Vicinity of Zion Nuclear Power Station, 2014.

I. Summary and Conclusions

In 2006, Exelon instituted a comprehensive program to evaluate the impact of station operations on groundwater and surface water in the vicinity of Zion Nuclear Power Station. This is the ninth in a series of annual reports on the status of the Radiological Groundwater Protection Program (RGPP) conducted at Zion Nuclear Power Station. This report covers both groundwater and surface water samples, collected from the environment, on station property in 2014. During that time period, 433 analyses were performed on 45 samples from 12 locations. Phase 1 of the monitoring was part of a comprehensive study initiated by Exelon to determine whether groundwater or surface water at and in the vicinity of Zion Nuclear Power Station had been adversely impacted by any releases of radionuclides. Phase 1 was conducted by Conestoga Rovers and Associates (CRA) and the conclusions were made available to state and federal regulators as well as the public in station specific reports.

Phase 2 of the RGPP was conducted by *ZionSolutions* (Exelon was responsible for the program up to 8/31/2010; *ZionSolutions* became the licensee on 9/1/2010, thus assuming responsibility for the RGPP) personnel to initiate follow up of Phase 1 and begin long-term monitoring at groundwater and surface water locations selected during Phase 1. All analytical results from Phase 2 monitoring are reported herein.

In assessing all the data gathered for this report, it was concluded that the operation of Zion Nuclear Power Station had no adverse radiological impact on the environment, and there are no known active releases into the groundwater at Zion Nuclear Power Station.

Naturally occurring K-40 was detected in two groundwater samples. No other gamma-emitting radionuclides were not detected at concentrations greater than their respective Lower Limits of Detection (LLDs) as specified in the Offsite Dose Calculation Manual (ODCM) in any of the groundwater or surface water samples.

Strontium-90 was not detected in any of the samples analyzed in 2014.

Tritium was detected in one groundwater sample at a concentration of 167 pCi/L. Tritium was not detected in any surface water samples analyzed in 2014. In the case of tritium, *ZionSolutions* specified that its laboratories achieve a lower limit of detection 10 times lower than that required by federal regulation.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples during all four quarters of sampling in 2014. Gross Alpha (dissolved) was not detected at any of the groundwater location. Gross Alpha (suspended) was not detected at any of the groundwater

locations. Gross Beta (dissolved) was detected at all thirty-six groundwater locations. The concentrations ranged from 3.3 to 15.3 pCi/L. Gross Beta (suspended) was not detected in any of the groundwater locations.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on surface water samples during all four quarters of sampling in 2014. Gross Alpha (dissolved) and Gross Alpha (suspended) was not detected in any of the surface water locations. Gross Beta (dissolved) was detected at one surface water location. The concentrations ranged from 2.4 to 3.4 pCi/L. Gross Beta (suspended) was not detected in any of the surface water locations. Dissolved Gross Alpha and Dissolved Gross Beta are detectable in samples from background isotopes.

Iron-55 and Nickel-63 analyses were performed in 2014 on 48 samples from 11 groundwater and one surface water location. All results were less than their respective LLDs.

II. Introduction

The Zion Nuclear Power Station (ZNPS), consisting of two 1,100 MWt pressurized water reactor was owned and operated by Exelon Corporation, is located in Zion, Illinois adjacent to Lake Michigan. Unit No. 1 went critical in December 1973. Unit No. 2 went critical in September 1974. The plant permanently ceased operation in January of 1998 and has been permanently defueled. The site is located in northeast Illinois on the western shore of Lake Michigan, approximately 50 miles north of Chicago, Illinois.

This report covers those analyses performed by Teledyne Brown Engineering (TBE) and Environmental Inc. (Midwest Labs) on samples collected in 2014.

A. Objective of the RGPP

The long-term objectives of the RGPP are as follows:

1. Identify suitable locations to monitor and evaluate potential impacts from station operations before significant radiological impact to the environment and potential drinking water sources.
2. Understand the local hydrogeologic regime in the vicinity of the station and maintain up-to-date knowledge of flow patterns on the surface and shallow subsurface.
3. Perform routine water sampling and radiological analysis of water from selected locations.
4. Report new leaks, spills, or other detections with potential radiological significance to stakeholders in a timely manner.
5. Regularly assess analytical results to identify adverse trends.
6. Take necessary corrective actions to protect groundwater resources.

B. Implementation of the Objectives

The objectives identified have been implemented at Zion Nuclear Power Station as discussed below:

1. Exelon and its consultant identified locations as described in the Phase 1 study. Phase 1 studies were conducted by Conestoga Rovers and Associates (CRA) and the results and conclusions were made available to state and federal regulators as well as the public in station specific reports.

2. The Zion Nuclear Power Station reports describe the local hydrogeologic regime. Periodically, the flow patterns on the surface and shallow subsurface are updated based on ongoing measurements.
3. Zion Nuclear Power Station will continue to perform routine sampling and radiological analysis of water from selected locations.
4. Zion Nuclear Power Station has implemented new procedures to identify and report new leaks, spills, or other detections with potential radiological significance in a timely manner.
5. Zion Nuclear Power Station staff and consulting hydrogeologist assess analytical results on an ongoing basis to identify adverse trends.

C. Program Description

1. Sample Collection

Sample locations can be found in Table A-1 and Figures A-1, Appendix A.

