May 12, 2014 ZS-2014-0101

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, 50-304 and 72-1037

Subject: Zion Nuclear Power Station, Units 1, 2 and Independent Spent Fuel Storage Installation 2013 Annual Radiological Environmental Operating Report

In accordance with Facility Operating License Nos. DPR-39 and DPR-48, Appendix A, Technical Specification 5.7.2 "Annual Radiological Environmental Operating Report" and Certificate of Compliance No. 1031 of the MAGNASTOR SYSTEM, Appendix A, Technical Specification Section 5.1.3, Zion Station is submitting the 2013 Annual Radiological Environmental Operating Report for Units 1, 2 and Independent Spent Fuel Storage Installation (ISFSI). Technical Specification 5.7.2 requires submittal of an Annual Radiological Environmental Operating Report before May 15 of each year. Technical Specification 5.1.3 requires submittal of an Annual Radiological Environmental Operating Report that may be included in the report for Zion Station Units 1 and 2. The attachment to this letter is the Annual Radiological Environmental Operating Report and includes the ISFSI environmental monitoring program.

There are no new regulatory commitments in this submittal.

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

Respectfully,

Gerard van Noordennen

Gerard van Noordennen
Vice President of Regulatory Affairs
Zion*Solutions*, LLC

Attachment:
2013 Annual Radiological Environmental Operating Report

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

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FSME

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NRC Docket No: 50-295
50-304
72-1037

# ZION NUCLEAR POWER STATION
# UNITS 1 and 2

## Annual Radiological
## Environmental Operating Report

1 January Through 31 December 2013

**Prepared By**

Teledyne Brown Engineering
Environmental Services

ZIONSOLUTIONS LLC
An EnergySolutions Company

Zion Nuclear Power Station
Zion, IL 60099

**May 2014**

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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 2013 through 31 December 2013. During that time period, 559 analyses were performed on 480 samples. In assessing all the data gathered for this report and comparing these results with preoperational data, it was concluded that the operation of ZNPS had no adverse radiological impact on the environment.

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

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

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

Environmental gamma radiation measurements were performed quarterly using thermoluminescent dosimeters.

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## II. Introduction

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

This report covers those analyses performed by Teledyne Brown Engineering (TBE), Mirion Technologies and Environmental Inc. (Midwest Labs) on samples collected during the period 1 January 2013 through 31 December 2013.

### 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 2013. Sample locations and descriptions can be found in Table B–1 and Figures B–1 and B–2, Appendix B. The sampling methods used by Environmental Inc. (Midwest Labs) are listed in Table B-2.

Aquatic Environment

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

Atmospheric Environment

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

Ambient Gamma Radiation

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

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

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

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

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

Control: Z-13

The specific TLD locations were determined by the following criteria:

1. The presence of relatively dense population;

2. Site meteorological data taking into account distance and elevation for each of the sixteen–22 1/2 degree sectors around the site, where estimated annual dose from ZNPS, if any, would be most significant;

3. On hills free from local obstructions and within sight of the vents (where practical);

4. And near the closest dwelling to the vents in the prevailing downwind direction.

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

B. Sample Analysis

This section describes the general analytical methodologies used by TBE and Environmental Inc. (Midwest Labs) to analyze the environmental samples for radioactivity for the ZNPS REMP in 2013. The analytical procedures used by the laboratories are listed in Table B-2.

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

1. Concentrations of beta emitters in public water and air particulates.

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

3. Concentrations of tritium in public water.

4. Ambient gamma radiation levels at various site environs.

C. Data Interpretation

The radiological and direct radiation data collected prior to Zion Nuclear Power Station becoming operational were used as a baseline with which

these operational data were compared. For the purpose of this report, Zion Nuclear Power Station was considered operational at initial criticality. In addition, data was compared to previous years' operational data for consistency and trending. Several factors were important in the interpretation of the data:

1. Lower Limit of Detection and Minimum Detectable Concentration

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

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

2. Net Activity Calculation and Reporting of Results

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

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

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

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

D. Program Exceptions

For 2013 the ZNPS REMP had a sample recovery rate in excess of 99%. Sample anomalies and missed samples are listed in the tables below:

Table D-1 LISTING OF SAMPLE ANOMALIES

| Sample Type | Location Code | Collection Date | Reason |
|---|---|---|---|
| TLD | Z-301-2 | 01/02/13 | 1$^{St}$ quarter TLD misplaced at quarterly exchange; station gave collector spare to place in field. Station located misplaced TLD and changed out spare on 01/03/13. |
| AP | Z-01 | 03/06/13 | Road blocked by snow; collector unable to access sampler. AP collected 03/07/13. |
| AP | Z-03 | 03/06/13 | Road blocked by snow; collector unable to access sampler. AP collected 03/07/13. |
| AP | Z-01 | 04/10/13 | Collector inadvertently placed double filters on 04/03/13, causing low flow rate reading on 50 CFH due to decreased draw. Filter slightly lighter than other locations. |
| AP | Z-13 | 04/10/13 | Low reading of 147.6 hours due to recent startup on 04/04/13 @ 9:40. |
| AP | Z-01 | 04/17/13 | Low flow rate due to $FL_R$ not reset on 04/10/13. |
| PW | Z-14 | 05/15/13 | Water plant shut down on 05/15/13; collector obtained sample on 05/16/13. |
| AP | Z-01 | 10/16/13 | No apparent reason for low reading of 86.7 hours. |
| AP | Z-02 | 10/30/13 | No apparent reason for low reading of 75.7 hours. |
| AP | Z-01 | 12/04/13 | No apparent reason for low reading of 160.7 hours. |

Table D-2 LISTING OF MISSED SAMPLES

After TLD's were collected for Quarter 3, six locations (12 type 17 Environmental TLD's) were inadvertently sent through airmail for expedited readings. The reason the shipment was expedited was to verify that hand held micro-R meters were over-responding to low energy gammas; however, the data was lost after the TLD's travelled through shipping X-ray machines. The remainder of the quarterly TLD reads were shipped properly and an additional set of TLD's including control TLD's were placed and collected monthly to compensate for the anomalous data. This event was reported and managed through Zion station Corrective Action Program listed under CR-2013-001198.
The following TLD locations for Quarter 3 cannot be used as they were exposed to shipping X-rays.

| Designation | Descriptive location |
|---|---|
| Z-13-1,2 | Control TLDs |
| Z-122-1,2 | NW of ISFSI pad |
| Z-123-1,2 | NE of ISFSI pad |
| Z-124-1,2 | SW of ISFSI pad @ property boundary |
| Z-125-1,2 | SE of ISFSI pad @ property boundary |
| Z-01-1,2 | South Air sample location |

Z-122-125 were being used to determine seasonal background dose for the ISFSI pad. No fuel was present on the pad at the time of the anomaly. Sector data from TLD locations: Z-110-1&2, Z-111-1&2, and Z-112-1&2 covering sectors J,K,L,M were shipped normally and these locations effectively cover Zion station fence line direct radiation dose in the sectors affected by the anomalous data.

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

1. Air particulate location Z-13 was added to the REMP in April of 2013.

2. Three groups of TLDs were added to the REMP in 2013:

    1. ISFSI Inner Ring (five locations)
    2. Outer Ring (seven locations)
    3. Control (one location)

IV. Results and Discussion

A. Aquatic Environment

1. Public Water

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

Gross Beta

Samples from all locations were analyzed for concentrations of gross beta (Table C–I.1, Appendix C). Gross beta was detected in 27 of 48 samples. The values ranged from 2.0 pCi/l to 4.0 pCi/l. Concentrations detected were consistent with those detected in previous years (Figures C–1 and C–2, Appendix C).

Tritium

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

Gamma Spectrometry

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

2. Fish

Fish samples comprised of common carp, chinook salmon, lake

trout, longnose sucker, burbot 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 6 E-3 pCi/$m^3$ to 56 E–3 pCi/$m^3$ with a mean of 18 E–3 pCi/$m^3$. The results from the Control location ranged from 6 E-3 pCi/$m^3$ to 42 E–3 pCi/$m^3$ with a mean of 18 E–3 pCi/$m^3$. Comparison of the 2013 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. Sixty 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 16 mR/quarter to 38 mR/quarter.

D. Land Use Survey

A Land Use Census conducted during August 2013 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. It was identified in 2012 while reviewing the results of the land use census that only the nearest resident was being reviewed and no formal review for milk producing animal or garden of greater than 500 $ft^2$ was being performed nor had they been performed since the year 2000. Exelon performed a justification for not performing these reviews in 2000. This does not meet the intent of NUREG-1301 or Chapter 3 of the ODCM. Zion Condition Report CR-2012-001362 was initiated to document this finding. The Annual Land Use Census needs to be performed during the growing season and Zion was unable to perform these reviews in 2012. A corrective action, CR-2012-001362-CA001, is tracking completion of the Land Use Census for 2013 to ensure compliance with the ODCM and meet the intent of NUREG-1301. The scope of work for Environmental Inc. (Midwest Labs) was also changed to include the requirement to perform the review of milk producing animal and garden of greater than 500 $ft^2$ for 2013 and future years in each of the sixteen 22 ½ degree sectors around the site. The results of this survey are summarized below.

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

E. Errata Data

Errata Data for Unmonitored Release/Release Potential 1995 – 2009

CR-2013-000165 Identified a potential unmonitored release path upstream of both Unit 1 and Unit 2 vent stack radiation monitors via backflow into the Off-Gas system piping into the turbine building. There were two identified paths in Unit 2 and one in Unit 1. During additional walk downs there was an additional path in Unit 1. Applicable valves were shut and a clearance order was generated which danger tagged shut the valves in Unit 2 (see CO108065). The two paths in Unit 1 had no associated valves, as a result, the lines were cut and capped removing them as a release path. (See WO 01614942). Plant modifications were reviewed and it was determined that this condition existed prior to Zion*Solutions* becoming the lincensee of Zion Station. The purpose of this erratum is to report the additional dose to a member of the public that was not included in the prior years of 1995 and 2009 due to this unmonitored path.

Engineering determined the calculated maximum flow through this potential release path to be 1.90E+02 cfm at the maximum designed vent flow of 1.50E+05 cfm. A Bounding ratio of 1.27E-03 of the ventilation flow was diverted to this unmonitored path and will be used in calculations, however a conservative percentage of one percent was used for correcting dose impact to the public. After adding the one percent increase calculation correction, Zion *Solutions* is still well within limits.

For a detailed report of changes, please see the Zion*Solutions* Annual Radiological Effluent Release Report for 2013.

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

3. DOE Evaluation Criteria

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

   The MAPEP defines three levels of performance: Acceptable (flag = "A"), Acceptable with Warning (flag = "W"), and Not Acceptable (flag = "N"). Performance is considered acceptable when a mean result for the specified analyte is ± 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 TBE laboratory, 178 out of 185 analyses performed met the specified acceptance criteria. Seven analyses (Sr-89 and Sr-90 in milk, Co-57, Zn-65 and Sr-90 in soil, Cs-134 in air particulate and Sr-90 in vegetation [two low warning in a row]) did not meet the specified acceptance criteria or internal QA requirements for the following reason:

1. Teledyne Brown Engineering's Analytics September 2013 Sr-89 in milk result of 63.9 pCi/L was lower than the known value of 96.0 pCi/L. The failure was a result of analyst error and was specific to the Analytics sample. Client samples for the associated time period were evaluated and no client samples were affected by this failure. NCR 13-15

2. Teledyne Brown Engineering's Analytics September 2013 Sr-90 in milk result of 8.88 pCi/L was lower than the known value of 13.2 pCi/L. The failure was a result of analyst error and was specific to the Analytics sample. Client samples for the associated time period were evaluated and no client samples were affected by this failure. NCR 13-15

3. & 4. Teledyne Brown Engineering's MAPEP September 2013 Co-57 and Zn-65 in soil were evaluated as failing the false positive test. While MAPEP evaluated the results as failures, the gamma software listed the results as non identified nuclides. The two nuclides would never have been reported as detected nuclides to a client. MAPEP does not allow laboratories to put in qualifiers for the submitted data nor "less than" results. MAPEP evaluates results based on the relationship between the activity and the uncertainty. MAPEP spiked the soil sample with an extremely large concentration of Eu-152, which was identified by the gamma software as an interfering nuclide, resulting in forced activity results that were evaluated by MAPEP as detected Co-57 and Zn-65. No client samples were affected by these failures. NCR 13-14

5. Teledyne Brown Engineering's MAPEP September 2013 Sr-90 in soil result of 664 Bq/kg was higher than the known value of 460 Bq/kg, exceeding the upper control limit of 598 Bq/kg. An incorrect Sr-90 result was entered into the MAPEP database. The correct Sr-90 activity of 322 Bq/kg would have been evaluated as acceptable with warning. No client samples were affected by this failure. NCR 13-14

6. Teledyne Brown Engineering's MAPEP September 2013 Cs-134 in air particulate activity of -0.570 Bq/sample was evaluated as a failed false positive test, based on MAPEP's evaluation of the result as a significant negative value at 3 standard deviations. A negative number would never have been reported as a detected nuclide to a

client, therefore no client samples were affected by this failure. NCR 13-14

7. Teledyne Brown Engineering's MAPEP September 2013 Sr-90 in vegetation result was investigated due to two low warnings in a row. It appears the September sample was double spike with carrier, resulting in a low activity. With a recovery of around 50% lower, the Sr-90 result would have fallen within the acceptance range. No client samples were affected by this issue. NCR 13-14

For the EIML laboratory, 89 of 92 analyses met the specified acceptance criteria. Three analyses (AP - Gross Alpha, Soil - Sr-90 and Co-57) did not meet the specified acceptance criteria for the following reasons:

1. Environmental Inc., Midwest Laboratory's MAPEP February 2013 air particulate gross alpha result of 0.14 Bq/total sample was lower than the known value of 1.20 Bq/total sample, exceeding the lower control limit of 0.36 Bq/total sample. The filter was recounted overnight. No significant activity could be detected.
2. Environmental Inc., Midwest Laboratory's MAPEP February 2013 soil Co-57 result of 408.40 Bq/kg was lower than the known value of 628.0 Bq/kg, exceeding the lower control limit of 440.0 Bq/kg. The sample was reanalyzed using additional fuming nitric separations. The reanalysis result of 574.4 fell within the control limits.
3. Environmental Inc., Midwest Laboratory's MAPEP August 2013 soil C-57 result of 699.60 Bq/kg was higher than the known value of 0.00 Bq/kg, exceeding the upper control limit of 5.00 Bq/kg. Interference from Eu-152 resulted in misidentification of Co-57.

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

# APPENDIX A

# RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

## TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE ZION NUCLEAR POWER STATION, 2013

**Name of Facility: ZION** **DOCKET NUMBER: 50-295 & 50-304 2013**
**Location of Facility: ZION, IL** **REPORTING PERIOD: ANNUAL**

| MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT) | TYPES OF ANALYSIS PERFORMED | NUMBER OF ANALYSIS PERFORMED | REQUIRED LOWER LIMIT OF DETECTION (LLD) | INDICATOR LOCATIONS 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 | 2.9<br>(20/36)<br>(2.0/4.0) | 3.3<br>(7/12)<br>(2.3/3.9) | 3.3<br>(7/12)<br>(2.3/3.9) | Z-18 CONTROL<br>LAKE FOREST WATER WORKS<br>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 |

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

## TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE ZION NUCLEAR POWER STATION, 2013

**Name of Facility: ZION** **DOCKET NUMBER: 50-295 & 50-304 2013**
**Location of Facility: ZION, IL** **REPORTING PERIOD: ANNUAL**

| MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT) | TYPES OF ANALYSIS PERFORMED | NUMBER OF ANALYSIS PERFORMED | REQUIRED LOWER LIMIT OF DETECTION (LLD) | INDICATOR LOCATIONS 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) | NB-95 | | 15 | <LLD | <LLD | - | | 0 |
| | 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 | 8 | | | | | | |
| | MN-54 | | 130 | <LLD | NA | - | | 0 |

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

## TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE ZION NUCLEAR POWER STATION, 2013

**Name of Facility: ZION** **DOCKET NUMBER: 50-295 & 50-304 2013**
**Location of Facility: ZION, IL** **REPORTING PERIOD: ANNUAL**

| MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT) | TYPES OF ANALYSIS PERFORMED | NUMBER OF ANALYSIS PERFORMED | REQUIRED LOWER LIMIT OF DETECTION (LLD) | INDICATOR LOCATIONS 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 |
|---|---|---|---|---|---|---|---|---|
| FISH (PCI/KG WET) | CO-58 | | 130 | <LLD | NA | - | | 0 |
| | FE-59 | | 260 | <LLD | NA | - | | 0 |
| | 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 |

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

## TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE ZION NUCLEAR POWER STATION, 2013

**Name of Facility: ZION** **DOCKET NUMBER: 50-295 & 50-304 2013**
**Location of Facility: ZION, IL** **REPORTING PERIOD: ANNUAL**

| MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT) | TYPES OF ANALYSIS PERFORMED | NUMBER OF ANALYSIS PERFORMED | REQUIRED LOWER LIMIT OF DETECTION (LLD) | INDICATOR LOCATIONS 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 |
|---|---|---|---|---|---|---|---|---|
| FISH (PCI/KG WET) | BA-140 | | NA | <LLD | NA | - | | 0 |
| | LA-140 | | NA | <LLD | NA | - | | 0 |
| 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 |

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

## TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE ZION NUCLEAR POWER STATION, 2013

**Name of Facility: ZION** **DOCKET NUMBER: 50-295 & 50-304 2013**
**Location of Facility: ZION, IL** **REPORTING PERIOD: ANNUAL**

| MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT) | TYPES OF ANALYSIS PERFORMED | NUMBER OF ANALYSIS PERFORMED | REQUIRED LOWER LIMIT OF DETECTION (LLD) | INDICATOR LOCATIONS 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) | NB-95 | | NA | <LLD | NA | - | | 0 |
| | ZR-95 | | NA | <LLD | NA | - | | 0 |
| | CS-134 | | 150 | <LLD | NA | - | | 0 |
| | CS-137 | | 180 | <LLD | NA | - | | 0 |
| | BA-140 | | NA | <LLD | NA | - | | 0 |
| | LA-140 | | NA | <LLD | NA | - | | 0 |
| AIR PARTICULATE (E-3 PCI/CU.METER) | GR-B | 195 | 10 | 18 (154/156) (6/56) | 18 (39/39) (6/42) | 19 (50/52) (6/56) | Z-01 INDICATOR ONSITE 1 0.3 MILES S OF SITE | 0 |

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

## TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE ZION NUCLEAR POWER STATION, 2013

**Name of Facility: ZION** **DOCKET NUMBER: 50-295 & 50-304 2013**
**Location of Facility: ZION, IL** **REPORTING PERIOD: ANNUAL**

| MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT) | TYPES OF ANALYSIS PERFORMED | NUMBER OF ANALYSIS PERFORMED | REQUIRED LOWER LIMIT OF DETECTION (LLD) | INDICATOR LOCATIONS 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 |
|---|---|---|---|---|---|---|---|---|
| AIR PARTICULATE (E-3 PCI/CU METER) | GAMMA MN-54 | 15 | NA | <LLD | <LLD | - | | 0 |
| | CO-58 | | NA | <LLD | <LLD | - | | 0 |
| | FE-59 | | NA | <LLD | <LLD | - | | 0 |
| | CO-60 | | NA | <LLD | <LLD | - | | 0 |
| | ZN-65 | | NA | <LLD | <LLD | - | | 0 |
| | NB-95 | | NA | <LLD | <LLD | - | | 0 |
| | ZR-95 | | NA | <LLD | <LLD | - | | 0 |

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

## TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR THE ZION NUCLEAR POWER STATION, 2013

**Name of Facility: ZION** **DOCKET NUMBER: 50-295 & 50-304 2013**
**Location of Facility: ZION, IL** **REPORTING PERIOD: ANNUAL**

| MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT) | TYPES OF ANALYSIS PERFORMED | NUMBER OF ANALYSIS PERFORMED | REQUIRED LOWER LIMIT OF DETECTION (LLD) | INDICATOR LOCATIONS 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 |
|---|---|---|---|---|---|---|---|---|
| AIR PARTICULATE (E-3 PCI/CU.METER) | CS-134 | | 10 | <LLD | <LLD | - | | 0 |
| | CS-137 | | 10 | <LLD | <LLD | - | | 0 |
| | BA-140 | | NA | <LLD | <LLD | - | | 0 |
| | LA-140 | | NA | <LLD | <LLD | - | | 0 |
| DIRECT RADIATION (MILLI-ROENTGEN/QTR.) | TLD-QUARTERLY | 227 | NA | 22 (221/221) (16/38) | 23 (6/6) (19/26) | 28 (4/4) (25/29) | Z-213-2 INDICATOR 5.1 MILES W | 0 |

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

# APPENDIX B

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

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Zion Nuclear Power Station, 2013

