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An EnergySolutions Company

May 14, 2012 ZS-2012-0218

U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

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

Subject: Submittal of Zion Nuclear Power Station, Unit 1 and 2, 2011 Annual Radiological Environmental Operating Report

In accordance with Technical Specification 5.7.2, "Annual Radiological Environmental Operating Report" Zion Station is submitting the 2011 Annual Radiological Environmental Operating Report for Unit 1 and 2. Technical Specification 5.7.2 requires submittal of an Annual Radiological Environmental Operating Report before May 15 of each year. The attachment to this letter is the Annual Radiological Environmental Operating Report.

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

Respectfully,

Gary H. Bouchard

Gary Bouchard
Decommissioning Plant Manager
Zion Station

cc: John Hickman, U.S. NRC Senior Project Manager
Service List

Attachment:
2011 Annual Radiological Environmental Operating Report

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IE ZS
NRR

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NRC Docket No: 50-295

50-304

ZION NUCLEAR POWER STATION
UNITS 1 and 2

Annual Radiological
Environmental Operating Report

1 January Through 31 December 2011

Prepared By

Teledyne Brown Engineering
Environmental Services

ZIONSOLUTIONS LLC
An Energy Solutions Company

Zion Nuclear Power Station
Zion, IL 60099

May 2012

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Appendices

I. Summary and Conclusions

This report on the Radiological Environmental Monitoring Program conducted for the Zion Nuclear Power Station (ZNPS) by Zion*Solutions* (ZS) covers the period 1 January 2011 through 31 December 2011. During that time period, 434 analyses were performed on 358 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.

On March 11, 2011 an earthquake off the Japanese islands produced a massive tsunami that caused a nuclear accident at four of the six Fukushima Daiichi reactors. In planning for the potential radioactive plume reaching the United States, surrounding Exelon nuclear facilities increased their sampling frequency and added additional analyses of select media from pathways that were expected to be the most sensitive to any increase in ambient radiation levels. Low level I-131 analyses and gamma spectroscopy analyses were performed on air particulates, air iodine, and milk, as appropriate.

The radioactive half-life of I-131 is about 8 days. This short half-life allowed the effects of this radioactive plume to subside over approximately for 3 to 4 weeks. Iodine-131 was detected in several air iodine samples and one milk sample at surrounding Exelon nuclear facilities just above their respective LLD (Lower Limit of Detection). As of April 13, 2011, no further impacts from the Fukushima Daiichi accident were evident at nuclear facilities in the area.

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 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. Levels detected were consistent with those observed in previous years.

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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 2011 through 31 December 2011.

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 2011. 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, king 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 three locations (Z-01, Z-02 and Z-03). No control location was required. 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.

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:

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, Z-115, Z-301, Z-01, Z-02 and Z-03.

No control location was required.

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 in a PVC conduit located 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 2011. 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 were 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 effecting 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 2011 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
PW	Z-16	01/20/11	Sample taken from out building; usual water pump not operating.
PW	Z-16	01/26/11	Sample taken from out building; usual water pump not operating.
PW	Z-16	02/01/11	Sample taken from out building; usual water pump not operating.
TLD	Z-101-2	03/01/11	TLD found on ground; collector remounted.
AP/I	Z-01	07/06/11	Low reading of 148.3 hours due to power outage from storm.
AP/I	Z-02	07/06/11	Low reading of 157.3 hours due to power outage from storm.
AP/I	Z-03	07/06/11	Low reading 158.0 hours due to power outage from storms.
AP/I	Z-01	07/13/11	Low reading of 134.1 hours due to power outage from storms.
AP/I	Z-01, Z-02 Z-03	07/27/11	Air particulates collected 07/28/11 due to safety issues from electrical storm on 07/27/11
AP/I	Z-03	09/14/11	Backup collector found pump running but no vacuum; filter appeared to have 7-day collection; reset flow rate to 60 CFH. Pump checked on 09/16/11; running; filter collecting particulate matter but vacuum still low (approximately 5 inchesHg).
AP/I	Z-03	09/22/11	Primary collector replaced pump (see below). Particulate appeared to have 7-day collection.

Table D-2 LISTING OF MISSED SAMPLES

Sample Type	Location Code	Collection Date	Reason

There were no missed samples for 2011.

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 changes to the REMP program in 2011.

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). The values ranged from 1.6 pCi/l to 6.8 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, king salmon, lake trout, long nose sucker, trout, and largemouth 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 5 E-3 pCi/m^3 to 44 E–3 pCi/m^3 with a mean of 18 E–3 pCi/m^3. Comparison of the 2011 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. Ambient Gamma Radiation

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

Most TLD measurements were below 25 mR/quarter, with a range of 17 mR/quarter to 35 mR/quarter.

D. Land Use Survey

A Land Use Survey conducted during August 2011 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 ft^2 in each of the sixteen 22 ½ degree sectors around the site. There were no changes required to the ZNPS REMP, as a result of this survey. The results of this survey are summarized below.

Distance in Miles from the ZNPS Reactor Buildings			
Sector	Residence Miles	Livestock Miles	Milk Farm Miles
A N	2.5	-	-
B NNE	-	-	-
C NE	-	-	-
D ENE	-	-	-
E E	-	-	-
F ESE	-	-	-
G SE	-	-	-
H SSE	-	-	-
J S	-	-	-
K SSW	1.9	-	-
L SW	1.1	-	-
M WSW	1.0	-	-
N W	1.1	-	-
P WNW	1.0	-	-
Q NW	1.0	-	-
R NNW	1.3	-	-

E. Errata Data

In the 2010 Annual Radiological Environmental Operating Report, the results of the Public Water Samples in Table C-1.3 for Ba-140 and La-140 demonstrated higher than normal LLD results. The results for both isotopes were less than the LLD's; however, were greater than our reporting limits of 200 pCi/L per Zion station ODCM. There were contractual delays in sample analysis of some of the 2010 water samples. Due to the relatively short half-lives of both isotopes and the longer than normal transit time between when the samples were obtained and when they were analyzed, the ability of the laboratory to analyze to lower levels of detection was inhibited.

F. 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, NELAC, state specific 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 ± 20% of the reference value. Performance is acceptable with warning when a mean result falls in the range from ±20% to ±30% of the reference value (i.e., 20% < bias < 30%). If the bias is greater than 30%, the results are deemed not acceptable.

For the primary laboratory, 14 out of 18 analytes met the specified acceptance criteria. Four analytes did not meet the specified acceptance criteria for the following reason:

1. Teledyne Brown Engineering's Analytics March 2011 Cr-51 in milk result of 398 pCi/L was higher than the known value of 298 pCi/L, resulting in a found to known ratio of 1.34. NCR 11-13 was initiated to investigate this failure. There was a slightly high bias in all the gamma activities. The June gamma results in milk did not show a high bias. No further action was required.
2. Teledyne Brown Engineering's ERA May 2011 Gross Alpha in water result of 64.1 pCi/L was higher than the known value of 50.1 pCi/L, which exceeded the upper control limit of 62.9 pCi/L. NCR 11-08 was initiated to investigate this failure. The solids on the planchet exceeded 100 mg, which was beyond the range of the efficiency curve.

Teledyne Brown Engineering's MAPEP March 2011 Gross Alpha in air particulate result of 0.101 Bq/sample was lower than the known value of 0.659 Bq/sample, which exceeded the lower control limit of 0.198 Bq/sample. NCR 11-11 was initiated to investigate this failure. The air particulate filter was counted on the wrong side.

3. Teledyne Brown Engineering's ERA November 2011 Sr-89 in water result of 81.0 pCi/L was higher than the known value of 69.7 pCi/L, which exceeded the upper control limit of 77.9 pCi/L. NCR 11-16 was initiated to investigate this failure. The TBE reported value to known ratio of 1.16 fell within the acceptable range of ± 20%, which TBE considers acceptable.
4. Teledyne Brown Engineering's MAPEP March 2011 Sr-90 in soil, air particulate and vegetation were non-reports that were evaluated as failed. NCR 11-11 was initiated to investigate these failures. MAPEP evaluated the non-reports as failed due to not reporting a previously reported analyte.

For the secondary laboratory, Environmental, Inc., 12 out of 14 analytes met the specified acceptance criteria.

1. Environmental Inc.'s ERA October 2011 Cs-134 in water result of 38.8 pCi/L was higher than the known value of 33.4 pCi/L, which exceeded the upper control limit of 36.7 pCi/L. The sample was reanalyzed. The reanalyzed result of 32.9 was acceptable.
2. Environmental Inc.'s MAPEP February 2011 Sr-90 in air particulate result of 1.89 Bq/sample was higher than the known value of 1.36 Bq/sample, which exceeded the upper control limit of 1.77 Bq/sample. No errors were found in the calculation or procedure. The reanalyzed result of 1.73 Bq/sample was acceptable.

   Environmental Inc.'s MAPEP August 2011 Sr-90 in soil result of 219.4 Bq/kg, less than the known value of 320 Bq/kg, was below the lower control limit of 224 Bq/kg. The sample was reanalyzed in triplicate through a strontium column. The reanalyzed result of 304.2 Bq/kg was acceptable.

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 NUCLER POWER STATION, 2011

Name of Facility: ZION **DOCKET NUMBER: 50-295 & 50-304**

Location of Facility: ZION, IL **REPORTING PERIOD: ANNUAL 2011**

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) RANGE	CONTROL LOCATION MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
PUBLIC WATER (PCI/LITER)	GR-B	48	4	3.0 (12/24) (1.8/4.0)	3.3 (15/24) (1.6/6.8)	3.4 (7/12) (2.3/4.4)	Z-18 CONTROL LAKE FOREST WATER WORKS 12.9 MILES S OF SITE	0
	H-3	16	200	<LLD	<LLD	-		0
	GAMMA	48						
	MN-54		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

* 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)

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PUBLIC WATER (PCI/LITER)	ZR-95		15	<LLD	<LLD	-		0
	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

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FISH (PCI/KG WET)	CO-60		130	<LLD	NA	-		0
	ZN-65		260	<LLD	NA	-		0
	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

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SEDIMENT (PCI/KG DRY)	GAMMA	2						
	MN-54		NA	<LLD	NA	-		0
	CO-58		NA	<LLD	NA	-		0
	FE-59		NA	<LLD	NA	-		0
	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

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) RANGE	CONTROL LOCATION MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) RANGE	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SEDIMENT (PCI/KG DRY)	CS-137		180	<LLD	NA	-		0
	BA-140		NA	<LLD	NA	-		0
	LA-140		NA	<LLD	NA	-		0
AIR PARTICULATE (E-3 PCI/CU.METER)	GR-B	156	10	18 (156/156) (5/44)	NA	18 (52/52) (7/44)	Z-03 INDICATOR ONSITE 3 0.2 MILES NNW OF SITE	0
	GAMMA	12						
	MN-54		NA	<LLD	NA	-		0
	CO-58		NA	<LLD	NA	-		0
	FE-59		NA	<LLD	NA	-		0
	CO-60		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 NUCLER POWER STATION, 2011

Name of Facility: ZION **DOCKET NUMBER: 50-295 & 50-304**

Location of Facility: ZION, IL **REPORTING PERIOD: ANNUAL 2011**

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (M) (F) RANGE	CONTROL LOCATION MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) MEAN (M) (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN (M) STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATE (E-3 PCI/CU.METER)	ZN-65		NA	<LLD	NA	-		0
	NB-95		NA	<LLD	NA	-		0
	ZR-95		NA	<LLD	NA	-		0
	CS-134		10	<LLD	NA	-		0
	CS-137		10	<LLD	NA	-		0
	BA-140		NA	<LLD	NA	-		0
	LA-140		NA	<LLD	NA	-		0
DIRECT RADIATION (MILLI-ROENTGEN/QTR.)	TLD-QUARTERLY	144	NA	22 (144/144) (17/35)	NA	24 (4/4) (19/35)	Z-104-1 INDICATOR 0.1 MILES ENE	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, 2011

Location	Location Description	Distance & Direction From Site
A. Public Water		
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
B. Air Particulates		
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
C. Fish		
Z-26	Lake Michigan Nearsite (indicator)	At station
Z-27	Lake Michigan Farsite (indicator)	10.1 miles N
D. Sediment		
Z-25	Lake Michigan, Illinois Beach State Park (indicator)	0.2 miles S
E. Environmental Dosimetry - TLD		
Inner Ring		
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
Z-301-1 and -2		0.5 miles NW
Other		
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

TABLE B-2: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Zion Nuclear Power Station, 2011

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

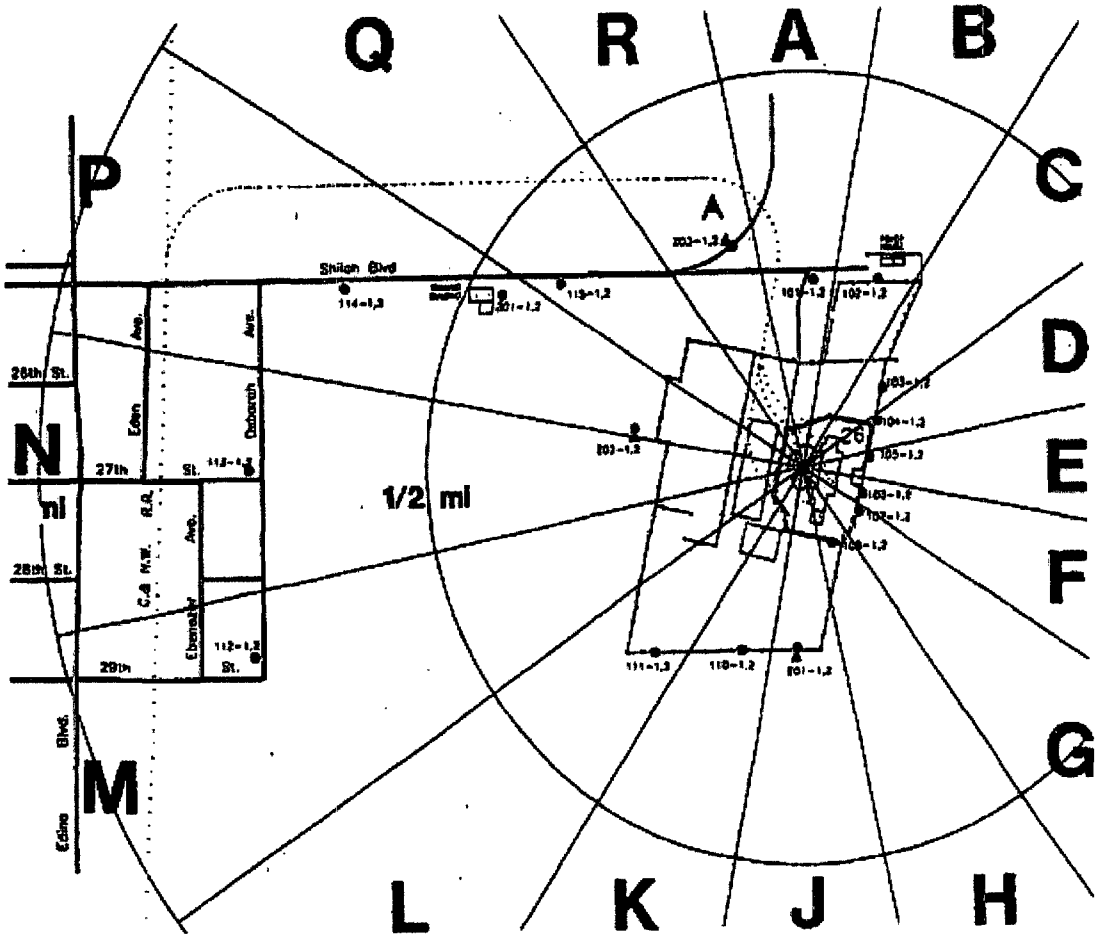


Figure B-1
Inner Ring TLD Locations and Fixed Air Samplers of the Zion Nuclear Power Station, 2011

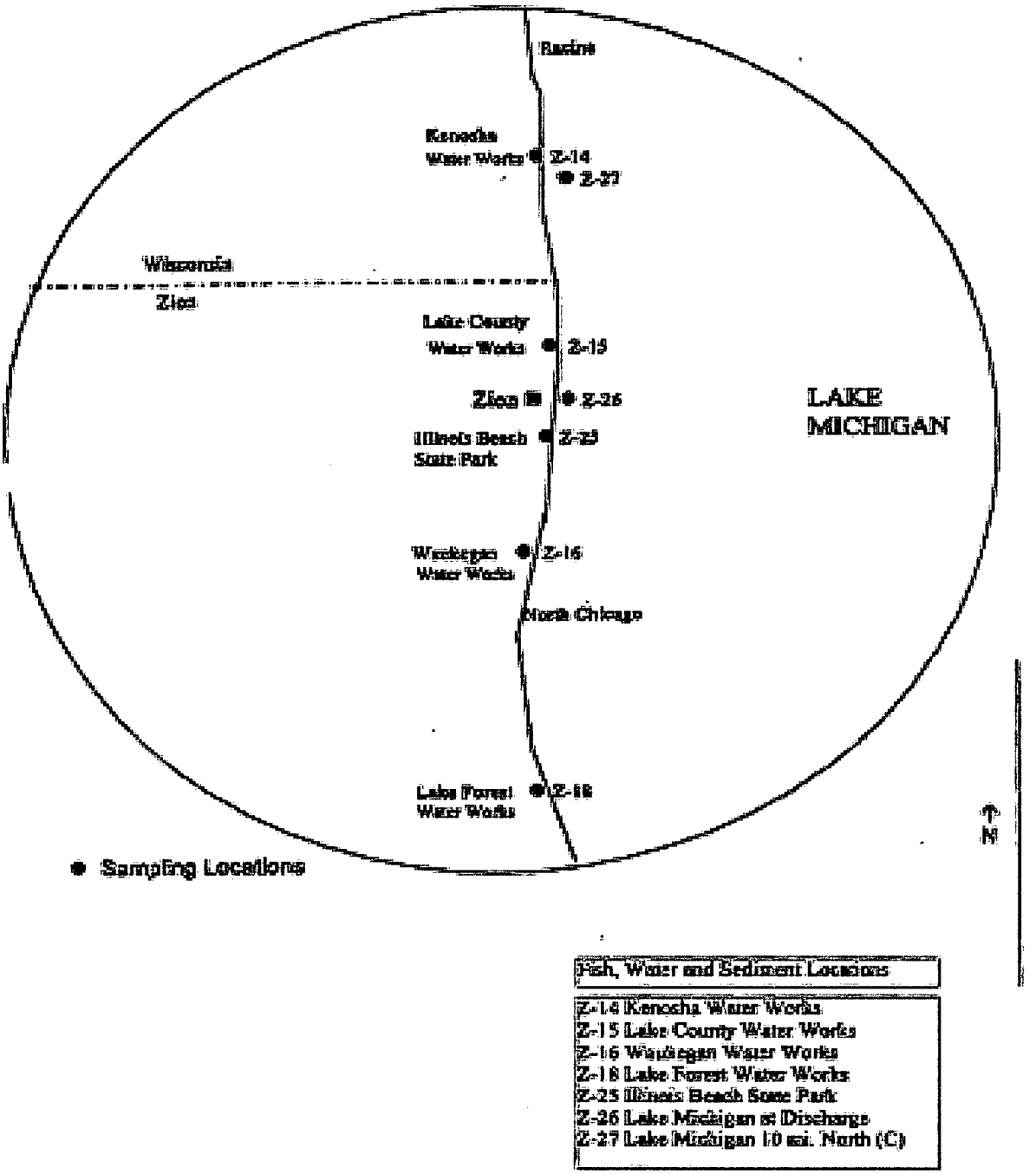


Figure B-2
Fish, Water and Sediment Locations of the Zion Nuclear Power Station, 2011