Groundwater and Surface Water

Samples of water are collected, managed, transported and analyzed in accordance with approved procedures following EPA methods. Groundwater samples were collected. Sample locations, sample collection frequencies and analytical frequencies are controlled in accordance with approved station procedures. Contractor and/or station personnel are trained in the collection, preservation management, and shipment of samples, as well as in documentation of sampling events. Analytical laboratories are subject to internal quality assurance programs, industry cross-check programs, as well as nuclear industry audits. Station personnel review and evaluate all analytical data deliverables as data are received.

Analytical data results are reviewed by both station personnel and an independent hydrogeologist for adverse trends or changes to hydrogeologic conditions.

D. Characteristics of Tritium (H-3)

Tritium (chemical symbol H-3) is a radioactive isotope of hydrogen. The

most common form of tritium is tritium oxide, which is also called "tritiated water". The chemical properties of tritium are essentially those of ordinary hydrogen.

Tritiated water behaves the same as ordinary water in both the environment and the body. Tritium can be taken into the body by drinking water, breathing air, eating food, or absorption through skin. Once tritium enters the body, it disperses quickly and is uniformly distributed throughout the body. Tritium is excreted primarily through urine with a clearance rate characterized by an effective biological half-life of about 14 days. Within one month or so after ingestion, essentially all tritium is cleared. Organically bound tritium (tritium that is incorporated in organic compounds) can remain in the body for a longer period.

Tritium is produced naturally in the upper atmosphere when cosmic rays strike air molecules. Tritium is also produced during nuclear weapons explosions, as a by-product in reactors producing electricity, and in special production reactors, where the isotopes lithium-7 and/or boron-10 are activated to produce tritium. Like normal water, tritiated water is colorless and odorless. Tritiated water behaves chemically and physically like non-tritiated water in the subsurface, and therefore tritiated water will travel at the same velocity as the average groundwater velocity.

Tritium has a half-life of approximately 12.3 years. It decays spontaneously to helium-3 (^3He). This radioactive decay releases a beta particle (low-energy electron). The radioactive decay of tritium is the source of the health risk from exposure to tritium. Tritium is one of the least dangerous radionuclides because it emits very weak radiation and leaves the body relatively quickly. Since tritium is almost always found as water, it goes directly into soft tissues and organs. The associated dose to these tissues is generally uniform and is dependent on the water content of the specific tissue.

III. Program Description

A. Sample Analysis

This section describes the general analytical methodologies used by TBE to analyze the environmental samples for radioactivity for the Zion Nuclear Power Station RGPP in 2014.

In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of gamma emitters in groundwater and surface water.
2. Concentrations of strontium in groundwater and surface water.
3. Concentrations of tritium in groundwater and surface water.
4. Concentration of gross alpha and gross beta in groundwater and surface water.
5. Concentrations of Iron-55 in groundwater and surface water.
6. Concentrations of Nickel-63 in groundwater and surface water.

B. Data Interpretation

The radiological data collected prior to Zion Nuclear Power Station becoming operational were used as a baseline with which these operational data were compared. For the purpose of this report, Zion Nuclear Power Station was considered operational at initial criticality. Several factors were important in the interpretation of the data:

1. Lower Limit of Detection and Minimum Detectable Concentration

The lower limit of detection (LLD) is specified by federal regulation as a minimum sensitivity value that must be achieved routinely by the analytical parameter.

2. Laboratory Measurements Uncertainty

The estimated uncertainty in measurement of tritium in environmental samples is frequently on the order of 50% of the measurement value.

Statistically, the exact value of a measurement is expressed as a range with a stated level of confidence. The convention is to report results with a 95% level of confidence. The uncertainty comes from calibration standards, sample volume or weight measurements, sampling uncertainty and other factors. ZionSolutions reports the uncertainty of a measurement created by statistical process (counting error) as well as all sources of error (Total Propagated Uncertainty or TPU). Each result has two values calculated. ZionSolutions reports the TPU by following the result with plus or minus \pm the estimated sample standard deviation, as TPU, that is obtained by propagating all sources of analytical

uncertainty in measurements.

Analytical uncertainties are reported at the 95% confidence level in this report for reporting consistency with the AREOR.

C. Background Analysis

A pre-operational Radiological Environmental Monitoring Program (pre-operational REMP) was conducted to establish background radioactivity levels prior to operation of the Station. The environmental media sampled and analyzed during the pre-operational REMP were atmospheric radiation, fall-out, domestic water, surface water, marine life, and foodstuffs. The results of the monitoring were detailed in the report entitled, Environmental Radiological Monitoring for Zion Nuclear Power Station, Commonwealth Edison Company, Annual Report 1973, issued May 1974.

The pre-operational REMP contained analytical results from samples collected from the surface water and groundwater.

Tritium levels in Lake Michigan water were studied in the vicinity of Zion Station throughout 1970. The concentration of tritium in the surface water samples from the Lake at Zion ranged from approximately 311 ± 20 pCi/L to 374 ± 34 pCi/L and averaged 340 pCi/L. There was no statistical difference in average tritium concentrations among the stations (eight stations from Kenosha to Waukegan).