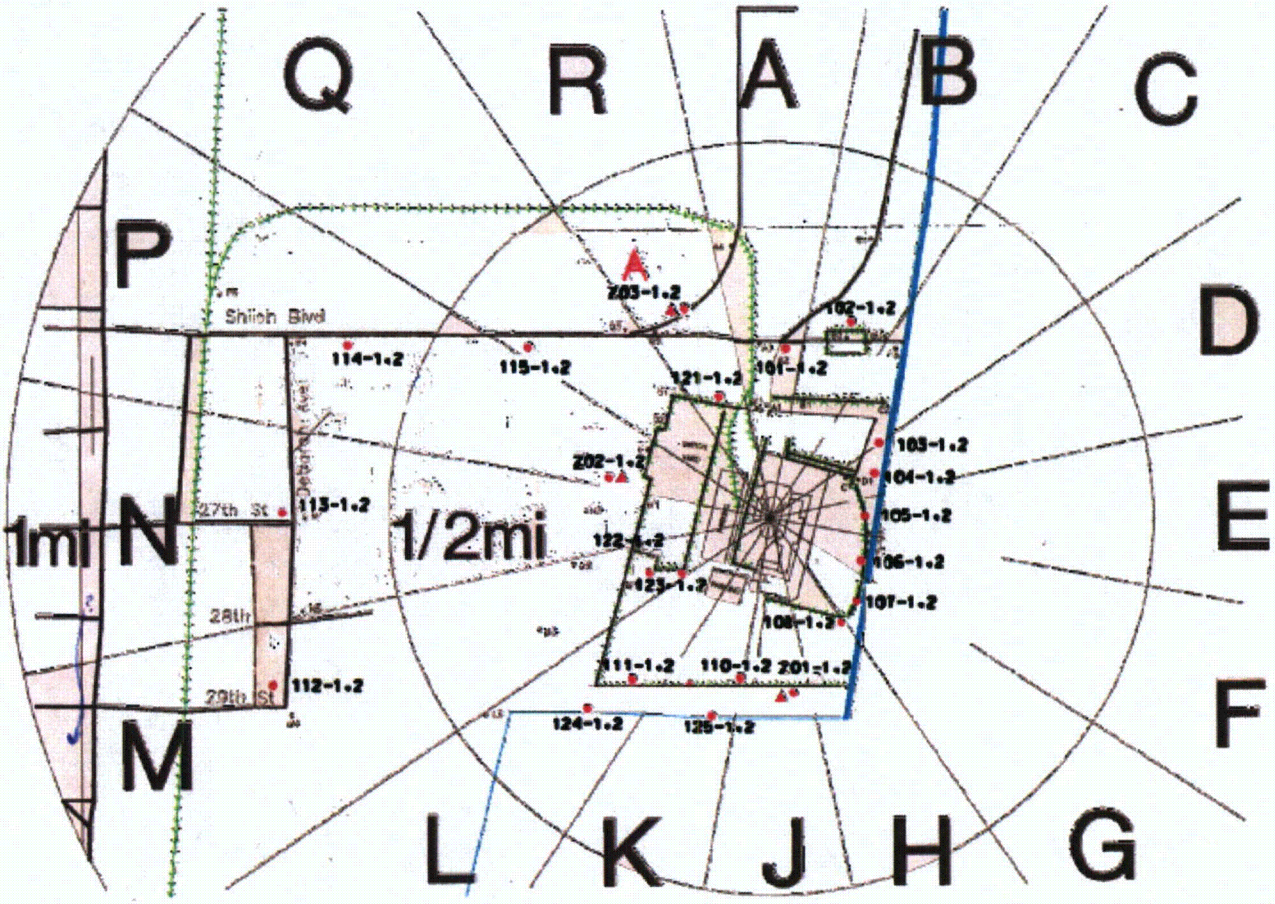
| Location | Location Description | Distance & Direction From Site |
|---|---|---|
| A. Public Water | | |
| Z-14 | Kenosha Water Works (control) | 10.0 miles N |
| Z-15 | Lake County Water Works (indicator) | 1.4 miles NNW |
| Z-16 | Waukegan Water Works (indicator) | 6.1 miles S |
| Z-18 | Lake Forest 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 |
| Z-13 | Offsite Control | 10 miles NW |
| 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 |
| 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 |
| ISFSI Inner Ring | | |
| Z-121-1 and -2 | | 0.2 miles NNW |
| Z-122-1 and -2 | | 0.2 miles W |
| Z-123-1 and -2 | | 0.1 miles WSW |
| Z-124-1 and -2 | | 0.5 miles SW |
| Z-125-1 and -2 | | 0.4 miles SSW |

TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Zion Nuclear Power Station, 2013

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

TABLE B-2: Radiological Environmental Monitoring Program – Summary of Sample Collection and Analytical Methods, Zion Nuclear Power Station, 2013

| 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<br><br>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<br><br>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<br><br>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<br><br>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<br><br>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<br><br>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<br><br>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 |




● TLD Monitoring Location

▲ Air Sampling Location

Figure B-1
Inner Ring TLD and Fixed Air Sampler Locations of the Zion Nuclear Power Station, 2013

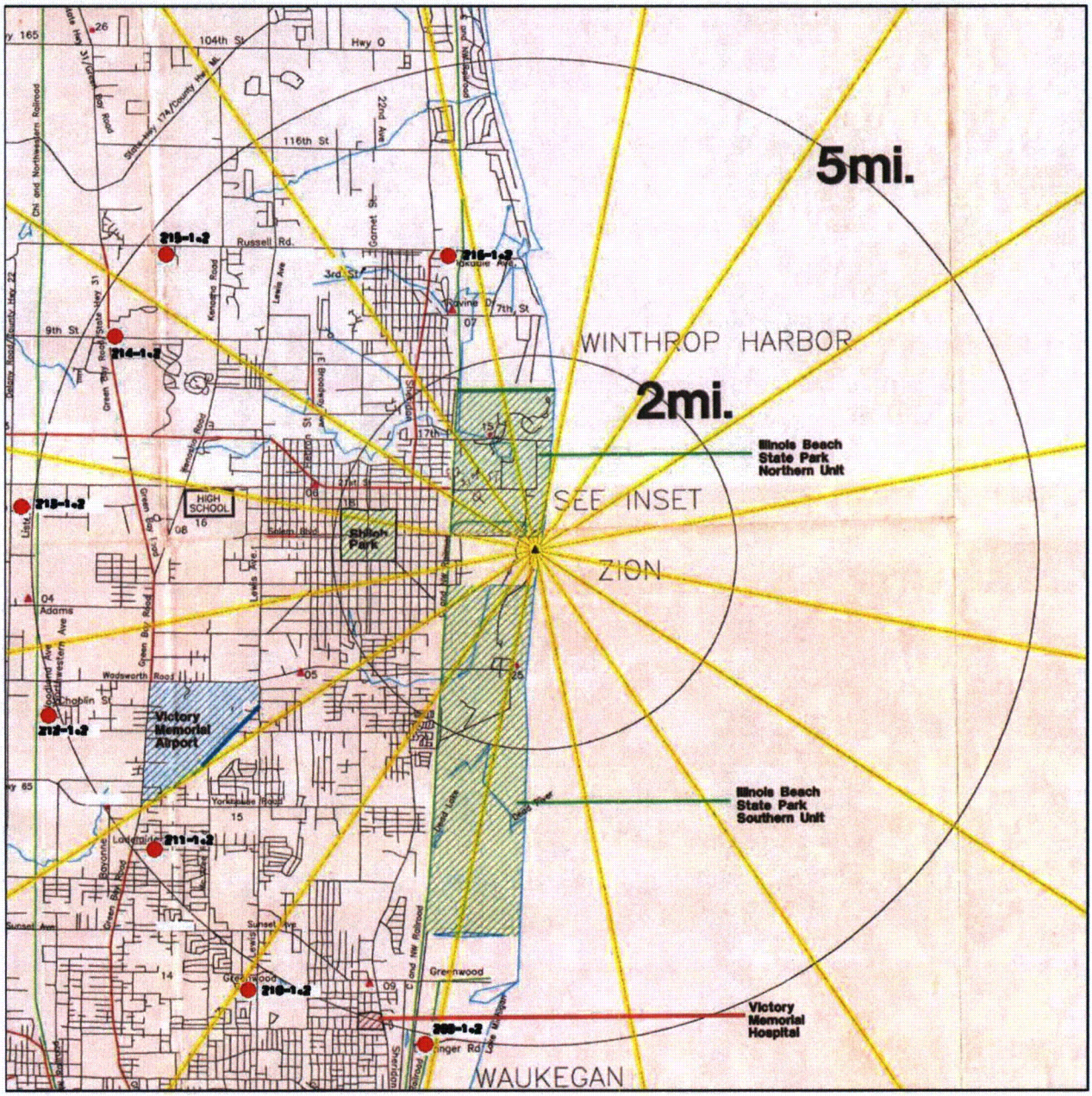



Figure B-2
Outer Ring TLD and Fixed Air Sampler Locations of the Zion Nuclear Power Station, 2013

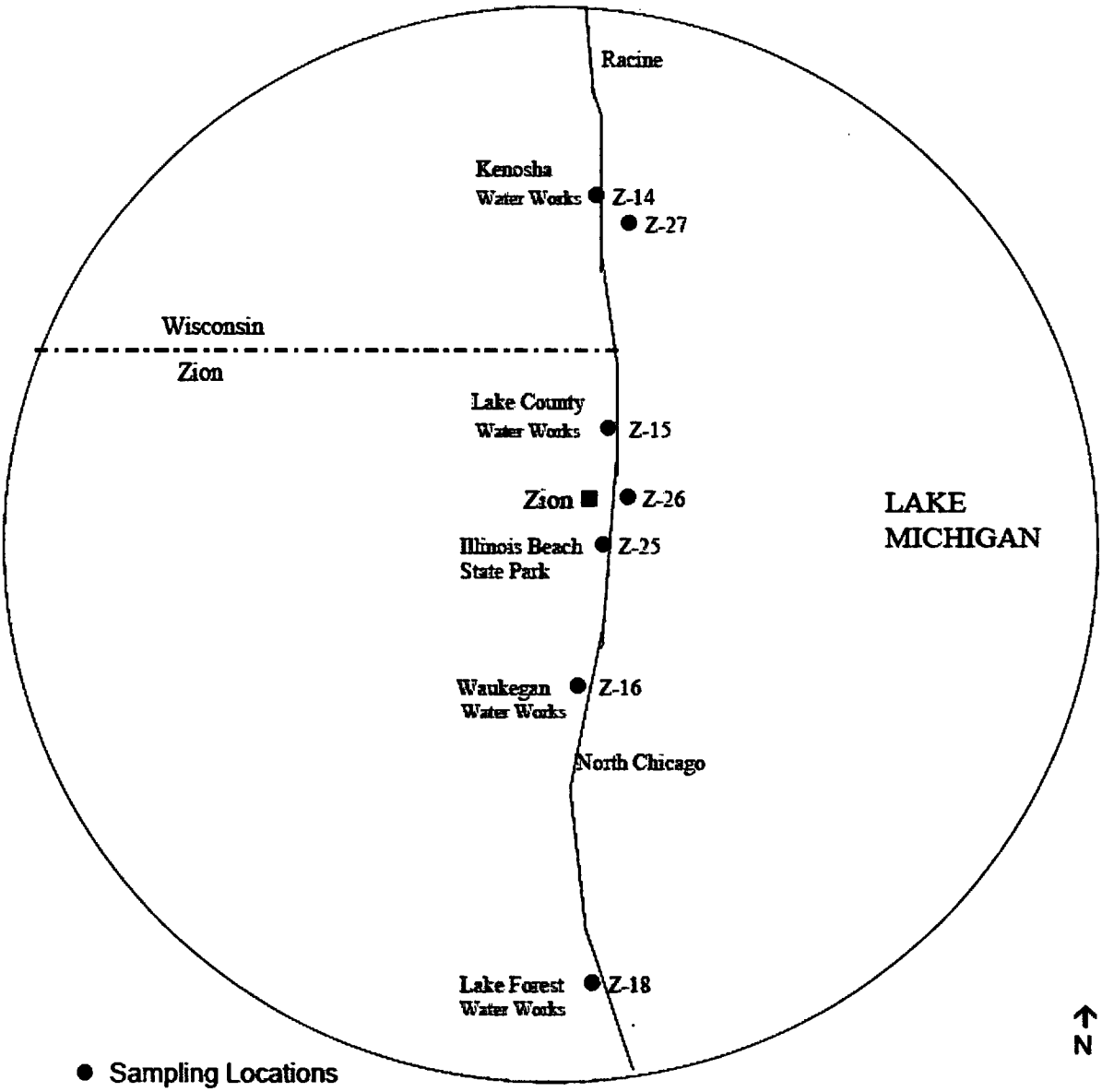



Figure B-3
Fish, Water and Sediment Sampling Locations of the Zion Nuclear Power Station, 2013

# 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, 2013**

Results in Units of pCi/liter ± 2 Sigma

| COLLECTION PERIOD | Z-14 | Z-15 | Z-16 | Z-18 |
|---|---|---|---|---|
| 01/02/13 - 01/30/13 | < 2.1 | 2.9 ± 1.4 | 3.2 ± 1.4 | 3.4 ± 1.4 |
| 02/06/13 - 02/28/13 | 2.6 ± 1.4 | 2.1 ± 1.4 | < 2.1 | < 2.1 |
| 03/06/13 - 03/27/13 | 2.8 ± 1.6 | 2.7 ± 1.5 | < 2.3 | 3.7 ± 1.5 |
| 04/03/13 - 04/24/13 | 3.0 ± 1.4 | 3.1 ± 1.4 | 3.5 ± 1.4 | 3.1 ± 1.4 |
| 05/01/13 - 05/29/13 | 2.9 ± 1.4 (1) | 3.2 ± 1.4 | 3.4 ± 1.4 | 3.9 ± 1.4 |
| 06/05/13 - 06/26/13 | 3.1 ± 1.2 | 2.4 ± 1.2 | 2.0 ± 1.2 | 3.5 ± 1.2 |
| 07/03/13 - 07/31/13 | < 2.6 (1) | < 2.6 | < 2.6 | 3.1 ± 1.8 |
| 08/07/13 - 08/29/13 | 2.4 ± 1.5 | < 2.2 | < 2.1 | 2.3 ± 1.5 |
| 09/04/13 - 09/25/13 | 3.3 ± 1.8 | < 2.7 | 4.0 ± 1.9 | < 2.7 |
| 10/02/13 - 10/30/13 | < 1.9 | < 1.9 | < 2.1 | < 2.2 |
| 11/06/13 - 11/27/13 | < 2.0 | 2.5 ± 1.5 | < 2.1 | < 2.3 |
| 12/04/13 - 12/26/13 | < 2.0 | < 2.0 | 2.3 ± 1.4 | < 2.0 |
| MEAN | 2.8 ± 0.6 | 2.7 ± 0.8 | 3.1 ± 1.5 | 3.3 ± 1.1 |

**Table C-I.2** **Concentrations of Tritium in Public Water Samples Collected in the Vicinity of Zion Nuclear Power Station, 2013**

Results in Units of pCi/liter ± 2 Sigma

| COLLECTION PERIOD | Z-14 | Z-15 | Z-16 | Z-18 |
|---|---|---|---|---|
| 01/02/13 - 03/27/13 | < 190 | < 199 | < 200 | < 196 |
| 04/03/13 - 06/26/13 | < 199 (1) | < 194 | < 191 | < 200 |
| 07/03/13 - 09/25/13 | < 188 (1) | < 191 | < 160 | < 189 |
| 10/02/13 - 12/26/13 | < 182 | < 177 | < 178 | < 181 |
| MEAN | - | - | - | - |

THE MEAN AND 2 STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES
(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

**Table C-I.3** **Concentrations of Gamma Emitters in Public Water Samples Collected in the Vicinity of Zion Nuclear Power Station, 2013**

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 | 01/02/13 - 01/30/13 | < 2 | < 2 | < 4 | < 2 | < 5 | < 2 | < 3 | < 2 | < 2 | < 14 | < 5 |
| | 02/06/13 - 02/28/13 | < 4 | < 5 | < 13 | < 5 | < 10 | < 5 | < 8 | < 4 | < 5 | < 47 | < 16 |
| | 03/06/13 - 03/27/13 | < 5 | < 5 | < 12 | < 4 | < 10 | < 5 | < 10 | < 4 | < 4 | < 39 | < 18 |
| | 04/03/13 - 04/24/13 | < 3 | < 4 | < 10 | < 4 | < 7 | < 5 | < 7 | < 3 | < 4 | < 42 | < 13 |
| | 05/01/13 - 05/29/13 (1) | < 4 | < 4 | < 10 | < 4 | < 9 | < 5 | < 7 | < 4 | < 5 | < 42 | < 13 |
| | 06/05/13 - 06/26/13 | < 4 | < 4 | < 12 | < 4 | < 7 | < 5 | < 7 | < 4 | < 4 | < 53 | < 19 |
| | 07/03/13 - 07/31/13 (1) | < 4 | < 4 | < 11 | < 3 | < 10 | < 5 | < 9 | < 4 | < 5 | < 46 | < 17 |
| | 08/07/13 - 08/29/13 | < 3 | < 4 | < 8 | < 3 | < 7 | < 4 | < 7 | < 3 | < 3 | < 45 | < 9 |
| | 09/04/13 - 09/25/13 | < 5 | < 6 | < 13 | < 6 | < 11 | < 7 | < 12 | < 4 | < 4 | < 65 | < 22 |
| | 10/02/13 - 10/30/13 | < 4 | < 4 | < 10 | < 4 | < 8 | < 4 | < 8 | < 4 | < 4 | < 26 | < 8 |
| | 11/06/13 - 11/27/13 | < 5 | < 6 | < 12 | < 6 | < 11 | < 6 | < 11 | < 4 | < 4 | < 57 | < 20 |
| | 12/04/13 - 12/26/13 | < 6 | < 6 | < 12 | < 5 | < 9 | < 7 | < 12 | < 6 | < 5 | < 35 | < 13 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |
| Z-15 | 01/02/13 - 01/30/13 | < 5 | < 5 | < 13 | < 5 | < 11 | < 6 | < 10 | < 5 | < 5 | < 36 | < 13 |
| | 02/06/13 - 02/28/13 | < 3 | < 4 | < 10 | < 4 | < 8 | < 4 | < 8 | < 4 | < 4 | < 47 | < 13 |
| | 03/06/13 - 03/27/13 | < 4 | < 5 | < 10 | < 5 | < 8 | < 6 | < 9 | < 4 | < 5 | < 48 | < 15 |
| | 04/03/13 - 04/24/13 | < 3 | < 4 | < 9 | < 3 | < 7 | < 4 | < 7 | < 3 | < 4 | < 45 | < 13 |
| | 05/01/13 - 05/29/13 | < 5 | < 6 | < 14 | < 6 | < 10 | < 5 | < 9 | < 4 | < 5 | < 46 | < 19 |
| | 06/05/13 - 06/26/13 | < 5 | < 6 | < 12 | < 6 | < 10 | < 7 | < 11 | < 5 | < 6 | < 67 | < 22 |
| | 07/03/13 - 07/31/13 | < 6 | < 7 | < 15 | < 7 | < 14 | < 8 | < 13 | < 6 | < 6 | < 60 | < 21 |
| | 08/07/13 - 08/29/13 | < 6 | < 6 | < 12 | < 4 | < 13 | < 6 | < 9 | < 5 | < 5 | < 52 | < 15 |
| | 09/04/13 - 09/25/13 | < 6 | < 6 | < 15 | < 4 | < 13 | < 8 | < 11 | < 5 | < 6 | < 74 | < 28 |
| | 10/02/13 - 10/30/13 | < 5 | < 5 | < 11 | < 5 | < 11 | < 4 | < 8 | < 4 | < 5 | < 33 | < 10 |
| | 11/06/13 - 11/27/13 | < 6 | < 7 | < 12 | < 4 | < 10 | < 6 | < 11 | < 5 | < 7 | < 67 | < 20 |
| | 12/04/13 - 12/26/13 | < 7 | < 6 | < 12 | < 6 | < 11 | < 7 | < 11 | < 5 | < 7 | < 38 | < 14 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

**Table C-I.3** **Concentrations of Gamma Emitters in Public Water Samples Collected in the Vicinity of Zion Nuclear Power Station, 2013**