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, 2011**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	Z-14	Z-15	Z-16	Z-18
01/05/11 - 01/26/11	3.3 ± 2.1	3.2 ± 2.1	3.5 ± 2.1 (1)	< 3.1
02/01/11 - 02/23/11	2.7 ± 1.4	3.5 ± 1.5	3.6 ± 1.5 (1)	3.8 ± 1.5
03/01/11 - 03/30/11	< 2.3	< 3.5	< 3.7	< 3.7
04/06/11 - 04/27/11	< 2.5	< 2.6	< 2.5	< 2.6
05/04/11 - 05/25/11	6.8 ± 2.5	< 3.3	3.6 ± 2.2	4.2 ± 2.2
06/01/11 - 06/29/11	3.8 ± 2.2	4.0 ± 2.2	3.2 ± 2.1	3.2 ± 2.1
07/06/11 - 07/27/11	< 2.5	< 2.5	< 2.4	3.3 ± 2.0
08/03/11 - 08/31/11	< 3.1	< 3.1	< 3.1	4.4 ± 2.6
09/07/11 - 09/28/11	2.9 ± 1.5	< 2.3	< 2.3	< 2.3
10/05/11 - 10/26/11	2.9 ± 1.2	< 1.7	3.1 ± 1.4	< 1.7
11/02/11 - 11/23/11	2.1 ± 1.1	1.9 ± 1.1	1.8 ± 1.0	2.3 ± 1.1
12/01/11 - 12/28/11	1.6 ± 1.0	2.1 ± 1.0	2.4 ± 1.0	2.6 ± 1.1
MEAN*	3.3 ± 3.2	2.9 ± 1.8	3.0 ± 1.4	3.4 ± 1.6

TABLE C-I.2 **CONCENTRATIONS OF TRITIUM IN PUBLIC WATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2011**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	Z-14	Z-15	Z-16	Z-18
01/05/11 - 03/30/11	< 167	< 167	< 163 (1)	< 164
04/06/11 - 06/29/11	< 164	< 165	< 166 (1)	< 149
07/06/11 - 09/28/11	< 189	< 190	< 189	< 189
10/05/11 - 12/28/11	< 178	< 183	< 181	< 179
MEAN	-	-	-	-

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

TABLE C-I.3 **CONCENTRATIONS OF GAMMMA EMITTERS IN PUBLIC WATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2011**

RESULTS IN UNITS OF PCI/LITER ± 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	01/05/11 - 01/26/11	< 3	< 4	< 9	< 3	< 6	< 4	< 7	< 3	< 3	< 30	< 9
	02/01/11 - 02/23/11	< 6	< 7	< 17	< 6	< 15	< 7	< 13	< 7	< 6	< 87	< 31
	03/01/11 - 03/30/11	< 5	< 6	< 15	< 6	< 11	< 7	< 14	< 5	< 6	< 120	< 26
	04/06/11 - 04/27/11	< 6	< 8	< 18	< 5	< 8	< 7	< 13	< 5	< 6	< 177	< 53
	05/04/11 - 05/25/11	< 4	< 6	< 16	< 4	< 8	< 5	< 11	< 4	< 4	< 155	< 65
	06/01/11 - 06/29/11	< 5	< 5	< 13	< 5	< 10	< 6	< 8	< 4	< 4	< 50	< 16
	07/06/11 - 07/27/11	< 6	< 5	< 14	< 7	< 14	< 7	< 14	< 5	< 7	< 43	< 12
	08/03/11 - 08/31/11	< 2	< 2	< 4	< 2	< 4	< 2	< 4	< 2	< 2	< 15	< 4
	09/07/11 - 09/28/11	< 5	< 6	< 15	< 7	< 15	< 7	< 13	< 6	< 5	< 67	< 23
	10/05/11 - 10/26/11	< 6	< 7	< 14	< 8	< 14	< 7	< 12	< 5	< 7	< 56	< 17
	11/02/11 - 11/23/11	< 5	< 5	< 12	< 4	< 7	< 7	< 8	< 4	< 4	< 73	< 22
	12/01/11 - 12/28/11	< 5	< 7	< 12	< 5	< 10	< 6	< 8	< 5	< 5	< 77	< 29
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-15	01/05/11 - 01/26/11	< 4	< 5	< 10	< 4	< 9	< 6	< 9	< 4	< 4	< 46	< 13
	02/01/11 - 02/23/11	< 7	< 7	< 16	< 6	< 16	< 8	< 13	< 8	< 6	< 99	< 37
	03/01/11 - 03/30/11	< 6	< 7	< 16	< 6	< 14	< 7	< 12	< 5	< 6	< 116	< 29
	04/06/11 - 04/27/11	< 5	< 7	< 18	< 5	< 10	< 8	< 13	< 5	< 4	< 163	< 39
	05/04/11 - 05/25/11	< 3	< 4	< 9	< 3	< 5	< 4	< 6	< 3	< 3	< 120	< 34
	06/01/11 - 06/29/11	< 4	< 6	< 11	< 4	< 10	< 5	< 9	< 4	< 5	< 48	< 17
	07/06/11 - 07/27/11	< 3	< 5	< 11	< 5	< 9	< 5	< 8	< 3	< 4	< 33	< 4
	08/03/11 - 08/31/11	< 1	< 2	< 3	< 1	< 3	< 2	< 3	< 1	< 2	< 11	< 3
	09/07/11 - 09/28/11	< 6	< 8	< 19	< 5	< 15	< 8	< 13	< 8	< 6	< 81	< 22
	10/05/11 - 10/26/11	< 5	< 7	< 12	< 6	< 11	< 5	< 10	< 4	< 6	< 59	< 16
	11/02/11 - 11/23/11	< 5	< 7	< 15	< 6	< 10	< 6	< 12	< 4	< 6	< 89	< 34
	12/01/11 - 12/28/11	< 5	< 5	< 13	< 7	< 10	< 6	< 10	< 5	< 6	< 65	< 23
	MEAN	-	-	-	-	-	-	-	-	-	-	-

TABLE C-I.3 **CONCENTRATIONS OF GAMMMA EMITTERS IN PUBLIC WATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2011**

RESULTS IN UNITS OF PCI/LITER ± 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	01/05/11 - 01/26/11	< 4	< 4	< 10	< 4	< 8	< 5	< 7	< 3	< 4	< 40	< 11
	02/01/11 - 02/23/11	< 7	< 8	< 20	< 6	< 21	< 10	< 15	< 11	< 7	< 114	< 33
	03/01/11 - 03/30/11	< 5	< 6	< 16	< 6	< 12	< 7	< 13	< 5	< 6	< 109	< 29
	04/06/11 - 04/27/11	< 5	< 7	< 17	< 4	< 12	< 7	< 13	< 5	< 6	< 167	< 45
	05/04/11 - 05/25/11	< 3	< 5	< 12	< 3	< 6	< 5	< 9	< 3	< 3	< 140	< 43
	06/01/11 - 06/29/11	< 5	< 5	< 12	< 5	< 9	< 5	< 9	< 4	< 5	< 47	< 18
	07/06/11 - 07/27/11	< 5	< 6	< 12	< 8	< 12	< 7	< 10	< 4	< 6	< 36	< 15
	08/03/11 - 08/31/11	< 2	< 2	< 4	< 2	< 4	< 2	< 3	< 2	< 2	< 14	< 4
	09/07/11 - 09/28/11	< 7	< 7	< 16	< 4	< 10	< 6	< 11	< 6	< 5	< 47	< 10
	10/05/11 - 10/26/11	< 5	< 5	< 14	< 4	< 11	< 5	< 11	< 5	< 5	< 58	< 23
	11/02/11 - 11/23/11	< 5	< 6	< 16	< 4	< 9	< 7	< 11	< 5	< 5	< 79	< 29
	12/01/11 - 12/28/11	< 6	< 7	< 16	< 7	< 12	< 6	< 11	< 5	< 6	< 83	< 27
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-18	01/05/11 - 01/26/11 (1)	< 4	< 5	< 10	< 4	< 9	< 5	< 9	< 4	< 4	< 43	< 13
	02/01/11 - 02/23/11 (1)	< 3	< 3	< 7	< 3	< 5	< 3	< 5	< 2	< 3	< 39	< 10
	03/01/11 - 03/30/11	< 5	< 6	< 16	< 6	< 11	< 7	< 13	< 5	< 5	< 118	< 32
	04/06/11 - 04/27/11	< 5	< 5	< 15	< 5	< 10	< 6	< 13	< 4	< 5	< 153	< 36
	05/04/11 - 05/25/11	< 3	< 4	< 9	< 2	< 6	< 5	< 7	< 3	< 3	< 129	< 35
	06/01/11 - 06/29/11	< 5	< 7	< 19	< 6	< 14	< 9	< 13	< 7	< 5	< 61	< 22
	07/06/11 - 07/27/11	< 6	< 6	< 15	< 7	< 11	< 7	< 11	< 6	< 6	< 48	< 14
	08/03/11 - 08/31/11	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 12	< 3
	09/07/11 - 09/28/11	< 6	< 6	< 15	< 5	< 16	< 9	< 11	< 5	< 7	< 40	< 18
	10/05/11 - 10/26/11	< 5	< 6	< 15	< 6	< 11	< 7	< 11	< 5	< 6	< 53	< 21
	11/02/11 - 11/23/11	< 6	< 8	< 17	< 5	< 11	< 10	< 13	< 6	< 6	< 102	< 33
	12/01/11 - 12/28/11	< 5	< 6	< 14	< 4	< 8	< 7	< 10	< 4	< 5	< 63	< 22
	MEAN	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

TABLE C-II.1 **CONCENTRATIONS OF GAMMMA EMITTERS IN FISH SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2011**

RESULTS IN UNITS OF PCI/KG WET ± 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	05/17/11	< 54	< 61	< 162	< 56	< 152	< 67	< 91	< 77	< 59	< 788	< 194
Largemouth Bass	05/17/11	< 69	< 79	< 181	< 52	< 119	< 82	< 123	< 61	< 72	< 989	< 322
Common Carp	10/21/11	< 53	< 57	< 129	< 83	< 121	< 54	< 109	< 54	< 63	< 345	< 127
King Salmon	10/21/11	< 60	< 68	< 173	< 73	< 122	< 63	< 114	< 59	< 78	< 433	< 162
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-27												
Lake Trout	05/03/11	< 63	< 72	< 194	< 63	< 118	< 95	< 121	< 50	< 74	< 1590	< 652
Burbot	05/10/11	< 54	< 70	< 206	< 67	< 166	< 92	< 152	< 54	< 76	< 1480	< 423
Lake Trout	10/12/11	< 35	< 36	< 91	< 45	< 69	< 50	< 62	< 35	< 47	< 440	< 117
Longnose Sucker	10/12/11	< 39	< 43	< 101	< 39	< 82	< 51	< 74	< 36	< 43	< 401	< 111
	MEAN	-	-	-	-	-	-	-	-	-	-	-

TABLE C-III.1 CONCENTRATIONS OF GAMMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2011

RESULTS IN UNITS OF PCI/KG DRY ± 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	5/11/2011	< 35	< 38	< 102	< 42	< 88	< 48	< 83	< 32	< 38	< 520	< 154
	10/5/2011	< 43	< 48	< 98	< 47	< 111	< 44	< 84	< 50	< 46	< 306	< 73
	MEAN	-	-	-	-	-	-	-	-	-	-	-

TABLE C-IV.1 CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2011

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

COLLECTION PERIOD	GROUP I					
	Z-01		Z-02		Z-03	
12/29/10 - 01/05/11	28 ± 5		27 ± 5		24 ± 4	
01/05/11 - 01/12/11	19 ± 4		20 ± 4		25 ± 5	
01/12/11 - 01/20/11	19 ± 4		11 ± 3		21 ± 4	
01/20/11 - 01/26/11	30 ± 6		26 ± 6		37 ± 6	
01/26/11 - 02/01/11	11 ± 4		21 ± 5		18 ± 5	
02/01/11 - 02/09/11	20 ± 4		15 ± 4		20 ± 4	
02/09/11 - 02/16/11	21 ± 5		19 ± 4		17 ± 4	
02/16/11 - 02/23/11	16 ± 4		15 ± 4		15 ± 4	
02/23/11 - 03/01/11	22 ± 5		18 ± 5		24 ± 5	
03/01/11 - 03/08/11	14 ± 4		14 ± 4		16 ± 4	
03/08/11 - 03/16/11	15 ± 4		16 ± 4		16 ± 4	
03/16/11 - 03/23/11	22 ± 4		16 ± 4		23 ± 5	
03/23/11 - 03/30/11	16 ± 4		18 ± 4		21 ± 5	
03/30/11 - 04/06/11	31 ± 5		20 ± 4		29 ± 5	
04/06/11 - 04/13/11	14 ± 4		13 ± 4		13 ± 5	
04/13/11 - 04/20/11	18 ± 4		16 ± 4		19 ± 4	
04/20/11 - 04/27/11	11 ± 4		10 ± 4		9 ± 4	
04/27/11 - 05/04/11	13 ± 4		13 ± 4		16 ± 5	
05/04/11 - 05/11/11	7 ± 4		6 ± 3		11 ± 4	
05/11/11 - 05/18/11	12 ± 4		11 ± 4		14 ± 4	
05/18/11 - 05/25/11	8 ± 4		5 ± 3		9 ± 4	
05/25/11 - 06/01/11	6 ± 4		6 ± 4		8 ± 4	
06/01/11 - 06/08/11	19 ± 4		17 ± 4		19 ± 5	
06/08/11 - 06/15/11	9 ± 3		9 ± 3		12 ± 3	
06/15/11 - 06/22/11	10 ± 5		13 ± 5		13 ± 5	
06/22/11 - 06/29/11	14 ± 5		10 ± 4		11 ± 4	
06/29/11 - 07/06/11	18 ± 5	(1)	22 ± 5	(1)	21 ± 5	(1)
07/06/11 - 07/13/11	17 ± 5	(1)	15 ± 4		15 ± 4	
07/13/11 - 07/20/11	19 ± 4		14 ± 4		20 ± 5	
07/20/11 - 07/28/11	14 ± 4	(1)	11 ± 4	(1)	13 ± 4	(1)
07/28/11 - 08/03/11	19 ± 5		20 ± 5		28 ± 6	
08/03/11 - 08/10/11	15 ± 4		11 ± 4		17 ± 5	
08/10/11 - 08/18/11	18 ± 4		15 ± 3		20 ± 4	
08/18/11 - 08/24/11	19 ± 5		17 ± 5		20 ± 6	
08/24/11 - 08/31/11	16 ± 4		18 ± 4		15 ± 4	
08/31/11 - 09/07/11	29 ± 5		23 ± 4		16 ± 4	
09/07/11 - 09/14/11	20 ± 4		19 ± 4		10 ± 4	(1)
09/14/11 - 09/22/11	14 ± 4		11 ± 4		7 ± 3	(1)
09/22/11 - 09/28/11	11 ± 4		15 ± 4		21 ± 5	
09/28/11 - 10/05/11	9 ± 4		11 ± 4		11 ± 4	
10/05/11 - 10/12/11	40 ± 6		42 ± 6		44 ± 6	
10/12/11 - 10/19/11	18 ± 5		23 ± 5		18 ± 5	
10/19/11 - 10/26/11	16 ± 4		20 ± 4		17 ± 4	
10/26/11 - 11/02/11	17 ± 5		17 ± 5		24 ± 5	
11/02/11 - 11/09/11	22 ± 4		16 ± 4		21 ± 4	
11/09/11 - 11/16/11	29 ± 5		29 ± 5		26 ± 5	
11/16/11 - 11/23/11	15 ± 4		15 ± 4		14 ± 4	
11/23/11 - 12/01/11	17 ± 4		17 ± 4		16 ± 4	
12/01/11 - 12/07/11	16 ± 5		20 ± 5		18 ± 5	
12/07/11 - 12/14/11	31 ± 5		31 ± 5		29 ± 5	
12/14/11 - 12/21/11	26 ± 5		26 ± 5		25 ± 5	
12/21/11 - 12/28/11	24 ± 5		15 ± 4		16 ± 4	
MEAN	18 ± 14		17 ± 13		18 ± 14	

(1) SEE PROGRAM EXCEPTION SECTION FOR EXPLANATION

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, 2011**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

GROUP I - ONSITE LOCATIONS

COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD
12/29/10 - 02/01/11	11	37	22 ± 14
02/01/11 - 03/01/11	15	24	18 ± 6
03/01/11 - 03/30/11	14	23	17 ± 6
03/30/11 - 04/27/11	9	31	17 ± 14
04/27/11 - 06/01/11	5	16	10 ± 7
06/01/11 - 06/29/11	9	19	13 ± 7
06/29/11 - 08/03/11	11	28	18 ± 8
08/03/11 - 08/31/11	11	20	17 ± 5
08/31/11 - 09/28/11	7	29	16 ± 13
09/28/11 - 11/02/11	9	44	21 ± 22
11/02/11 - 12/01/11	14	29	20 ± 11
12/01/11 - 12/28/11	15	31	23 ± 12
12/29/10 - 12/28/11	5	44	18 ± 14