Prior to 1998, surface water samples were collected at the following six locations along Lake Michigan:

- Kenosha, Wisconsin (intake located 10 miles north of the station)
- Lake County Public Water District (intake located 1.1 miles north of the Station)
- Waukegan, Illinois (intake located 6 miles south of the Station)
- North Chicago, Illinois (intake located 10 miles south of the Station)
- Great Lakes NTS (intake located 13 miles south of the Station)
- Lake Forest, Illinois (intake located 16.5 miles south of the Station)

After 1998, surface water samples were collected at the following four locations along Lake Michigan:

- Kenosha, Wisconsin (intake located 10 miles north of the station)
- Lake County Public Water District (intake located 1.1 miles north of the Station)
- Waukegan, Illinois (intake located 6 miles south of the Station)

- Lake Forest, Illinois (intake located 16.5 miles south of the Station)

Lake Michigan surface water data are collected as part of the REMP. Tritium concentrations in surface water samples from Lake Michigan taken between 1973 and 2012 have ranged from non-detect to 660 pCi/L. Groundwater was collected from one off-site well on a quarterly basis. Gamma isotopic, radiostrontium and tritium analyses were performed on all samples. Strontium-89, strontium-90, tritium and gamma emitters were below their respective LLDs.

1. Background Concentrations of Tritium

The purpose of the following discussion is to summarize background measurements of tritium in various media performed by others. Additional detail may be found by consulting references (CRA 2006).

a. Tritium Production

Tritium is created in the environment from naturally occurring processes both cosmic and subterranean, as well as from anthropogenic (i.e., man-made) sources. In the upper atmosphere, "Cosmogenic" tritium is produced from the bombardment of stable nuclides and combines with oxygen to form tritiated water, which will then enter the hydrologic cycle. Below ground, "lithogenic" tritium is produced by the bombardment of natural lithium present in crystalline rocks by neutrons produced by the radioactive decay of naturally abundant uranium and thorium. Lithogenic production of tritium is usually negligible compared to other sources due to the limited abundance of lithium in rock. The lithogenic tritium is introduced directly to groundwater.

A major anthropogenic source of tritium and strontium-90 comes from the former atmospheric testing of thermonuclear weapons. Levels of tritium in precipitation increased significantly during the 1950s and early 1960s, and later with additional testing, resulting in the release of significant amounts of tritium to the atmosphere. The Canadian heavy water nuclear power reactors, other commercial power reactors, nuclear research and weapons production continue to influence tritium concentrations in the environment.

b. Precipitation Data

Precipitation samples are routinely collected at stations around the world for the analysis of tritium and other radionuclides. Two publicly available databases that provide tritium concentrations in precipitation are Global Network of Isotopes in Precipitation (GNIP) and USEPA's RadNet database. GNIP provides tritium precipitation concentration data for samples collected world wide from 1960 to 2006. RadNet provides tritium precipitation concentration data for samples collected at stations through out the U.S. from 1960 up to and including 2006. Based on GNIP data for sample stations located in the U.S. Midwest, tritium concentrations peaked around 1963. This peak, which approached 10,000 pCi/L for some stations, coincided with the atmospheric testing of thermonuclear weapons. Tritium concentrations in surface water showed a sharp decline up until 1975 followed by a gradual decline since that time. Tritium concentrations in Midwest precipitation have typically been below 100 pCi/L since around 1980. Tritium concentrations in wells may still be above the 200 pCi/L detection limit from the external causes described above. Water from previous years and decades is naturally captured in groundwater, so some well water sources today are affected by the surface water from the 1960s that were elevated in tritium.

c. Surface Water Data

Tritium concentrations are routinely measured in large surface water bodies, including Lake Michigan and the Mississippi River. Illinois surface water data were typically less than 100 pCi/L.

The USEPA RadNet surface water data typically has a reported 'Combined Standard Uncertainty' of 35 to 50 pCi/L. According to USEPA, this corresponds to a ± 70 to 100 pCi/L 95% confidence bound on each given measurement. Therefore, the typical background data provided may be subject to measurement uncertainty of approximately ± 70 to 100 pCi/L.

The radio-analytical laboratory is counting tritium results to an Exelon specified LLD of 200 pCi/L. Typically, the lowest positive measurement will be reported within a range of 40 – 240 pCi/L or 140 ± 100 pCi/L. Clearly, these sample results

cannot be distinguished as different from background at this concentration.

IV. Results and Discussion

A. Groundwater and Surface Water Results

Groundwater and Surface Water

Samples were collected from on-site wells throughout the year in accordance with the station radiological groundwater protection program. Analytical results and anomalies are discussed below.

Tritium

Samples from all locations were analyzed for tritium activity (Table B–I.1, Appendix B) (Table B–II.1, Appendix B). Tritium was detected in one groundwater sample at a concentration of 167 pCi/L. Tritium was not detected in any surface water samples analyzed. Zion Nuclear Power Station does not have any off-site wells.

Strontium

Strontium-90 was not detected in any of the samples analyzed in 2014.

Gross Alpha and Gross Beta (Dissolved and Suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples during all four quarters of sampling in 2014. Gross Alpha (dissolved) was not detected at any of the groundwater location. Gross Alpha (suspended) was not detected at any of the groundwater locations. Gross Beta (dissolved) was detected at all thirty-six groundwater locations. The concentrations ranged from 3.3 to 15.3 pCi/L. Gross Beta (suspended) was not detected in any of the groundwater locations.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on surface water samples during all four quarters of sampling in 2014. Gross Alpha (dissolved) and Gross Alpha (suspended) was not detected in any of the surface water locations. Gross Beta (dissolved) was detected at one surface water location. The concentrations ranged

from 2.4 to 3.4 pCi/L. Gross Beta (suspended) was not detected in any of the surface water locations. Dissolved Gross Alpha and Dissolved Gross Beta are detectable in samples from background isotopes. A more detailed discussion on where these isotopes come from is explained later in this section. The concentration range of the isotopes can be found in (Table B–I.1, Appendix B) (Table B–II.1, Appendix B).