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 | 01/02/13 - 01/30/13 | < 6 | < 7 | < 12 | < 3 | < 10 | < 7 | < 11 | < 6 | < 6 | < 46 | < 7 |
| | 02/06/13 - 02/28/13 | < 4 | < 5 | < 11 | < 4 | < 9 | < 6 | < 10 | < 4 | < 4 | < 48 | < 14 |
| | 03/06/13 - 03/27/13 | < 5 | < 5 | < 11 | < 5 | < 10 | < 6 | < 9 | < 4 | < 5 | < 51 | < 14 |
| | 04/03/13 - 04/24/13 | < 3 | < 4 | < 10 | < 4 | < 7 | < 4 | < 7 | < 3 | < 3 | < 34 | < 14 |
| | 05/01/13 - 05/29/13 | < 8 | < 8 | < 19 | < 9 | < 14 | < 9 | < 14 | < 6 | < 7 | < 64 | < 24 |
| | 06/05/13 - 06/26/13 | < 6 | < 7 | < 17 | < 5 | < 12 | < 7 | < 12 | < 6 | < 6 | < 85 | < 29 |
| | 07/03/13 - 07/31/13 | < 5 | < 7 | < 13 | < 5 | < 11 | < 7 | < 12 | < 5 | < 6 | < 65 | < 14 |
| | 08/07/13 - 08/29/13 | < 4 | < 6 | < 13 | < 5 | < 10 | < 5 | < 11 | < 5 | < 6 | < 70 | < 12 |
| | 09/04/13 - 09/25/13 | < 5 | < 5 | < 18 | < 6 | < 14 | < 7 | < 12 | < 5 | < 6 | < 67 | < 22 |
| | 10/02/13 - 10/30/13 | < 4 | < 5 | < 9 | < 5 | < 10 | < 5 | < 10 | < 4 | < 5 | < 32 | < 8 |
| | 11/06/13 - 11/27/13 | < 5 | < 6 | < 13 | < 5 | < 10 | < 6 | < 10 | < 6 | < 6 | < 69 | < 22 |
| | 12/04/13 - 12/26/13 | < 6 | < 7 | < 15 | < 7 | < 10 | < 7 | < 12 | < 6 | < 7 | < 46 | < 15 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |
| Z-18 | 01/02/13 - 01/30/13 | < 4 | < 5 | < 9 | < 5 | < 8 | < 4 | < 8 | < 4 | < 5 | < 30 | < 8 |
| | 02/06/13 - 02/28/13 | < 4 | < 5 | < 11 | < 5 | < 9 | < 6 | < 10 | < 5 | < 5 | < 50 | < 15 |
| | 03/06/13 - 03/27/13 | < 4 | < 4 | < 11 | < 5 | < 8 | < 5 | < 9 | < 4 | < 4 | < 43 | < 18 |
| | 04/03/13 - 04/24/13 | < 3 | < 3 | < 7 | < 3 | < 6 | < 4 | < 6 | < 3 | < 3 | < 33 | < 10 |
| | 05/01/13 - 05/29/13 | < 5 | < 6 | < 12 | < 4 | < 11 | < 7 | < 10 | < 5 | < 6 | < 48 | < 16 |
| | 06/05/13 - 06/26/13 | < 5 | < 6 | < 15 | < 5 | < 8 | < 6 | < 9 | < 5 | < 5 | < 75 | < 20 |
| | 07/03/13 - 07/31/13 | < 7 | < 10 | < 15 | < 9 | < 16 | < 9 | < 14 | < 7 | < 7 | < 65 | < 23 |
| | 08/07/13 - 08/29/13 | < 5 | < 5 | < 12 | < 5 | < 8 | < 6 | < 10 | < 5 | < 6 | < 59 | < 18 |
| | 09/04/13 - 09/25/13 | < 7 | < 7 | < 18 | < 6 | < 15 | < 9 | < 15 | < 5 | < 5 | < 89 | < 26 |
| | 10/02/13 - 10/30/13 | < 5 | < 6 | < 13 | < 6 | < 15 | < 7 | < 10 | < 5 | < 6 | < 43 | < 12 |
| | 11/06/13 - 11/27/13 | < 4 | < 5 | < 16 | < 5 | < 9 | < 6 | < 9 | < 5 | < 6 | < 54 | < 19 |
| | 12/04/13 - 12/26/13 | < 6 | < 5 | < 10 | < 6 | < 12 | < 5 | < 9 | < 5 | < 6 | < 40 | < 13 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |

**Table C-II.1** **Concentrations of Gamma Emitters in Fish Samples Collected in the Vicinity of Zion Nuclear Power Station, 2013**

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 | 05/14/13 | < 41 | < 84 | < 170 | < 56 | < 162 | < 90 | < 143 | < 65 | < 61 | < 861 | < 364 |
| Largemouth Bass | 05/14/13 | < 67 | < 83 | < 240 | < 79 | < 188 | < 95 | < 172 | < 77 | < 89 | < 1068 | < 339 |
| Chinook Salmon | 10/30/13 | < 52 | < 68 | < 153 | < 66 | < 105 | < 69 | < 78 | < 50 | < 66 | < 451 | < 101 |
| Common Carp | 10/30/13 | < 53 | < 55 | < 106 | < 61 | < 120 | < 54 | < 104 | < 45 | < 45 | < 378 | < 111 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |
| Z-27 | | | | | | | | | | | | |
| Burbot | 05/14/13 | < 51 | < 75 | < 138 | < 59 | < 127 | < 94 | < 107 | < 59 | < 77 | < 903 | < 237 |
| Lake Trout | 05/14/13 | < 51 | < 86 | < 195 | < 88 | < 169 | < 83 | < 176 | < 67 | < 71 | < 1076 | < 253 |
| Lake Trout | 10/23/13 | < 70 | < 64 | < 210 | < 71 | < 114 | < 84 | < 123 | < 73 | < 78 | < 886 | < 237 |
| Longnose Sucker | 10/23/13 | < 49 | < 46 | < 115 | < 47 | < 125 | < 80 | < 97 | < 53 | < 58 | < 447 | < 122 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |

**Table C-III.1** **Concentrations of Gamma Emitters in Sediment Samples Collected in the Vicinity of Zion Nuclear Power Station, 2013**

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 | 05/08/13 | < 35 | < 47 | < 119 | < 52 | < 113 | < 52 | < 77 | < 40 | < 40 | < 434 | < 105 |
| | 10/16/13 | < 35 | < 38 | < 79 | < 36 | < 76 | < 43 | < 70 | < 29 | < 32 | < 394 | < 116 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |

**Table C-IV.1** **Concentrations of Gross Beta in Air Particulate Samples Collected in the Vicinity of Zion Nuclear Power Station, 2013**

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

| COLLECTION PERIOD | GROUP I | | | | | | GROUP II | |
|---|---|---|---|---|---|---|---|---|
| | Z-01 | | Z-02 | | Z-03 | | Z-13 | |
| 01/02/13 - 01/09/13 | 56 ± 6 | | 52 ± 6 | | 50 ± 6 | | | |
| 01/09/13 - 01/16/13 | 23 ± 4 | | 23 ± 4 | | 27 ± 5 | | | |
| 01/16/13 - 01/24/13 | 29 ± 4 | | 23 ± 4 | | 23 ± 4 | | | |
| 01/24/13 - 01/30/13 | 22 ± 5 | | 27 ± 6 | | 23 ± 5 | | | |
| 01/30/13 - 02/06/13 | 38 ± 6 | | 33 ± 6 | | 39 ± 6 | | | |
| 02/06/13 - 02/13/13 | 16 ± 4 | | 14 ± 4 | | 15 ± 4 | | | |
| 02/13/13 - 02/20/13 | 18 ± 4 | | 20 ± 4 | | 23 ± 5 | | | |
| 02/20/13 - 02/28/13 | < 6 | | 12 ± 4 | | 9 ± 4 | | | |
| 02/28/13 - 03/07/13 | 12 ± 4 | (1) | 12 ± 4 | | 12 ± 4 | (1) | | |
| 03/07/13 - 03/13/13 | 8 ± 4 | | 11 ± 4 | | 11 ± 4 | | | |
| 03/13/13 - 03/20/13 | 21 ± 5 | | 15 ± 4 | | 18 ± 4 | | | |
| 03/20/13 - 03/27/13 | 6 ± 3 | | 9 ± 4 | | 9 ± 4 | | | |
| 03/27/13 - 04/03/13 | 17 ± 4 | | 12 ± 4 | | 11 ± 4 | | | |
| 04/03/13 - 04/10/13 | 15 ± 5 | (1) | 11 ± 4 | | 12 ± 4 | | 14 ± 5 | (1)(2) |
| 04/10/13 - 04/17/13 | < 6 | (1) | 9 ± 4 | | 6 ± 4 | | 7 ± 3 | |
| 04/17/13 - 04/24/13 | 9 ± 4 | | 11 ± 4 | | 12 ± 4 | | 13 ± 4 | |
| 04/24/13 - 05/01/13 | 26 ± 5 | | 21 ± 5 | | 19 ± 4 | | 23 ± 5 | |
| 05/01/13 - 05/08/13 | 14 ± 4 | | 14 ± 4 | | 11 ± 4 | | 14 ± 4 | |
| 05/08/13 - 05/15/13 | 13 ± 4 | | 9 ± 4 | | 11 ± 4 | | 12 ± 4 | |
| 05/15/13 - 05/22/13 | 13 ± 4 | | 12 ± 4 | | 14 ± 4 | | 17 ± 4 | |
| 05/22/13 - 05/29/13 | 9 ± 4 | | 11 ± 4 | | 6 ± 4 | | 9 ± 4 | |
| 05/29/13 - 06/05/13 | 9 ± 3 | | 7 ± 3 | | 9 ± 3 | | 6 ± 3 | |
| 06/05/13 - 06/12/13 | 15 ± 4 | | 14 ± 4 | | 17 ± 4 | | 19 ± 4 | |
| 06/12/13 - 06/19/13 | 17 ± 4 | | 10 ± 3 | | 15 ± 4 | | 17 ± 4 | |
| 06/19/13 - 06/26/13 | 13 ± 4 | | 16 ± 4 | | 15 ± 4 | | 12 ± 3 | |
| 06/26/13 - 07/03/13 | 10 ± 4 | | 6 ± 3 | | 8 ± 4 | | 9 ± 4 | |
| 07/03/13 - 07/10/13 | 15 ± 4 | | 18 ± 4 | | 17 ± 4 | | 20 ± 4 | |
| 07/10/13 - 07/17/13 | 11 ± 4 | | 10 ± 4 | | 9 ± 3 | | 11 ± 4 | |
| 07/17/13 - 07/24/13 | 9 ± 3 | | 11 ± 3 | | 10 ± 3 | | 12 ± 4 | |
| 07/24/13 - 07/31/13 | 13 ± 4 | | 6 ± 3 | | 6 ± 3 | | 6 ± 3 | |
| 07/31/13 - 08/07/13 | 11 ± 4 | | 12 ± 4 | | 17 ± 4 | | 12 ± 4 | |
| 08/07/13 - 08/14/13 | 12 ± 4 | | 18 ± 4 | | 16 ± 4 | | 14 ± 4 | |
| 08/14/13 - 08/21/13 | 22 ± 4 | | 24 ± 5 | | 28 ± 5 | | 25 ± 5 | |
| 08/21/13 - 08/29/13 | 17 ± 4 | | 25 ± 5 | | 23 ± 5 | | 17 ± 4 | |
| 08/29/13 - 09/04/13 | 14 ± 4 | | 14 ± 4 | | 15 ± 4 | | 18 ± 5 | |
| 09/04/13 - 09/11/13 | 25 ± 5 | | 28 ± 5 | | 30 ± 5 | | 31 ± 5 | |
| 09/11/13 - 09/18/13 | 12 ± 4 | | 12 ± 4 | | 14 ± 4 | | 18 ± 4 | |
| 09/18/13 - 09/25/13 | 11 ± 4 | | 14 ± 4 | | 12 ± 4 | | 15 ± 4 | |
| 09/25/13 - 10/02/13 | 18 ± 4 | | 20 ± 5 | | 18 ± 4 | | 22 ± 5 | |
| 10/02/13 - 10/09/13 | 15 ± 4 | | 12 ± 4 | | 14 ± 4 | | 16 ± 4 | |
| 10/09/13 - 10/16/13 | 45 ± 9 | (1) | 18 ± 4 | | 20 ± 4 | | 19 ± 4 | |
| 10/16/13 - 10/23/13 | 13 ± 4 | | 13 ± 4 | | 11 ± 4 | | 9 ± 4 | |
| 10/23/13 - 10/30/13 | 13 ± 4 | | 28 ± 9 | (1) | 14 ± 4 | | 15 ± 4 | |
| 10/30/13 - 11/06/13 | 26 ± 5 | | 23 ± 4 | | 29 ± 5 | | 30 ± 5 | |
| 11/06/13 - 11/13/13 | 18 ± 4 | | 14 ± 4 | | 14 ± 4 | | 18 ± 4 | |
| 11/13/13 - 11/20/13 | 16 ± 4 | | 14 ± 4 | | 15 ± 4 | | 18 ± 4 | |
| 11/20/13 - 11/27/13 | 21 ± 4 | | 22 ± 4 | | 21 ± 4 | | 23 ± 4 | |
| 11/27/13 - 12/04/13 | 34 ± 5 | (1) | 31 ± 5 | | 31 ± 5 | | 42 ± 6 | |
| 12/04/13 - 12/11/13 | 32 ± 5 | | 32 ± 5 | | 36 ± 5 | | 29 ± 5 | |
| 12/11/13 - 12/18/13 | 32 ± 5 | | 30 ± 5 | | 33 ± 5 | | 31 ± 5 | |
| 12/18/13 - 12/26/13 | 25 ± 4 | | 29 ± 5 | | 26 ± 4 | | 25 ± 4 | |
| 12/26/13 - 01/03/14 | 22 ± 4 | | 23 ± 4 | | 27 ± 5 | | 24 ± 4 | |
| MEAN | 19 ± 20 | | 18 ± 18 | | 18 ± 18 | | 18 ± 16 | |

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

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

(2) SEE PROGRAM CHANGES 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, 2013**

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

| GROUP I - ONSITE LOCATIONS | | | | GROUP II - OFFSITE CONTROL LOCATION | | | |
|---|---|---|---|---|---|---|---|
| COLLECTION PERIOD | MIN | MAX | MEAN ± 2SD | COLLECTION PERIOD | MIN | MAX | MEAN ± 2SD |
| 01/02/13 - 01/30/13 | 22 | 56 | 32 ± 26 | 01/02/13 - 01/30/13 | - | - | - - |
| 01/30/13 - 02/28/13 | 9 | 39 | 22 ± 21 | 01/30/13 - 02/28/13 | - | - | - - |
| 02/28/13 - 04/03/13 | 6 | 21 | 12 ± 8 | 02/28/13 - 04/03/13 | - | - | - - |
| 04/03/13 - 05/01/13 | 6 | 26 | 14 ± 12 | 04/04/13 - 05/01/13 | 7 | 23 | 14 ± 13 |
| 05/01/13 - 05/29/13 | 6 | 14 | 11 ± 5 | 05/01/13 - 05/29/13 | 9 | 17 | 13 ± 7 |
| 05/29/13 - 07/03/13 | 6 | 17 | 12 ± 7 | 05/29/13 - 07/03/13 | 6 | 19 | 13 ± 10 |
| 07/03/13 - 07/31/13 | 6 | 18 | 11 ± 8 | 07/03/13 - 07/31/13 | 6 | 20 | 12 ± 11 |
| 07/31/13 - 08/29/13 | 11 | 28 | 19 ± 11 | 07/31/13 - 08/29/13 | 12 | 25 | 17 ± 11 |
| 08/29/13 - 10/02/13 | 11 | 30 | 17 ± 12 | 08/29/13 - 10/02/13 | 15 | 31 | 20 ± 12 |
| 10/02/13 - 10/30/13 | 11 | 45 | 18 ± 20 | 10/02/13 - 10/30/13 | 9 | 19 | 15 ± 9 |
| 10/30/13 - 12/04/13 | 14 | 34 | 22 ± 14 | 10/30/13 - 12/04/13 | 18 | 42 | 26 ± 20 |
| 12/04/13 - 01/03/14 | 22 | 36 | 29 ± 9 | 12/04/13 - 01/03/14 | 24 | 31 | 27 ± 7 |
| 01/02/13 - 01/03/14 | 6 | 56 | 18 ± 18 | 04/04/13 - 01/03/14 | 6 | 42 | 18 ± 16 |

**Table C-IV.3** **Concentrations of Gamma Emitters in Air Particulate Samples Collected in the Vicinity of Zion Nuclear Power Station, 2013**

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 | 01/02/13 - 04/03/13 | < 3 | < 3 | < 10 | < 3 | < 4 | < 4 | < 6 | < 2 | < 2 | < 98 | < 40 |
| | 04/03/13 - 07/03/13 | < 2 | < 3 | < 8 | < 3 | < 6 | < 3 | < 5 | < 3 | < 3 | < 57 | < 16 |
| | 07/03/13 - 10/02/13 | < 2 | < 2 | < 5 | < 3 | < 7 | < 2 | < 4 | < 3 | < 2 | < 30 | < 10 |
| | 10/02/13 - 01/03/14 | < 5 | < 5 | < 10 | < 4 | < 11 | < 4 | < 6 | < 3 | < 4 | < 54 | < 22 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |
| Z-02 | 01/02/13 - 04/03/13 | < 2 | < 3 | < 10 | < 2 | < 7 | < 4 | < 5 | < 2 | < 2 | < 79 | < 36 |
| | 04/03/13 - 07/03/13 | < 3 | < 3 | < 9 | < 2 | < 6 | < 4 | < 6 | < 3 | < 3 | < 56 | < 13 |
| | 07/03/13 - 10/02/13 | < 4 | < 4 | < 11 | < 4 | < 9 | < 5 | < 7 | < 4 | < 3 | < 46 | < 11 |
| | 10/02/13 - 01/03/14 | < 2 | < 2 | < 6 | < 3 | < 6 | < 3 | < 6 | < 3 | < 3 | < 36 | < 7 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |
| Z-03 | 01/02/13 - 04/03/13 | < 3 | < 5 | < 10 | < 3 | < 9 | < 5 | < 9 | < 3 | < 4 | < 136 | < 53 |
| | 04/03/13 - 07/03/13 | < 3 | < 4 | < 9 | < 3 | < 7 | < 5 | < 8 | < 4 | < 3 | < 61 | < 28 |
| | 07/03/13 - 10/02/13 | < 2 | < 2 | < 5 | < 3 | < 5 | < 2 | < 5 | < 2 | < 2 | < 21 | < 10 |
| | 10/02/13 - 01/03/14 | < 3 | < 3 | < 9 | < 3 | < 7 | < 3 | < 7 | < 3 | < 3 | < 43 | < 16 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |
| Z-13 | 01/02/13 - 04/03/13 | - | - | - | - | - | - | - | - | - | - | - |
| | 04/04/13 - 07/03/13 (1) | < 2 | < 3 | < 7 | < 2 | < 6 | < 3 | < 5 | < 2 | < 2 | < 39 | < 12 |
| | 07/03/13 - 10/02/13 | < 1 | < 3 | < 6 | < 3 | < 4 | < 3 | < 5 | < 2 | < 2 | < 23 | < 10 |
| | 10/02/13 - 01/03/14 | < 3 | < 4 | < 5 | < 3 | < 8 | < 4 | < 6 | < 4 | < 3 | < 45 | < 14 |
| | MEAN | - | - | - | - | - | - | - | - | - | - | - |

(1) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

**Table C-V.1** **Quarterly TLD Results for Zion Nuclear Power Station, 2013**

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 | | 23 ± 5 | 25 | 20 | (1) | 23 |
| Z-01-2 | | 23 ± 7 | 25 | 19 | (1) | 25 |
| Z-02-1 | | 20 ± 3 | 20 | 17 | 21 | 20 |
| Z-02-2 | | 20 ± 6 | 24 | 17 | 20 | 20 |
| Z-03-1 | | 21 ± 7 | 24 | 17 | 19 | 23 |
| Z-03-2 | | 20 ± 3 | 21 | 17 | 20 | 20 |
| Z-13-1 | (2) | 22 ± 7 | 22 | 19 | (1) | 26 |
| Z-13-2 | (2) | 23 ± 7 | 26 | 19 | (1) | 24 |
| Z-101-1 | | 19 ± 2 | 20 | 18 | 19 | 20 |
| Z-101-2 | | 19 ± 4 | 21 | 17 | 17 | 20 |
| Z-102-1 | | 22 ± 5 | 22 | 19 | 21 | 25 |
| Z-102-2 | | 21 ± 3 | 22 | 19 | 22 | 21 |
| Z-103-1 | | 22 ± 3 | 22 | 20 | 21 | 24 |
| Z-103-2 | | 21 ± 2 | 21 | 19 | 21 | 21 |
| Z-104-1 | | 19 ± 3 | 20 | 17 | 19 | 21 |
| Z-104-2 | | 19 ± 3 | 21 | 17 | 19 | 20 |
| Z-105-1 | | 21 ± 4 | 20 | 18 | 22 | 22 |
| Z-105-2 | | 20 ± 4 | 21 | 17 | 21 | 22 |
| Z-106-1 | | 19 ± 4 | 21 | 17 | 18 | 20 |
| Z-106-2 | | 21 ± 6 | 24 | 17 | 19 | 22 |
| Z-107-1 | | 20 ± 3 | 21 | 18 | 20 | 20 |
| Z-107-2 | | 21 ± 7 | 25 | 17 | 19 | 22 |
| Z-108-1 | | 26 ± 17 | 38 | 21 | 22 | 21 |
| Z-108-2 | | 24 ± 10 | 30 | 18 | 21 | 25 |
| Z-110-1 | | 23 ± 1 | 23 | 23 | 24 | 23 |
| Z-110-2 | | 25 ± 7 | 26 | 20 | 27 | 27 |
| Z-111-1 | | 21 ± 5 | 20 | 18 | 23 | 23 |
| Z-111-2 | | 20 ± 4 | 21 | 17 | 21 | 20 |
| Z-112-1 | | 23 ± 3 | 23 | 21 | 24 | 22 |
| Z-112-2 | | 21 ± 3 | 21 | 19 | 21 | 22 |
| Z-113-1 | | 21 ± 4 | 24 | 19 | 21 | 20 |
| Z-113-2 | | 20 ± 3 | 21 | 18 | 20 | 20 |
| Z-114-1 | | 21 ± 4 | 21 | 19 | 21 | 24 |
| Z-114-2 | | 20 ± 2 | 21 | 19 | 21 | 20 |
| Z-115-1 | | 22 ± 4 | 23 | 20 | 21 | 24 |
| Z-115-2 | | 20 ± 3 | 21 | 18 | 21 | 21 |
| Z-121-1 | (2) | 21 ± 3 | 21 | 18 | 21 | 22 |
| Z-121-2 | (2) | 22 ± 2 | 23 | 23 | 21 | 21 |
| Z-122-1 | (2) | 21 ± 7 | 24 | 17 | (1) | 22 |
| Z-122-2 | (2) | 23 ± 8 | 25 | 18 | (1) | 25 |
| Z-123-1 | (2) | 21 ± 4 | 23 | 19 | (1) | 22 |
| Z-123-2 | (2) | 22 ± 6 | 25 | 19 | (1) | 23 |
| Z-124-1 | (2) | 21 ± 0 | 21 | (1) | (1) | 21 |
| Z-124-2 | (2) | 22 ± 5 | 24 | 19 | (1) | 22 |