TABLE C-IV.3 **CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2011**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 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	12/29/10 - 03/30/11	< 2	< 3	< 8	< 3	< 5	< 3	< 7	< 3	< 2	< 51	< 17
	03/30/11 - 06/29/11	< 4	< 4	< 11	< 3	< 8	< 4	< 8	< 3	< 4	< 87	< 59
	06/29/11 - 09/28/11	< 3	< 4	< 8	< 3	< 5	< 4	< 6	< 4	< 3	< 38	< 17
	09/28/11 - 12/28/11	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 2	< 2	< 10	< 5
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-02	12/29/10 - 03/30/11	< 2	< 3	< 7	< 3	< 5	< 4	< 5	< 2	< 2	< 43	< 18
	03/30/11 - 06/29/11	< 3	< 4	< 12	< 4	< 8	< 4	< 8	< 4	< 3	< 119	< 59
	06/29/11 - 09/28/11	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 1	< 1	< 20	< 8
	09/28/11 - 12/28/11	< 3	< 3	< 7	< 3	< 8	< 3	< 6	< 3	< 3	< 16	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Z-03	12/29/10 - 03/30/11	< 3	< 4	< 8	< 3	< 7	< 3	< 6	< 3	< 3	< 54	< 19
	03/30/11 - 06/29/11	< 3	< 5	< 10	< 3	< 9	< 3	< 9	< 3	< 4	< 115	< 44
	06/29/11 - 09/28/11	< 4	< 4	< 7	< 3	< 10	< 4	< 6	< 3	< 3	< 41	< 18
	09/28/11 - 12/28/11	< 2	< 2	< 6	< 2	< 6	< 3	< 4	< 2	< 3	< 18	< 8
	MEAN	-	-	-	-	-	-	-	-	-	-	-

TABLE C-V.1 QUARTERLY TLD RESULTS FOR ZION NUCLEAR POWER STATION, 2011

RESULTS IN UNITS OF MILLI-ROENTGEN/QUARTER ± 2 STANDARD DEVIATIONS

STATION CODE	MEAN ± 2 S.D.	JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC
Z-01-1	22.5 ± 3.5	22	22	21	25
Z-01-2	23.5 ± 6.2	23	21	22	28
Z-02-1	20.5 ± 3.5	20	20	19	23
Z-02-2	19.3 ± 5.3	19	18	17	23
Z-03-1	21.8 ± 4.4	21	20	21	25
Z-03-2	20.3 ± 4.1	20	20	18	23
Z-101-1	22.3 ± 5.0	21 (1)	21	21	26
Z-101-2	22.0 ± 7.3	24	20	18	26
Z-102-1	23.8 ± 3.4	24	22	23	26
Z-102-2	23.5 ± 3.5	23	22	23	26
Z-103-1	22.8 ± 4.1	21	24	21	25
Z-103-2	23.5 ± 3.5	25	22	22	25
Z-104-1	24.3 ± 14.5	21	22	19	35
Z-104-2	23.5 ± 14.0	20	20	20	34
Z-105-1	23.5 ± 10.1	22	20	21	31
Z-105-2	22.5 ± 6.2	22	20	21	27
Z-106-1	23.0 ± 5.4	22	22	21	27
Z-106-2	21.0 ± 3.3	21	21	19	23
Z-107-1	20.3 ± 3.8	19	19	20	23
Z-107-2	20.8 ± 5.0	21	20	18	24
Z-108-1	21.0 ± 4.3	21	20	19	24
Z-108-2	21.8 ± 4.1	22	22	19	24
Z-110-1	23.0 ± 2.3	22	24	22	24
Z-110-2	23.0 ± 4.3	23	21	22	26
Z-111-1	21.5 ± 2.0	22	20	22	22
Z-111-2	21.5 ± 3.8	22	20	20	24
Z-112-1	22.5 ± 5.3	23	20	21	26
Z-112-2	24.3 ± 9.1	22	21	23	31
Z-113-1	21.3 ± 6.8	21	20	18	26
Z-113-2	21.0 ± 3.7	22	20	19	23
Z-114-1	22.5 ± 8.7	21	20	20	29
Z-114-2	22.0 ± 3.3	22	22	20	24
Z-115-1	23.8 ± 5.5	25	21	22	27
Z-115-2	22.8 ± 7.7	23	21	19	28
Z-301-1	23.5 ± 2.6	24	22	23	25
Z-301-2	24.3 ± 6.4	22	23	23	29

(1) SEE PROGRAM EXCEPTION SECTION FOR EXPLANATION

TABLE C-V.2 MEAN QUARTERLY TLD RESULTS FOR INNER RING AND OTHER LOCATIONS FOR ZION NUCLEAR POWER STATION, 2011

RESULTS IN UNITS OF MILLI-ROENTGEN/QUARTER
STANDARD DEVIATIONS OF THE STATION DATA

COLLECTION PERIOD	INNER RING ± 2 S.D.	OTHER
JAN-MAR	22.1 ± 2.7	20.8 ± 2.9
APR-JUN	21.1 ± 2.5	20.2 ± 2.7
JUL-SEP	20.6 ± 3.3	19.7 ± 3.9
OCT-DEC	26.3 ± 6.3	24.5 ± 3.9

TABLE C-V.3 SUMMARY OF THE AMBIENT DOSIMETRY PROGRAM FOR ZION NUCLEAR POWER STATION, 2011

RESULTS IN UNITS OF MILLI-ROENTGEN/QUARTER

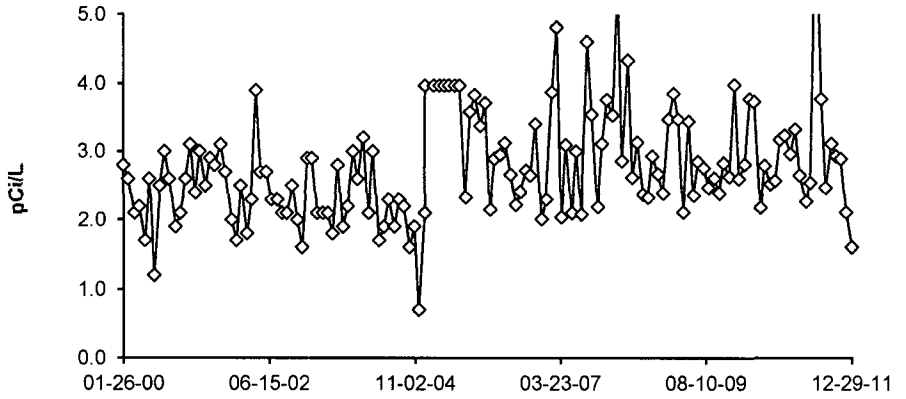
LOCATION	SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN ± 2 S.D.
INNER RING	120	18	35	22.5 ± 6.0
OTHER	24	17	28	21.3 ± 5.0

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, Z-301-1, Z-301-2

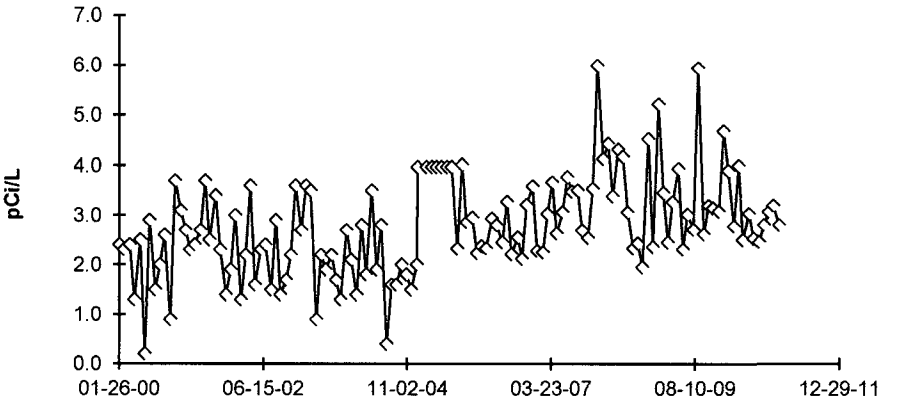
OTHER STATIONS - Z-01-1, Z-01-2, Z-02-1, Z-02-2, Z-03-1, Z-03-2

FIGURE C-1
PUBLIC WATER - GROSS BETA - STATIONS Z-14 AND Z-15 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2011

Z-14 (C) Kenosha Water Works



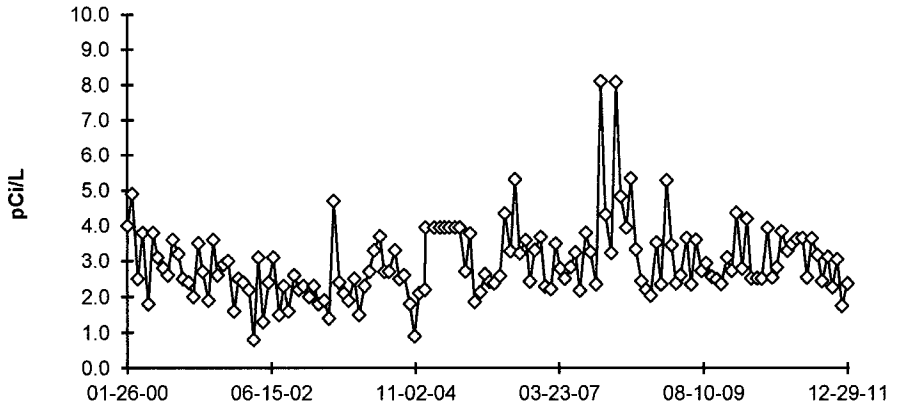
Z-15 Lake County Water Works



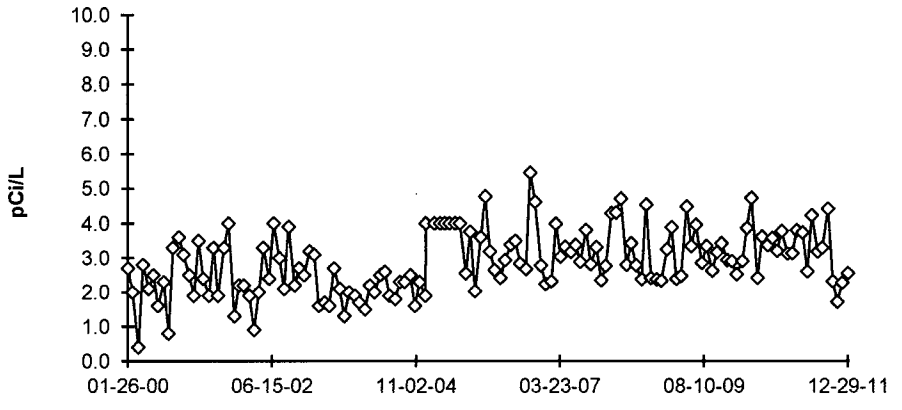
DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

FIGURE C-2
PUBLIC WATER - GROSS BETA - STATIONS Z-16 AND Z-18 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2011

Z-16 Waukegan Water Works



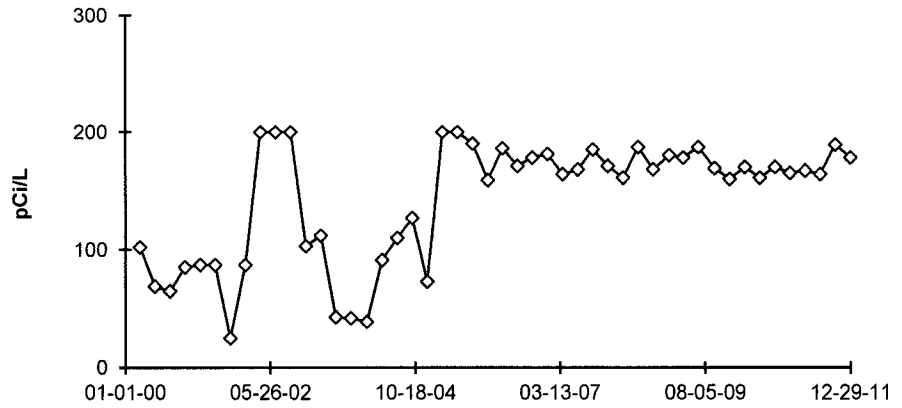
Z-18 (C) Lake Forest Water Works



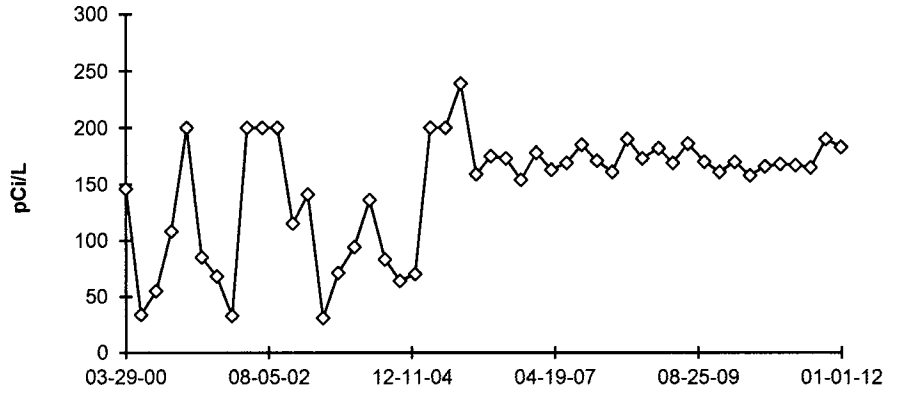
DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

FIGURE C-3
PUBLIC WATER - TRITIUM - STATION Z-14 AND Z-15 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2011

Z-14 (C) Kenosha Water Works



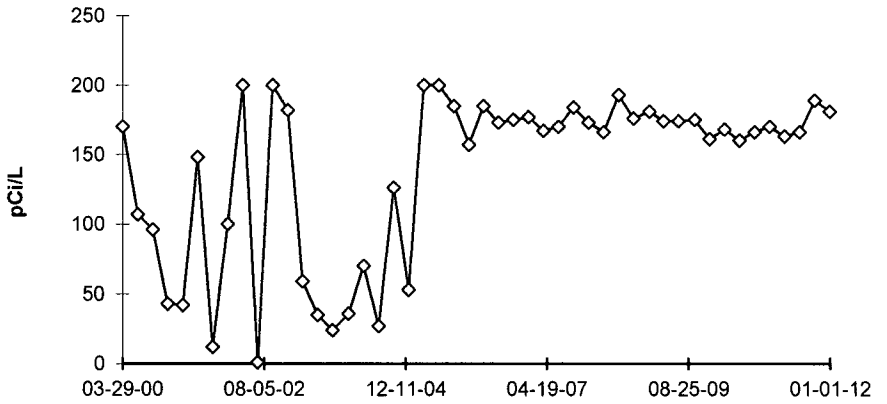
Z-15 Lake County Water Works



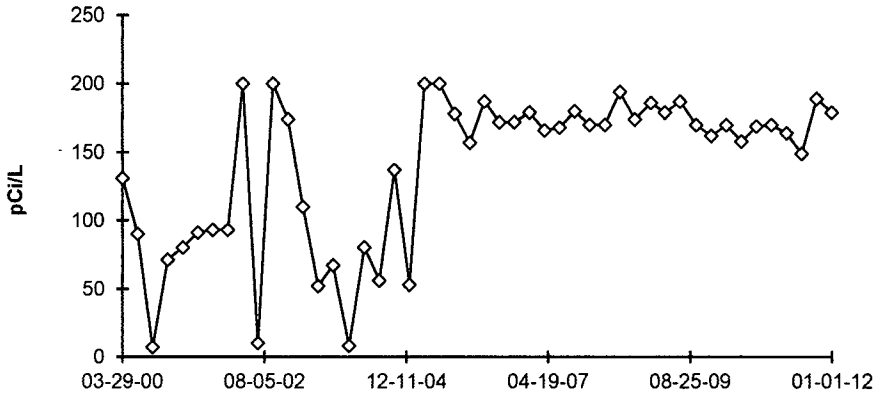
DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

FIGURE C-4
PUBLIC WATER - TRITIUM - STATION Z-16 AND Z-18 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2011

Z-16 Waukegan Water Works



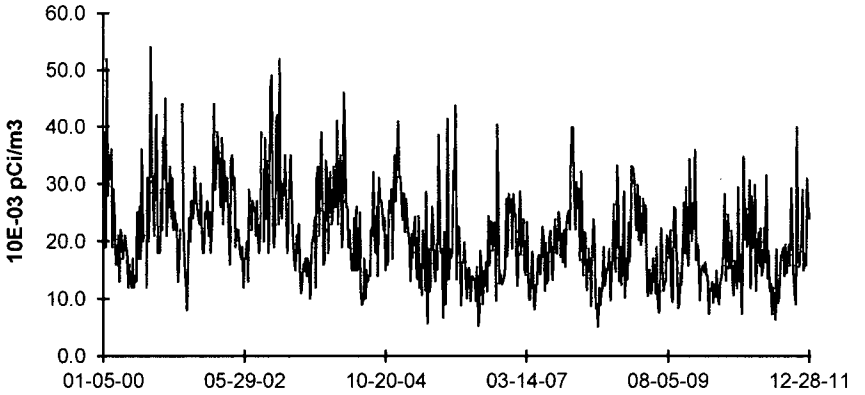
Z-18 (C) Lake Forest Water Works



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 - 2011

Z-01 Onsite No. 1, Southside



Z-02 Onsite No. 2, Westside

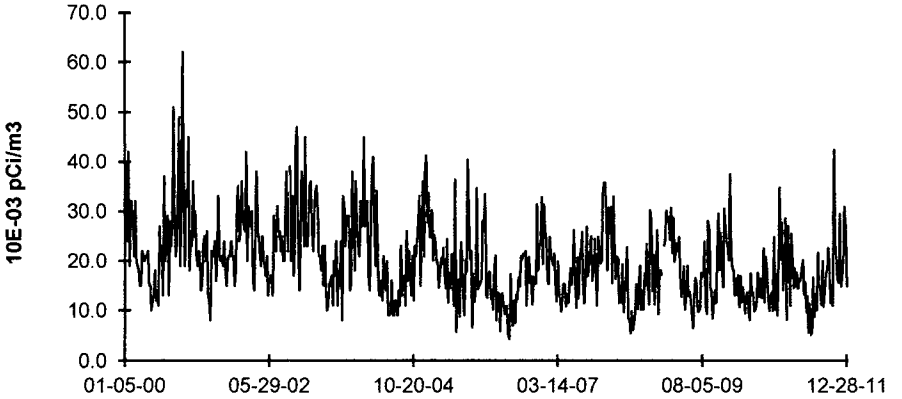
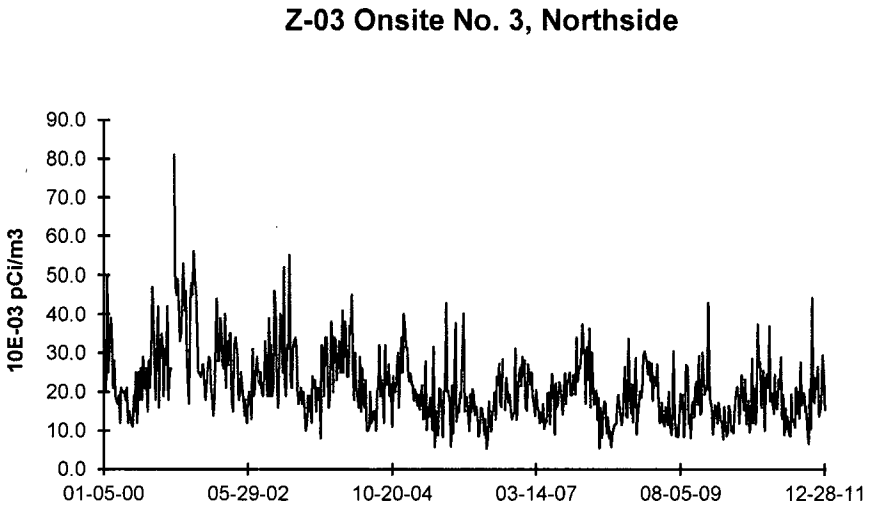