Gamma Emitters

Naturally occurring K-40 was detected in two of 48 samples analyzed. The concentration ranged from 79 to 87 pCi/L. All other gamma-emitting radionuclides were not detected in either groundwater or surface water samples analyzed (Table B–I.2, Appendix B) (Table B–II.1, Appendix B).

Other Naturally Occurring Isotopes

Gross Beta activity present in the environment may be detected from the following sources: Be-7 and H-3 produced in the upper atmosphere when galactic rays strike nitrogen atoms, which then may reach the ground during precipitation. Gross Beta may also be detected from Cs-137 from past atomic bomb testing as it is still detectable in the environment. K-40 is a naturally occurring radioactive isotope that occurs as a percentage of all stable isotopes of potassium. Gross alpha can occur as naturally occurring uranium in soil undergoes decay to form Radon gases and in this decay chain, many isotopes of alpha emitting radionuclides are present.

B. Drinking Water Well Survey

A drinking water well survey was conducted during the summer 2006 by CRA (CRA 2006) around the Zion Nuclear Power Station.

C. Summary of Results – Inter-Laboratory Comparison Program

Inter-Laboratory Comparison Program results for TBE and Environmental Inc. (Midwest Labs) are presented in the AREOR.

D. Leaks, Spills, and Releases

On 10/15/2014 a frame used to support the Moveable Transport Cask (MTC stand) was temporarily staged outside of Unit 2 turbine roll up doors. The MTC stand was bagged and a catch was placed under the

stand to catch any water than may seep through in the event of rain. There was a rainstorm and there was water that leaked from the bag into the catch. A plan was created to remove the water first from the bagged MTC stand and then water from the catch pumped into storage drums. While removing the water from bag, the change in weight on the bag caused the side of the bag to sag down and overhang the catch. Some water leaked through the seams of the bag and onto the ground. It is estimated approximately 40 ounces of water leaked through the bag onto the ground(significantly less than reportable quantity). Zion initiated groundwater spill procedure, the control room and radiation protection were notified. The spill was contained, the damp soil collected and a soil sample taken. Soil was counted for 16 hours to achieve required environmental lower limits of detection and activity measured was less than reportable levels. The nearest groundwater well ZN-05S as well as the nearest downstream well ZN-04S were sampled and found to have less than minimum detectable levels of activity. This activity was entered into corrective action program to prevent recurrence.

E. Trends

There are no previously identified plumes therefore there are no trends.

F. Investigations

There are currently no investigations at this time.

G. Actions Taken

1. Compensatory Actions

There have been no station events requiring compensatory actions at the Zion Nuclear Power Station.

2. Installation of Monitoring Wells

No new wells were required to be installed.

3. Actions to Recover/Reverse Plumes

There have been no station events requiring actions to recover/reverse any plumes.

APPENDIX A

LOCATION & DIRECTION

TABLE A-1: Sampling Locations and Distance for the Radiological Groundwater Protection Program, Zion Station, 2014.

Site	Site Type	Temporary/Permanent	Distance
MW-ZN-01S	Monitoring Well	Permanent	On-Site
MW-ZN-02S	Monitoring Well	Permanent	On-Site
MW-ZN-03S	Monitoring Well	Permanent	On-Site
MW-ZN-04S	Monitoring Well	Permanent	On-Site
MW-ZN-05S	Monitoring Well	Permanent	On-Site
MW-ZN-06S	Monitoring Well	Permanent	On-Site
MW-ZN-07S	Monitoring Well	Permanent	On-Site
MW-ZN-08S	Monitoring Well	Permanent	On-Site
MW-ZN-09S	Monitoring Well	Permanent	On-Site
MW-ZN-10S	Monitoring Well	Permanent	On-Site
MW-ZN-11S	Monitoring Well	Permanent	On-Site
SW-ZN-01	Surface Water	Lake Michigan	On-Site