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION
(2) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

**Table C-V.1** **Quarterly TLD Results for Zion Nuclear Power Station, 2013**

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-125-1 | (2) | 19 ± 5 | 21 | 16 | (1) | 20 |
| Z-125-2 | (2) | 20 ± 4 | 21 | 18 | (1) | 22 |
| Z-209-1 | (2) | 22 ± 5 | 24 | 19 | 21 | 24 |
| Z-209-2 | (2) | 21 ± 5 | 22 | 18 | 20 | 24 |
| Z-211-1 | (2) | 25 ± 5 | 27 | 22 | 27 | 25 |
| Z-211-2 | (2) | 26 ± 6 | 30 | 23 | 25 | 24 |
| Z-212-1 | (2) | 27 ± 6 | 26 | 23 | 29 | 30 |
| Z-212-2 | (2) | 26 ± 3 | 25 | 24 | 28 | 26 |
| Z-213-1 | (2) | 25 ± 5 | 24 | 22 | 25 | 28 |
| Z-213-2 | (2) | 28 ± 3 | 28 | 25 | 28 | 29 |
| Z-214-1 | (2) | 25 ± 4 | 24 | 22 | 26 | 27 |
| Z-214-2 | (2) | 25 ± 5 | 26 | 22 | 28 | 25 |
| Z-215-1 | (2) | 26 ± 4 | 26 | 23 | 28 | 25 |
| Z-215-2 | (2) | 27 ± 3 | 26 | 26 | 27 | 29 |
| Z-216-1 | (2) | 21 ± 3 | 23 | 19 | 21 | 22 |
| Z-216-2 | (2) | 21 ± 4 | 22 | 18 | 20 | 22 |

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION
(2) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

**Table C-V.2 Mean Quarterly TLD Results for Inner Ring, ISFSI Inner Ring, Other, Outer Ring, and Control Locations For Zion Nuclear Power Station, 2013**

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

| COLLECTION PERIOD | INNER RING ± 2 S.D. | OUTER RING (2) | OTHER | CONTROL (2) | ISFSI INNER RING (2) |
|---|---|---|---|---|---|
| JAN-MAR | 23 ± 7 | 25 ± 5 | 23 ± 4 | 24 ± 6 | 23 ± 3 |
| APR-JUN | 19 ± 3 | 22 ± 5 | 18 ± 3 | 19 ± 0 | 19 ± 4 |
| JUL-SEP | 21 ± 4 | 25 ± 7 | 20 ± 2 | (1) | 21 ± 0 |
| OCT-DEC | 22 ± 4 | 26 ± 5 | 22 ± 4 | 25 ± 3 | 22 ± 3 |

**Table C-V.3 Summary of the Ambient Dosimetry Program for Zion Nuclear Power Station, 2013**

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

| LOCATION | SAMPLES ANALYZED | PERIOD MINIMUM | PERIOD MAXIMUM | PERIOD MEAN ± 2 S.D. |
|---|---|---|---|---|
| INNER RING | 112 | 17 | 38 | 21 ± 6 |
| OUTER RING | 56 | 18 | 30 | 25 ± 6 |
| OTHER | 22 | 17 | 25 | 21 ± 5 |
| CONTROL | 6 | 19 | 26 | 23 ± 6 |
| ISFSI INNER RING | 31 | 16 | 25 | 21 ± 5 |

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

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

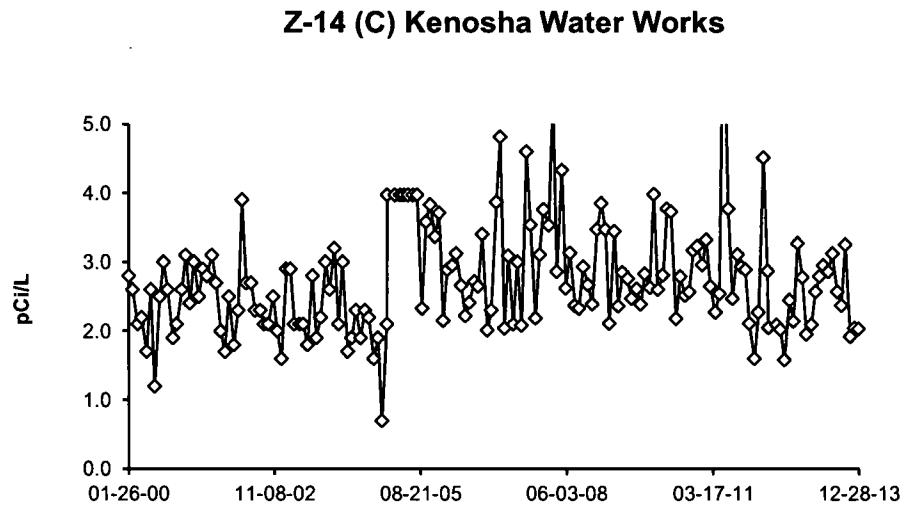
OTHER STATIONS - Z-01-1, Z-01-2, Z-02-1, Z-02-2, Z-03-1, Z-03-2

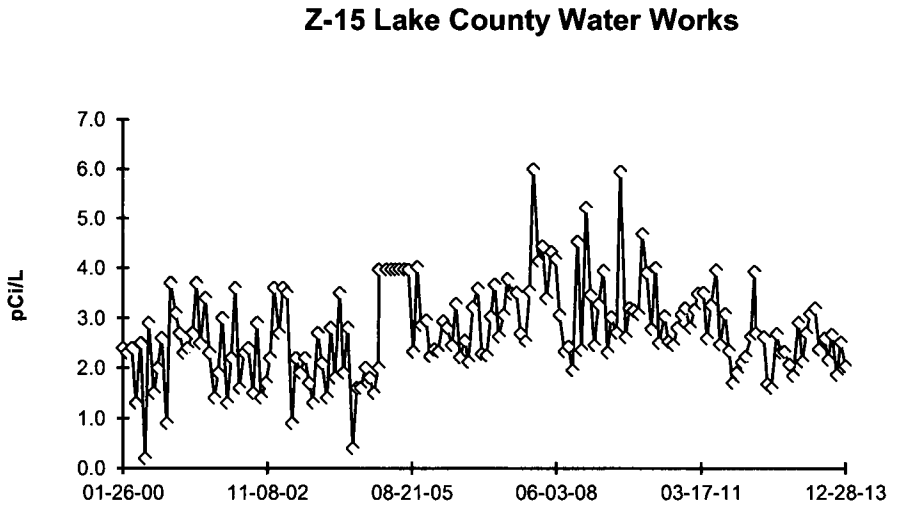
CONTROL STATIONS - Z-13-1, Z-13-2

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

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION
(2) SEE PROGRAM CHANGES SECTION FOR EXPLANATION

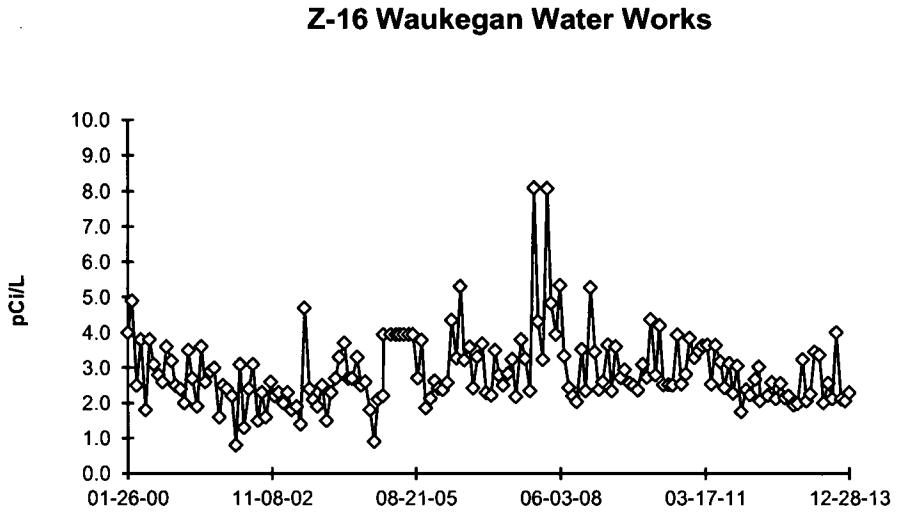
# FIGURE C-1
# PUBLIC WATER - GROSS BETA - STATIONS Z-14 AND Z-15 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2013

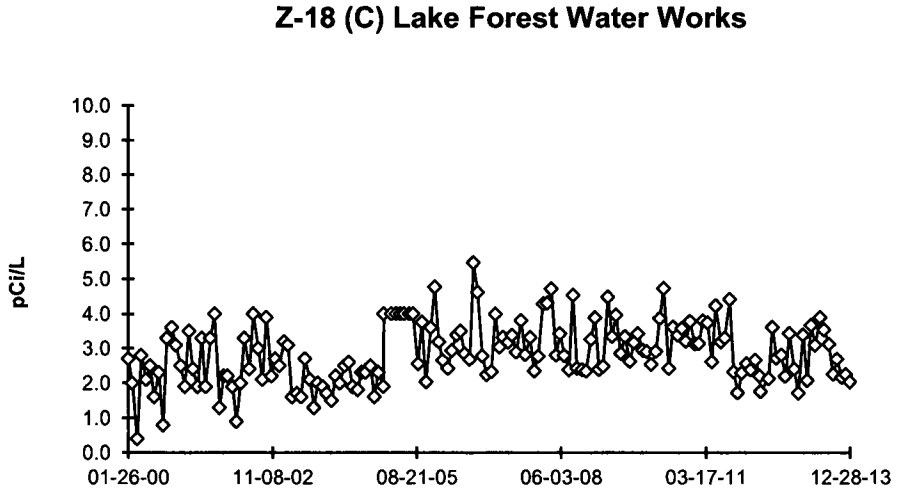



DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

# FIGURE C-2
# PUBLIC WATER - GROSS BETA - STATIONS Z-16 AND Z-18 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2013

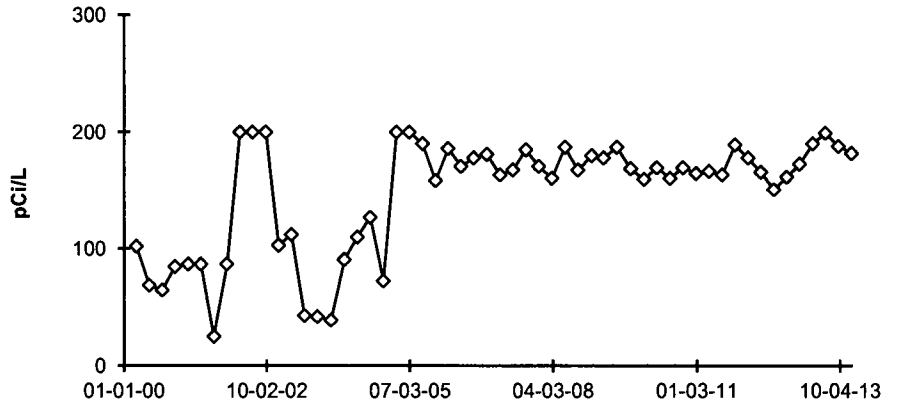


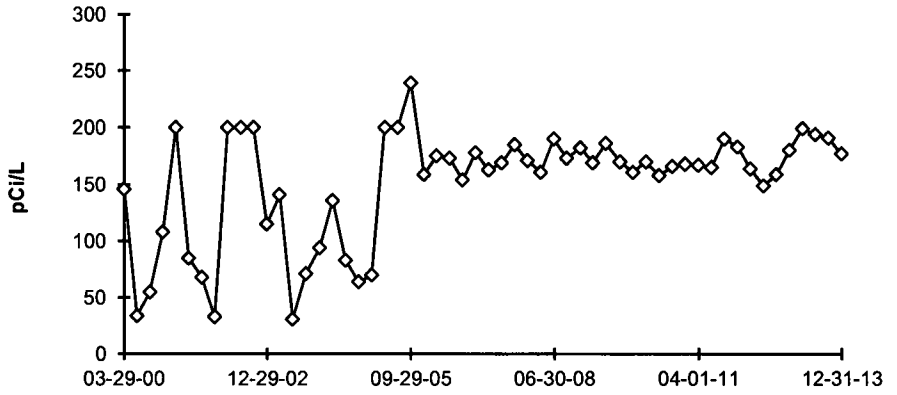

DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

# FIGURE C-3
# PUBLIC WATER - TRITIUM - STATION Z-14 AND Z-15 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2013

**Z-14 (C) Kenosha Water Works**

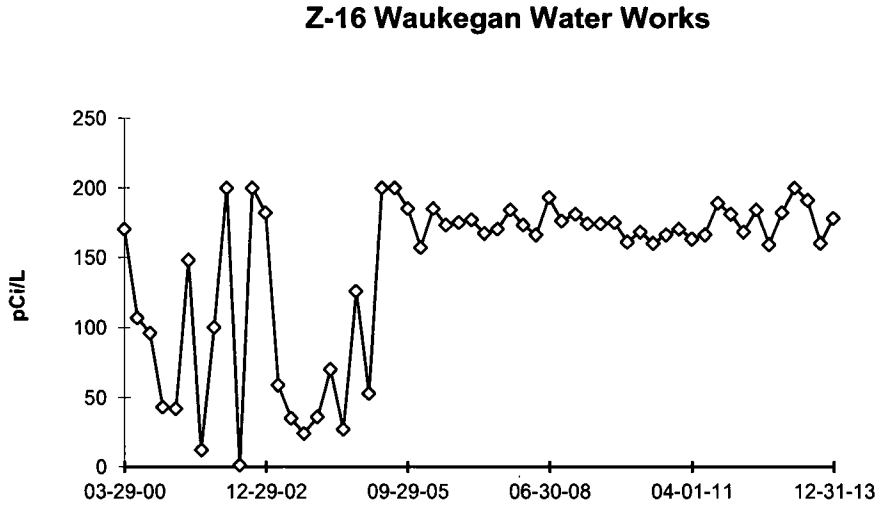


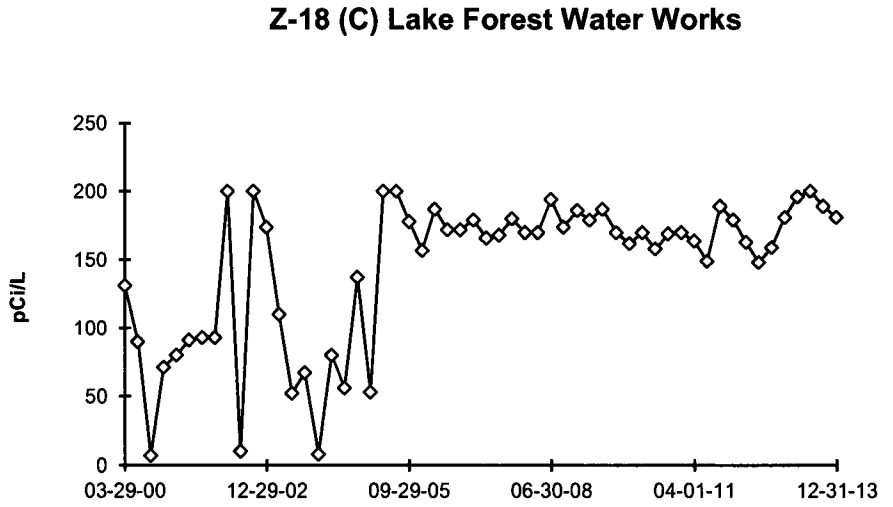

**Z-15 Lake County Water Works**




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 - 2013

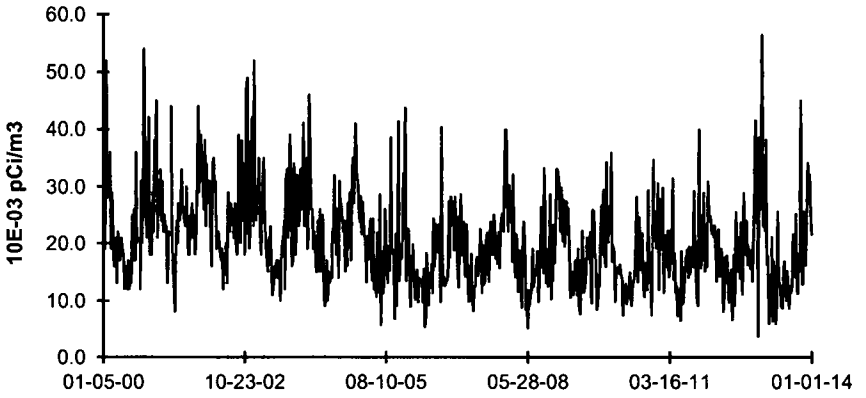


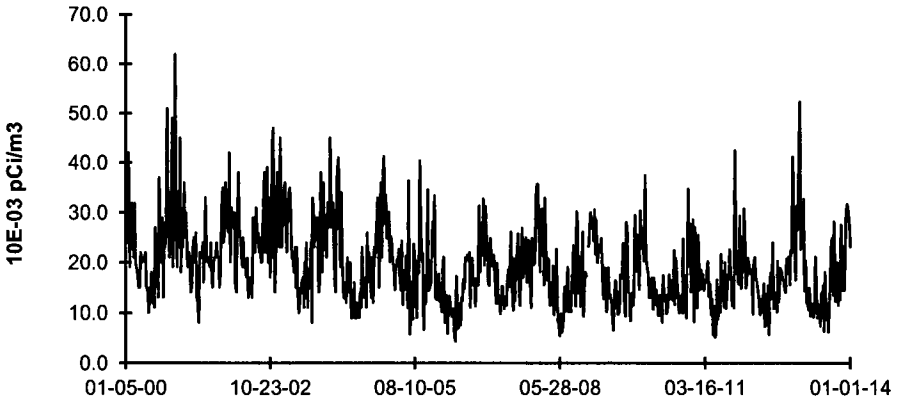

DUE TO VENDOR CHANGE IN 2005, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JUNE 2005

# FIGURE C-5
# AIR PARTICULATES - GROSS BETA - STATIONS Z-01 AND Z-02 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2013