FIGURE C-6
AIR PARTICULATES - GROSS BETA - STATIONS Z-03 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2011



APPENDIX D

INTER-LABORATORY COMPARISON PROGRAM

TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2011
(PAGE 1 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
March 2011	E7460-396	Milk	Sr-89	pCi/L	98.8	97.4	1.01	A
			Sr-90	pCi/L	15.2	15.8	0.96	A
	E7461-396	Milk	I-131	pCi/L	92.9	96.9	0.96	A
			Ce-141	pCi/L	not provided by Analytics for this study			
			Cr-51	pCi/L	398	298	1.34	N (1)
			Cs-134	pCi/L	130	130	1.00	A
			Cs-137	pCi/L	232	205	1.13	A
			Co-58	pCi/L	121	113	1.07	A
			Mn-54	pCi/L	289	266	1.09	A
			Fe-59	pCi/L	201	175	1.15	A
			Zn-65	pCi/L	287	261	1.10	A
			Co-60	pCi/L	186	172	1.08	A
	E7463-396	AP	Ce-141	pCi	not provided by Analytics for this study			
			Cr-51	pCi	243	215	1.13	A
			Cs-134	pCi	85.0	94.2	0.90	A
			Cs-137	pCi	168	148	1.14	A
			Co-58	pCi	89.2	81.8	1.09	A
			Mn-54	pCi	171	192	0.89	A
			Fe-59	pCi	129	126	1.02	A
			Zn-65	pCi	159	189	0.84	A
			Co-60	pCi	132	124	1.06	A
	E7462-396	Charcoal	I-131	pCi	96.5	96.3	1.00	A
June 2011	E7851-396	Milk	Sr-89	pCi/L	96.7	103	0.94	A
			Sr-90	pCi/L	13.8	15.6	0.88	A
	E7852-396	Milk	I-131	pCi/L	110	103.0	1.07	A
			Ce-141	pCi/L	68.1	79.9	0.85	A
			Cr-51	pCi/L	186	206	0.90	A
			Cs-134	pCi/L	164	190	0.86	A
			Cs-137	pCi/L	140	138	1.01	A
			Co-58	pCi/L	141	152	0.93	A
			Mn-54	pCi/L	136	138	0.99	A
			Fe-59	pCi/L	128	123	1.04	A
			Zn-65	pCi/L	263	261	1.01	A
			Co-60	pCi/L	189	195	0.97	A
	E7854-396	AP	Ce-141	pCi	49.9	42.9	1.16	A
			Cr-51	pCi	95.6	110	0.87	A
			Cs-134	pCi	104	102	1.02	A
			Cs-137	pCi	83.8	74.0	1.13	A
			Co-58	pCi	90.7	81.3	1.12	A
			Mn-54	pCi	74.5	73.9	1.01	A
			Fe-59	pCi	62.0	66.1	0.94	A
			Zn-65	pCi	140	140	1.00	A
			Co-60	pCi	119	104	1.14	A
	E7853-396	Charcoal	I-131	pCi	76.2	86.1	0.89	A

TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2011
(PAGE 2 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
September 2011	E8070-396	Milk	Sr-89	pCi/L	102	90.8	1.12	A
			Sr-90	pCi/L	13.2	14.7	0.90	A
	E8071-396	Milk	I-131	pCi/L	74.2	89.2	0.83	A
			Ce-141	pCi/L	66.9	66.7	1.00	A
			Cr-51	pCi/L	249	226	1.10	A
			Cs-134	pCi/L	116	128	0.91	A
			Cs-137	pCi/L	106	114	0.93	A
			Co-58	pCi/L	95.4	97.5	0.98	A
			Mn-54	pCi/L	147	151	0.97	A
			Fe-59	pCi/L	53.1	54.8	0.97	A
			Zn-65	pCi/L	175	180	0.97	A
			Co-60	pCi/L	150	157	0.96	A
	E8073-396	AP	Ce-141	pCi	66.6	67.5	0.99	A
			Cr-51	pCi	263	229	1.15	A
			Cs-134	pCi	139	130	1.07	A
			Cs-137	pCi	110	115	0.96	A
			Co-58	pCi	108	98.6	1.10	A
			Mn-54	pCi	152	153	0.99	A
			Fe-59	pCi	57.5	55.5	1.04	A
			Zn-65	pCi	190	183	1.04	A
			Co-60	pCi	156	159	0.98	A
	E8072-396	Charcoal	I-131	pCi	77.6	80.6	0.96	A
December, 2011	E8230-396	Milk	Sr-89	pCi/L	93.3	93.1	1.00	A
			Sr-90	pCi/L	12.7	15.4	0.82	A
	E8231-396	Milk	I-131	pCi/L	82.5	90.2	0.91	A
			Ce-141	pCi/L	not provided by Analytics for this study			
			Cr-51	pCi/L	465	566	0.82	A
			Cs-134	pCi/L	142	171	0.83	A
			Cs-137	pCi/L	185	210	0.88	A
			Co-58	pCi/L	177	221	0.80	A
			Mn-54	pCi/L	208	241	0.86	A
			Fe-59	pCi/L	164	183	0.90	A
			Zn-65	pCi/L	259	291	0.89	A
			Co-60	pCi/L	224	270	0.83	A
	E8233-396	AP	Ce-141	pCi	not provided by Analytics for this study			
			Cr-51	pCi	344	368	0.93	A
			Cs-134	pCi	105	111	0.95	A
			Cs-137	pCi	129	137	0.94	A
			Co-58	pCi	145	144	1.01	A
			Mn-54	pCi	137	157	0.87	A
			Fe-59	pCi	119	119	1.00	A
			Zn-65	pCi	145	190	0.76	W
			Co-60	pCi	168	176	0.95	A

TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING, 2011
(PAGE 3 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
December 2011	E8232-396	Charcoal	I-131	pCi	100	89.5	1.12	A

(1) Sample appears to be biased high. Corrective Action evaluated after the 2nd Quarter Analytics PE sample; no action required. NCR 11-13

(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, 2011
(PAGE 1 OF 1)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Control Limits	Evaluation (c)
May 2011	RAD-85	Water	Sr-89	pCi/L	59.8	63.2	51.1 - 71.2	A
			Sr-90	pCi/L	42.5	42.5	31.3 - 48.8	A
			Ba-133	pCi/L	73.3	75.3	63.0 - 82.8	A
			Cs-134	pCi/L	64.9	72.9	59.5 - 80.2	A
			Cs-137	pCi/L	74.6	77.0	69.3 - 87.4	A
			Co-60	pCi/L	87.8	88.8	79.9 - 100	A
			Zn-65	pCi/L	103	98.9	89.0 - 118	A
			Gr-A	pCi/L	64.1	50.1	26.1 - 62.9	N (1)
			Gr-B	pCi/L	51.8	49.8	33.8 - 56.9	A
			I-131	pCi/L	27.4	27.5	22.9 - 32.3	A
			U-Nat	pCi/L	38.5	39.8	32.2 - 44.4	A
			H-3	pCi/L	10057	10200	8870 - 11200	A
	MRAD-14	Filter	Gr-A	pCi/filter	79.7	74.3	38.5 - 112	A
November 2011	RAD-87	Water	Sr-89	pCi/L	81.0	69.7	56.9 - 77.9	N (2)
			Sr-90	pCi/L	35.5	41.4	30.2 - 47.2	A
			Ba-133	pCi/L	90.7	96.9	81.8 - 106	A
			Cs-134	pCi/L	36.6	33.4	26.3 - 36.7	A
			Cs-137	pCi/L	44.7	44.3	39.4 - 51.7	A
			Co-60	pCi/L	118.7	119	107 - 133	A
			Zn-65	pCi/L	80.2	76.8	68.9 - 92.5	A
			Gr-A	pCi/L	34.2	53.2	27.8 - 66.6	A
			Gr-B	pCi/L	39.3	45.9	30.9 - 53.1	A
			I-131	pCi/L	22.9	27.5	22.9 - 32.3	A
			U-Nat	pCi/L	46.8	48.6	39.4 - 54.0	A
			H-3	pCi/L	15733	17400	15200 - 19100	A
	MRAD-15	Filter	Gr-A	pCi/filter	44.6	58.4	30.3 - 87.8	A

(1) The solids on the planchet exceeded 100 mg, which was beyond the range of the efficiency curve. NCR 11-08

(2) Sr-89 TBE to known ratio of 1.16 fell within acceptable range of ± 20%. No action required. NCR 11-16

(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, 2011
(PAGE 1 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
March 2011	11-MaW24	Water	Cs-134	Bq/L	19.1	21.5	15.1 - 28.0	A
			Cs-137	Bq/L	29.0	29.4	20.6 - 38.2	A
			Co-57	Bq/L	0.139		(1)	A
			Co-60	Bq/L	23.9	24.6	17.2 - 32.0	A
			H-3	Bq/L	265	243	170 - 316	A
			Mn-54	Bq/L	31.8	31.6	22.1 - 41.1	A
			K-40	Bq/L	94.8	91	64 - 118	A
			Sr-90	Bq/L	9.64	8.72	6.10 - 11.34	A
			Zn-65	Bq/L	-0.142		(1)	A
	11-GrW24	Water	Gr-A	Bq/L	0.767	1.136	0.341 - 1.931	A
			Gr-B	Bq/L	3.43	2.96	1.48 - 4.44	A
	11-MaS24	Soil	Cs-134	Bq/kg	612	680	476 - 884	A
			Cs-137	Bq/kg	772	758	531 - 985	A
			Co-57	Bq/kg	910	927	649 - 1205	A
			Co-60	Bq/kg	500	482	337 - 627	A
			Mn-54	Bq/kg	0.607		(1)	A
			K-40	Bq/kg	569	540	378 - 702	A
			Sr-90	Bq/kg	NR	160	112 - 208	N (2)
			Zn-65	Bq/kg	1497	1359	951 - 1767	A
	11-RdF24	AP	Cs-134	Bq/sample	3.26	3.49	2.44 - 4.54	A
			Cs-137	Bq/sample	2.36	2.28	1.60 - 2.96	A
			Co-57	Bq/sample	3.30	3.33	2.33 - 4.33	A
			Co-60	Bq/sample	0.0765		(1)	A
			Mn-54	Bq/sample	2.84	2.64	1.85 - 3.43	A
			Sr-90	Bq/sample	NR	1.36	0.95 - 1.77	N (2)
			Zn-65	Bq/sample	3.30	3.18	2.23 - 4.13	A
	11-GrF24	AP	Gr-A	Bq/sample	0.101	0.659	0.198 - 1.120	N (3)
			Gr-B	Bq/sample	1.23	1.323	0.662 - 1.985	A
	11-RdV24	Vegetation	Cs-134	Bq/sample	4.97	5.50	3.85 - 7.15	A
			Cs-137	Bq/sample	0.0356		(1)	A
			Co-57	Bq/sample	10.8	9.94	6.96 - 12.92	A
			Co-60	Bq/sample	4.89	4.91	3.44 - 6.38	A
			Mn-54	Bq/sample	6.42	6.40	4.48 - 8.32	A
			Sr-90	Bq/sample	NR	2.46	1.72 - 3.20	N (2)
			Zn-65	Bq/sample	3.07	2.99	2.09 - 3.89	A
September 2011	11-MaW25	Water	Cs-134	Bq/L	16.0	19.1	13.4 - 24.8	A
			Cs-137	Bq/L	0.0043		(1)	A
			Co-57	Bq/L	33.1	36.6	25.6 - 47.6	A
			Co-60	Bq/L	26.9	29.3	20.5 - 38.1	A
			H-3	Bq/L	1011	1014	710 - 1318	A
			Mn-54	Bq/L	23.2	25.0	17.5 - 32.5	A
			K-40	Bq/L	147	156	109 - 203	A
			Sr-90	Bq/L	15.8	14.2	9.9 - 18.5	A
			Zn-65	Bq/L	27.3	28.5	20.0 - 37.1	A

TABLE D-3 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
TELEDYNE BROWN ENGINEERING, 2011
(PAGE 2 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
September 2011	11-GrW25	Water	Gr-A	Bq/L	0.894	0.866	0.260 - 1.472	A
			Gr-B	Bq/L	5.87	4.81	2.41 - 7.22	A
	11-MaS25	Soil	Cs-134	Bq/kg	-0.213		(1)	A
			Cs-137	Bq/kg	1110	979	685 - 1273	A
			Co-57	Bq/kg	1290	1180	826 - 1534	A
			Co-60	Bq/kg	731	644	451 - 837	A
			Mn-54	Bq/kg	987	848	594 - 1102	A
			K-40	Bq/kg	753	625	438 - 813	W
			Sr-90	Bq/kg	276	320	224 - 416	A
			Zn-65	Bq/kg	1870	1560	1092 - 2028	A
September 2011	11-RdF25	AP	Cs-134	Bq/sample	-0.043		(1)	A
			Cs-137	Bq/sample	3.09	2.60	1.82 - 3.38	A
			Co-57	Bq/sample	5.36	5.09	3.56 - 6.62	A
			Co-60	Bq/sample	3.41	3.20	2.24 - 4.16	A
			Mn-54	Bq/sample	0.067		(1)	A
			Sr-90	Bq/sample	1.84	1.67	1.17 - 2.17	A
			Zn-65	Bq/sample	5.17	4.11	2.88 - 5.34	W
	11-GrF25	AP	Gr-A	Bq/sample	0.0058		(1)	A
			Gr-B	Bq/sample	-0.01		(1)	A
	11-RdV25	Vegetation	Cs-134	Bq/sample	0.0081		(1)	A
			Cs-137	Bq/sample	4.94	4.71	3.30 - 6.12	A
			Co-57	Bq/sample	0.0639		(1)	A
			Co-60	Bq/sample	3.36	3.38	2.37 - 4.39	A
			Mn-54	Bq/sample	5.89	5.71	4.00 - 7.42	A
			Sr-90	Bq/sample	1.31	1.26	0.88 - 1.64	A
			Zn-65	Bq/sample	6.54	6.39	4.47 - 8.31	A

(1) False positive test.

(2) Evaluated as failed due to not reporting a previously reported analyte. NCR 11-11

(3) The filter for Gross Alpha was counted on the wrong side. Recounted on the correct side resulted in acceptable results. NCR 11-11

(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., 2011
(Page 1 of 1)

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result [b]	ERA Result [c]	Control Limits	Acceptance
STW-1243	04/04/11	Sr-89	68.2 ± 5.8	63.2	51.1 - 71.2	Pass
STW-1243	04/04/11	Sr-90	44.3 ± 2.4	42.5	31.3 - 48.8	Pass
STW-1244	04/04/11	Ba-133	69.8 ± 3.9	75.3	63.0 - 82.8	Pass
STW-1244	04/04/11	Co-60	87.9 ± 3.8	88.8	79.9 - 100.0	Pass
STW-1244	04/04/11	Cs-134	69.5 ± 3.7	72.9	59.5 - 80.2	Pass
STW-1244	04/04/11	Cs-137	77.9 ± 5.3	77.0	69.3 - 87.4	Pass
STW-1244	04/04/11	Zn-65	105.2 ± 8.4	98.9	89.0 - 118.0	Pass
STW-1245	04/04/11	Gr. Alpha	41.5 ± 2.3	50.1	26.1 - 62.9	Pass
STW-1245	04/04/11	Gr. Beta	48.9 ± 1.8	49.8	33.8 - 56.9	Pass
STW-1246	04/04/11	I-131	26.6 ± 1.7	27.5	22.9 - 32.3	Pass
STW-1248	04/04/11	H-3	10322 ± 285	10200.0	8870 - 11200	Pass
STW-1256	10/07/11	Sr-89	68.7 ± 6.0	69.7	56.9 - 77.9	Pass
STW-1256	10/07/11	Sr-90	36.9 ± 2.4	41.1	30.2 - 47.2	Pass
STW-1257	10/07/11	Ba-133	88.2 ± 7.8	96.9	81.8 - 106.0	Pass
STW-1257	10/07/11	Co-60	116.5 ± 7.1	119.0	107.0 - 133.0	Pass
STW-1257 [d]	10/07/11	Cs-134	38.8 ± 8.0	33.4	26.3 - 36.7	Fail
STW-1257	10/07/11	Cs-137	45.6 ± 7.3	44.3	39.4 - 51.7	Pass
STW-1257	10/07/11	Zn-65	84.9 ± 15.4	76.8	68.9 - 92.5	Pass
STW-1258	10/07/11	Gr. Alpha	35.7 ± 3.8	53.2	27.8 - 66.6	Pass
STW-1258	10/07/11	Gr. Beta	36.1 ± 3.3	45.9	30.9 - 53.1	Pass
STW-1259	10/07/11	I-131	25.0 ± 1.1	27.5	22.9 - 32.3	Pass
STW-1261	10/07/11	H-3	17435 ± 382	17400	15200 - 19100	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.

[d] The sample was reanalyzed. Result of reanalysis was acceptable, 32.9 ± 7.4 pCi/L.