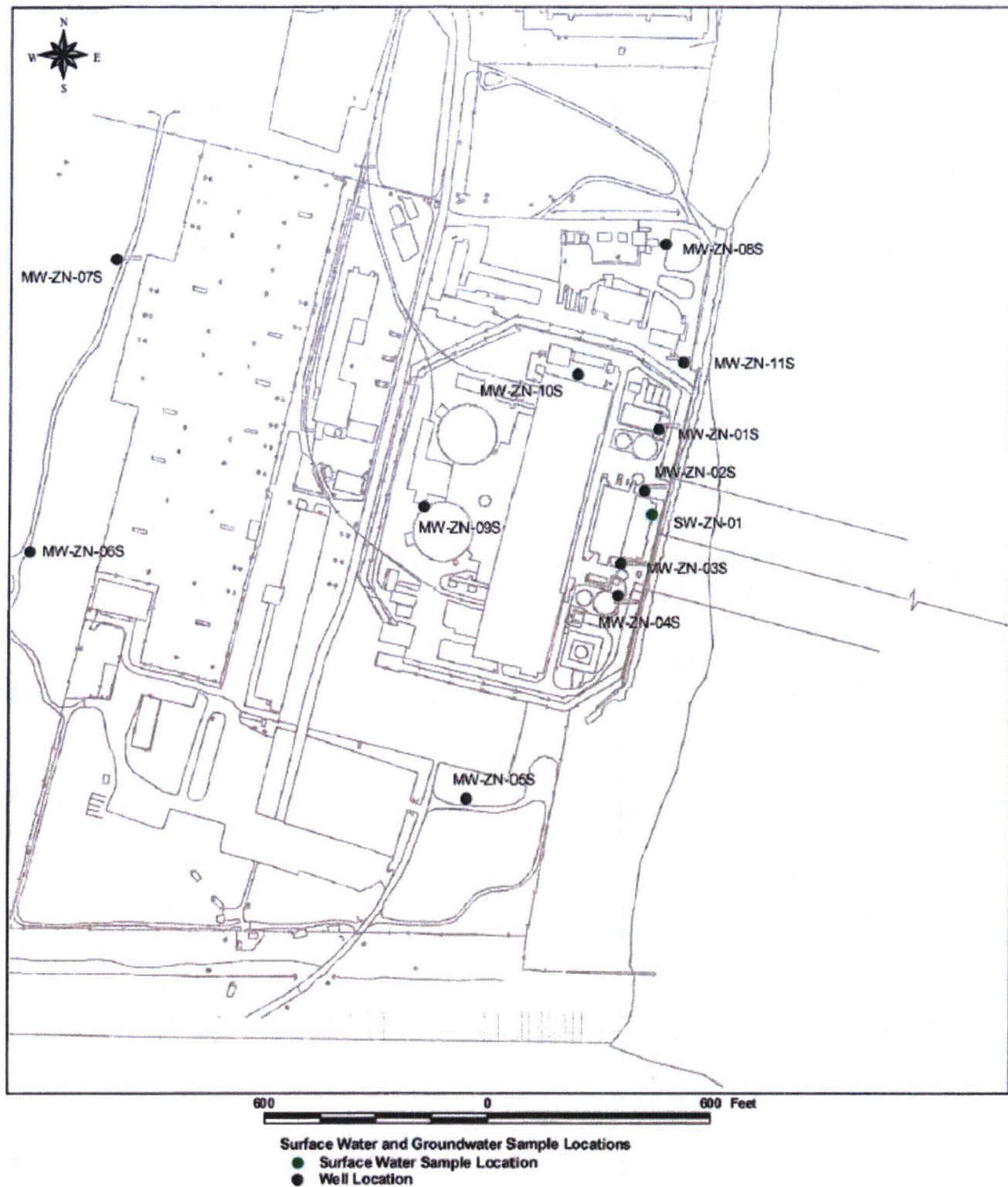


Figure A-1

Radiological Ground Water Protection Program
Groundwater and Surface Water Locations of the Zion Station, 2014

APPENDIX B

DATA TABLES

TABLE B-I.1

**CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND
GROSS BETA IN GROUNDWATER SAMPLES COLLECTED IN THE
VICINITY OF ZION NUCLEAR POWER STATION, 2014**