**Z-01 Onsite No. 1, Southside**

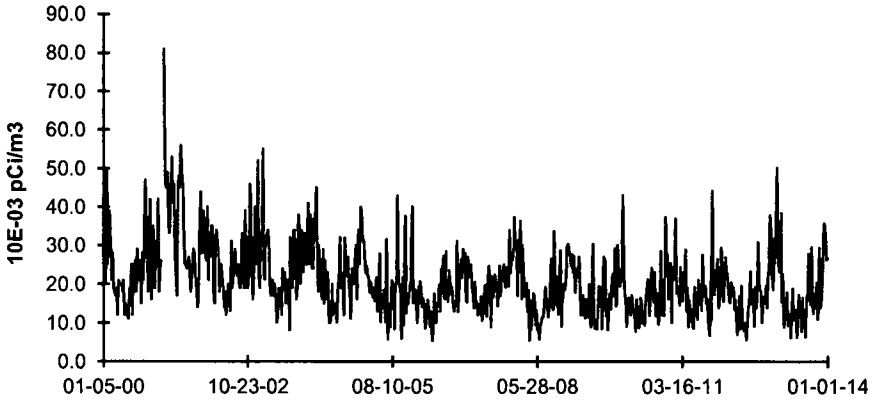



**Z-02 Onsite No. 2, Westside**

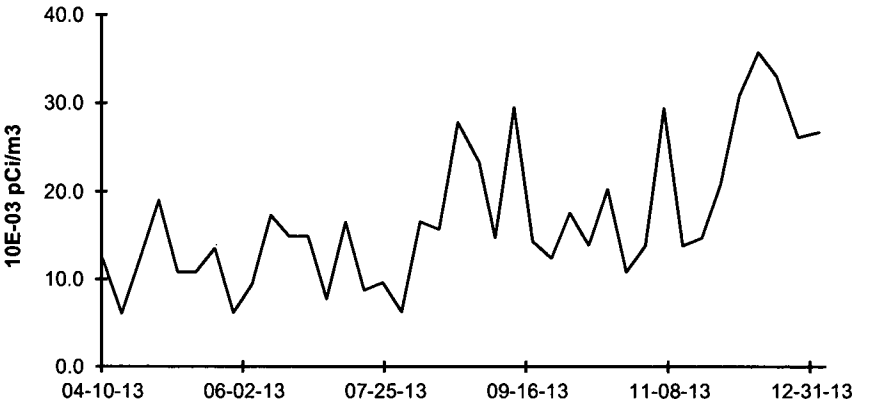


# FIGURE C-6
# AIR PARTICULATES - GROSS BETA - STATIONS Z-03 AND Z-13 COLLECTED IN THE VICINITY OF ZNPS, 2000 - 2013

**Z-03 Onsite No. 3, Northside**




**Z-13 Offsite Control**



# APPENDIX D

# INTER-LABORATORY COMPARISON PROGRAM

**TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**
**TELEDYNE BROWN ENGINEERING, 2013**
**(PAGE 1 OF 3)**

| Month/Year | Identification Number | Matrix | Nuclide | Units | Reported Value (a) | Known Value (b) | Ratio (c) TBE/Analytics | Evaluation (d) |
|---|---|---|---|---|---|---|---|---|
| March 2013 | E10477 | Milk | Sr-89 | pCi/L | 120 | 99.7 | 1.20 | A |
| | | | Sr-90 | pCi/L | 9.21 | 11.0 | 0.84 | A |
| | E10478 | Milk | I-131 | pCi/L | 87.1 | 100 | 0.87 | A |
| | | | Ce-141 | pCi/L | 186 | 187 | 0.99 | A |
| | | | Cr-51 | pCi/L | 463 | 472 | 0.98 | A |
| | | | Cs-134 | pCi/L | 201 | 214 | 0.94 | A |
| | | | Cs-137 | pCi/L | 262 | 266 | 0.98 | A |
| | | | Co-58 | pCi/L | 200 | 208 | 0.96 | A |
| | | | Mn-54 | pCi/L | 215 | 208 | 1.03 | A |
| | | | Fe-59 | pCi/L | 266 | 252 | 1.06 | A |
| | | | Zn-65 | pCi/L | 311 | 301 | 1.03 | A |
| | | | Co-60 | pCi/L | 384 | 400 | 0.96 | A |
| | E10480 | AP | Ce-141 | pCi | 95.3 | 95.6 | 1.00 | A |
| | | | Cr-51 | pCi | 264 | 241 | 1.10 | A |
| | | | Cs-134 | pCi | 123 | 109 | 1.13 | A |
| | | | Cs-137 | pCi | 142 | 136 | 1.04 | A |
| | | | Co-58 | pCi | 112 | 106 | 1.06 | A |
| | | | Mn-54 | pCi | 115 | 106 | 1.08 | A |
| | | | Fe-59 | pCi | 139 | 129 | 1.08 | A |
| | | | Zn-65 | pCi | 163 | 153 | 1.07 | A |
| | | | Co-60 | pCi | 212 | 204 | 1.04 | A |
| | E10479 | Charcoal | I-131 | pCi | 90.1 | 92.6 | 0.97 | A |
| | E10481 | Water | Fe-55 | pCi/L | 1840 | 1890 | 0.97 | A |
| June 2013 | E10564 | Milk | Sr-89 | pCi/L | 110 | 95.0 | 1.16 | A |
| | | | Sr-90 | pCi/L | 15.8 | 17.0 | 0.93 | A |
| | E10545 | Milk | I-131 | pCi/L | 92.6 | 95.5 | 0.97 | A |
| | | | Ce-141 | pCi/L | 83.1 | 90.4 | 0.92 | A |
| | | | Cr-51 | pCi/L | 253 | 250 | 1.01 | A |
| | | | Cs-134 | pCi/L | 118 | 125 | 0.94 | A |
| | | | Cs-137 | pCi/L | 143 | 151 | 0.95 | A |
| | | | Co-58 | pCi/L | 87.1 | 94.0 | 0.93 | A |
| | | | Mn-54 | pCi/L | 171 | 172 | 0.99 | A |
| | | | Fe-59 | pCi/L | 125 | 120 | 1.04 | A |
| | | | Zn-65 | pCi/L | 220 | 217 | 1.01 | A |
| | | | Co-60 | pCi/L | 169 | 175 | 0.97 | A |
| | E10547 | AP | Ce-141 | pCi | 56.8 | 56.7 | 1.00 | A |
| | | | Cr-51 | pCi | 168 | 157 | 1.07 | A |
| | | | Cs-134 | pCi | 85.2 | 78.4 | 1.09 | A |
| | | | Cs-137 | pCi | 101 | 94.6 | 1.07 | A |
| | | | Co-58 | pCi | 62.7 | 58.9 | 1.06 | A |
| | | | Mn-54 | pCi | 125 | 108 | 1.16 | A |
| | | | Fe-59 | pCi | 85.7 | 75.0 | 1.14 | A |
| | | | Zn-65 | pCi | 169 | 136 | 1.24 | W |
| | | | Co-60 | pCi | 116 | 110 | 1.05 | A |
| | E10546 | Charcoal | I-131 | pCi | 86.5 | 89.7 | 0.96 | A |

**TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**
**TELEDYNE BROWN ENGINEERING, 2013**
**(PAGE 2 OF 3)**

| Month/Year | Identification Number | Matrix | Nuclide | Units | Reported Value (a) | Known Value (b) | Ratio (c) TBE/Analytics | Evaluation (d) |
|---|---|---|---|---|---|---|---|---|
| June 2013 | E10549 | Water | Fe-55 | pCi/L | 1610 | 1610 | 1.00 | A |
| September 2013 | E10646 | Milk | Sr-89 | pCi/L | 63.9 | 96.0 | 0.67 | N (1) |
| | | | Sr-90 | pCi/L | 8.88 | 13.2 | 0.67 | N (1) |
| | E10647 | Milk | I-131 | pCi/L | 93.9 | 98.3 | 0.96 | A |
| | | | Ce-141 | pCi/L | | | | NA (2) |
| | | | Cr-51 | pCi/L | 272 | 277 | 0.98 | A |
| | | | Cs-134 | pCi/L | 150 | 172 | 0.87 | A |
| | | | Cs-137 | pCi/L | 125 | 131 | 0.95 | A |
| | | | Co-58 | pCi/L | 105 | 108 | 0.97 | A |
| | | | Mn-54 | pCi/L | 138 | 139 | 0.99 | A |
| | | | Fe-59 | pCi/L | 125 | 130 | 0.96 | A |
| | | | Zn-65 | pCi/L | 264 | 266 | 0.99 | A |
| | | | Co-60 | pCi/L | 187 | 196 | 0.95 | A |
| | E10672 | AP | Ce-141 | pCi | | | | NA (2) |
| | | | Cr-51 | pCi | 208 | 223 | 0.93 | A |
| | | | Cs-134 | pCi | 143 | 139 | 1.03 | A |
| | | | Cs-137 | pCi | 106 | 105 | 1.01 | A |
| | | | Co-58 | pCi | 97.0 | 86.5 | 1.12 | A |
| | | | Mn-54 | pCi | 116 | 112 | 1.04 | A |
| | | | Fe-59 | pCi | 98.6 | 105 | 0.94 | A |
| | | | Zn-65 | pCi | 219 | 214 | 1.02 | A |
| | | | Co-60 | pCi | 166 | 158 | 1.05 | A |
| | E10648 | Charcoal | I-131 | pCi | 76.3 | 71.7 | 1.06 | A |
| | E10673 | Water | Fe-55 | pCi/L | 1790 | 1690 | 1.06 | A |
| December 2013 | E10774 | Milk | Sr-89 | pCi/L | 97.3 | 93.8 | 1.04 | A |
| | | | Sr-90 | pCi/L | 13.3 | 12.9 | 1.03 | A |
| | E10775 | Milk | I-131 | pCi/L | 89.7 | 96.1 | 0.93 | A |
| | | | Ce-141 | pCi/L | 99.8 | 110 | 0.91 | A |
| | | | Cr-51 | pCi/L | 297 | 297 | 1.00 | A |
| | | | Cs-134 | pCi/L | 129 | 142 | 0.91 | A |
| | | | Cs-137 | pCi/L | 126 | 126 | 1.00 | A |
| | | | Co-58 | pCi/L | 116 | 112 | 1.04 | A |
| | | | Mn-54 | pCi/L | 167 | 168 | 0.99 | A |
| | | | Fe-59 | pCi/L | 117 | 110 | 1.06 | A |
| | | | Zn-65 | pCi/L | 757 | 741 | 1.02 | A |
| | | | Co-60 | pCi/L | 141 | 147 | 0.96 | A |
| | E10777 | AP | Ce-141 | pCi | 85.1 | 88.0 | 0.97 | A |
| | | | Cr-51 | pCi | 278 | 238 | 1.17 | A |
| | | | Cs-134 | pCi | 123 | 114 | 1.08 | A |
| | | | Cs-137 | pCi | 102 | 101 | 1.01 | A |
| | | | Co-58 | pCi | 84.4 | 89.9 | 0.94 | A |
| | | | Mn-54 | pCi | 132 | 135 | 0.98 | A |
| | | | Fe-59 | pCi | 101 | 88.3 | 1.14 | A |
| | | | Zn-65 | pCi | 506 | 595 | 0.85 | A |
| | | | Co-60 | pCi | 118 | 118 | 1.00 | A |

**TABLE D-1 ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**
**TELEDYNE BROWN ENGINEERING, 2013**
**(PAGE 3 OF 3)**

| Month/Year | Identification Number | Matrix | Nuclide | Units | Reported Value (a) | Known Value (b) | Ratio (c) TBE/Analytics | Evaluation (d) |
|---|---|---|---|---|---|---|---|---|
| December 2013 | E10776 | Charcoal | I-131 | pCi | 84.7 | 80.5 | 1.05 | A |
| | E10778 | Water | Fe-55 | pCi/L | 2010 | 1910 | 1.05 | A |

*(1) Milk, Sr-89/90 - The failure was due to analyst error. No client samples were affected by this failure. NCR 13-15*

*(2) The sample was not spiked with Ce-141*

*(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, 2013**
**(PAGE 1 OF 1)**

| Month/Year | Identification Number | Media | Nuclide | Units | Reported Value (a) | Known Value (b) | Acceptance Limits | Evaluation (c) |
|---|---|---|---|---|---|---|---|---|
| May 2013 | RAD-93 | Water | Sr-89 | pCi/L | 48.3 | 41.3 | 31.6 - 48.4 | A |
| | | | Sr-90 | pCi/L | 19.3 | 23.9 | 17.2 - 28.0 | A |
| | | | Ba-133 | pCi/L | 81.9 | 82.1 | 69.0 - 90.3 | A |
| | | | Cs-134 | pCi/L | 40.9 | 42.8 | 34.2 - 47.1 | A |
| | | | Cs-137 | pCi/L | 44.0 | 41.7 | 37.0 - 48.8 | A |
| | | | Co-60 | pCi/L | 61.9 | 65.9 | 59.3 - 75.0 | A |
| | | | Zn-65 | pCi/L | 202 | 189 | 170 - 222 | A |
| | | | Gr-A | pCi/L | 34.2 | 40.8 | 21.1 - 51.9 | A |
| | | | Gr-B | pCi/L | 18.0 | 21.6 | 13.0 - 29.7 | A |
| | | | I-131 | pCi/L | 23.8 | 23.8 | 19.7 - 28.3 | A |
| | | | U-Nat | pCi/L | 60.4 | 61.2 | 49.8 - 67.9 | A |
| | | | H-3 | pCi/L | 3970 | 4050 | 3450 - 4460 | A |
| | MRAD-18 | Filter | Gr-A | pCi/filter | Lost during processing | | | |
| November 2013 | RAD-95 | Water | Sr-89 | pCi/L | 25.5 | 21.9 | 14.4 - 28.2 | A |
| | | | Sr-90 | pCi/L | 14.3 | 18.1 | 12.8 - 21.5 | A |
| | | | Ba-133 | pCi/L | 57.2 | 54.2 | 44.7 - 59.9 | A |
| | | | Cs-134 | pCi/L | 83.3 | 86.7 | 71.1 - 95.4 | A |
| | | | Cs-137 | pCi/L | 201 | 206 | 185 - 228 | A |
| | | | Co-60 | pCi/L | 104 | 102 | 91.8 - 114 | A |
| | | | Zn-65 | pCi/L | 361 | 333 | 300 - 389 | A |
| | | | Gr-A | pCi/L | 29.5 | 42.8 | 22.2 - 54.3 | A |
| | | | Gr-B | pCi/L | 30.1 | 32.2 | 20.8 - 39.9 | A |
| | | | I-131 | pCi/L | 23.1 | 23.6 | 19.6 - 28.0 | A |
| | | | U-Nat | pCi/L | 5.53 | 6.24 | 47.0 - 7.44 | A |
| | | | H-3 | pCi/L | 17650 | 17700 | 15500 - 19500 | A |
| | MRAD-19 | Filter | Gr-A | pCi/filter | 33.0 | 83.0 | 27.8 - 129 | A |

*(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, 2013**
**(PAGE 1 OF 2)**

| Month/Year | Identification Number | Media | Nuclide | Units | Reported Value (a) | Known Value (b) | Acceptance Range | Evaluation (c) |
|---|---|---|---|---|---|---|---|---|
| March 2013 | 13-MaW28 | Water | Cs-134 | Bq/L | 21.0 | 24.4 | 17.1 - 31.7 | A |
| | | | Cs-137 | Bq/L | 0.0446 | | (1) | A |
| | | | Co-57 | Bq/L | 28.3 | 30.9 | 21.6 - 40.2 | A |
| | | | Co-60 | Bq/L | 18.2 | 19.56 | 13.69 - 25.43 | A |
| | | | H-3 | Bq/L | 506 | 507 | 355 - 659 | A |
| | | | Mn-54 | Bq/L | 25.7 | 27.4 | 19.2 - 35.6 | A |
| | | | K-40 | Bq/L | 2.09 | | (1) | A |
| | | | Sr-90 | Bq/L | 10.5 | 10.5 | 7.4 - 13.7 | A |
| | | | Zn-65 | Bq/L | 29.2 | 30.4 | 21.3 - 39.5 | A |
| | 13-GrW28 | Water | Gr-A | Bq/L | 2.74 | 2.31 | 0.69 - 3.93 | A |
| | | | Gr-B | Bq/L | 15.6 | 13.0 | 6.5 - 19.5 | A |
| | 13-MaS28 | Soil | Cs-134 | Bq/kg | 859 | 887 | 621 - 1153 | A |
| | | | Cs-137 | Bq/kg | 633 | 587 | 411 - 763 | A |
| | | | Co-57 | Bq/kg | 0.256 | | (1) | A |
| | | | Co-60 | Bq/kg | 738 | 691 | 484 - 898 | A |
| | | | Mn-54 | Bq/kg | 0.671 | | (1) | A |
| | | | K-40 | Bq/kg | 714 | 625.3 | 437.7 - 812.9 | A |
| | | | Sr-90 | Bq/kg | 442 | 628 | 440 - 816 | W |
| | | | Zn-65 | Bq/kg | 1057 | 995 | 697 - 1294 | A |
| | 13-RdF28 | AP | Cs-134 | Bq/sample | 1.73 | 1.78 | 1.25 - 2.31 | A |
| | | | Cs-137 | Bq/sample | 2.73 | 2.60 | 1.82 - 3.38 | A |
| | | | Co-57 | Bq/sample | 2.38 | 2.36 | 1.65 - 3.07 | A |
| | | | Co-60 | Bq/sample | 0.0302 | | (1) | A |
| | | | Mn-54 | Bq/sample | 4.36 | 4.26 | 2.98 - 5.54 | A |
| | | | Sr-90 | Bq/sample | 1.43 | 1.49 | 1.04 - 1.94 | A |
| | | | Zn-65 | Bq/sample | 3.14 | 3.13 | 2.19 - 4.07 | A |
| | 13-GrF28 | AP | Gr-A | Bq/sample | 0.767 | 1.20 | 0.36 - 2.04 | A |
| | | | Gr-B | Bq/sample | 0.871 | 0.85 | 0.43 - 1.28 | A |
| | 13-RdV28 | Vegetation | Cs-134 | Bq/sample | -0.197 | | (1) | A |
| | | | Cs-137 | Bq/sample | 7.39 | 6.87 | 4.81 - 8.93 | A |
| | | | Co-57 | Bq/sample | 9.87 | 8.68 | 6.08 - 11.28 | A |
| | | | Co-60 | Bq/sample | 6.08 | 5.85 | 4.10 - 7.61 | A |
| | | | Mn-54 | Bq/sample | -0.0104 | | (1) | A |
| | | | Sr-90 | Bq/sample | 1.28 | 1.64 | 1.15 - 2.13 | W |
| | | | Zn-65 | Bq/sample | 6.84 | 6.25 | 4.38 - 8.13 | A |
| September 2013 | 13-MaW29 | Water | Cs-134 | Bq/L | 29.1 | 30.0 | 21.0 - 39.0 | A |
| | | | Cs-137 | Bq/L | 34.5 | 31.6 | 22.1 - 41.1 | A |
| | | | Co-57 | Bq/L | 0.0358 | | (1) | A |
| | | | Co-60 | Bq/L | 24.6 | 23.58 | 16.51 - 30.65 | A |
| | | | H-3 | Bq/L | 2.45 | | (1) | A |
| | | | Mn-54 | Bq/L | 0.0337 | | (1) | A |
| | | | K-40 | Bq/L | 0.193 | | (1) | A |
| | | | Sr-90 | Bq/L | 9.12 | 7.22 | 5.05 - 9.39 | W |
| | | | Zn-65 | Bq/L | 38.1 | 34.6 | 24.2 - 45.0 | A |
| | 13-GrW29 | Water | Gr-A | Bq/L | 1.13 | 0.701 | 0.210 - 1.192 | A |
| | | | Gr-B | Bq/L | 7.61 | 5.94 | 2.97 - 8.91 | A |

**TABLE D-3 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)**
**TELEDYNE BROWN ENGINEERING, 2013**
**(PAGE 2 OF 2)**

| Month/Year | Identification Number | Media | Nuclide | Units | Reported Value (a) | Known Value (b) | Acceptance Range | Evaluation (c) |
|---|---|---|---|---|---|---|---|---|
| September 2013 | 13-MaS29 | Soil | Cs-134 | Bq/kg | 1150 | 1172 | 820 - 1524 | A |
| | | | Cs-137 | Bq/kg | 1100 | 977 | 684 - 1270 | A |
| | | | Co-57 | Bq/kg | 670 | | (1) | N (2) |
| | | | Co-60 | Bq/kg | 502 | 451 | 316 - 586 | A |
| | | | Mn-54 | Bq/kg | 758 | 674 | 472 - 876 | A |
| | | | K-40 | Bq/kg | 796 | 633 | 443 - 823 | W |
| | | | Sr-90 | Bq/kg | 664 | 460 | 322 - 598 | N (2) |
| | | | Zn-65 | Bq/kg | 210 | | (1) | N (2) |
| | 13-RdF29 | AP | Cs-134 | Bq/sample | -0.570 | | (1) | N (2) |
| | | | Cs-137 | Bq/sample | 2.85 | 2.7 | 1.9 - 3.5 | A |
| | | | Co-57 | Bq/sample | 3.30 | 3.4 | 2.4 - 4.4 | A |
| | | | Co-60 | Bq/sample | 2.41 | 2.3 | 1.6 - 3.0 | A |
| | | | Mn-54 | Bq/sample | 3.65 | 3.5 | 2.5 - 4.6 | A |
| | | | Sr-90 | Bq/sample | 1.40 | 1.81 | 1.27 - 2.35 | W |
| | | | Zn-65 | Bq/sample | 2.90 | 2.7 | 1.9 - 3.5 | A |
| | 13-GrF29 | AP | Gr-A | Bq/sample | 0.872 | 0.9 | 0.3 - 1.5 | A |
| | | | Gr-B | Bq/sample | 1.57 | 1.63 | 0.82 - 2.45 | A |
| | 13-RdV29 | Vegetation | Cs-134 | Bq/sample | 5.29 | 5.20 | 3.64 - 6.76 | A |
| | | | Cs-137 | Bq/sample | 7.48 | 6.60 | 4.62 - 8.58 | A |
| | | | Co-57 | Bq/sample | 0.0129 | | (1) | A |
| | | | Co-60 | Bq/sample | 0.0523 | | (1) | A |
| | | | Mn-54 | Bq/sample | 8.78 | 7.88 | 5.52 - 10.24 | A |
| | | | Sr-90 | Bq/sample | 1.63 | 2.32 | 1.62 - 3.02 | W (2) |
| | | | Zn-65 | Bq/sample | 3.18 | 2.63 | 1.84 - 3.42 | W |

*(1) False positive test.*

*(2) Soil, Co-57 & Zn-65 identified by gamma software as not detected, MAPEP evaluated as failing the false positive test. A large concentration of Eu-152 was spiked into the sample, causing interference in the analysis. Gamma software recognized the interference and identified them as not detected. MAPEP does not allow clients to enter non-detect designation. NCR 13-04*
*Soil, Sr-90 - incorrect results were submitted to MAPEP. Actual result was 332 bq/kg, which is with the acceptance range. NCR 13-04*
*AP, Cs-134 - MAPEP evaluated the -0.570 as a failed false positive test. No client samples were affected by these failures. NCR 13-04*
*Vegetation, Sr-90 - it appears that the carrier was double spiked into the sample, resulting in the low activity for this sample. NCR 13-04*