TABLE D-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)[a]
ENVIRONMENTAL, INC., 2011

			Concentration [b]			
Lab Code [c]	Date	Analysis	Laboratory result	Activity	Limits [d]	Acceptance
STW-1237	02/01/11	Co-57	< 0.2	0.00	-	Pass
STW-1237	02/01/11	Co-60	24.10 ± 0.40	24.60	17.20 - 32.00	Pass
STW-1237	02/01/11	Cs-134	19.80 ± 0.40	21.50	15.10 - 28.00	Pass
STW-1237	02/01/11	Cs-137	29.40 ± 0.50	29.40	20.60 - 38.20	Pass
STW-1237	02/01/11	H-3	238.90 ± 8.80	243.00	170.00 - 316.00	Pass
STW-1237	02/01/11	K-40	95.40 ± 3.10	91.00	64.00 - 118.00	Pass
STW-1237	02/01/11	Mn-54	32.50 ± 0.60	31.60	22.10 - 41.10	Pass
STW-1237	02/01/11	Sr-90	8.70 ± 0.70	8.72	6.10 - 11.34	Pass
STW-1237	02/01/11	Zn-65	< 0.5	0.00	-	Pass
STW-1238	02/01/11	Gr. Alpha	0.82 ± 0.07	1.14	0.34 - 1.93	Pass
STW-1238	02/01/11	Gr. Beta	2.82 ± 0.07	2.96	1.48 - 4.44	Pass
STVE-1239	02/01/11	Co-57	11.27 ± 0.21	9.94	6.96 - 12.92	Pass
STVE-1239	02/01/11	Co-60	4.95 ± 0.16	4.91	3.44 - 6.38	Pass
STVE-1239	02/01/11	Cs-134	5.18 ± 0.19	5.50	3.85 - 7.15	Pass
STVE-1239	02/01/11	Cs-137	< 0.09	0.00	-	Pass
STVE-1239	02/01/11	Mn-54	6.91 ± 0.25	6.40	4.48 - 8.32	Pass
STVE-1239	02/01/11	Zn-65	3.10 ± 0.32	2.99	2.09 - 3.89	Pass
STSO-1240	02/01/11	Co-57	984.10 ± 4.10	927.00	649.00 - 1205.00	Pass
STSO-1240	02/01/11	Co-60	540.70 ± 3.00	482.00	337.00 - 627.00	Pass
STSO-1240	02/01/11	Cs-134	726.70 ± 5.92	680.00	476.00 - 884.00	Pass
STSO-1240	02/01/11	Cs-137	883.10 ± 4.70	758.00	531.00 - 985.00	Pass
STSO-1240	02/01/11	K-40	622.70 ± 16.70	540.00	378.00 - 702.00	Pass
STSO-1240	02/01/11	Mn-54	-0.30 ± 1.00	0.00	-	Pass
STSO-1240	02/01/11	Zn-65	1671.00 ± 13.10	1359.00	951.00 - 1767.00	Pass
STAP-1241	02/01/11	Co-57	3.48 ± 0.06	3.33	2.33 - 4.33	Pass
STAP-1241	02/01/11	Co-60	0.00 ± 0.02	0.00	-0.10 - 0.10	Pass
STAP-1241	02/01/11	Cs-134	3.44 ± 0.27	3.49	2.44 - 4.54	Pass
STAP-1241	02/01/11	Cs-137	2.46 ± 0.27	2.28	1.60 - 2.96	Pass
STAP-1241	02/01/11	Gr. Alpha	0.39 ± 0.05	0.66	0.20 - 1.12	Pass
STAP-1241	02/01/11	Gr. Beta	1.54 ± 0.07	1.32	0.66 - 1.99	Pass
STAP-1241	02/01/11	Mn-54	2.90 ± 0.10	2.64	1.85 - 3.43	Pass
STAP-1241 e	02/01/11	Sr-90	1.89 ± 0.15	1.36	0.95 - 1.77	Fail
STAP-1241	02/01/11	Zn-65	3.80 ± 0.18	3.18	2.23 - 4.13	Pass
STVE-1250	08/01/11	Co-57	0.01 ± 0.02	0.00	-	Pass
STVE-1250	08/01/11	Co-60	3.57 ± 0.13	3.38	2.37 - 4.39	Pass
STVE-1250	08/01/11	Cs-134	-0.02 ± 0.04	0.00	-0.10 - 0.10	Pass
STVE-1250	08/01/11	Cs-137	5.28 ± 0.20	4.71	3.30 - 6.12	Pass
STVE-1250	08/01/11	Mn-54	6.48 ± 0.22	5.71	4.00 - 7.42	Pass
STVE-1250	08/01/11	Zn-65	7.35 ± 0.34	6.39	4.47 - 8.31	Pass

TABLE D-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)[a] ENVIRONMENTAL, INC., 2011

			Concentration [b]			
Lab Code [c]	Date	Analysis	Laboratory result	Known Activity	Control Limits [d]	Acceptance
STSO-1251	08/01/11	Co-57	1333.90 ± 4.20	1180.00	826.00 - 1534.00	Pass
STSO-1251	08/01/11	Co-60	701.30 ± 3.40	644.00	451.00 - 837.00	Pass
STSO-1251	08/01/11	Cs-134	0.71 ± 1.05	0.00	-	Pass
STSO-1251	08/01/11	Cs-137	1106.00 ± 5.60	979.00	685.00 - 1273.00	Pass
STSO-1251	08/01/11	K-40	749.20 ± 19.00	625.00	438.00 - 813.00	Pass
STSO-1251	08/01/11	Mn-54	984.30 ± 5.40	848.00	594.00 - 1102.00	Pass
STSO-1251 f	08/01/11	Sr-90	219.40 ± 16.70	320.00	224.00 - 416.00	Fail
STSO-1251	08/01/11	Zn-65	1639.90 ± 11.40	1560.00	1092.00 - 2028.00	Pass
STAP-1252	08/01/11	Co-57	5.06 ± 0.08	5.09	3.56 - 6.62	Pass
STAP-1252	08/01/11	Co-60	3.13 ± 0.09	3.20	2.24 - 4.16	Pass
STAP-1252	08/01/11	Cs-134	0.01 ± 0.03	0.00	-0.10 - 0.10	Pass
STAP-1252	08/01/11	Cs-137	2.61 ± 0.09	2.60	1.82 - 3.38	Pass
STAP-1252	08/01/11	Mn-54	0.01 ± 0.03	0.00	-0.10 - 0.10	Pass
STAP-1252	08/01/11	Sr-90	1.65 ± 0.16	1.67	1.17 - 2.17	Pass
STAP-1252	08/01/11	Zn-65	4.46 ± 0.23	4.11	2.88 - 5.34	Pass
STW-1254	08/01/11	Co-57	37.20 ± 0.50	36.60	25.60 - 47.60	Pass
STW-1254	08/01/11	Co-60	28.80 ± 0.40	29.30	20.50 - 38.10	Pass
STW-1254	08/01/11	Cs-134	18.00 ± 0.60	19.10	13.40 - 24.80	Pass
STW-1254	08/01/11	Cs-137	0.06 ± 0.13	0.00	-	Pass
STW-1254	08/01/11	H-3	1039.90 ± 17.90	1014.00	710.00 - 1318.00	Pass
STW-1254	08/01/11	K-40	161.40 ± 4.10	156.00	109.00 - 203.00	Pass
STW-1254	08/01/11	Mn-54	25.70 ± 0.50	25.00	17.50 - 32.50	Pass
STW-1254	08/01/11	Sr-90	15.60 ± 1.80	14.20	9.90 - 18.50	Pass
STW-1254	08/01/11	Zn-65	30.20 ± 0.90	28.50	20.00 - 37.10	Pass
STW-1255	08/01/11	Gr. Alpha	0.72 ± 0.12	0.87	0.26 - 1.47	Pass
STW-1255	08/01/11	Gr. Beta	4.71 ± 0.15	4.81	2.41 - 7.22	Pass

[a] Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the Department of Energy's Mixed Analyte Performance Evaluation Program, Idaho Operations office, Idaho Falls, Idaho

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

[c] Laboratory codes as follows: STW (water), STAP (air filter), STSO (soil), STVE (vegetation).

[d] 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.

[e] No errors found in calculation or procedure, results of reanalysis; 1.73 Bq/filter.

[f] The analyses were repeated through a strontium column; mean result of triplicate analyses, 304.2 Bq/kg.

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APPENDIX E

EFFLUENT DATA

TABLE OF CONTENTS

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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 2011 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 Kr85 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.

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.

SUMMARY

Gaseous and liquid 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 radionuclides released to the atmosphere represented the critical pathway for the period with a maximum individual total body dose estimated to be 3.10E-04 mrem for the year, where a shielding and occupancy factor of 0.7 is assumed. 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, 1OCFR20 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 µCi/sec during any one quarter period.

A total of 2.28E+00 microcuries of beta-gamma emitters was released as airborne particulate matter with a maximum average quarterly release rate of 3.75E-06 µCi/sec. Alpha-emitting radionuclides were not measurable. Also, 4.71E-02 curies of tritium were released with a maximum average quarterly release rate of 1.15E-03 µCi/sec.

1.2 Liquids Released to Lake Michigan

A total of 1.58E+07 liters of liquid waste containing 0.00E+00 microcuries was discharged from the station via an approved pathway after dilution with a total of 4.37E+10 liters of water. These wastes were released at a maximum quarterly average concentration of 0.00E+00 µCi/ml. A total of 0.00E-00 curies of tritium was released. Alpha activity released totaled 0.00 µCi for the year. Monthly release estimates and principal radionuclides in liquid effluents are reported in the Zion Nuclear Power Station Radioactive Effluent Report for 2011.

2.0 SOLID RADIOACTIVE WASTE

There were 24 solid radioactive waste shipments in 2011. For more detail, refer to the Zion Station 2011 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 3.10 E-04 mrem (child) for the year (Table 3.1-1), with an occupancy or shielding factor of 0.7 included, and based on measured effluents and concurrent meteorological data would be 0.00E+00 mrem (Table 3.4-1). The maximum gamma air dose was 0.00E+00 mrad based on measured effluents and average meteorological data (Table 3.1-1), and 0.00E+00 mrad based on measured effluents and concurrent meteorological data (Table 3.4-1).

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 thickness of 7.0 mg/cm^2 and an occupancy factor of 1.0 is used. The skin dose from beta and gamma radiation for the year was 0.00E+00 mrem based on measured effluents and average meteorological data (Table 3.1-1), and 0.00E+00 mrem based on measured effluents

and concurrent meteorological data (Table 3.4-1).
The maximum offsite beta air dose for the year was 0.00E+00 mrad based on measured effluents and average meteorological data (Table 3.1-1), and 0.00E+00 mrad based on measured effluents and concurrent meteorological data (Table 3.4-1).

3.1.2 Radioactive Iodine

The human thyroid exhibits a significant capacity to concentrate ingested or inhaled iodine. The radioiodine, 1-131, 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 1-131 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 0.00E+00 mrem and no organ dose exceeded 0.00E+00 mrem (Table 3.2-1).

3.3 Assessment of Dose to Member of Public

During the period January to December, 2011, 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 Figure 3.1-1 (based on concurrent meteorological data):

- 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 mrads 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).

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.

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*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 99.7% during 2011 (Table 3.4-1).

APPENDIX E-1

DATA TABLES AND FIGURES

Table 2.0-1
Solid Radioactive Waste

Table 2.0-1 has been deliberately deleted. For details on solid waste disposal, see the Zion 2010 Annual Effluent Report

Table 3.1-1
Maximum Dose Resulting from Airborne Releases

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== I&P DOSE LIMIT ANALYSIS ========== QUARTER 1 =========

Quarter - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Qtr 1 - Admin. Any Organ	CHILD	LIVER	2.98E-05	5.63E+00	5.30E-04
Qtr 1 - Admin. Total Body	CHILD	TBODY	2.98E-05	5.25E+00	5.68E-04
Qtr 1 - T.Spc. Any Organ	CHILD	LIVER	2.98E-05	7.50E+00	3.98E-04

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Vegetation (VEG)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	1.00E+02

Qtr 1 - T.Spc. Total Body	CHILD	TBODY	2.98E-05	7.50E+00	3.98E-04

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Vegetation (VEG)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	1.00E+02

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== NG DOSE LIMIT ANALYSIS ========== QUARTER 1 ======

Quartr - Limit	Dose (mrad)	Limit (mrad)	Max % of Limit
Qtr 1 - Admin. Gamma	0.00E+00	7.50E+00	0.00E+00
Qtr 1 - Admin. Beta	0.00E+00	7.50E+00	0.00E+00
Qtr 1 - T.Spc. Gamma	0.00E+00	7.50E+00	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

Qtr 1 - T.Spc. Beta	0.00E+00	7.50E+00	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== I&P DOSE LIMIT ANALYSIS ========== QUARTER 2 ========

Quarter - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Qtr 2 - Admin. Any Organ	CHILD	LIVER	3.01E-05	5.63E+00	5.36E-04
Qtr 2 - Admin. Total Body	CHILD	TBODY	3.01E-05	5.25E+00	5.74E-04
Qtr 2 - T.Spc. Any Organ	CHILD	LIVER	3.01E-05	7.50E+00	4.02E-04

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Vegetation (VEG)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	1.00E+02

Qtr 2 - T.Spc. Total Body	CHILD	TBODY	3.01E-05	7.50E+00	4.02E-04

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Vegetation (VEG)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	1.00E+02

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== NG DOSE LIMIT ANALYSIS ========== QUARTER 2 ========

Quarter - Limit	Dose (mrad)	Limit (mrad)	Max % of Limit
Qtr 2 - Admin. Gamma	0.00E+00	7.50E+00	0.00E+00
Qtr 2 - Admin. Beta	0.00E+00	7.50E+00	0.00E+00
Qtr 2 - T.Spc. Gamma	0.00E+00	7.50E+00	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

Qtr 2 - T.Spc. Beta	0.00E+00	7.50E+00	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== I&P DOSE LIMIT ANALYSIS ========== QUARTER 3 ========

Quarter - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Qtr 3 - Admin. Any Organ	CHILD	LIVER	3.00E-05	5.63E+00	5.33E-04
Qtr 3 - Admin. Total Body	CHILD	TBODY	3.00E-05	5.25E+00	5.71E-04
Qtr 3 - T.Spc. Any Organ	CHILD	LIVER	3.00E-05	7.50E+00	4.00E-04

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Vegetation (VEG)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	1.00E+02

Qtr 3 - T.Spc. Total Body	CHILD	TBODY	3.00E-05	7.50E+00	4.00E-04

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Vegetation (VEG)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	1.00E+02

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== NG DOSE LIMIT ANALYSIS ========== QUARTER 3 ========

Quarter - Limit	Dose (mrad)	Limit (mrad)	Max % of Limit
Qtr 3 - Admin. Gamma	0.00E+00	7.50E+00	0.00E+00
Qtr 3 - Admin. Beta	0.00E+00	7.50E+00	0.00E+00
Qtr 3 - T.Spc. Gamma	0.00E+00	7.50E+00	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

Qtr 3 - T.Spc. Beta	0.00E+00	7.50E+00	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== I&P DOSE LIMIT ANALYSIS ========== QUARTER 4 ========

Quartr - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Qtr 4 - Admin. Any Organ	INFANT	LIVER	6.32E-04	5.63E+00	1.12E-02
Qtr 4 - Admin. Total Body	ADULT	TBODY	2.26E-04	5.25E+00	4.31E-03
Qtr 4 - T.Spc. Any Organ	INFANT	LIVER	6.32E-04	7.50E+00	8.42E-03

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Grs/Goat/Milk (GMILK)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	3.69E+00
CO-60	1.71E+01
CS-137	7.92E+01

Qtr 4 - T.Spc. Total Body	ADULT	TBODY	2.26E-04	7.50E+00	3.01E-03

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Ground Plane Deposition (GPD)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	8.05E+00
CO-60	4.86E+01
CS-137	4.33E+01

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== NG DOSE LIMIT ANALYSIS ========== QUARTER 4 ========

Quarter - Limit	Dose (mrad)	Limit (mrad)	Max % of Limit
Qtr 4 - Admin. Gamma	0.00E+00	7.50E+00	0.00E+00
Qtr 4 - Admin. Beta	0.00E+00	7.50E+00	0.00E+00
Qtr 4 - T.Spc. Gamma	0.00E+00	7.50E+00	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

Qtr 4 - T.Spc. Beta	0.00E+00	7.50E+00	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== I&P DOSE LIMIT ANALYSIS ========== ANNUAL 2011 ======

Annual - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
2011 - Admin. Any Organ	INFANT	LIVER	7.02E-04	1.13E+01	6.24E-03
2011 - Admin. Total Body	CHILD	TBODY	3.10E-04	1.05E+01	2.95E-03
2011 - T.Spc. Any Organ	INFANT	LIVER	7.02E-04	1.50E+01	4.68E-03

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Grs/Goat/Milk (GMILK)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	1.33E+01
CO-60	1.54E+01
CS-137	7.13E+01

2011 - T.Spc. Total Body	CHILD	TBODY	3.10E-04	1.50E+01	2.07E-03

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA
Critical Pathway: Ground Plane Deposition (GPD)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	3.87E+01
CO-60	3.67E+01
CS-137	2.46E+01

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

GASEOUS DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

=== NG DOSE LIMIT ANALYSIS ========== ANNUAL 2011 ======

Annual - Limit	Dose (mrad)	Limit (mrad)	Max % of Limit
2011 - Admin. Gamma	0.00E+00	1.50E+01	0.00E+00
2011 - Admin. Beta	0.00E+00	1.50E+01	0.00E+00
2011 - T.Spc. Gamma	0.00E+00	1.50E+01	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

2011 - T.Spc. Beta	0.00E+00	1.50E+01	0.00E+00

Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Nuclide	Percentage

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

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

Report for: 2011
Unit Range - From: 1 To: 2

=== MAXIMUM DOSE ANALYSIS ========== ANNUAL 2011 ======

Dose Type	Age Group	Organ	Dose (mrem)
Any Organ	INFANT	LIVER	7.02E-04

Liquid Receptor: NA
Gaseous Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Liquid Dose: 0.00E+00 % of Total: 0.00E+00
Critical Pathway: Potable Water (PWtr)
Major Contributors (0% or greater to total)

Nuclide	Percentage

Gaseous Dose: 7.02E-04 % of Total: 9.99E+01
Critical Pathway: Grs/Goat/Milk (GMILK)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	1.33E+01
CO-60	1.54E+01
CS-137	7.13E+01

=== MAXIMUM DOSE ANALYSIS ========== ANNUAL 2011 ======

Dose Type	Age Group	Organ	Dose (mrem)
Total Body	CHILD	TBODY	3.10E-04

Liquid Receptor: NA
Gaseous Receptor: 5 Composite Crit. Receptor - IP
Distance: 0.00 (meters) Compass Point: NA

Liquid Dose: 0.00E+00 % of Total: 0.00E+00
Critical Pathway: Potable Water (PWtr)
Major Contributors (0% or greater to total)

Nuclide	Percentage

Gaseous Dose: 3.10E-04 % of Total: 1.00E+02
Critical Pathway: Ground Plane Deposition (GPD)
Major Contributors (0% or greater to total)

Nuclide	Percentage
H-3	3.87E+01
CO-60	3.67E+01
CS-137	2.46E+01

Table 3.2-1
Maximum Dose Resulting from Liquid Effluents

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

LIQUID DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

Liquid Receptor

=== PERIOD DOSE BY ORGAN AND AGE GROUP (mrem) ========= QUARTER 1========

Agegrp	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	Skin	TB

=== SITE DOSE LIMIT ANALYSIS ========== QUARTER 1 =======

Quarter - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % Limit
Qtr 1 - Admin. Any Organ			0.00E+00	1.50E+01	0.00E+00
Qtr 1 - Admin. Total Body	ADULT	TBODY	0.00E+00	1.13E+00	0.00E+00
Qtr 1 - T.Spc. Any Organ			0.00E+00	3.75E+00	0.00E+00

Critical Pathway:
Major Contributors (0% or greater to total)