RESULTS IN UNITS OF PCI/LITER \pm 2 SIGMA

COLLECTION							
SITE	DATE	H-3	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
MW-ZN-01S	03/10/14	< 185	< 0.7	< 1.1	< 1.0	8.7 ± 1.3	< 1.6
MW-ZN-01S	05/19/14	< 181	< 0.5	< 2.6	< 0.6	8.4 ± 1.9	< 2.6
MW-ZN-01S	09/25/14	< 180	< 0.5	< 1.5	< 0.5	11.5 ± 1.4	< 1.5
MW-ZN-01S	10/14/14	< 162	< 0.7	< 1.2	< 0.5	11.2 ± 1.4	< 1.7
MW-ZN-02S	03/10/14	< 179	< 0.8	< 0.9	< 1.1	15.3 ± 1.4	< 1.6
MW-ZN-02S	05/19/14	< 181	< 0.5	< 2.1	< 0.6	13.0 ± 1.8	< 2.6
MW-ZN-02S	09/25/14	< 184	< 0.5	< 1.4	< 0.5	9.6 ± 1.3	< 1.5
MW-ZN-02S	10/14/14	< 163	< 0.9	< 0.9	< 0.5	11.6 ± 1.1	< 1.7
MW-ZN-03S	03/10/14	< 180	< 0.8	< 1.0	< 1.0	8.3 ± 1.3	< 1.4
MW-ZN-03S	05/19/14	< 185	< 0.5	< 2.4	< 0.6	7.4 ± 1.7	< 2.6
MW-ZN-03S	09/25/14	< 183	< 0.7	< 0.9	< 0.5	8.9 ± 1.1	< 1.5
MW-ZN-03S	10/15/14	< 162	< 0.6	< 1.4	< 0.5	12.7 ± 1.5	< 1.7
MW-ZN-04S	03/10/14	< 178	< 0.8	< 2.2	< 1.0	6.5 ± 2.6	< 1.4
MW-ZN-04S	05/19/14	< 185	< 0.4	< 2.4	< 0.6	8.5 ± 1.8	< 2.6
MW-ZN-04S	09/25/14	< 180	< 0.5	< 1.1	< 0.5	9.9 ± 1.3	< 1.5
MW-ZN-04S	10/15/14	< 162	< 0.6	< 1.6	< 0.5	14.2 ± 1.6	< 1.7
MW-ZN-05S	03/13/14	< 181	< 0.8	< 0.7	< 1.0	3.7 ± 1.1	< 1.4
MW-ZN-05S	05/20/14	< 183	< 0.6	< 2.5	< 0.6	3.8 ± 1.7	< 2.6
MW-ZN-05S	09/25/14	< 185	< 0.5	< 1.1	< 0.8	4.9 ± 1.1	< 1.5
MW-ZN-05S	10/13/14	167 ± 108	< 0.7	< 1.1	< 0.5	5.0 ± 1.3	< 1.7
MW-ZN-05S	12/03/14	< 186					
MW-ZN-06S	03/11/14	< 179	< 0.6	< 0.8	< 1.0	5.3 ± 1.2	< 1.4
MW-ZN-06S	05/21/14	< 183	< 0.7	< 2.5	< 0.6	4.1 ± 1.7	< 2.6
MW-ZN-06S	09/26/14	< 184	< 0.7	< 1.1	< 0.8	5.9 ± 1.2	< 1.5
MW-ZN-06S	10/14/14	< 158	< 0.6	< 1.0	< 0.5	8.0 ± 1.3	< 1.7
MW-ZN-07S	03/11/14	< 179	< 0.8	< 0.9	< 1.1	4.0 ± 1.1	< 1.5
MW-ZN-07S	05/21/14	< 182	< 0.5	< 2.5	< 0.6	3.6 ± 1.7	< 2.6
MW-ZN-07S	09/26/14	< 182	< 0.6	< 1.3	< 0.8	4.4 ± 1.2	< 1.5
MW-ZN-07S	10/14/14	< 163	< 0.8	< 1.3	< 0.5	5.4 ± 1.4	< 1.7
MW-ZN-08S	03/11/14	< 181	< 0.7	< 0.7	< 1.0	4.8 ± 1.1	< 1.7
MW-ZN-08S	05/21/14	< 184	< 0.6	< 2.6	< 0.6	3.3 ± 1.7	< 2.6
MW-ZN-08S	09/26/14	< 181	< 0.7	< 1.2	< 0.8	4.7 ± 1.2	< 1.5
MW-ZN-08S	10/13/14	< 158	< 0.9	< 1.1	< 0.5	6.5 ± 1.3	< 1.7
MW-ZN-09S	03/10/14	< 182	< 1.0	< 2.2	< 1.0	11.4 ± 2.9	< 1.7
MW-ZN-09S	05/19/14	< 183	< 0.5	< 2.1	< 0.6	6.9 ± 1.5	< 2.6
MW-ZN-09S	09/15/14	< 184	< 0.6	< 0.8	< 0.7	6.2 ± 1.0	< 1.6
MW-ZN-09S	10/15/14	< 161	< 0.9	< 1.0	< 0.5	6.3 ± 0.9	< 1.7
MW-ZN-10S	03/10/14	< 177	< 0.7	< 0.9	< 1.0	10.6 ± 1.3	< 1.7
MW-ZN-10S	05/20/14	< 182	< 0.6	< 1.1	< 2.6	7.0 ± 1.1	< 3.3
MW-ZN-10S	09/25/14	< 182	< 0.4	< 1.2	< 0.7	8.3 ± 1.3	< 1.6
MW-ZN-10S	10/15/14	< 161	< 0.8	< 1.6	< 0.5	12.4 ± 1.5	< 1.7
MW-ZN-11S	03/11/14	< 181	< 0.6	< 0.9	< 1.0	8.5 ± 1.3	< 1.7
MW-ZN-11S	05/21/14	< 183	< 0.6	< 4.3	< 1.1	9.5 ± 2.4	< 2.5
MW-ZN-11S	09/26/14	< 184	< 0.5	< 1.3	< 0.7	7.5 ± 1.3	< 1.6
MW-ZN-11S	10/13/14	< 159	< 0.7	< 1.5	< 0.5	7.3 ± 1.3	< 1.7