*(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., 2013**



| Lab Code | Date | Analysis | Concentration (pCi/L) Laboratory Result (b) | ERA Result (c) | Control Limits | Acceptance |
|---|---|---|---|---|---|---|
| ERW-1593 | 04/08/13 | Sr-89 | 43.6 ± 4.3 | 41.30 | 31.6 - 48.4 | Pass |
| ERW-1593 | 04/08/13 | Sr-90 | 23.2 ± 1.7 | 23.90 | 17.2 - 28.0 | Pass |
| ERW-1596 | 04/08/13 | Ba-133 | 74.80 4.00 | 82.10 | 69.00 90.30 | Pass |
| ERW-1596 | 04/08/13 | Co-60 | 65.50 3.42 | 65.90 | 59.30 75.00 | Pass |
| ERW-1596 | 04/08/13 | Cs-134 | 41.10 3.47 | 42.80 | 34.20 47.10 | Pass |
| ERW-1596 | 04/08/13 | Cs-137 | 42.30 4.03 | 41.70 | 37.00 48.80 | Pass |
| ERW-1596 | 04/08/13 | Zn-65 | 200.3 ± 10.1 | 189.0 | 170.0 - 222.0 | Pass |
| ERW-1598 | 04/08/13 | Gr. Alpha | 34.30 1.98 | 40.80 | 21.10 51.90 | Pass |
| ERW-1598 | 04/08/13 | Gr. Beta | 18.70 0.98 | 21.60 | 13.00 29.70 | Pass |
| ERW-1600 | 04/08/13 | I-131 | 23.00 ± 1.10 | 23.80 | 19.70 - 28.30 | Pass |
| ERW-1600 | 04/08/13 | I-131(G) | 23.48 ± 9.44 | 23.80 | 19.70 ± 28.30 | Pass |
| ERW-1606 | 04/08/13 | H-3 | 4041 ± 194 | 4050 | 3450 - 4460 | Pass |
| ERW-6009 | 10/07/13 | Sr-89 | 22.00 2.80 | 21.90 | 14.40 28.20 | Pass |
| ERW-6009 | 10/07/13 | Sr-90 | 17.10 2.55 | 18.10 | 12.80 21.50 | Pass |
| ERW-6012 | 10/07/13 | Ba-133 | 48.20 4.29 | 54.20 | 44.70 59.90 | Pass |
| ERW-6012 | 10/07/13 | Co-60 | 100.8 ± 4.7 | 102.0 | 91.8 - 114.0 | Pass |
| ERW-6012 | 10/07/13 | Cs-134 | 87.30 4.35 | 86.70 | 71.10 95.40 | Pass |
| ERW-6012 | 10/07/13 | Cs-137 | 199.6 ± 7.4 | 206.0 | 185.0 - 228.0 | Pass |
| ERW-6012 | 10/07/13 | Zn-65 | 356.2 ± 13.2 | 333.0 | 300.0 - 389.0 | Pass |
| ERW-6015 | 10/07/13 | Gr. Alpha | 30.70 11.90 | 42.80 | 22.20 54.30 | Pass |
| ERW-6015 | 10/07/13 | Gr. Beta | 25.70 6.48 | 32.20 | 20.80 39.90 | Pass |
| ERW-6019 | 10/07/13 | I-131 | 22.50 1.01 | 23.60 | 19.60 28.00 | Pass |
| ERW-6024 | 10/07/13 | H-3 | 18397 695 | 17700 | 15500 19500 | Pass |

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

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

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

**TABLE D-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)**
**ENVIRONMENTAL, INC., 2013**
**(Page 1 of 2)**

| | | | Concentration (a) | | | |
|---|---|---|---|---|---|---|
| Lab Code (b) | Date | Analysis | Laboratory result | Known Activity | Control Limits (c) | Acceptance |
| MAAP-738 | 02/01/13 | Co-57 | 2.58 ± 0.06 | 2.36 | 1.65 - 3.07 | Pass |
| MAAP-738 | 02/01/13 | Co-60 | 0.01 ± 0.03 | 0.00 | 0.00 - 0.10 | Pass |
| MAAP-738 | 02/01/13 | Cs-134 | 1.82 ± 0.13 | 1.78 | 1.25 - 2.31 | Pass |
| MAAP-738 | 02/01/13 | Cs-137 | 2.93 ± 0.10 | 2.60 | 1.82 - 3.38 | Pass |
| MAAP-738 | 02/01/13 | Mn-54 | 4.87 ± 0.13 | 4.26 | 2.98 - 5.54 | Pass |
| MAAP-738 | 02/01/13 | Sr-90 | 1.39 ± 0.14 | 1.49 | 1.04 - 1.94 | Pass |
| MAAP-738 | 02/01/13 | Zn-65 | 3.84 ± 0.20 | 3.13 | 2.19 - 4.07 | Pass |
| MAAP-738 d | 02/01/13 | Gr. Alpha | 0.14 ± 0.03 | 1.20 | 0.36 - 2.04 | Fail (1) |
| MAAP-738 | 02/01/13 | Gr. Beta | 0.93 ± 0.06 | 0.85 | 0.43 - 1.28 | Pass |
| MAW-806 | 02/01/13 | Co-57 | 31.20 0.40 | 30.90 | 21.60 40.20 | Pass |
| MAW-806 | 02/01/13 | Co-60 | 19.70 ± 0.30 | 16.56 | 13.69 - 25.43 | Pass |
| MAW-806 | 02/01/13 | Cs-134 | 23.20 ± 0.50 | 24.40 | 17.10 - 31.70 | Pass |
| MAW-806 | 02/01/13 | Cs-137 | 0.03 ± 0.12 | 0.00 | 0.00 - 1.00 | Pass |
| MAW-806 | 02/01/13 | Fe-55 | 34.00 ± 3.30 | 44.00 | 30.80 - 57.20 | Pass |
| MAW-806 | 02/01/13 | H-3 | 511.60 ± 12.50 | 507.00 | 355.00 - 659.00 | Pass |
| MAW-806 | 02/01/13 | K-40 | 2.20 ± 0.90 | 0.00 | 0.00 - 5.00 | Pass |
| MAW-806 | 02/01/13 | Mn-54 | 27.60 ± 0.50 | 27.40 | 19.20 - 35.60 | Pass |
| MAW-806 | 02/01/13 | Sr-90 | 9.30 ± 0.80 | 10.50 | 7.40 - 13.70 | Pass |
| MAW-806 | 02/01/13 | Zn-65 | 31.60 ± 0.80 | 30.40 | 21.30 - 39.50 | Pass |
| MAW-811 | 02/01/13 | Gr. Alpha | 1.87 ± 0.09 | 2.31 | 0.69 - 3.93 | Pass |
| MAW-811 | 02/01/13 | Gr. Beta | 13.04 ± 0.13 | 13.00 | 6.50 - 19.50 | Pass |
| MASO-739 | 02/01/13 | Co-57 | 0.60 ± 0.50 | 0.00 | 0.00 - 5.00 | Pass |
| MASO-739 | 02/01/13 | Co-60 | 739.20 ± 28.50 | 691.00 | 484.00 - 898.00 | Pass |
| MASO-739 | 02/01/13 | Cs-134 | 863.30 ± 34.10 | 887.00 | 621.00 - 1153.00 | Pass |
| MASO-739 | 02/01/13 | Cs-137 | 661.80 ± 25.70 | 587.00 | 411.00 - 763.00 | Pass |
| MASO-739 | 02/01/13 | K-40 | 745.80 ± 33.30 | 625.30 | 437.70 - 812.90 | Pass |
| MASO-739 | 02/01/13 | Mn-54 | 1.10 ± 1.00 | 0.00 | 0.00 - 5.00 | Pass |
| MASO-739 | 02/01/13 | Zn-65 | 1109.60 ± 44.10 | 995.00 | 697.00 - 1294.00 | Pass |
| MASO-744 e | 02/01/13 | Sr-90 | 408.40 ± 14.00 | 628.00 | 440.00 - 816.00 | Fail (2) |
| MAVE-747 | 02/01/13 | Co-57 | 10.37 ± 0.17 | 8.68 | 6.08 - 11.28 | Pass |
| MAVE-747 | 02/01/13 | Co-60 | 6.48 ± 0.17 | 5.85 | 4.10 - 7.61 | Pass |
| MAVE-747 | 02/01/13 | Cs-134 | 0.02 ± 0.04 | 0.00 | 0.00 - 0.10 | Pass |
| MAVE-747 | 02/01/13 | Cs-137 | 7.79 ± 0.21 | 6.87 | 4.81 - 8.93 | Pass |
| MAVE-747 | 02/01/13 | Mn-54 | 0.00 ± 0.05 | 0.00 | 0.00 - 0.10 | Pass |
| MAVE-747 | 02/01/13 | Zn-65 | 7.29 ± 0.33 | 6.25 | 4.38 - 8.13 | Pass |
| MASO-5043 f | 08/01/13 | Co-57 | 699.60 ± 3.90 | 0.00 | 0.00 - 5.00 | Fail (3) |
| MASO-5043 | 08/01/13 | Cs-134 | 1191.70 ± 23.00 | 1172.00 | 820.00 - 1524.00 | Pass |
| MASO-5043 | 08/01/13 | Cs-137 | 1072.00 ± 5.10 | 977.00 | 684.00 - 1270.00 | Pass |
| MASO-5043 | 08/01/13 | K-40 | 760.00 ± 16.20 | 633.00 | 443.00 - 823.00 | Pass |
| MASO-5043 | 08/01/13 | Mn-54 | 753.80 ± 4.90 | 674.00 | 472.000 - 876.000 | Pass |

**TABLE D-5 DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP) ENVIRONMENTAL, INC., 2013**



| | | | Concentration (a) | | | |
|---|---|---|---|---|---|---|
| Lab Code (b) | Date | Analysis | Laboratory result | Known Activity | Control Limits (c) | Acceptance |
| MASO-5043 | 08/01/13 | Sr-90 | 383.90 ± 14.50 | 460.00 | 322.00 - 598.00 | Pass |
| MASO-5043 | 08/01/13 | Zn-65 | -351.50 ± 5.50 | 0.00 | 0.00 - 0.00 | Pass |
| MAW-5094 | 08/01/13 | Co-57 | 0.01 ± 0.09 | 0.00 | 0.00 - 5.00 | Pass |
| MAW-5094 | 08/01/13 | Co-60 | 23.20 ± 0.32 | 23.58 | 16.51 - 30.65 | Pass |
| MAW-5094 | 08/01/13 | Cs-134 | 27.60 ± 0.58 | 30.40 | 21.00 - 39.00 | Pass |
| MAW-5094 | 08/01/13 | Cs-137 | 32.31 ± 0.52 | 31.60 | 22.10 - 41.10 | Pass |
| MAW-5094 | 08/01/13 | Fe-55 | 39.20 ± 3.50 | 53.30 | 37.30 - 69.30 | Pass |
| MAW-5094 | 08/01/13 | Gr. Alpha | 0.54 ± 0.05 | 0.70 | 0.21 - 1.19 | Pass |
| MAW-5094 | 08/01/13 | Gr. Beta | 5.85 ± 0.09 | 5.94 | 2.97 - 8.91 | Pass |
| MAW-5094 | 08/01/13 | H-3 | 1.20 ± 3.00 | 0.00 | 0.00 - 5.00 | Pass |
| MAW-5094 | 08/01/13 | K-40 | 2.22 ± 0.90 | 0.00 | 0.00 - 5.00 | Pass |
| MAW-5094 | 08/01/13 | Mn-54 | 0.010 ± 0.11 | 0.00 | 0.00 - 5.00 | Pass |
| MAW-5094 | 08/01/13 | Sr-90 | 6.40 ± 0.60 | 7.22 | 5.05 - 9.39 | Pass |
| MAW-5094 | 08/01/13 | Zn-65 | 35.30 ± 0.90 | 34.60 | 24.20 - 45.00 | Pass |
| MAVE-5046 | 08/01/13 | Co-57 | 0.01 ± 0.03 | 0.00 | 0.00 - 0.00 | Pass |
| MAVE-5046 | 08/01/13 | Co-60 | 0.00 ± 0.04 | 0.00 | 0.00 - 0.00 | Pass |
| MAVE-5046 | 08/01/13 | Cs-134 | 5.71 ± 0.23 | 5.20 | 3.64 - 6.76 | Pass |
| MAVE-5046 | 08/01/13 | Cs-137 | 7.64 ± 0.20 | 6.60 | 4.62 - 8.58 | Pass |
| MAVE-5046 | 08/01/13 | Mn-54 | 9.08 ± 0.24 | 7.88 | 5.52 - 10.24 | Pass |
| MAVE-5046 | 08/01/13 | Zn-65 | 2.92 ± 0.25 | 2.63 | 1.84 - 3.42 | Pass |
| MAAP-5046 | 08/01/13 | Co-57 | 3.48 ± 0.14 | 3.40 | 1.90 - 3.50 | Pass |
| MAAP-5046 | 08/01/13 | Co-60 | 2.44 ± 0.08 | 3.40 | 1.60 - 3.00 | Pass |
| MAAP-5046 | 08/01/13 | Cs-134 | 0.01 ± 0.03 | 0.00 | 0.02 - 0.04 | Pass |
| MAAP-5046 | 08/01/13 | Cs-137 | 3.09 ± 0.13 | 2.70 | 1.90 - 3.50 | Pass |
| MAAP-5046 | 08/01/13 | Gr. Alpha | 0.28 ± 0.04 | 0.90 | 0.27 - 1.53 | Pass |
| MAAP-5046 | 08/01/13 | Gr. Beta | 1.90 ± 0.08 | 1.63 | 0.82 - 2.45 | Pass |
| MAAP-5046 | 08/01/13 | Mn-54 | 3.95 ± 0.12 | 3.50 | 2.50 - 4.60 | Pass |
| MAAP-5046 | 08/01/13 | Sr-90 | 1.69 ± 4.10 | 1.81 | 1.27 - 2.35 | Pass |
| MAAP-5046 | 08/01/13 | Zn-65 | 3.27 ± 0.18 | 2.70 | 2.50 - 4.60 | Pass |

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

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

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

(1) The filter was recounted overnight, no significant alpha activity could be detected.

(2) The sample was reanalyzed using additional fuming nitric separations. Result of reanalysis: 574.4 ± 35.2 Bq/kg.

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

# APPENDIX E

# EFFLUENT DATA

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Table of Contents (cont.)

# 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 2013 showed minimal releases above background for a variety of monitored pathways, e.g. water, vegetation, air samples and TLIV.

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

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

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

## SUMMARY

Gaseous, liquid and solid waste effluents for the period contributed to only a small fraction of the Station Technical Specification limits. Calculations of environmental concentrations based on effluent and meteorological data for the period indicate that consumption by the public of radionuclides attributable to the Zion Station does not exceed regulatory limits. Radiation exposure from direct radiation from containerized waste at the site boundary represented the critical pathway for the period with a maximum individual total body dose estimated to be 4.68E+00 mrem for the year, where a factor to analyze exposure based on habits of the real individual of 3.33E-01 was applied. The assessment of radiation doses is performed in accordance with the Zion Station Offsite Dose Calculation Manual (ODCM). The results of analysis confirm that the station is operating in compliance with 10CFR50 Appendix 1, 10CFR20, 10CFR72 and 40CFR190.

## 1.0 EFFLUENTS

### 1.1 Gaseous Effluents to the Atmosphere

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

A total of 0.00E+00 microcuries of beta-gamma emitters was released as airborne particulate matter with a maximum average quarterly release rate of 0.00E+00 µCi/sec. Alpha-emitting radionuclides were not measurable. Also, 6.49E-02 curies of tritium were released with a maximum average quarterly release rate of 2.40E-03 µCi/sec.

### 1.2 Liquids Released to Lake Michigan

A total of 1.20E+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 4.96E+09 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 0.00E+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 2013.

## 2.0 SOLID RADIOACTIVE WASTE

There were 33 solid radioactive waste shipments in 2013. For more detail, refer to the Zion Station 2013 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 1.65E-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 3.5-1). 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 3.5-1).

#### 3.1.1.2 Beta Air and Skin Dose Rates

The range of beta particles in air is relatively small (on the order of a few meters or less); consequently, plumes of gaseous effluents may be considered "infinite" for purpose of calculating the dose from beta radiation incident on the skin. However, the actual dose to sensitive skin tissues is difficult to calculate due to the effect of the beta particle energies, thickness of inert skin and clothing covering sensitive tissues. For purposes of this report the skin is taken to have a 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 3.5-1).

The maximum offsite beta air dose for the year was 0.00E+00 mrad based on measured effluents

and average meteorological data (Table 3.1-1), and 0.00E+00 mrad based on measured effluents and concurrent meteorological data (Table 3.5-1).

3.1.2 Radioactive Iodine

The human thyroid exhibits a significant capacity to concentrate ingested or inhaled iodine. The radioiodine, 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 Direct Radiation

During the period January to December 2013, Zion Station during decommissioning has stored containerized radioactive waste that contributed a total of 4.68E+00 mrem to the whole body of a maximally exposed individual at site boundary taking into account

the occupancy factor of 3.33E-01 calculated in Zion Station ES&H Technical Support Document(TSD) 13-009 "Member of the Public Dose from All Onsite Sources."

3.4 Assessment of Dose to Member of Public

During the period January to December, 2013, 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) and Table 3.3(based on TLD results):

- The RETS limits on dose or dose commitment to an individual due to radioactive materials in liquid effluents from each reactor unit (3 mrem to the whole body or 10 mrem to any organ during any calendar year).

- The RETS limits on air dose in noble gases released in gaseous effluents to a member of the public from each reactor unit (10 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).

- The 10CFR72.104 limit on Total Effective Dose Equivalent to individual members of the public from combined effluents and radioactive material including ISFSI(25 mrem).

4.0 SITE METEOROLOGY

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

*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 **98.9%** during **2013** (Table 3.5-1).

# APPENDIX E-1

# DATA TABLES AND FIGURES

# Table 3.1-1
# Maximum Dose Resulting from Airborne Releases
# Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 01/01/2013 00:00
Period End Date.....: 04/01/2013 00:00
Period Duration (min): 1.296E+05
Coefficient Type.....: Historical

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 5.184E+05 |
| Total Release Volume (cf) | 1.681E+10 |
| Average Release Flowrate (cfm) | 3.243E+04 |
| Average Period Flowrate (cfm) | 1.297E+05 |

=== NUCLIDE DATA ==========

| Nuclide | uCi | Average uCi/cc | ECrcent Ratio | EC |
|---|---|---|---|---|
| H-3 | 1.87E+04 | 3.93E-11 | 3.93E-04 | 1.00E-07 |
| H-3 | 1.87E+04 | 3.93E-11 | 3.93E-04 | |
| Total | 1.87E+04 | 3.93E-11 | 3.93E-04 | |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 01/01/2013 00:00
Period End Date.....: 04/01/2013 00:00
Period Duration (min): 1.296E+05
Coefficient Type.....: Historical
Receptor.....: 5 Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point.....: 0.0

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ==========

| Age/Path | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| AINHL | 0.00E+00 | 5.90E-06 | 5.90E-06 | 5.90E-06 | 5.90E-06 | 5.90E-06 | 0.00E+00 | 5.90E-06 |
| AVEG | 0.00E+00 | 1.06E-05 | 1.06E-05 | 1.06E-05 | 1.06E-05 | 1.06E-05 | 0.00E+00 | 1.06E-05 |
| AGMILK | 0.00E+00 | 7.30E-06 | 7.30E-06 | 7.30E-06 | 7.30E-06 | 7.30E-06 | 0.00E+00 | 7.30E-06 |
| ACMEAT | 0.00E+00 | 1.52E-06 | 1.52E-06 | 1.52E-06 | 1.52E-06 | 1.52E-06 | 0.00E+00 | 1.52E-06 |
| ACMILK | 0.00E+00 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 0.00E+00 | 3.58E-06 |
| TINHL | 0.00E+00 | 5.96E-06 | 5.96E-06 | 5.96E-06 | 5.96E-06 | 5.96E-06 | 0.00E+00 | 5.96E-06 |
| TVEG | 0.00E+00 | 1.21E-05 | 1.21E-05 | 1.21E-05 | 1.21E-05 | 1.21E-05 | 0.00E+00 | 1.21E-05 |
| TGMILK | 0.00E+00 | 9.49E-06 | 9.49E-06 | 9.49E-06 | 9.49E-06 | 9.49E-06 | 0.00E+00 | 9.49E-06 |
| TCMEAT | 0.00E+00 | 9.07E-07 | 9.07E-07 | 9.07E-07 | 9.07E-07 | 9.07E-07 | 0.00E+00 | 9.07E-07 |
| TCMILK | 0.00E+00 | 4.65E-06 | 4.65E-06 | 4.65E-06 | 4.65E-06 | 4.65E-06 | 0.00E+00 | 4.65E-06 |
| CINHL | 0.00E+00 | 5.26E-06 | 5.26E-06 | 5.26E-06 | 5.26E-06 | 5.26E-06 | 0.00E+00 | 5.26E-06 |
| CVEG | 0.00E+00 | 1.88E-05 | 1.88E-05 | 1.88E-05 | 1.88E-05 | 1.88E-05 | 0.00E+00 | 1.88E-05 |
| CGMILK | 0.00E+00 | 1.50E-05 | 1.50E-05 | 1.50E-05 | 1.50E-05 | 1.50E-05 | 0.00E+00 | 1.50E-05 |
| CCMEAT | 0.00E+00 | 1.10E-06 | 1.10E-06 | 1.10E-06 | 1.10E-06 | 1.10E-06 | 0.00E+00 | 1.10E-06 |
| CCMILK | 0.00E+00 | 7.37E-06 | 7.37E-06 | 7.37E-06 | 7.37E-06 | 7.37E-06 | 0.00E+00 | 7.37E-06 |
| IINHL | 0.00E+00 | 3.03E-06 | 3.03E-06 | 3.03E-06 | 3.03E-06 | 3.03E-06 | 0.00E+00 | 3.03E-06 |
| IGMILK | 0.00E+00 | 2.28E-05 | 2.28E-05 | 2.28E-05 | 2.28E-05 | 2.28E-05 | 0.00E+00 | 2.28E-05 |
| ICMILK | 0.00E+00 | 1.12E-05 | 1.12E-05 | 1.12E-05 | 1.12E-05 | 1.12E-05 | 0.00E+00 | 1.12E-05 |