Nuclide	Percentage

Qtr 1 - T.Spc. Total Body	ADULT	TBODY	0.00E+00	1.50E+00	0.00E+00

Critical Pathway: Potable Water (PWtr)
Major Contributors (0% or greater to total)

Nuclide	Percentage

Table 3.2-1 (continued)
Maximum Dose Resulting from Liquid Effluents

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

LIQUID DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

Liquid Receptor

=== PERIOD DOSE BY ORGAN AND AGE GROUP (mrem) ========= QUARTER 2 =======

Agegrp	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	Skin	TB

=== SITE DOSE LIMIT ANALYSIS ========================== QUARTER 2 =======

Quarter - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Qtr 2 - Admin. Any Organ			0.00E+00	5.00E+00	0.00E+00
Qtr 2 - Admin. Total Body	ADULT	TBODY	0.00E+00	1.13E+00	0.00E+00
Qtr 2 - T.Spc. Any Organ			0.00E+00	3.75E+00	0.00E+00

Critical Pathway:
Major Contributors (0% or greater to total)

Nuclide	Percentage

Qtr 2 - T.Spc. Total Body	ADULT	TBODY	0.00E+00	1.50E+00	0.00E+00

Critical Pathway: Potable Water (PWtr)
Major Contributors (0% or greater to total)

Nuclide	Percentage

Table 3.2-1 (continued)
Maximum Dose Resulting from Liquid Effluents

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

LIQUID DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

Liquid Receptor

=== PERIOD DOSE BY ORGAN AND AGE GROUP (mrem) ========= QUARTER 3 =======

Agegrp	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	Skin	TB

=== SITE DOSE LIMIT ANALYSIS ========================== QUARTER 3 =======

Quarter - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Qtr 3 - Admin. Any Organ			0.00E+00	5.00E+00	0.00E+00
Qtr 3 - Admin. Total Body	ADULT	TBODY	0.00E+00	1.13E+00	0.00E+00
Qtr 3 - T.Spc. Any Organ			0.00E+00	3.75E+00	0.00E+00

Critical Pathway:
Major Contributors (0% or greater to total)

Nuclide	Percentage

Qtr 3 - T.Spc. Total Body	ADULT	TBODY	0.00E+00	1.50E+00	0.00E+00

Critical Pathway: Potable Water (PWtr)
Major Contributors (0% or greater to total)

Nuclide	Percentage

Table 3.2-1 (continued)
Maximum Dose Resulting from Liquid Effluents

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

LIQUID DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

Liquid Receptor

=== PERIOD DOSE BY ORGAN AND AGE GROUP (mrem) ========= QUARTER 4 =======

Agegrp	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	Skin	TB

=== SITE DOSE LIMIT ANALYSIS ========== QUARTER 4 =======

Quarter - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
Qtr 4 - Admin. Any Organ			0.00E+00	5.00E+00	0.00E+00
Qtr 4 - Admin. Total Body	ADULT	TBODY	0.00E+00	1.13E+00	0.00E+00
Qtr 4 - T.Spc. Any Organ			0.00E+00	3.75E+00	0.00E+00

Critical Pathway:
Major Contributors (0% or greater to total)

Nuclide	Percentage

Qtr 4 - T.Spc. Total Body	ADULT	TBODY	0.00E+00	1.50E+00	0.00E+00

Critical Pathway: Potable Water (PWtr)
Major Contributors (0% or greater to total)

Nuclide	Percentage

Table 3.2-1 (continued)
Maximum Dose Resulting from Liquid Effluents

40CFR190 URANIUM FUEL CYCLE DOSE REPORT

LIQUID DOSE SUMMARY

Report for: 2011
Unit Range - From: 1 To: 2

Liquid Receptor

=== PERIOD DOSE BY ORGAN AND AGE GROUP (mrem) ========= ANNUAL 2011 =====

Agegrp	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	Skin	TB

=== SITE DOSE LIMIT ANALYSIS ========== ANNUAL 2011 =====

Annual - Limit	Age Group	Organ	Dose (mrem)	Limit (mrem)	Max % of Limit
2011 - Admin. Any Organ			0.00E+00	5.00E+00	0.00E+00
2011 - Admin. Total Body	ADULT	TBODY	0.00E+00	2.25E+00	0.00E+00
2011 - T.Spc. Any Organ			0.00E+00	7.50E+00	0.00E+00

Critical Pathway:
Major Contributors (0% or greater to total)

Nuclide	Percentage

2011 - T.Spc. Total Body	ADULT	TBODY	0.00E+00	3.00E+00	0.00E+00

Critical Pathway: Potable Water (PWtr)
Major Contributors (0% or greater to total)

Nuclide	Percentage

Table 3.3-1
10CFR20 Compliance Assessment

ZION STATION
2011
Unit 1
10CFR20 Compliance Assessment

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

   Total Effective Dose Equivalent 9.03E-04 mrem/year

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

   % of the limit 0.000903

2. Compliance Summary 10CFR20

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr	% of Limit
TEDE	1.49E-05	1.51E-05	1.50E-05	8.58E-04	0.000903

Table 3.3-1 (continued)
10CFR20 Compliance Assessment

ZION STATION
2011
Unit 2
10CFR20 Compliance Assessment

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

Total Effective Dose Equivalent	6.00E-05 mrem/year
10 CFR 20.1301 (a) (1) limit	100 mrem/year
% of the limit	0.000060

2. Compliance Summary 10CFR20

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr	% of Limit
TEDE	1.49E-05	1.51E-05	1.50E-05	1.50E-05	0.000060

Table 3.4-1

Doses Resulting from Airborne Releases

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

Unit 1:

Dose	*Maximum Value*	*Sector Affected*
gamma air [1]	0.000 x 10^{-0} mrad	North
beta air [2]	0.000 x 10^{-0} mrad	North
whole body [3]	3.290 x 10^{-6} mrem	North
skin [4]	3.860 x 10^{-6} mrem	North
organ [5] (teenager lung)	1.668 x 10^{-5} mrem	North

Unit 2:

Dose	*Maximum Value*	Sector *Affected*
gamma air [1]	0.000 x 10^{-0} mrad	-
beta air [2]	0.000 x 10^{-0} mrad	-
whole body [3]	0.000 x 10^{-0} mrem	-
skin [4]	0.000 x 10^{-0} mrem	-
organ [5] (teenager liver)	1.238 x 10^{-5} mrem	East-Northeast

(1) Gamma Air Dose – Finite Cloud Model; M+T ODCM Rev. 9
(2) Beta Air Dose – Finite Cloud Model; M+T ODCM Rev. 9
(3) Whole Body Dose – Finite Cloud Model; M+T ODCM Rev. 9
(4) Skin Dose – Finite Cloud Model; M+T ODCM Rev. 9
(5) Inhalation and Food Pathways Dose – Finite Cloud Model; M+T ODCM Rev. 9

APPENDIX F

METEOROLOGICAL DATA

Zion Nuclear Station

Period of Record: January - March 2011
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	2	0	0	0	3
NNE	0	5	30	1	0	0	36
NE	0	5	10	4	0	0	19
ENE	0	8	5	0	0	0	13
E	0	10	15	0	0	0	25
ESE	0	0	0	0	0	0	0
SE	0	0	1	0	0	0	1
SSE	0	1	0	0	0	0	1
S	0	0	2	0	0	0	2
SSW	0	0	0	5	0	0	5
SW	0	1	5	3	0	0	9
WSW	0	0	4	1	0	0	5
W	0	0	9	9	0	0	18
WNW	0	3	11	0	0	0	14
NW	0	0	1	0	0	0	1
NNW	0	0	3	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	0	34	98	23	0	0	155

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: January - March 2011
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	3	3	0	0	0	6
NNE	0	4	6	0	0	0	10
NE	0	3	2	0	0	0	5
ENE	0	1	1	0	0	0	2
E	0	0	0	0	0	0	0
ESE	0	0	1	0	0	0	1
SE	0	0	1	0	0	0	1
SSE	0	2	5	0	0	0	7
S	0	0	1	0	0	0	1
SSW	0	0	2	0	0	0	2
SW	0	1	4	1	0	0	6
WSW	0	4	4	2	1	0	11
W	0	1	4	2	0	0	7
WNW	0	2	7	0	0	0	9
NW	0	0	3	2	0	0	5
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	21	44	7	1	0	73

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: January - March 2011
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	8	0	0	0	8
NNE	0	5	9	0	0	0	14
NE	0	5	2	1	5	0	13
ENE	0	4	1	3	4	0	12
E	0	1	1	1	0	0	3
ESE	0	0	1	0	0	0	1
SE	0	3	2	0	0	0	5
SSE	1	2	5	4	0	0	12
S	0	1	3	0	0	0	4
SSW	0	1	1	1	0	0	3
SW	0	4	8	4	0	0	16
WSW	0	5	7	4	0	0	16
W	0	8	5	1	0	0	14
WNW	0	3	12	0	0	0	15
NW	0	1	8	4	0	0	13
NNW	0	1	4	0	0	0	5
Variable	0	0	0	0	0	0	0
Total	1	44	77	23	9	0	154

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: January - March 2011
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	23	32	27	9	0	93
NNE	7	24	42	19	4	4	100
NE	4	21	27	15	7	8	82
ENE	2	9	21	25	25	1	83
E	3	1	13	21	3	0	41
ESE	2	10	10	5	0	0	27
SE	2	6	10	2	0	0	20
SSE	0	6	21	25	8	0	60
S	3	13	25	3	0	0	44
SSW	4	25	18	10	0	0	57
SW	3	35	39	32	0	0	109
WSW	4	38	34	21	0	0	97
W	5	37	34	26	0	0	102
WNW	4	50	53	2	0	0	109
NW	2	51	67	3	0	0	123
NNW	3	22	53	11	1	0	90
Variable	0	0	0	0	0	0	0
Total	50	371	499	247	57	13	1237

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 23
Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: January - March 2011
Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	12	0	0	0	0	15
NNE	7	17	3	0	0	0	27
NE	1	7	0	1	0	0	9
ENE	3	1	2	0	0	0	6
E	1	2	1	0	0	0	4
ESE	2	2	1	0	0	0	5
SE	1	5	7	0	0	0	13
SSE	2	2	5	0	0	0	9
S	4	8	11	0	0	0	23
SSW	4	15	9	0	0	0	28
SW	8	14	7	3	0	0	32
WSW	7	26	18	6	0	0	57
W	7	26	18	1	0	0	52
WNW	8	39	23	0	0	0	70
NW	9	29	1	0	0	0	39
NNW	9	1	0	0	0	0	10
Variable	0	0	0	0	0	0	0
Total	76	206	106	11	0	0	399

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: January - March 2011
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	1	0	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	2	0	0	0	0	0	2
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	2	5	0	0	0	7
S	0	4	2	0	0	0	6
SSW	0	2	1	0	0	0	3
SW	5	1	0	0	0	0	6
WSW	6	5	0	0	0	0	11
W	7	4	0	0	0	0	11
WNW	6	8	0	0	0	0	14
NW	4	8	0	0	0	0	12
NNW	2	4	0	0	0	0	6
Variable	0	0	0	0	0	0	0
Total	33	39	8	0	0	0	80

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: January - March 2011
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
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	2	1	0	0	0	5
S	1	7	1	0	0	0	9
SSW	1	0	0	0	0	0	1
SW	1	0	0	0	0	0	1
WSW	2	0	0	0	0	0	2
W	4	1	0	0	0	0	5
WNW	3	2	0	0	0	0	5
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	14	12	2	0	0	0	28

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: January - March 2011
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	2	0	0	4
NNE	0	0	20	9	0	0	29
NE	0	0	12	9	2	0	23
ENE	0	2	8	2	0	0	12
E	0	3	17	3	0	0	23
ESE	0	0	6	0	0	0	6
SE	0	0	0	0	1	0	1
SSE	0	0	1	0	0	0	1
S	0	0	2	0	0	0	2
SSW	0	0	0	1	3	0	4
SW	0	1	1	4	4	0	10
WSW	0	0	0	2	2	0	4
W	0	0	3	4	2	7	16
WNW	0	0	8	6	0	0	14
NW	0	0	1	3	0	0	4
NNW	0	0	2	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	0	6	83	45	14	7	155

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: January - March 2011
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	1	1	0	0	3
NNE	0	2	3	5	0	0	10
NE	0	3	2	2	0	0	7
ENE	0	1	1	1	0	0	3
E	0	0	1	0	0	0	1
ESE	0	0	1	0	0	0	1
SE	0	0	0	0	0	0	0
SSE	0	1	3	1	0	0	5
S	0	0	4	0	0	0	4
SSW	0	0	2	0	0	0	2
SW	0	0	3	1	1	0	5
WSW	0	1	2	4	1	2	10
W	0	0	3	3	0	2	8
WNW	0	0	2	7	0	0	9
NW	0	0	1	1	3	0	5
NNW	0	0	0	1	0	0	1
Variable	0	0	0	0	0	0	0
Total	0	9	29	27	5	4	74

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: January - March 2011
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	5	2	0	0	7
NNE	0	0	8	3	0	0	11
NE	0	1	5	1	0	5	12
ENE	0	4	4	0	3	3	14
E	1	2	3	0	1	2	9
ESE	0	0	2	0	0	0	2
SE	0	0	2	1	2	0	5
SSE	0	1	2	3	1	0	7
S	0	0	6	0	1	0	7
SSW	0	0	1	2	0	0	3
SW	0	0	1	2	3	0	6
WSW	0	2	9	8	1	4	24
W	0	2	3	4	2	1	12
WNW	0	3	7	5	0	0	15
NW	0	0	3	7	4	0	14
NNW	0	1	2	4	1	0	8
Variable	0	0	0	0	0	0	0
Total	1	16	63	42	19	15	156

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

Zion Nuclear Station

Period of Record: January - March 2011
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	8	11	14	15	20	68
NNE	1	14	22	32	11	15	95
NE	0	7	21	26	8	11	73
ENE	0	8	17	11	31	29	96
E	0	5	10	19	17	11	62
ESE	1	7	6	8	7	2	31
SE	1	2	9	10	12	1	35
SSE	1	5	3	13	13	8	43
S	0	2	13	24	11	3	53
SSW	0	8	23	6	10	1	48
SW	0	6	34	20	26	5	91
WSW	0	13	34	27	23	4	101
W	1	12	17	32	38	12	112
WNW	0	9	30	34	9	3	85
NW	0	8	33	64	17	0	122
NNW	0	8	20	54	9	5	96
Variable	0	0	0	0	0	0	0
Total	5	122	303	394	257	130	1211

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 49
Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: January - March 2011
Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	7	2	0	0	0	10
NNE	1	8	8	4	1	0	22
NE	0	6	7	3	0	0	16
ENE	0	4	8	2	1	1	16
E	0	2	5	0	2	0	9
ESE	0	0	6	2	2	0	10
SE	0	2	2	2	6	1	13
SSE	0	2	4	3	2	0	11
S	0	1	1	7	2	0	11
SSW	0	4	7	7	7	0	25
SW	0	4	11	10	0	2	27
WSW	0	2	8	17	13	3	43
W	1	4	13	33	14	2	67
WNW	0	3	13	14	9	0	39
NW	0	2	9	35	6	0	52
NNW	0	2	11	14	1	0	28
Variable	0	0	0	0	0	0	0
Total	3	53	115	153	66	9	399

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: January - March 2011
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	1	9	0	0	0	11
NNE	2	3	5	1	0	0	11
NE	0	3	0	0	0	0	3
ENE	0	2	1	0	0	0	3
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	1	3	0	0	4
S	0	2	2	3	1	0	8
SSW	1	0	2	8	1	0	12
SW	0	1	0	0	0	0	1
WSW	1	0	1	2	0	0	4
W	0	2	2	2	0	0	6
WNW	0	2	2	1	0	0	5
NW	1	1	0	2	0	0	4
NNW	0	2	1	4	1	0	8
Variable	0	0	0	0	0	0	0
Total	6	19	26	26	3	0	80

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: January - March 2011
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	1	0	0	0	0	2
NNE	1	1	0	0	0	0	2
NE	2	0	0	0	0	0	2
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	0	0	0	0	0	0
SSE	0	0	1	1	1	0	3
S	0	0	2	2	1	0	5
SSW	0	2	2	3	1	0	8
SW	0	2	0	0	0	0	2
WSW	1	0	1	0	0	0	2
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
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	6	6	6	6	3	0	27

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 2011
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	12	28	3	0	45
NNE	0	9	26	0	1	0	36
NE	0	13	3	0	0	0	16
ENE	0	3	7	0	0	0	10
E	0	7	0	2	0	0	9
ESE	0	2	0	0	0	0	2
SE	0	1	0	0	0	0	1
SSE	0	1	2	1	0	0	4
S	0	0	0	0	0	0	0
SSW	0	0	2	6	0	0	8
SW	0	0	8	9	0	0	17
WSW	0	0	8	17	0	0	25
W	0	0	25	17	0	0	42
WNW	0	3	23	2	0	0	28
NW	0	0	7	0	0	0	7
NNW	0	1	0	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	0	42	123	82	4	0	251

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	10	9	0	0	21
NNE	0	7	12	0	0	0	19
NE	1	2	1	0	0	0	4
ENE	0	2	0	1	0	0	3
E	0	1	0	0	0	0	1
ESE	1	2	0	0	0	0	3
SE	0	2	0	0	0	0	2
SSE	0	1	0	0	0	0	1
S	0	0	0	0	0	0	0
SSW	0	0	0	5	0	0	5
SW	0	0	2	3	0	0	5
WSW	0	0	6	2	0	0	8
W	0	0	4	2	0	0	6
WNW	0	0	6	0	0	0	6
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	2	19	41	22	0	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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	11	11	2	0	28
NNE	1	10	15	1	0	0	27
NE	0	3	1	0	0	0	4
ENE	0	3	1	1	0	0	5
E	0	5	0	0	0	0	5
ESE	0	2	0	0	0	0	2
SE	0	2	0	0	0	0	2
SSE	0	2	4	0	0	0	6
S	0	0	0	0	0	0	0
SSW	0	0	5	3	1	0	9
SW	0	0	3	3	0	0	6
WSW	0	1	5	1	0	0	7
W	0	1	10	1	0	0	12
WNW	0	1	7	0	0	0	8
NW	0	1	1	0	0	0	2
NNW	0	1	0	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	1	36	63	21	3	0	124

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	29	100	52	54	2	239
NNE	3	55	28	13	0	0	99
NE	7	18	9	4	6	0	44
ENE	3	19	9	12	6	0	49
E	5	12	3	8	1	0	29
ESE	2	11	1	7	0	0	21
SE	2	18	6	5	1	0	32
SSE	0	19	27	5	1	0	52
S	1	6	4	0	0	0	11
SSW	2	2	15	9	1	0	29
SW	2	9	32	9	0	0	52
WSW	2	11	21	2	1	0	37
W	0	13	26	21	0	0	60
WNW	2	22	32	2	0	0	58
NW	4	12	7	2	0	0	25
NNW	1	14	5	2	0	0	22
Variable	0	0	0	0	0	0	0
Total	38	270	325	153	71	2	859