TABLE B-I.1

**Concentrations of Gamma Emitters in Groundwater Samples
Collected in the Vicinity of Zion Nuclear Station, 2014**

Results in Units of pCi/liter \pm 2 Sigma

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
MW-ZN-01S	03/10/14	< 45	< 36	< 4	< 5	< 10	< 3	< 6	< 4	< 8	< 4	< 3	< 38	< 10
MW-ZN-01S	05/19/14	< 37	< 55	< 4	< 4	< 8	< 3	< 7	< 4	< 8	< 3	< 4	< 32	< 9
MW-ZN-01S	09/25/14	< 45	79 \pm 37	< 4	< 4	< 10	< 4	< 8	< 6	< 10	< 4	< 5	< 57	< 14
MW-ZN-01S	10/14/14	< 45	< 97	< 4	< 5	< 10	< 4	< 9	< 4	< 8	< 4	< 5	< 44	< 12
MW-ZN-02S	03/10/14	< 52	< 119	< 4	< 6	< 12	< 7	< 11	< 6	< 11	< 4	< 5	< 54	< 17
MW-ZN-02S	05/19/14	< 44	< 88	< 5	< 6	< 15	< 5	< 9	< 5	< 10	< 4	< 4	< 50	< 13
MW-ZN-02S	09/25/14	< 57	< 119	< 5	< 6	< 12	< 5	< 11	< 6	< 10	< 5	< 6	< 71	< 22
MW-ZN-02S	10/14/14	< 51	< 78	< 4	< 5	< 9	< 4	< 9	< 5	< 8	< 5	< 4	< 54	< 11
MW-ZN-03S	03/10/14	< 54	< 40	< 5	< 6	< 13	< 6	< 7	< 7	< 10	< 5	< 4	< 52	< 15
MW-ZN-03S	05/19/14	< 54	< 107	< 5	< 6	< 13	< 5	< 9	< 6	< 11	< 5	< 5	< 59	< 14
MW-ZN-03S	09/25/14	< 52	< 93	< 5	< 5	< 13	< 4	< 8	< 5	< 11	< 4	< 5	< 62	< 18
MW-ZN-03S	10/15/14	< 48	< 37	< 4	< 5	< 10	< 3	< 9	< 5	< 9	< 4	< 4	< 41	< 14
MW-ZN-04S	03/10/14	< 57	< 105	< 5	< 6	< 16	< 6	< 11	< 7	< 12	< 5	< 5	< 56	< 20
MW-ZN-04S	05/19/14	< 57	< 58	< 5	< 5	< 13	< 5	< 10	< 6	< 11	< 5	< 5	< 48	< 15
MW-ZN-04S	09/25/14	< 63	< 52	< 6	< 7	< 15	< 7	< 13	< 7	< 12	< 5	< 5	< 71	< 25
MW-ZN-04S	10/15/14	< 51	< 79	< 5	< 5	< 14	< 5	< 9	< 6	< 10	< 5	< 5	< 49	< 14
MW-ZN-05S	03/13/14	< 34	< 34	< 3	< 3	< 7	< 3	< 6	< 4	< 6	< 3	< 3	< 32	< 10
MW-ZN-05S	05/20/14	< 39	< 84	< 4	< 4	< 11	< 4	< 9	< 5	< 7	< 4	< 4	< 42	< 16
MW-ZN-05S	09/25/14	< 55	< 81	< 5	< 6	< 13	< 5	< 10	< 6	< 11	< 5	< 5	< 67	< 17
MW-ZN-05S	10/13/14	< 46	< 33	< 4	< 5	< 10	< 4	< 10	< 5	< 9	< 4	< 4	< 50	< 17
MW-ZN-06S	03/11/14	< 48	< 90	< 5	< 5	< 12	< 5	< 8	< 5	< 11	< 5	< 5	< 52	< 18
MW-ZN-06S	05/21/14	< 46	< 52	< 5	< 5	< 10	< 5	< 9	< 5	< 8	< 4	< 5	< 41	< 15
MW-ZN-06S	09/26/14	< 66	< 39	< 5	< 5	< 13	< 6	< 10	< 9	< 11	< 5	< 5	< 79	< 23
MW-ZN-06S	10/14/14	< 35	< 31	< 3	< 4	< 8	< 3	< 6	< 4	< 7	< 3	< 4	< 35	< 10
MW-ZN-07S	03/11/14	< 40	< 36	< 4	< 5	< 9	< 3	< 8	< 5	< 8	< 4	< 4	< 41	< 12
MW-ZN-07S	05/21/14	< 40	< 36	< 5	< 5	< 12	< 4	< 9	< 5	< 9	< 5	< 5	< 40	< 11
MW-ZN-07S	09/26/14	< 52	87 \pm 56	< 4	< 6	< 13	< 4	< 8	< 6	< 9	< 4	< 4	< 62	< 18
MW-ZN-07S	10/14/14	< 46	< 33	< 4	< 5	< 13	< 5	< 8	< 5	< 8	< 4	< 5	< 51	< 14
MW-ZN-08S	03/11/14	< 44	< 37	< 4	< 5	< 10	< 5	< 8	< 4	< 7	< 4	< 4	< 40	< 13
MW-ZN-08S	05/21/14	< 43	< 35	< 4	< 5	< 10	< 4	< 8	< 4	< 9	< 4	< 5	< 39	< 10
MW-ZN-08S	09/26/14	< 48	< 93	< 4	< 5	< 13	< 4	< 8	< 5	< 9	< 4	< 4	< 61	< 16
MW-ZN-08S	10/13/14	< 50	< 105	< 5	< 5	< 11	< 4	< 8	< 5	< 8	< 4	< 5	< 48	< 14
MW-ZN-09S	03/10/14	< 54	< 39	< 5	< 6	< 13	< 4	< 10	< 6	< 10	< 5	< 5	< 54	< 17
MW-ZN-09S	05/19/14	< 48	< 39	< 5	< 5	< 10	< 6	< 11	< 5	< 10	< 5	< 4	< 49	< 13
MW-ZN-09S	09/15/14	< 59	< 40	< 5	< 7	< 16	< 4	< 10	< 7	< 11	< 5	< 5	< 111	< 39
MW-ZN-09S	10/15/14	< 46	< 63	< 5	< 5	< 11	< 4	< 9	< 5	< 9	< 5	< 4	< 46	< 13
MW-ZN-10S	03/10/14	< 51	< 39	< 5	< 4	< 11	< 5	< 9	< 6	< 10	< 5	< 5	< 51	< 17
MW-ZN-10S	05/20/14	< 48	< 47	< 4	< 4	< 11	< 7	< 10	< 5	< 9	< 3	< 5	< 39	< 14
MW-ZN-10S	09/25/14	< 64	< 49	< 5	< 6	< 14	< 6	< 10	< 7	< 12	< 5	< 6	< 80	< 23
MW-ZN-10S	10/15/14	< 44	< 25	< 4	< 5	< 7	< 4	< 7	< 6	< 9	< 4	< 4	< 46	< 7
MW-ZN-11S	03/11/14	< 40	< 73	< 4	< 4	< 12	< 4	< 9	< 5	< 7	< 4	< 4	< 43	< 14
MW-ZN-11S	05/21/14	< 46	< 89	< 4	< 4	< 12	< 5	< 8	< 5	< 8	< 4	< 4	< 43	< 14
MW-ZN-11S	09/26/14	< 50	< 38	< 4	< 5	< 13	< 3	< 12	< 6	< 9	< 4	< 4	< 59	< 16
MW-ZN-11S	10/13/14	< 46	< 43	< 5	< 5	< 12	< 4	< 9	< 6	< 10	< 4	< 5	< 56	< 14