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ==========

| Agegroup | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| ADULT | 0.00E+00 | 2.89E-05 | 2.89E-05 | 2.89E-05 | 2.89E-05 | 2.89E-05 | 0.00E+00 | 2.89E-05 |
| TEEN | 0.00E+00 | 3.31E-05 | 3.31E-05 | 3.31E-05 | 3.31E-05 | 3.31E-05 | 0.00E+00 | 3.31E-05 |
| CHILD | 0.00E+00 | 4.76E-05 | 4.76E-05 | 4.76E-05 | 4.76E-05 | 4.76E-05 | 0.00E+00 | 4.76E-05 |
| INFANT | 0.00E+00 | 3.70E-05 | 3.70E-05 | 3.70E-05 | 3.70E-05 | 3.70E-05 | 0.00E+00 | 3.70E-05 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

```
Release ID.............: 1  All Gas Releases
Period Start Date....: 01/01/2013 00:00
Period End Date......: 04/01/2013 00:00
Period Duration (min): 1.296E+05
Coefficient Type.....: Historical
Receptor.............: 5   Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0
```

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | LIVER | 4.76E-05 | 31-day | 2.25E-01 | 2.12E-02 | 3.00E-01 | 1.59E-02 |
| | | | | Quarter | 5.63E+00 | 8.46E-04 | 7.50E+00 | 6.35E-04 |
| | | | | Annual | 1.13E+01 | 4.23E-04 | 1.50E+01 | 3.17E-04 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 1.00E+02 |

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | TBODY | 4.76E-05 | 31-day | 1.50E-01 | 3.17E-02 | 2.00E-01 | 2.38E-02 |
| | | | | Quarter | 5.25E+00 | 9.06E-04 | 7.50E+00 | 6.35E-04 |
| | | | | Annual | 1.05E+01 | 4.53E-04 | 1.50E+01 | 3.17E-04 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 1.00E+02 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 04/01/2013 00:00
Period End Date.....: 07/01/2013 00:00
Period Duration (min): 1.310E+05
Coefficient Type.....: Historical

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 5.242E+05 |
| Total Release Volume (cf) | 1.704E+10 |
| Average Release Flowrate (cfm) | 3.250E+04 |
| Average Period Flowrate (cfm) | 1.300E+05 |

=== NUCLIDE DATA ==========

| Nuclide | uCi | Average uCi/cc | ECrcent Ratio | EC |
|---|---|---|---|---|
| H-3 | 1.30E+04 | 2.69E-11 | 2.69E-04 | 1.00E-07 |
| H-3 | 1.30E+04 | 2.69E-11 | 2.69E-04 | |
| Total | 1.30E+04 | 2.69E-11 | 2.69E-04 | |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

```
Release ID...........: 1  All Gas Releases
Period Start Date....: 04/01/2013 00:00
Period End Date......: 07/01/2013 00:00
Period Duration (min): 1.310E+05
Coefficient Type.....: Historical
Receptor.............: 5   Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0
```

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ==========

| Age/Path | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| AINHL | 0.00E+00 | 4.10E-06 | 4.10E-06 | 4.10E-06 | 4.10E-06 | 4.10E-06 | 0.00E+00 | 4.10E-06 |
| AVEG | 0.00E+00 | 7.36E-06 | 7.36E-06 | 7.36E-06 | 7.36E-06 | 7.36E-06 | 0.00E+00 | 7.36E-06 |
| AGMILK | 0.00E+00 | 5.07E-06 | 5.07E-06 | 5.07E-06 | 5.07E-06 | 5.07E-06 | 0.00E+00 | 5.07E-06 |
| ACMEAT | 0.00E+00 | 1.06E-06 | 1.06E-06 | 1.06E-06 | 1.06E-06 | 1.06E-06 | 0.00E+00 | 1.06E-06 |
| ACMILK | 0.00E+00 | 2.48E-06 | 2.48E-06 | 2.48E-06 | 2.48E-06 | 2.48E-06 | 0.00E+00 | 2.48E-06 |
| TINHL | 0.00E+00 | 4.14E-06 | 4.14E-06 | 4.14E-06 | 4.14E-06 | 4.14E-06 | 0.00E+00 | 4.14E-06 |
| TVEG | 0.00E+00 | 8.42E-06 | 8.42E-06 | 8.42E-06 | 8.42E-06 | 8.42E-06 | 0.00E+00 | 8.42E-06 |
| TGMILK | 0.00E+00 | 6.59E-06 | 6.59E-06 | 6.59E-06 | 6.59E-06 | 6.59E-06 | 0.00E+00 | 6.59E-06 |
| TCMEAT | 0.00E+00 | 6.30E-07 | 6.30E-07 | 6.30E-07 | 6.30E-07 | 6.30E-07 | 0.00E+00 | 6.30E-07 |
| TCMILK | 0.00E+00 | 3.23E-06 | 3.23E-06 | 3.23E-06 | 3.23E-06 | 3.23E-06 | 0.00E+00 | 3.23E-06 |
| CINHL | 0.00E+00 | 3.65E-06 | 3.65E-06 | 3.65E-06 | 3.65E-06 | 3.65E-06 | 0.00E+00 | 3.65E-06 |
| CVEG | 0.00E+00 | 1.31E-05 | 1.31E-05 | 1.31E-05 | 1.31E-05 | 1.31E-05 | 0.00E+00 | 1.31E-05 |
| CGMILK | 0.00E+00 | 1.04E-05 | 1.04E-05 | 1.04E-05 | 1.04E-05 | 1.04E-05 | 0.00E+00 | 1.04E-05 |
| CCMEAT | 0.00E+00 | 7.64E-07 | 7.64E-07 | 7.64E-07 | 7.64E-07 | 7.64E-07 | 0.00E+00 | 7.64E-07 |
| CCMILK | 0.00E+00 | 5.12E-06 | 5.12E-06 | 5.12E-06 | 5.12E-06 | 5.12E-06 | 0.00E+00 | 5.12E-06 |
| IINHL | 0.00E+00 | 2.10E-06 | 2.10E-06 | 2.10E-06 | 2.10E-06 | 2.10E-06 | 0.00E+00 | 2.10E-06 |
| IGMILK | 0.00E+00 | 1.58E-05 | 1.58E-05 | 1.58E-05 | 1.58E-05 | 1.58E-05 | 0.00E+00 | 1.58E-05 |
| ICMILK | 0.00E+00 | 7.77E-06 | 7.77E-06 | 7.77E-06 | 7.77E-06 | 7.77E-06 | 0.00E+00 | 7.77E-06 |

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ==========

| Agegroup | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| ADULT | 0.00E+00 | 2.01E-05 | 2.01E-05 | 2.01E-05 | 2.01E-05 | 2.01E-05 | 0.00E+00 | 2.01E-05 |
| TEEN | 0.00E+00 | 2.30E-05 | 2.30E-05 | 2.30E-05 | 2.30E-05 | 2.30E-05 | 0.00E+00 | 2.30E-05 |
| CHILD | 0.00E+00 | 3.30E-05 | 3.30E-05 | 3.30E-05 | 3.30E-05 | 3.30E-05 | 0.00E+00 | 3.30E-05 |
| INFANT | 0.00E+00 | 2.57E-05 | 2.57E-05 | 2.57E-05 | 2.57E-05 | 2.57E-05 | 0.00E+00 | 2.57E-05 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

```
Release ID.............: 1  All Gas Releases
Period Start Date....: 04/01/2013 00:00
Period End Date.......: 07/01/2013 00:00
Period Duration (min): 1.310E+05
Coefficient Type......: Historical
Receptor..............: 5   Composite Crit. Receptor - IP
Distance (meters).....: 0.0
Compass Point.........: 0.0
```

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | LIVER | 3.30E-05 | 31-day | 2.25E-01 | 1.47E-02 | 3.00E-01 | 1.10E-02 |
| | | | | Quarter | 5.63E+00 | 5.87E-04 | 7.50E+00 | 4.41E-04 |
| | | | | Annual | 1.13E+01 | 2.94E-04 | 1.50E+01 | 2.20E-04 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 9.99E+01 |

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | TBODY | 3.30E-05 | 31-day | 1.50E-01 | 2.20E-02 | 2.00E-01 | 1.65E-02 |
| | | | | Quarter | 5.25E+00 | 6.29E-04 | 7.50E+00 | 4.41E-04 |
| | | | | Annual | 1.05E+01 | 3.15E-04 | 1.50E+01 | 2.20E-04 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 9.99E+01 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 07/01/2013 00:00
Period End Date.....: 10/01/2013 00:00
Period Duration (min): 1.325E+05
Coefficient Type.....: Historical

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 5.299E+05 |
| Total Release Volume (cf) | 1.722E+10 |
| Average Release Flowrate (cfm) | 3.250E+04 |
| Average Period Flowrate (cfm) | 1.300E+05 |

=== NUCLIDE DATA ==========

| Nuclide | uCi | Average uCi/cc | ECrcent Ratio | EC |
|---|---|---|---|---|
| H-3 | 1.50E+04 | 3.08E-11 | 3.08E-04 | 1.00E-07 |
| H-3 | 1.50E+04 | 3.08E-11 | 3.08E-04 | |
| Total | 1.50E+04 | 3.08E-11 | 3.08E-04 | |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

```
Release ID...........: 1  All Gas Releases
Period Start Date....: 07/01/2013 00:00
Period End Date......: 10/01/2013 00:00
Period Duration (min): 1.325E+05
Coefficient Type.....: Historical
Receptor.............: 5   Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0
```

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ==========

| Age/Path | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| AINHL | 0.00E+00 | 4.74E-06 | 4.74E-06 | 4.74E-06 | 4.74E-06 | 4.74E-06 | 0.00E+00 | 4.74E-06 |
| AVEG | 0.00E+00 | 8.51E-06 | 8.51E-06 | 8.51E-06 | 8.51E-06 | 8.51E-06 | 0.00E+00 | 8.51E-06 |
| AGMILK | 0.00E+00 | 5.86E-06 | 5.86E-06 | 5.86E-06 | 5.86E-06 | 5.86E-06 | 0.00E+00 | 5.86E-06 |
| ACMEAT | 0.00E+00 | 1.22E-06 | 1.22E-06 | 1.22E-06 | 1.22E-06 | 1.22E-06 | 0.00E+00 | 1.22E-06 |
| ACMILK | 0.00E+00 | 2.87E-06 | 2.87E-06 | 2.87E-06 | 2.87E-06 | 2.87E-06 | 0.00E+00 | 2.87E-06 |
| TINHL | 0.00E+00 | 4.78E-06 | 4.78E-06 | 4.78E-06 | 4.78E-06 | 4.78E-06 | 0.00E+00 | 4.78E-06 |
| TVEG | 0.00E+00 | 9.73E-06 | 9.73E-06 | 9.73E-06 | 9.73E-06 | 9.73E-06 | 0.00E+00 | 9.73E-06 |
| TGMILK | 0.00E+00 | 7.62E-06 | 7.62E-06 | 7.62E-06 | 7.62E-06 | 7.62E-06 | 0.00E+00 | 7.62E-06 |
| TCMEAT | 0.00E+00 | 7.29E-07 | 7.29E-07 | 7.29E-07 | 7.29E-07 | 7.29E-07 | 0.00E+00 | 7.29E-07 |
| TCMILK | 0.00E+00 | 3.74E-06 | 3.74E-06 | 3.74E-06 | 3.74E-06 | 3.74E-06 | 0.00E+00 | 3.74E-06 |
| CINHL | 0.00E+00 | 4.22E-06 | 4.22E-06 | 4.22E-06 | 4.22E-06 | 4.22E-06 | 0.00E+00 | 4.22E-06 |
| CVEG | 0.00E+00 | 1.51E-05 | 1.51E-05 | 1.51E-05 | 1.51E-05 | 1.51E-05 | 0.00E+00 | 1.51E-05 |
| CGMILK | 0.00E+00 | 1.21E-05 | 1.21E-05 | 1.21E-05 | 1.21E-05 | 1.21E-05 | 0.00E+00 | 1.21E-05 |
| CCMEAT | 0.00E+00 | 8.83E-07 | 8.83E-07 | 8.83E-07 | 8.83E-07 | 8.83E-07 | 0.00E+00 | 8.83E-07 |
| CCMILK | 0.00E+00 | 5.92E-06 | 5.92E-06 | 5.92E-06 | 5.92E-06 | 5.92E-06 | 0.00E+00 | 5.92E-06 |
| IINHL | 0.00E+00 | 2.43E-06 | 2.43E-06 | 2.43E-06 | 2.43E-06 | 2.43E-06 | 0.00E+00 | 2.43E-06 |
| IGMILK | 0.00E+00 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 0.00E+00 | 1.83E-05 |
| ICMILK | 0.00E+00 | 8.98E-06 | 8.98E-06 | 8.98E-06 | 8.98E-06 | 8.98E-06 | 0.00E+00 | 8.98E-06 |

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ==========

| Agegroup | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| ADULT | 0.00E+00 | 2.32E-05 | 2.32E-05 | 2.32E-05 | 2.32E-05 | 2.32E-05 | 0.00E+00 | 2.32E-05 |
| TEEN | 0.00E+00 | 2.66E-05 | 2.66E-05 | 2.66E-05 | 2.66E-05 | 2.66E-05 | 0.00E+00 | 2.66E-05 |
| CHILD | 0.00E+00 | 3.82E-05 | 3.82E-05 | 3.82E-05 | 3.82E-05 | 3.82E-05 | 0.00E+00 | 3.82E-05 |
| INFANT | 0.00E+00 | 2.97E-05 | 2.97E-05 | 2.97E-05 | 2.97E-05 | 2.97E-05 | 0.00E+00 | 2.97E-05 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

```
Release ID...........: 1  All Gas Releases
Period Start Date....: 07/01/2013 00:00
Period End Date......: 10/01/2013 00:00
Period Duration (min): 1.325E+05
Coefficient Type.....: Historical
Receptor.............: 5   Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0
```

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | LIVER | 3.82E-05 | 31-day | 2.25E-01 | 1.70E-02 | 3.00E-01 | 1.27E-02 |
| | | | | Quarter | 5.63E+00 | 6.79E-04 | 7.50E+00 | 5.10E-04 |
| | | | | Annual | 1.13E+01 | 3.40E-04 | 1.50E+01 | 2.55E-04 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 1.00E+02 |

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | TBODY | 3.82E-05 | 31-day | 1.50E-01 | 2.55E-02 | 2.00E-01 | 1.91E-02 |
| | | | | Quarter | 5.25E+00 | 7.28E-04 | 7.50E+00 | 5.10E-04 |
| | | | | Annual | 1.05E+01 | 3.64E-04 | 1.50E+01 | 2.55E-04 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 1.00E+02 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 10/01/2013 00:00
Period End Date.....: 01/01/2014 00:00
Period Duration (min): 1.325E+05
Coefficient Type.....: Historical

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 5.299E+05 |
| Total Release Volume (cf) | 1.717E+10 |
| Average Release Flowrate (cfm) | 3.240E+04 |
| Average Period Flowrate (cfm) | 1.296E+05 |

=== NUCLIDE DATA ==========

| Nuclide | uCi | Average uCi/cc | ECrcent Ratio | EC |
|---|---|---|---|---|
| H-3 | 1.82E+04 | 3.74E-11 | 3.74E-04 | 1.00E-07 |
| H-3 | 1.82E+04 | 3.74E-11 | 3.74E-04 | |
| Total | 1.82E+04 | 3.74E-11 | 3.74E-04 | |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

```
Release ID...........: 1  All Gas Releases
Period Start Date....: 10/01/2013 00:00
Period End Date......: 01/01/2014 00:00
Period Duration (min): 1.325E+05
Coefficient Type.....: Historical
Receptor.............: 5   Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point........: 0.0
```

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ==========

| Age/Path | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| AINHL | 0.00E+00 | 5.75E-06 | 5.75E-06 | 5.75E-06 | 5.75E-06 | 5.75E-06 | 0.00E+00 | 5.75E-06 |
| AVEG | 0.00E+00 | 1.03E-05 | 1.03E-05 | 1.03E-05 | 1.03E-05 | 1.03E-05 | 0.00E+00 | 1.03E-05 |
| AGMILK | 0.00E+00 | 7.10E-06 | 7.10E-06 | 7.10E-06 | 7.10E-06 | 7.10E-06 | 0.00E+00 | 7.10E-06 |
| ACMEAT | 0.00E+00 | 1.48E-06 | 1.48E-06 | 1.48E-06 | 1.48E-06 | 1.48E-06 | 0.00E+00 | 1.48E-06 |
| ACMILK | 0.00E+00 | 3.48E-06 | 3.48E-06 | 3.48E-06 | 3.48E-06 | 3.48E-06 | 0.00E+00 | 3.48E-06 |
| TINHL | 0.00E+00 | 5.80E-06 | 5.80E-06 | 5.80E-06 | 5.80E-06 | 5.80E-06 | 0.00E+00 | 5.80E-06 |
| TVEG | 0.00E+00 | 1.18E-05 | 1.18E-05 | 1.18E-05 | 1.18E-05 | 1.18E-05 | 0.00E+00 | 1.18E-05 |
| TGMILK | 0.00E+00 | 9.24E-06 | 9.24E-06 | 9.24E-06 | 9.24E-06 | 9.24E-06 | 0.00E+00 | 9.24E-06 |
| TCMEAT | 0.00E+00 | 8.83E-07 | 8.83E-07 | 8.83E-07 | 8.83E-07 | 8.83E-07 | 0.00E+00 | 8.83E-07 |
| TCMILK | 0.00E+00 | 4.53E-06 | 4.53E-06 | 4.53E-06 | 4.53E-06 | 4.53E-06 | 0.00E+00 | 4.53E-06 |
| CINHL | 0.00E+00 | 5.12E-06 | 5.12E-06 | 5.12E-06 | 5.12E-06 | 5.12E-06 | 0.00E+00 | 5.12E-06 |
| CVEG | 0.00E+00 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 0.00E+00 | 1.83E-05 |
| CGMILK | 0.00E+00 | 1.46E-05 | 1.46E-05 | 1.46E-05 | 1.46E-05 | 1.46E-05 | 0.00E+00 | 1.46E-05 |
| CCMEAT | 0.00E+00 | 1.07E-06 | 1.07E-06 | 1.07E-06 | 1.07E-06 | 1.07E-06 | 0.00E+00 | 1.07E-06 |
| CCMILK | 0.00E+00 | 7.18E-06 | 7.18E-06 | 7.18E-06 | 7.18E-06 | 7.18E-06 | 0.00E+00 | 7.18E-06 |
| IINHL | 0.00E+00 | 2.95E-06 | 2.95E-06 | 2.95E-06 | 2.95E-06 | 2.95E-06 | 0.00E+00 | 2.95E-06 |
| IGMILK | 0.00E+00 | 2.22E-05 | 2.22E-05 | 2.22E-05 | 2.22E-05 | 2.22E-05 | 0.00E+00 | 2.22E-05 |
| ICMILK | 0.00E+00 | 1.09E-05 | 1.09E-05 | 1.09E-05 | 1.09E-05 | 1.09E-05 | 0.00E+00 | 1.09E-05 |

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ==========

| Agegroup | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| ADULT | 0.00E+00 | 2.81E-05 | 2.81E-05 | 2.81E-05 | 2.81E-05 | 2.81E-05 | 0.00E+00 | 2.81E-05 |
| TEEN | 0.00E+00 | 3.22E-05 | 3.22E-05 | 3.22E-05 | 3.22E-05 | 3.22E-05 | 0.00E+00 | 3.22E-05 |
| CHILD | 0.00E+00 | 4.63E-05 | 4.63E-05 | 4.63E-05 | 4.63E-05 | 4.63E-05 | 0.00E+00 | 4.63E-05 |
| INFANT | 0.00E+00 | 3.60E-05 | 3.60E-05 | 3.60E-05 | 3.60E-05 | 3.60E-05 | 0.00E+00 | 3.60E-05 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 10/01/2013 00:00
Period End Date.....: 01/01/2014 00:00
Period Duration (min): 1.325E+05
Coefficient Type.....: Historical
Receptor.....: 5 Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point.....: 0.0

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | LIVER | 4.63E-05 | 31-day | 2.25E-01 | 2.06E-02 | 3.00E-01 | 1.54E-02 |
| | | | | Quarter | 5.63E+00 | 8.24E-04 | 7.50E+00 | 6.18E-04 |
| | | | | Annual | 1.13E+01 | 4.12E-04 | 1.50E+01 | 3.09E-04 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 1.00E+02 |

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | TBODY | 4.63E-05 | 31-day | 1.50E-01 | 3.09E-02 | 2.00E-01 | 2.32E-02 |
| | | | | Quarter | 5.25E+00 | 8.82E-04 | 7.50E+00 | 6.18E-04 |
| | | | | Annual | 1.05E+01 | 4.41E-04 | 1.50E+01 | 3.09E-04 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 1.00E+02 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 01/01/2013 00:00
Period End Date.....: 01/01/2014 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 2.102E+06 |
| Total Release Volume (cf) | 6.824E+10 |
| Average Release Flowrate (cfm) | 3.246E+04 |
| Average Period Flowrate (cfm) | 1.298E+05 |

=== NUCLIDE DATA ==========

| Nuclide | uCi | Average uCi/cc | ECrcent Ratio | EC |
|---|---|---|---|---|
| H-3 | 6.49E+04 | 3.36E-11 | 3.36E-04 | 1.00E-07 |
| H-3 | 6.49E+04 | 3.36E-11 | 3.36E-04 | |
| Total | 6.49E+04 | 3.36E-11 | 3.36E-04 | |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 01/01/2013 00:00
Period End Date.....: 01/01/2014 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Receptor.....: 5 Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point.....: 0.0