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	18	48	18	0	0	0	84
NNE	9	32	9	0	0	0	50
NE	13	11	3	0	0	0	27
ENE	6	7	6	3	1	0	23
E	7	11	3	1	0	0	22
ESE	7	7	3	0	0	0	17
SE	5	20	9	0	0	0	34
SSE	4	26	28	2	0	0	60
S	7	32	15	3	0	0	57
SSW	3	9	6	1	0	0	19
SW	5	14	7	0	0	0	26
WSW	3	18	4	0	0	0	25
W	4	26	5	0	0	0	35
WNW	7	8	0	0	0	0	15
NW	7	2	0	0	0	0	9
NNW	8	15	0	0	0	0	23
Variable	0	0	0	0	0	0	0
Total	113	286	116	10	1	0	526

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	6	5	0	0	0	0	11
NNE	8	6	1	0	0	0	15
NE	6	4	1	0	0	0	11
ENE	1	2	0	0	0	0	3
E	5	5	0	0	0	0	10
ESE	1	6	3	1	0	0	11
SE	2	8	4	0	0	0	14
SSE	3	6	19	3	0	0	31
S	5	21	5	2	0	0	33
SSW	5	2	1	0	0	0	8
SW	10	1	1	0	0	0	12
WSW	3	1	0	0	0	0	4
W	5	4	0	0	0	0	9
WNW	4	3	0	0	0	0	7
NW	3	2	0	0	0	0	5
NNW	4	0	0	0	0	0	4
Variable	0	0	0	0	0	0	0
Total	71	76	35	6	0	0	188

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	1	0	0	0	0	3
NNE	0	2	0	0	0	0	2
NE	1	0	2	0	0	0	3
ENE	3	1	1	1	0	0	6
E	2	2	4	0	0	0	8
ESE	1	3	2	1	0	0	7
SE	1	1	1	0	0	0	3
SSE	3	7	12	1	0	0	23
S	4	19	4	0	0	0	27
SSW	6	3	0	0	0	0	9
SW	1	1	0	0	0	0	2
WSW	11	1	0	0	0	0	12
W	10	5	0	0	0	0	15
WNW	8	4	0	0	0	0	12
NW	2	0	0	0	0	0	2
NNW	2	0	0	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	57	50	26	3	0	0	136

Hours of calm in this stability class: 5
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	1	1	6	4	13
NNE	0	0	19	19	13	7	58
NE	0	3	11	3	0	0	17
ENE	0	6	9	4	0	0	19
E	0	4	1	1	1	0	7
ESE	0	1	2	0	0	0	3
SE	0	0	1	1	0	0	2
SSE	0	0	1	0	2	0	3
S	0	0	0	0	1	0	1
SSW	0	0	0	0	5	0	5
SW	0	0	0	6	7	0	13
WSW	0	0	0	5	11	6	22
W	0	0	1	17	12	8	38
WNW	0	0	3	25	3	2	33
NW	0	0	2	13	1	0	16
NNW	0	0	1	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	0	15	52	95	62	27	251

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	1	5	5	3	14
NNE	0	2	9	10	1	0	22
NE	0	4	2	1	1	0	8
ENE	0	1	0	0	1	0	2
E	0	3	0	0	0	0	3
ESE	1	0	0	1	0	0	2
SE	0	0	0	0	0	0	0
SSE	0	1	2	0	0	0	3
S	0	0	0	0	0	0	0
SSW	0	0	0	1	3	0	4
SW	0	0	0	1	3	0	4
WSW	0	0	0	2	4	0	6
W	0	0	1	3	4	1	9
WNW	0	0	0	4	0	0	4
NW	0	0	0	3	0	0	3
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	1	11	15	31	22	4	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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	5	4	4	5	19
NNE	0	0	10	13	1	3	27
NE	0	1	7	2	0	0	10
ENE	0	1	3	1	0	1	6
E	0	1	3	0	0	0	4
ESE	0	3	3	1	0	0	7
SE	0	0	1	0	0	0	1
SSE	0	0	4	1	1	0	6
S	0	0	0	0	0	0	0
SSW	0	0	0	3	2	0	5
SW	0	0	1	2	6	1	10
WSW	0	0	1	4	0	0	5
W	0	0	0	7	4	0	11
WNW	0	0	1	8	0	0	9
NW	0	1	0	3	0	0	4
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	0	8	39	49	18	10	124

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	19	41	33	77	171
NNE	1	9	46	55	14	19	144
NE	2	13	13	16	3	3	50
ENE	0	11	12	12	10	15	60
E	0	12	3	2	5	1	23
ESE	1	7	10	3	11	6	38
SE	0	2	8	11	10	6	37
SSE	1	6	14	12	8	0	41
S	1	2	6	5	6	0	20
SSW	0	1	2	4	9	1	17
SW	1	1	7	29	18	2	58
WSW	1	0	1	13	6	3	24
W	0	0	6	25	24	4	59
WNW	0	0	17	38	9	3	67
NW	0	2	9	10	6	0	27
NNW	0	8	8	6	1	0	23
Variable	0	0	0	0	0	0	0
Total	8	75	181	282	173	140	859

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	5	13	15	0	0	35
NNE	1	5	24	27	0	0	57
NE	1	13	21	9	2	0	46
ENE	1	6	8	9	3	1	28
E	1	8	8	5	4	4	30
ESE	1	10	10	4	4	2	31
SE	2	9	17	11	8	6	53
SSE	1	7	17	20	14	2	61
S	0	2	9	20	9	2	42
SSW	0	4	3	13	4	1	25
SW	0	0	5	13	2	0	20
WSW	0	0	4	13	2	0	19
W	0	0	4	24	0	0	28
WNW	0	2	6	18	1	0	27
NW	0	1	8	5	0	0	14
NNW	0	1	6	2	0	0	9
Variable	1	0	0	0	0	0	1
Total	11	73	163	208	53	18	526

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	3	0	0	0	5
NNE	0	8	6	0	0	0	14
NE	1	2	3	1	1	0	8
ENE	0	3	2	1	1	0	7
E	0	3	3	1	2	0	9
ESE	0	5	4	3	4	2	18
SE	0	3	9	0	5	1	18
SSE	0	4	8	8	8	7	35
S	0	5	6	14	6	2	33
SSW	0	1	4	8	0	0	13
SW	0	2	2	5	1	0	10
WSW	0	0	0	0	0	0	0
W	0	0	1	1	0	0	2
WNW	0	1	1	5	0	0	7
NW	0	2	1	1	0	0	4
NNW	0	2	3	2	0	0	7
Variable	0	0	0	0	0	0	0
Total	1	43	56	50	28	12	190

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: 9

Zion Nuclear Station

Period of Record: April - June 2011
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	1	1	0	0	0	4
NNE	0	2	2	0	0	0	4
NE	1	0	1	0	2	1	5
ENE	1	0	0	0	0	0	1
E	0	0	1	0	0	3	4
ESE	0	2	1	0	1	6	10
SE	0	2	3	1	1	1	8
SSE	0	3	10	9	2	1	25
S	0	2	10	8	7	2	29
SSW	0	2	2	12	3	0	19
SW	0	2	5	4	0	0	11
WSW	1	3	2	0	0	0	6
W	0	0	2	0	0	0	2
WNW	0	0	1	0	0	0	1
NW	1	1	0	1	0	0	3
NNW	1	3	2	3	0	0	9
Variable	0	0	0	0	0	0	0
Total	7	23	43	38	16	14	141

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: 9

Zion Nuclear Station

Period of Record: July - September 2011
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	3	24	18	0	0	45
NNE	1	27	40	4	0	0	72
NE	0	33	13	0	0	0	46
ENE	1	27	1	0	0	0	29
E	0	31	1	0	0	0	32
ESE	0	28	7	0	0	0	35
SE	0	20	2	0	0	0	22
SSE	0	7	14	2	0	0	23
S	0	0	4	2	0	0	6
SSW	1	2	4	0	0	0	7
SW	1	8	8	2	0	0	19
WSW	0	16	24	2	0	0	42
W	0	9	10	1	0	0	20
WNW	0	4	9	0	0	0	13
NW	0	7	9	0	0	0	16
NNW	0	4	2	1	0	0	7
Variable	0	0	0	0	0	0	0
Total	4	226	172	32	0	0	434

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: July - September 2011
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	4	3	4	0	0	12
NNE	0	4	2	0	0	0	6
NE	0	2	4	0	0	0	6
ENE	1	4	0	0	0	0	5
E	0	1	1	0	0	0	2
ESE	0	1	0	0	0	0	1
SE	0	2	0	0	0	0	2
SSE	0	5	6	3	0	0	14
S	0	1	2	0	1	0	4
SSW	0	1	0	1	0	0	2
SW	0	0	2	1	0	0	3
WSW	0	2	7	2	0	0	11
W	0	2	4	0	0	0	6
WNW	0	1	1	0	0	0	2
NW	1	4	2	0	0	0	7
NNW	0	1	3	0	0	0	4
Variable	0	0	0	0	0	0	0
Total	3	35	37	11	1	0	87

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: July - September 2011
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	6	4	0	0	14
NNE	1	8	1	0	0	0	10
NE	2	6	1	0	0	0	9
ENE	0	4	0	0	0	0	4
E	0	1	1	0	0	0	2
ESE	0	5	0	0	0	0	5
SE	0	4	2	0	0	0	6
SSE	0	9	9	5	0	0	23
S	0	3	2	0	0	0	5
SSW	0	4	1	1	0	0	6
SW	0	3	2	0	0	0	5
WSW	0	4	5	1	0	0	10
W	1	2	0	0	0	0	3
WNW	0	4	2	0	0	0	6
NW	1	6	2	0	0	0	9
NNW	1	2	6	1	0	0	10
Variable	0	0	0	0	0	0	0
Total	6	69	40	12	0	0	127

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: July - September 2011
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	6	15	18	7	0	0	46
NNE	3	22	10	1	0	0	36
NE	3	13	17	0	0	0	33
ENE	9	6	7	0	0	0	22
E	0	9	13	5	2	0	29
ESE	6	13	6	2	0	0	27
SE	2	29	16	5	0	0	52
SSE	6	24	34	22	1	0	87
S	1	15	4	2	0	0	22
SSW	3	15	9	3	0	0	30
SW	3	20	25	3	0	0	51
WSW	1	20	21	0	0	0	42
W	1	21	8	4	0	0	34
WNW	3	9	4	2	0	0	18
NW	3	17	3	5	0	0	28
NNW	3	21	23	6	0	0	53
Variable	0	0	0	0	0	0	0
Total	53	269	218	67	3	0	610

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: July - September 2011
Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	9	17	5	0	0	0	31
NNE	7	17	13	0	0	0	37
NE	4	8	1	0	0	0	13
ENE	1	3	0	0	0	0	4
E	5	4	1	0	0	0	10
ESE	6	11	1	0	0	0	18
SE	7	11	4	1	0	0	23
SSE	7	10	13	2	0	0	32
S	15	25	5	1	0	0	46
SSW	22	26	7	0	0	0	55
SW	8	21	9	0	0	0	38
WSW	3	27	4	0	0	0	34
W	9	29	0	0	0	0	38
WNW	6	30	2	0	0	0	38
NW	16	27	3	0	0	0	46
NNW	9	31	3	0	0	0	43
Variable	0	0	0	0	0	0	0
Total	134	297	71	4	0	0	506

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: July - September 2011
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	4	1	0	0	0	0	5
NNE	1	1	0	0	0	0	2
NE	0	2	0	0	0	0	2
ENE	2	1	0	0	0	0	3
E	2	0	0	0	0	0	2
ESE	2	0	0	0	0	0	2
SE	0	0	2	0	0	0	2
SSE	2	0	0	0	0	0	2
S	7	10	0	0	0	0	17
SSW	22	16	0	0	0	0	38
SW	22	10	0	0	0	0	32
WSW	20	17	0	0	0	0	37
W	17	9	0	0	0	0	26
WNW	16	17	0	0	0	0	33
NW	16	26	0	0	0	0	42
NNW	12	9	0	0	0	0	21
Variable	0	0	0	0	0	0	0
Total	145	119	2	0	0	0	266

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: July - September 2011
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	0	0	0	0	1
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	1	0	0	0	0	0	1
E	0	0	0	0	0	0	0
ESE	2	0	0	0	0	0	2
SE	0	0	0	0	0	0	0
SSE	1	1	0	0	0	0	2
S	7	4	1	0	0	0	12
SSW	7	2	0	0	0	0	9
SW	12	3	0	0	0	0	15
WSW	37	5	0	0	0	0	42
W	24	21	0	0	0	0	45
WNW	6	29	0	0	0	0	35
NW	2	4	0	0	0	0	6
NNW	2	0	0	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	101	70	1	0	0	0	172

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: July - September 2011
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	2	8	11	1	26
NNE	1	4	26	34	13	1	79
NE	0	10	29	9	0	0	48
ENE	1	17	11	0	0	0	29
E	2	16	8	1	0	0	27
ESE	0	9	8	4	0	0	21
SE	0	10	26	4	0	0	40
SSE	0	4	14	3	1	0	22
S	0	0	2	5	1	0	8
SSW	0	0	2	1	1	0	4
SW	0	0	7	3	0	0	10
WSW	0	2	13	12	6	0	33
W	0	1	21	11	2	0	35
WNW	0	2	3	4	3	0	12
NW	1	0	11	10	0	0	22
NNW	0	1	3	1	1	0	6
Variable	0	0	0	0	0	0	0
Total	5	80	186	110	39	2	422

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 12
Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: July - September 2011
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	2	5	0	9
NNE	0	3	3	2	0	0	8
NE	1	2	0	4	0	0	7
ENE	0	3	0	0	0	0	3
E	0	2	2	0	0	0	4
ESE	0	0	1	0	0	0	1
SE	0	2	1	0	0	0	3
SSE	0	3	3	2	1	0	9
S	0	0	2	3	0	1	6
SSW	0	0	0	0	1	0	1
SW	0	0	1	1	0	0	2
WSW	0	0	1	1	4	0	6
W	0	0	3	4	3	0	10
WNW	0	0	0	3	1	0	4
NW	1	1	4	1	0	0	7
NNW	0	0	2	1	0	0	3
Variable	0	0	0	0	0	0	0
Total	2	16	25	24	15	1	83

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

Zion Nuclear Station

Period of Record: July - September 2011
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	1	2	3	4	0	11
NNE	0	4	5	2	2	0	13
NE	0	4	3	1	0	0	8
ENE	0	0	2	0	0	0	2
E	0	2	0	0	0	0	2
ESE	0	2	3	1	0	0	6
SE	0	2	1	4	0	0	7
SSE	0	2	6	7	2	0	17
S	0	2	5	2	1	0	10
SSW	0	1	1	1	1	0	4
SW	0	1	4	1	0	0	6
WSW	0	1	0	2	3	0	6
W	0	0	5	2	0	0	7
WNW	1	1	1	0	0	0	3
NW	0	0	6	3	1	0	10
NNW	0	1	2	5	2	0	10
Variable	0	0	0	0	0	0	0
Total	2	24	46	34	16	0	122

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 5
Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: July - September 2011
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	6	16	10	5	0	37
NNE	1	3	13	15	12	4	48
NE	1	9	7	12	9	1	39
ENE	1	7	6	5	0	0	19
E	0	4	5	11	3	5	28
ESE	0	8	7	9	3	1	28
SE	0	14	10	20	9	7	60
SSE	1	16	25	14	12	2	70
S	0	7	14	8	2	2	33
SSW	0	1	7	4	2	2	16
SW	1	2	10	20	8	0	41
WSW	0	2	14	18	12	0	46
W	0	3	12	20	3	1	39
WNW	0	3	7	4	1	4	19
NW	0	4	7	10	0	5	26
NNW	0	1	10	18	12	1	42
Variable	0	0	0	0	0	0	0
Total	5	90	170	198	93	35	591

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 19
Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: July - September 2011
Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	28	10	1	0	43
NNE	1	7	11	18	8	0	45
NE	1	12	10	3	0	0	26
ENE	0	8	4	1	0	0	13
E	1	3	4	3	0	0	11
ESE	1	5	7	1	1	0	15
SE	2	5	9	6	0	1	23
SSE	0	12	11	7	6	0	36
S	0	15	17	14	1	1	48
SSW	1	3	10	16	0	0	30
SW	2	4	7	19	6	0	38
WSW	0	0	8	11	3	0	22
W	0	0	11	23	0	0	34
WNW	1	2	4	18	0	0	25
NW	0	0	15	17	5	0	37
NNW	0	4	11	15	1	0	31
Variable	0	0	0	0	0	0	0
Total	10	84	167	182	32	2	477

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 30
Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: July - September 2011
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	3	14	10	0	0	28
NNE	1	8	9	0	0	0	18
NE	1	7	3	0	0	0	11
ENE	0	4	1	0	0	0	5
E	2	7	0	0	0	0	9
ESE	0	2	1	0	0	0	3
SE	0	5	0	0	1	0	6
SSE	0	8	1	0	0	0	9
S	1	9	17	5	0	0	32
SSW	0	4	11	9	0	0	24
SW	0	3	8	7	0	0	18
WSW	0	5	9	11	0	0	25
W	0	1	3	10	2	0	16
WNW	1	0	2	8	0	0	11
NW	0	6	3	7	1	0	17
NNW	1	2	6	11	2	0	22
Variable	0	0	0	0	0	0	0
Total	8	74	88	78	6	0	254

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 12
Hours of missing stability measurements in all stability classes: 4

Zion Nuclear Station

Period of Record: July - September 2011
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	7	13	3	0	0	23
NNE	2	5	3	0	0	0	10
NE	0	0	1	0	0	0	1
ENE	0	0	1	0	0	0	1
E	1	5	0	0	0	0	6
ESE	0	2	0	0	0	0	2
SE	2	1	1	0	0	0	4
SSE	1	3	2	0	0	0	6
S	1	6	4	2	0	0	13
SSW	0	8	11	4	0	0	23
SW	0	7	8	9	0	0	24
WSW	1	2	4	7	0	0	14
W	1	2	6	2	0	0	11
WNW	0	2	1	1	0	0	4
NW	2	5	8	1	0	0	16
NNW	1	8	4	0	0	0	13
Variable	0	0	0	0	0	0	0
Total	12	63	67	29	0	0	171