TABLE B-I.3

**CONCENTRATIONS OF IRON-55 AND NICKEL-63 IN GROUNDWATER SAMPLES
COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2014**

RESULTS IN UNITS OF PCI/LITER \pm 2 SIGMA

SITE	COLLECTION DATE	Fe-55	Ni-63
MW-ZN-01S	03/10/14	< 126	< 4.4
MW-ZN-01S	05/19/14	< 183	< 4.0
MW-ZN-01S	09/25/14	< 132	< 4.9
MW-ZN-01S	10/14/14	< 136	< 3.7
MW-ZN-02S	03/10/14	< 69	< 4.3
MW-ZN-02S	05/19/14	< 122	< 3.8
MW-ZN-02S	09/25/14	< 199	< 4.7
MW-ZN-02S	10/14/14	< 182	< 3.4
MW-ZN-03S	03/10/14	< 174	< 4.6
MW-ZN-03S	05/19/14	< 94	< 4.0
MW-ZN-03S	09/25/14	< 114	< 4.3
MW-ZN-03S	10/15/14	< 174	< 3.6
MW-ZN-04S	03/10/14	< 99	< 4.4
MW-ZN-04S	05/19/14	< 142	< 4.0
MW-ZN-04S	09/25/14	< 86	< 4.7
MW-ZN-04S	10/15/14	< 156	< 3.8
MW-ZN-05S	03/13/14	< 69	< 4.5
MW-ZN-05S	05/20/14	< 87	< 4.2
MW-ZN-05S	09/25/14	< 153	< 3.5
MW-ZN-05S	10/13/14	< 114	< 4.0
MW-ZN-06S	03/11/14	< 91	< 4.7
MW-ZN-06S	05/21/14	< 123	< 4.2
MW-ZN-06S	09/26/14	< 169	< 3.6
MW-ZN-06S	10/14/14	< 129	< 4.1
MW-ZN-07S	03/11/14	< 59	< 4.6
MW-ZN-07S	05/21/14	< 57	< 4.1
MW-ZN-07S	09/26/14	< 122	< 3.6
MW-ZN-07S	10/14/14	< 165	< 4.5
MW-ZN-08S	03/11/14	< 107	< 3.9
MW-ZN-08S	05/21/14	< 145	< 3.9
MW-ZN-08S	09/26/14	< 176	< 3.3
MW-ZN-08S	10/13/14	< 78	< 3.7
MW-ZN-09S	03/10/14	< 91	< 4.2
MW-ZN-09S	05/19/14	< 73	< 3.8
MW-ZN-09S	09/15/14	< 172	< 3.2
MW-ZN-09S	10/15/14	< 144	< 3.6
MW-ZN-10S	03/10/14	< 97	< 4.4
MW-ZN-10S	05/20/14	< 133	< 4.1
MW-ZN-10S	09/25/14	< 56	< 3.3
MW-ZN-10S	10/15/14	< 175	< 3.9
MW-ZN-11S	03/11/14	< 187	< 4.6
MW-ZN-11S	05/21/14	< 70	< 4.2
MW-ZN-11S	09/26/14	< 144	< 3.3
MW-ZN-11S	10/13/14	< 179	< 3.9

TABLE B-II.1

**CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND
GROSS BETA IN SURFACE WATER SAMPLES COLLECTED IN THE
VICINITY OF ZION NUCLEAR POWER STATION, 2014**

RESULTS IN UNITS OF PCI/LITER \pm 2 SIGMA

SITE	COLLECTION						
	DATE	H-3	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
SW-ZN-01	03/10/14	< 182	< 1.0	< 0.4	< 1.0	2.9 ± 0.7	< 1.7
SW-ZN-01	05/19/14	< 182	< 0.7	< 1.5	< 1.2	2.4 ± 1.0	< 2.7
SW-ZN-01	09/15/14	< 182	< 0.7	< 0.7	< 0.7	3.4 ± 0.8	< 1.6
SW-ZN-01	10/14/14	< 154	< 0.8	< 0.7	< 0.5	3.0 ± 0.7	< 1.7

TABLE B-I.1

**Concentrations of Gamma Emitters in Surface water Samples
Collected in the Vicinity of Zion Nuclear Station, 2014**

Results in Units of pCi/liter \pm 2 Sigma

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
SW-ZN-01	03/10/14	< 58	< 110	< 5	< 6	< 13	< 6	< 9	< 6	< 10	< 4	< 5	< 58	< 18
SW-ZN-01	05/19/14	< 48	< 32	< 4	< 5	< 11	< 4	< 9	< 6	< 9	< 5	< 5	< 51	< 13
SW-ZN-01	09/15/14	< 44	< 36	< 4	< 5	< 11	< 4	< 9	< 6	< 9	< 3	< 4	< 88	< 32
SW-ZN-01	10/14/14	< 40	< 61	< 4	< 4	< 9	< 3	< 7	< 5	< 7	< 3	< 4	< 40	< 12

TABLE B-II.3**CONCENTRATIONS OF IRON-55 AND NICKEL-63 IN SURFACE WATER SAMPLES
COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2014**RESULTS IN UNITS OF PCI/LITER \pm 2 SIGMA

SITE	COLLECTION DATE	Fe-55	Ni-63
SW-ZN-01	03/10/14	< 112	< 3.8
SW-ZN-01	05/19/14	< 109	< 3.6
SW-ZN-01	09/15/14	< 122	< 3.1
SW-ZN-01	10/14/14	< 195	< 3.4