Hours of calm in this stability class: 1
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: October - December 2011
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	3	0	0	3
NNE	0	2	7	1	0	0	10
NE	0	1	0	0	0	0	1
ENE	0	0	0	0	0	0	0
E	0	1	1	0	0	0	2
ESE	0	7	0	0	0	0	7
SE	0	7	0	0	0	0	7
SSE	0	3	4	0	0	0	7
S	0	0	0	0	0	0	0
SSW	1	3	0	2	0	0	6
SW	0	1	3	0	0	0	4
WSW	0	3	8	1	0	0	12
W	0	2	7	12	0	0	21
WNW	0	3	4	5	0	0	12
NW	0	5	1	0	0	0	6
NNW	0	2	0	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	1	40	35	24	0	0	100

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	1	0	0	0	2
NNE	0	0	1	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	0	2	0	0	0	0	2
E	0	0	1	0	0	0	1
ESE	0	0	0	0	0	0	0
SE	0	5	0	0	0	0	5
SSE	0	2	3	0	0	0	5
S	0	0	1	1	0	0	2
SSW	0	0	2	5	2	0	9
SW	0	0	7	4	0	0	11
WSW	0	1	4	4	0	0	9
W	0	2	6	2	0	0	10
WNW	0	0	5	4	0	0	9
NW	0	1	0	0	0	0	1
NNW	0	0	1	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	0	14	32	20	2	0	68

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	7	1	0	0	8
NNE	0	0	3	1	0	0	4
NE	1	1	0	0	0	0	2
ENE	0	4	0	0	0	0	4
E	0	1	2	0	0	0	3
ESE	0	4	2	0	0	0	6
SE	0	3	0	0	0	0	3
SSE	0	4	4	1	0	0	9
S	0	0	4	1	0	0	5
SSW	0	1	10	10	2	0	23
SW	0	4	19	7	0	0	30
WSW	0	5	3	0	0	0	8
W	0	5	5	3	0	0	13
WNW	0	3	7	2	0	0	12
NW	0	3	0	3	0	0	6
NNW	0	1	1	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	1	39	67	29	2	0	138

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	8	34	28	4	4	79
NNE	0	0	43	40	10	7	100
NE	0	0	23	18	7	0	48
ENE	3	2	12	6	0	0	23
E	1	1	14	12	0	0	28
ESE	2	3	9	1	0	0	15
SE	3	5	1	0	0	0	9
SSE	3	20	12	17	3	0	55
S	1	14	27	16	0	0	58
SSW	3	14	88	54	3	0	162
SW	9	28	54	24	1	0	116
WSW	8	42	22	10	0	0	82
W	6	41	34	19	0	0	100
WNW	6	30	31	11	0	0	78
NW	8	48	32	3	0	0	91
NNW	2	28	47	15	0	0	92
Variable	1	0	0	0	0	0	1
Total	57	284	483	274	28	11	1137

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	2	2	4	0	0	0	8
NNE	2	1	1	0	0	0	4
NE	1	0	1	0	0	0	2
ENE	0	0	1	0	0	0	1
E	2	0	0	0	0	0	2
ESE	2	0	0	0	0	0	2
SE	2	6	0	0	0	0	8
SSE	8	9	8	3	0	0	28
S	12	35	22	0	0	0	69
SSW	5	48	27	1	0	0	81
SW	4	40	11	0	0	0	55
WSW	8	29	23	0	0	0	60
W	8	39	32	0	0	0	79
WNW	6	29	18	0	0	0	53
NW	7	13	1	0	0	0	21
NNW	0	4	1	0	0	0	5
Variable	0	0	0	0	0	0	0
Total	69	255	150	4	0	0	478

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	3	0	0	0	0	0	3
NNE	2	0	0	0	0	0	2
NE	2	0	0	0	0	0	2
ENE	0	0	0	0	0	0	0
E	2	0	0	0	0	0	2
ESE	0	0	3	0	0	0	3
SE	1	0	0	0	0	0	1
SSE	1	1	4	0	0	0	6
S	9	21	1	0	0	0	31
SSW	5	12	0	0	0	0	17
SW	12	11	0	0	0	0	23
WSW	7	13	0	0	0	0	20
W	3	19	0	0	0	0	22
WNW	3	1	0	0	0	0	4
NW	1	6	0	0	0	0	7
NNW	1	2	0	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	52	86	8	0	0	0	146

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	1	0	0	0	0	0	1
NNE	0	0	0	0	0	0	0
NE	1	0	0	0	0	0	1
ENE	0	1	0	0	0	0	1
E	0	0	0	0	0	0	0
ESE	0	1	1	0	0	0	2
SE	1	0	0	0	0	0	1
SSE	0	0	0	0	0	0	0
S	2	7	0	0	0	0	9
SSW	8	4	0	0	0	0	12
SW	10	10	0	0	0	0	20
WSW	7	10	0	0	0	0	17
W	7	7	0	0	0	0	14
WNW	4	24	0	0	0	0	28
NW	0	5	0	0	0	0	5
NNW	0	0	0	0	0	0	0
Variable	0	0	0	0	0	0	0
Total	41	69	1	0	0	0	111

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	0	0	0	0
NNE	0	0	4	3	5	0	12
NE	0	1	1	0	0	0	2
ENE	0	0	0	0	0	0	0
E	0	0	1	0	0	0	1
ESE	0	3	2	1	0	0	6
SE	0	1	6	1	0	0	8
SSE	0	2	4	1	0	0	7
S	0	1	0	1	0	0	2
SSW	0	0	1	0	2	0	3
SW	0	1	3	1	0	0	5
WSW	0	1	7	3	1	0	12
W	0	0	2	6	4	5	17
WNW	0	0	2	2	6	6	16
NW	0	2	5	0	0	0	7
NNW	0	0	2	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	0	12	40	19	18	11	100

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	2	5	0	0	7
NNE	0	0	0	3	1	1	5
NE	0	1	1	0	0	0	2
ENE	0	1	3	0	0	0	4
E	0	1	2	0	0	0	3
ESE	0	2	2	1	0	0	5
SE	0	1	2	3	0	0	6
SSE	0	1	3	1	1	0	6
S	0	1	0	4	1	0	6
SSW	0	0	4	6	4	6	20
SW	0	3	6	15	6	0	30
WSW	0	0	5	4	2	0	11
W	0	1	4	3	1	2	11
WNW	0	3	4	4	1	2	14
NW	0	1	2	0	3	0	6
NNW	0	1	1	0	0	0	2
Variable	0	0	0	0	0	0	0
Total	0	17	41	49	20	11	138

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	0	1	0	0	1
NNE	0	0	1	1	0	0	2
NE	0	1	0	0	0	0	1
ENE	0	1	0	0	0	0	1
E	0	0	0	1	0	0	1
ESE	0	1	0	0	0	0	1
SE	0	1	3	0	0	0	4
SSE	0	2	1	2	0	0	5
S	0	0	0	1	1	0	2
SSW	0	0	0	3	0	3	6
SW	0	0	1	10	1	0	12
WSW	0	1	3	1	3	0	8
W	0	0	2	6	3	1	12
WNW	0	0	5	1	3	0	9
NW	0	0	1	0	1	0	2
NNW	0	0	1	0	0	0	1
Variable	0	0	0	0	0	0	0
Total	0	7	18	27	12	4	68

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	2	10	26	29	18	85
NNE	0	0	1	25	38	40	104
NE	1	0	1	17	15	16	50
ENE	0	1	6	10	5	0	22
E	0	3	5	10	11	0	29
ESE	0	4	0	8	1	0	13
SE	0	4	5	3	3	0	15
SSE	0	1	12	9	11	6	39
S	2	7	9	20	13	11	62
SSW	1	4	8	58	60	20	151
SW	1	10	25	49	35	1	121
WSW	0	16	28	14	16	1	75
W	2	10	29	29	22	7	99
WNW	1	8	15	31	15	8	78
NW	1	7	35	25	12	1	81
NNW	1	2	44	41	15	9	112
Variable	1	0	0	0	0	0	1
Total	11	79	233	375	301	138	1137

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Slightly Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	1	4	3	0	0	8
NNE	1	0	1	3	0	0	5
NE	0	2	0	0	1	0	3
ENE	0	0	1	1	0	0	2
E	0	2	0	0	0	0	2
ESE	2	0	0	0	1	0	3
SE	0	2	9	3	1	0	15
SSE	1	3	8	9	2	1	24
S	1	3	14	17	11	1	47
SSW	1	5	23	30	16	0	75
SW	1	4	26	34	3	0	68
WSW	1	3	12	22	9	0	47
W	0	2	12	53	13	0	80
WNW	0	4	12	19	17	0	52
NW	0	7	12	18	2	0	39
NNW	0	1	4	3	0	0	8
Variable	0	0	0	0	0	0	0
Total	8	39	138	215	76	2	478

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	0	3	5	0	0	8
NNE	0	0	1	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	1	3	1	0	0	5
ESE	1	1	2	0	2	1	7
SE	1	0	3	0	0	0	4
SSE	0	1	8	10	1	0	20
S	0	0	11	11	5	0	27
SSW	1	1	6	8	0	0	16
SW	0	3	7	10	0	0	20
WSW	0	2	0	7	1	0	10
W	0	1	0	11	0	0	12
WNW	0	1	3	8	1	0	13
NW	0	0	1	1	0	0	2
NNW	0	3	0	0	0	0	3
Variable	0	0	0	0	0	0	0
Total	3	14	48	72	10	1	148

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: 27

Zion Nuclear Station

Period of Record: October - December 2011
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Direction	Wind Speed (in mph) 1-3	4-7	8-12	13-18	19-24	> 24	Total
N	0	4	6	6	0	0	16
NNE	0	6	0	0	0	0	6
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	1	0	0	1	0	0	2
ESE	0	0	0	1	2	0	3
SE	0	1	3	0	0	0	4
SSE	0	0	2	2	0	0	4
S	0	1	5	5	4	0	15
SSW	0	1	0	4	1	0	6
SW	0	0	0	13	1	0	14
WSW	0	2	2	3	3	0	10
W	0	0	1	6	2	0	9
WNW	0	2	1	0	0	0	3
NW	0	1	2	1	0	0	4
NNW	0	3	4	5	4	0	16
Variable	0	0	0	0	0	0	0
Total	1	21	26	47	17	0	112

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: 27

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 2011

Prepared By

Teledyne Brown Engineering
Environmental Services

ZionSolutions LLC
An EnergySolutions Company

Zion Nuclear Power Station
Zion, IL 60099

May 2012

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Appendices

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 sixth 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 2011. During that time period, 105 analyses were performed on 36 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 Zion*Solutions* (Exelon was responsible for the program up to 8/31/2010; Zion*Solutions* 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.

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 2011.

Tritium was not detected in any of the groundwater or surface water samples analyzed in 2011. In the case of tritium, Zion*Solutions* specified that it's 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 the second quarter sampling in 2011. Gross Alpha (dissolved) was detected in one of nine groundwater locations at a concentration of 3.3 pCi/l. Gross Alpha (suspended) was not detected in any of the groundwater locations. Gross Beta (dissolved) was

detected at all nine groundwater locations. The concentrations ranged from 3.1 to 12.2 pCi/L. Gross Beta (suspended) was detected in one of nine groundwater locations at a concentration of 2.9 pCi/L.

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 2011.

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 2011.

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.

3. Concentrations of tritium in groundwater and surface water.

4. Concentration of gross alpha and gross beta 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. Zion*Solutions* 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. Zion*Solutions* reports the TPU by following the result with plus or minus ± 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 2011 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 not detected in any of the groundwater or 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 2011.

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 the second quarter sampling in 2011. Gross Alpha (dissolved) was detected in one of nine groundwater locations at a concentration of 3.3 pCi/l. Gross Alpha (suspended) was not detected in any of the groundwater locations. Gross Beta (dissolved) was detected at all nine groundwater locations. The concentrations ranged from 3.1 to 12.2 pCi/L. Gross Beta (suspended) was detected in one of nine groundwater locations at a concentration of 2.9 pCi/L Although Gross Alpha and Gross Beta were detected, this data is at or near background levels and consistent with environmental data (Table B–I.1, Appendix B).

Gamma Emitters

Naturally occurring Potassium-40 was detected in one of 22 groundwater samples at a concentration of 59 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).

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

There were no leaks, spills or releases.

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, 2011.

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-1	Surface Water	Lake Michigan	On-Site

Figure A-1

Radiological Ground Water Protection Program
Groundwater and Surface Water Locations of the Zion Station, 2011

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, 2011

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3	SR-90	GR-A (DIS)	GR-A (SUS)	GR-B (DIS)	GR-B (SUS)
MW-ZN-01S	06/14/11	< 192	< 0.6	< 1.4	< 0.5	8.7 ± 1.5	< 2.0
MW-ZN-01S	09/06/11	< 167					
MW-ZN-01S	10/03/11	< 178					
MW-ZN-02S	06/14/11	< 175	< 0.6	< 0.8	< 0.5	12.2 ± 1.4	< 1.9
MW-ZN-02S	09/06/11	< 168					
MW-ZN-02S	10/03/11	< 179					
MW-ZN-03S	06/14/11	< 166	< 0.5	< 0.8	< 0.9	7.3 ± 1.5	< 1.9
MW-ZN-03S	09/06/11	< 171					
MW-ZN-03S	10/03/11	< 181					
MW-ZN-04S	06/14/11	< 164	< 0.6	< 0.7	< 0.4	4.0 ± 1.3	< 2.3
MW-ZN-04S	09/06/11	< 168					
MW-ZN-04S	10/03/11	< 177					
MW-ZN-05S	06/15/11	< 164	< 0.6	< 1.4	< 0.5	3.1 ± 1.3	< 2.1
MW-ZN-05S	09/07/11	< 170					
MW-ZN-05S	10/04/11	< 177					
MW-ZN-06S	06/14/11	< 166					
MW-ZN-06S	09/08/11	< 170					
MW-ZN-06S	10/04/11	< 178					
MW-ZN-07S	06/14/11	< 165					
MW-ZN-07S	09/08/11	< 167					
MW-ZN-07S	10/04/11	< 180					
MW-ZN-08S	06/15/11	< 167	< 0.9	< 0.9	< 0.5	3.1 ± 1.2	< 1.9
MW-ZN-08S	09/07/11	< 168					
MW-ZN-08S	10/03/11	< 179					
MW-ZN-09S	06/14/11	< 166	< 0.6	3.3 ± 1.1	< 1.0	7.4 ± 1.5	2.9 ± 1.4
MW-ZN-09S	09/07/11	< 168					
MW-ZN-09S	10/04/11	< 178					
MW-ZN-10S	06/14/11	< 166	< 0.6	< 0.7	< 0.4	3.7 ± 1.3	< 2.3
MW-ZN-10S	09/07/11	< 200					
MW-ZN-10S	10/04/11	< 185					
MW-ZN-11S	06/15/11	< 166	< 0.6	< 1.5	< 0.5	4.2 ± 1.4	< 2.1
MW-ZN-11S	09/07/11	< 198					
MW-ZN-11S	10/03/11	< 160					

TABLE B-I.2 **CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2011**

RESULTS IN UNITS OF PCI/LITER ± 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	06/14/11	< 34	< 113	< 3	< 3	< 8	< 4	< 7	< 4	< 7	< 3	< 3	< 41	< 14
MW-ZN-01S	10/03/11	< 14	59 ± 31	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 1	< 1	< 22	< 7
MW-ZN-02S	06/14/11	< 25	< 76	< 2	< 3	< 7	< 3	< 4	< 3	< 5	< 2	< 2	< 33	< 10
MW-ZN-02S	10/03/11	< 12	< 8	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 1	< 1	< 17	< 5
MW-ZN-03S	06/14/11	< 30	< 22	< 3	< 3	< 6	< 2	< 6	< 3	< 6	< 3	< 2	< 38	< 8
MW-ZN-03S	10/03/11	< 14	< 10	< 1	< 1	< 3	< 1	< 2	< 2	< 3	< 1	< 1	< 18	< 5
MW-ZN-04S	06/14/11	< 25	< 18	< 2	< 2	< 4	< 2	< 4	< 3	< 5	< 2	< 2	< 32	< 9
MW-ZN-04S	10/03/11	< 15	< 12	< 1	< 2	< 4	< 1	< 3	< 2	< 3	< 1	< 1	< 21	< 6
MW-ZN-05S	06/15/11	< 37	< 29	< 4	< 4	< 8	< 4	< 7	< 4	< 7	< 3	< 3	< 45	< 15
MW-ZN-05S	10/04/11	< 15	< 30	< 1	< 1	< 4	< 1	< 3	< 2	< 3	< 1	< 1	< 20	< 6
MW-ZN-06S	06/14/11	< 32	< 82	< 3	< 4	< 8	< 3	< 6	< 4	< 7	< 3	< 3	< 43	< 13
MW-ZN-06S	10/04/11	< 16	< 34	< 1	< 2	< 4	< 1	< 3	< 2	< 3	< 1	< 2	< 21	< 7
MW-ZN-07S	06/14/11	< 37	< 28	< 3	< 4	< 8	< 3	< 6	< 4	< 7	< 3	< 3	< 52	< 14
MW-ZN-07S	10/04/11	< 17	< 15	< 2	< 2	< 5	< 2	< 3	< 2	< 4	< 2	< 2	< 22	< 7
MW-ZN-08S	06/15/11	< 40	< 120	< 4	< 4	< 10	< 4	< 8	< 5	< 7	< 4	< 4	< 47	< 13
MW-ZN-08S	10/03/11	< 14	< 12	< 1	< 2	< 3	< 1	< 3	< 2	< 3	< 1	< 1	< 19	< 6
MW-ZN-09S	06/14/11	< 34	< 27	< 3	< 4	< 7	< 3	< 7	< 4	< 7	< 3	< 4	< 46	< 12
MW-ZN-09S	10/04/11	< 14	< 11	< 1	< 2	< 4	< 1	< 3	< 2	< 3	< 1	< 1	< 21	< 6
MW-ZN-10S	06/14/11	< 31	< 22	< 2	< 4	< 8	< 3	< 6	< 4	< 7	< 3	< 3	< 45	< 13
MW-ZN-10S	10/04/11	< 17	< 34	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 1	< 2	< 21	< 6
MW-ZN-11S	06/15/11	< 30	< 76	< 3	< 3	< 7	< 3	< 5	< 3	< 5	< 2	< 2	< 39	< 10
MW-ZN-11S	10/03/11	< 13	< 9	< 1	< 1	< 3	< 1	< 2	< 1	< 2	< 1	< 1	< 16	< 5

TABLE B-II.1 CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2011

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3
SW-ZN-01	06/15/11	< 193
SW-ZN-01	09/08/11	< 196
SW-ZN-01	10/03/11	< 184

TABLE B-II.2 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2011**

RESULTS IN UNITS OF PCI/LITER ± 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	06/15/11	< 23	< 19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 2	< 2	< 24	< 6
SW-ZN-01	10/03/11	< 14	< 13	< 1	< 1	< 3	< 1	< 3	< 2	< 3	< 1	< 1	< 20	< 6