=== PERIOD DOSE BY AGEGROUP, PATHWAY, ORGAN (mrem) ==========

| Age/Path | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| AINHL | 0.00E+00 | 2.05E-05 | 2.05E-05 | 2.05E-05 | 2.05E-05 | 2.05E-05 | 0.00E+00 | 2.05E-05 |
| AVEG | 0.00E+00 | 3.68E-05 | 3.68E-05 | 3.68E-05 | 3.68E-05 | 3.68E-05 | 0.00E+00 | 3.68E-05 |
| AGMILK | 0.00E+00 | 2.53E-05 | 2.53E-05 | 2.53E-05 | 2.53E-05 | 2.53E-05 | 0.00E+00 | 2.53E-05 |
| ACMEAT | 0.00E+00 | 5.29E-06 | 5.29E-06 | 5.29E-06 | 5.29E-06 | 5.29E-06 | 0.00E+00 | 5.29E-06 |
| ACMILK | 0.00E+00 | 1.24E-05 | 1.24E-05 | 1.24E-05 | 1.24E-05 | 1.24E-05 | 0.00E+00 | 1.24E-05 |
| TINHL | 0.00E+00 | 2.07E-05 | 2.07E-05 | 2.07E-05 | 2.07E-05 | 2.07E-05 | 0.00E+00 | 2.07E-05 |
| TVEG | 0.00E+00 | 4.21E-05 | 4.21E-05 | 4.21E-05 | 4.21E-05 | 4.21E-05 | 0.00E+00 | 4.21E-05 |
| TGMILK | 0.00E+00 | 3.29E-05 | 3.29E-05 | 3.29E-05 | 3.29E-05 | 3.29E-05 | 0.00E+00 | 3.29E-05 |
| TCMEAT | 0.00E+00 | 3.15E-06 | 3.15E-06 | 3.15E-06 | 3.15E-06 | 3.15E-06 | 0.00E+00 | 3.15E-06 |
| TCMILK | 0.00E+00 | 1.62E-05 | 1.62E-05 | 1.62E-05 | 1.62E-05 | 1.62E-05 | 0.00E+00 | 1.62E-05 |
| CINHL | 0.00E+00 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 1.83E-05 | 0.00E+00 | 1.83E-05 |
| CVEG | 0.00E+00 | 6.53E-05 | 6.53E-05 | 6.53E-05 | 6.53E-05 | 6.53E-05 | 0.00E+00 | 6.53E-05 |
| CGMILK | 0.00E+00 | 5.22E-05 | 5.22E-05 | 5.22E-05 | 5.22E-05 | 5.22E-05 | 0.00E+00 | 5.22E-05 |
| CCMEAT | 0.00E+00 | 3.82E-06 | 3.82E-06 | 3.82E-06 | 3.82E-06 | 3.82E-06 | 0.00E+00 | 3.82E-06 |
| CCMILK | 0.00E+00 | 2.56E-05 | 2.56E-05 | 2.56E-05 | 2.56E-05 | 2.56E-05 | 0.00E+00 | 2.56E-05 |
| IINHL | 0.00E+00 | 1.05E-05 | 1.05E-05 | 1.05E-05 | 1.05E-05 | 1.05E-05 | 0.00E+00 | 1.05E-05 |
| IGMILK | 0.00E+00 | 7.92E-05 | 7.92E-05 | 7.92E-05 | 7.92E-05 | 7.92E-05 | 0.00E+00 | 7.92E-05 |
| ICMILK | 0.00E+00 | 3.88E-05 | 3.88E-05 | 3.88E-05 | 3.88E-05 | 3.88E-05 | 0.00E+00 | 3.88E-05 |

=== PERIOD DOSE BY AGEGROUP, ORGAN (mrem) ==========

| Agegroup | Bone | Liver | Thyroid | Kidney | Lung | GI-Lli | Skin | TB |
|---|---|---|---|---|---|---|---|---|
| ADULT | 0.00E+00 | 1.00E-04 | 1.00E-04 | 1.00E-04 | 1.00E-04 | 1.00E-04 | 0.00E+00 | 1.00E-04 |
| TEEN | 0.00E+00 | 1.15E-04 | 1.15E-04 | 1.15E-04 | 1.15E-04 | 1.15E-04 | 0.00E+00 | 1.15E-04 |
| CHILD | 0.00E+00 | 1.65E-04 | 1.65E-04 | 1.65E-04 | 1.65E-04 | 1.65E-04 | 0.00E+00 | 1.65E-04 |
| INFANT | 0.00E+00 | 1.29E-04 | 1.29E-04 | 1.29E-04 | 1.29E-04 | 1.29E-04 | 0.00E+00 | 1.29E-04 |

## Table 3.1-1 (cont'd)
## Maximum Dose Resulting from Airborne Releases
## Zion Station 2013

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

Release ID.....: 1 All Gas Releases
Period Start Date....: 01/01/2013 00:00
Period End Date.....: 01/01/2014 00:00
Period Duration (min): 5.256E+05
Coefficient Type.....: Historical
Receptor.....: 5 Composite Crit. Receptor - IP
Distance (meters)....: 0.0
Compass Point.....: 0.0

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | LIVER | 1.65E-04 | 31-day | 2.25E-01 | 7.34E-02 | 3.00E-01 | 5.51E-02 |
| | | | | Quarter | 5.63E+00 | 2.94E-03 | 7.50E+00 | 2.20E-03 |
| | | | | Annual | 1.13E+01 | 1.47E-03 | 1.50E+01 | 1.10E-03 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 9.99E+01 |

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

| Dose Period | Age Group | Organ | Dose (mrem) | Limit Period | Admin Limit | Admin % of Limit | T.Spec Limit | T.Spec % of Limit |
|---|---|---|---|---|---|---|---|---|
| Strt->End | CHILD | TBODY | 1.65E-04 | 31-day | 1.50E-01 | 1.10E-01 | 2.00E-01 | 8.26E-02 |
| | | | | Quarter | 5.25E+00 | 3.15E-03 | 7.50E+00 | 2.20E-03 |
| | | | | Annual | 1.05E+01 | 1.57E-03 | 1.50E+01 | 1.10E-03 |

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

| Nuclide | Percentage |
|---|---|
| H-3 | 9.99E+01 |

# Table 3.2-1
# Maximum dose Resulting from Liquid Effluents
# Zion Station 2013

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

Release ID.....: 1 All Liquid Release Types
Period Start Date.....: 01/01/2013 00:00
Period End Date.....: 04/01/2013 00:00
Period Duration (mins): 1.296E+05

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 1.296E+05 |
| Total Undiluted Volume Released (gallons) | 8.912E+05 |
| Average Undiluted Flowrate (gpm) | 6.876E+00 |
| Total Dilution Volume (gallons) | 3.240E+08 |
| Average Dilution Flowrate (gpm) | 2.500E+03 |

=== NUCLIDE DATA ==========

| | | Undiluted | | Diluted | |
|---|---|---|---|---|---|
| Nuclide | uCi | Average uCi/ml | Percent of 5*ECC | Average uCi/ml | Percent of 5*EC |

## Table 3.2-1 (cont'd)
## Maximum dose Resulting from Liquid Effluents
## Zion Station 2013

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

Release ID.....: 1 All Liquid Release Types
Period Start Date.....: 04/01/2013 00:00
Period End Date.....: 07/01/2013 00:00
Period Duration (mins): 1.310E+05

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 1.310E+05 |
| Total Undiluted Volume Released (gallons) | 9.501E+05 |
| Average Undiluted Flowrate (gpm) | 7.250E+00 |
| Total Dilution Volume (gallons) | 3.276E+08 |
| Average Dilution Flowrate (gpm) | 2.500E+03 |

=== NUCLIDE DATA ==========

| | | Undiluted | | Diluted | |
|---|---|---|---|---|---|
| Nuclide | uCi | Average uCi/ml | Percent of 5*ECC | Average uCi/ml | Percent of 5*EC |
| --- | --- | --- | --- | --- | --- |

## Table 3.2-1 (cont'd)
## Maximum dose Resulting from Liquid Effluents
## Zion Station 2013

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

Release ID.....: 1 All Liquid Release Types
Period Start Date.....: 07/01/2013 00:00
Period End Date.....: 10/01/2013 00:00
Period Duration (mins): 1.325E+05

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 1.325E+05 |
| Total Undiluted Volume Released (gallons) | 7.091E+05 |
| Average Undiluted Flowrate (gpm) | 5.352E+00 |
| Total Dilution Volume (gallons) | 3.312E+08 |
| Average Dilution Flowrate (gpm) | 2.500E+03 |

=== NUCLIDE DATA ==========

| | | Undiluted | | Diluted | |
|---|---|---|---|---|---|
| Nuclide | uCi | Average uCi/ml | Percent of 5*ECC | Average uCi/ml | Percent of 5*EC |

## Table 3.2-1 (cont'd)
## Maximum dose Resulting from Liquid Effluents
## Zion Station 2013

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

Release ID.....: 1 All Liquid Release Types
Period Start Date.....: 10/01/2013 00:00
Period End Date.....: 01/01/2014 00:00
Period Duration (mins): 1.325E+05

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 1.325E+05 |
| Total Undiluted Volume Released (gallons) | 6.270E+05 |
| Average Undiluted Flowrate (gpm) | 4.733E+00 |
| Total Dilution Volume (gallons) | 3.312E+08 |
| Average Dilution Flowrate (gpm) | 2.500E+03 |

=== NUCLIDE DATA ==========

| | | Undiluted | | Diluted | |
|---|---|---|---|---|---|
| Nuclide | uCi | Average uCi/ml | Percent of 5*ECC | Average uCi/ml | Percent of 5*EC |

## Table 3.2-1 (cont'd)
## Maximum dose Resulting from Liquid Effluents
## Zion Station 2013

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

Release ID.....: 1 All Liquid Release Types
Period Start Date.....: 01/01/2013 00:00
Period End Date.....: 01/01/2014 00:00
Period Duration (mins): 5.256E+05

=== RELEASE DATA ==========

| | |
|---|---|
| Total Release Duration (minutes) | 5.256E+05 |
| Total Undiluted Volume Released (gallons) | 3.177E+06 |
| Average Undiluted Flowrate (gpm) | 6.045E+00 |
| Total Dilution Volume (gallons) | 1.314E+09 |
| Average Dilution Flowrate (gpm) | 2.500E+03 |

=== NUCLIDE DATA ==========

| | | Undiluted | | Diluted | |
|---|---|---|---|---|---|
| Nuclide | uCi | Average uCi/ml | Percent of 5*ECC | Average uCi/ml | Percent of 5*EC |

**Table 3.3-1**
**Maximum Dose Resulting from Direct Radiation**
**Zion Station 2013**

Surveys indicate East fence line in Sector H of Zion site boundary was exposed to direct gamma radiation from 40' sealand shipping container ESUU #500031 during Quarter 1 of 2013. The shipping container was moved prior to Quarter 2. Direct radiation dose was calculated using habit's of the real individual as discussed in Zion ES&H TSD 13-009 for the affected sector. Data for calculation is indicated in chart below:

| | | |
|---|---|---|
| TLD Z-13-1 | Control TLD | 2.60E+01mR |
| TLD Z-13-2 | Control TLD | 2.20E+01mR |
| TLD Z-108-1 | Sector H fence line TLD | 3.80E+01mR |
| TLD Z-108-2 | Sector H fence line TLD | 3.00E+01mR |
| Number of hours per month of TLD exposure | | 7.30E+02 hours per quarter |
| ES&H TSD 13-009 occupancy factor for East fence line | 2.92E+03 hours per year | 2.44E+02 hours per quarter |
| Conservative conversion factor from mR to mrem | 1.00E+00 mR = 1.00E+00mrem | |

Average control TLD exposure to background radiation = 2.40E+01mRMaximum exposure of Sector H fence line TLD location Z-108= 3.80E+01mR(3.80E+01mR R - 2.40E+01mR)/ 7.30E+02 hrs per qtr = 1.92e-02 mR/hr

1.92e-02mR/hr*2.44E+02 hours = 4.68E+00mR = 4.68E+00mrem

Dose was a result of waste from combination of Unit 1 and Unit 2 thus the dose will be considered divided between the two units.

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

**Table 3.4-1**
**ZION STATION**
**2013**
**Unit 1**
**10CFR20 Compliance Assessment**

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

| | |
|---|---|
| Total Effective Dose Equivalent | **2.34E+00 mrem/year** |
| 10 CFR 20.1301 (a) (1) limit | 100 mrem/year |
| % of the limit | **2.34E+00%** |

2. Compliance Summary 10CFR20

| | 1st Qtr. | 2nd Qtr. | 3rd Qtr. | 4th Qtr | % of Limit |
|---|---|---|---|---|---|
| TEDE | **2.34E+00** | **1.65E-05** | **1.91E-05** | **2.32E-05** | **2.34E+00** |

**Table 3.4-1(continued)**
**ZION STATION**
**2013**
**Unit 2**
**10CFR20 Compliance Assessment**

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

| | |
|---|---|
| Total Effective Dose Equivalent | **2.34E+00 mrem/year** |
| 10 CFR 20.1301 (a) (1) limit | 100 mrem/year |
| % of the limit | **2.34E+00%** |

2. Compliance Summary 10CFR20

| | 1st Qtr. | 2nd Qtr. | 3rd Qtr. | 4th Qtr | % of Limit |
|---|---|---|---|---|---|
| TEDE | **2.34E+00** | **1.65E-05** | **1.91E-05** | **2.32E-05** | **2.34E+00** |

# Table 3.5-1

Doses Resulting from Airborne Releases

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

## Unit 1:

| *Dose* | *Maximum Value* | *Sector Affected* |
|---|---|---|
| gamma air [1] | 0.00E+00 mrad | |
| beta air [2] | 0.00E+00 mrad | |
| whole body [3] | 9.81E-05 mrem | East |
| skin [4] | 9.81E-05 mrem | East |
| organ [5] (child liver) | 9.81E-05 mrem | East |

## Unit 2:

| *Dose* | *Maximum Value* | *Sector Affected* |
|---|---|---|
| gamma air [1] | 0.00E+00 mrad | |
| beta air [2] | 0.00E+00 mrad | |
| whole body [3] | 9.81E-05 mrem | East |
| skin [4] | 9.81E-05 mrem | East |
| organ [5] (child liver) | 9.81E-05 mrem | East |

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

# APPENDIX F

# METEOROLOGICAL DATA

Zion Nuclear Station

Period of Record: January - March 2013
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 | 0 | 0 | 0 | 0 | 1 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 1 | 2 | 2 | 0 | 0 | 5 |
| ENE | 0 | 1 | 0 | 2 | 0 | 0 | 3 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| SE | 0 | 7 | 1 | 0 | 0 | 0 | 8 |
| SSE | 0 | 3 | 8 | 0 | 0 | 0 | 11 |
| S | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SSW | 0 | 2 | 3 | 4 | 1 | 0 | 10 |
| SW | 0 | 0 | 5 | 2 | 1 | 0 | 8 |
| WSW | 0 | 1 | 17 | 7 | 2 | 0 | 27 |
| W | 0 | 1 | 20 | 14 | 0 | 0 | 35 |
| WNW | 0 | 8 | 15 | 6 | 0 | 0 | 29 |
| NW | 0 | 2 | 32 | 3 | 0 | 0 | 37 |
| NNW | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 29 | 107 | 40 | 4 | 0 | 180 |

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: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 0 | 0 | 2 | 1 | 0 | 3 |
| NNE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| NE | 0 | 2 | 1 | 2 | 0 | 0 | 5 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| ESE | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| SE | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SSE | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| S | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| SSW | 0 | 1 | 1 | 2 | 1 | 0 | 5 |
| SW | 0 | 1 | 2 | 2 | 0 | 0 | 5 |
| WSW | 0 | 0 | 4 | 3 | 2 | 0 | 9 |
| W | 0 | 2 | 7 | 4 | 0 | 0 | 13 |
| WNW | 0 | 5 | 8 | 1 | 0 | 0 | 14 |
| NW | 0 | 7 | 12 | 1 | 0 | 0 | 20 |
| NNW | 0 | 3 | 4 | 0 | 0 | 0 | 7 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 28 | 44 | 17 | 4 | 0 | 93 |

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: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 1 | 2 | 6 | 0 | 0 | 9 |
| NNE | 0 | 2 | 3 | 2 | 0 | 0 | 7 |
| NE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ENE | 0 | 1 | 0 | 2 | 0 | 0 | 3 |
| E | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| ESE | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| SE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| SSE | 0 | 1 | 2 | 2 | 0 | 0 | 5 |
| S | 0 | 3 | 2 | 0 | 0 | 0 | 5 |
| SSW | 0 | 3 | 2 | 3 | 1 | 0 | 9 |
| SW | 0 | 1 | 2 | 6 | 0 | 0 | 9 |
| WSW | 1 | 6 | 10 | 4 | 0 | 0 | 21 |
| W | 0 | 3 | 12 | 7 | 0 | 0 | 22 |
| WNW | 0 | 8 | 13 | 6 | 0 | 0 | 27 |
| NW | 0 | 3 | 12 | 1 | 0 | 0 | 16 |
| NNW | 0 | 2 | 6 | 0 | 0 | 0 | 8 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 39 | 68 | 39 | 1 | 0 | 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: 246

Zion Nuclear Station

Period of Record: January - March 2013
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 1 | 4 | 19 | 23 | 0 | 0 | 47 |
| NNE | 1 | 5 | 9 | 16 | 1 | 0 | 32 |
| NE | 3 | 3 | 6 | 4 | 3 | 0 | 19 |
| ENE | 0 | 2 | 7 | 4 | 4 | 0 | 17 |
| E | 0 | 4 | 6 | 8 | 5 | 0 | 23 |
| ESE | 2 | 8 | 2 | 3 | 5 | 0 | 20 |
| SE | 0 | 2 | 8 | 0 | 0 | 0 | 10 |
| SSE | 0 | 9 | 35 | 38 | 6 | 0 | 88 |
| S | 2 | 12 | 38 | 2 | 0 | 0 | 54 |
| SSW | 3 | 17 | 26 | 5 | 1 | 0 | 52 |
| SW | 2 | 10 | 41 | 18 | 3 | 0 | 74 |
| WSW | 3 | 25 | 52 | 13 | 6 | 0 | 99 |
| W | 3 | 56 | 86 | 23 | 4 | 0 | 172 |
| WNW | 3 | 61 | 56 | 17 | 2 | 0 | 139 |
| NW | 1 | 60 | 55 | 1 | 0 | 0 | 117 |
| NNW | 0 | 31 | 70 | 7 | 0 | 0 | 108 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 24 | 309 | 516 | 182 | 40 | 0 | 1071 |

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: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 2 | 5 | 0 | 0 | 0 | 10 |
| NNE | 2 | 1 | 6 | 0 | 0 | 0 | 9 |
| NE | 0 | 2 | 1 | 5 | 0 | 0 | 8 |
| ENE | 1 | 3 | 4 | 0 | 0 | 0 | 8 |
| E | 0 | 3 | 1 | 0 | 0 | 0 | 4 |
| ESE | 1 | 3 | 0 | 0 | 0 | 0 | 4 |
| SE | 0 | 9 | 2 | 0 | 0 | 0 | 11 |
| SSE | 3 | 1 | 9 | 6 | 2 | 0 | 21 |
| S | 3 | 16 | 19 | 0 | 0 | 0 | 38 |
| SSW | 8 | 22 | 7 | 0 | 0 | 0 | 37 |
| SW | 6 | 10 | 8 | 1 | 0 | 0 | 25 |
| WSW | 6 | 15 | 0 | 0 | 0 | 0 | 21 |
| W | 6 | 39 | 2 | 0 | 0 | 0 | 47 |
| WNW | 10 | 22 | 0 | 0 | 0 | 0 | 32 |
| NW | 1 | 6 | 0 | 0 | 0 | 0 | 7 |
| NNW | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 52 | 155 | 64 | 12 | 2 | 0 | 285 |

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: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 1 | 3 | 0 | 0 | 0 | 0 | 4 |
| NE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| SE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSE | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| S | 1 | 4 | 7 | 0 | 0 | 0 | 12 |
| SSW | 2 | 2 | 1 | 0 | 0 | 0 | 5 |
| SW | 1 | 5 | 0 | 0 | 0 | 0 | 6 |
| WSW | 4 | 8 | 0 | 0 | 0 | 0 | 12 |
| W | 6 | 16 | 0 | 0 | 0 | 0 | 22 |
| WNW | 6 | 9 | 0 | 0 | 0 | 0 | 15 |
| NW | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 23 | 50 | 10 | 0 | 0 | 0 | 83 |

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: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| S | 0 | 1 | 4 | 0 | 0 | 0 | 5 |
| SSW | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| SW | 3 | 1 | 0 | 0 | 0 | 0 | 4 |
| WSW | 5 | 6 | 0 | 0 | 0 | 0 | 11 |
| W | 18 | 2 | 0 | 0 | 0 | 0 | 20 |
| WNW | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| NW | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 31 | 15 | 5 | 0 | 0 | 0 | 51 |

Hours of calm in this stability class: 3
Hours of missing wind measurements in this stability class: 0
Hours of missing stability measurements in all stability classes: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 0 | 0 | 0 | 0 | 1 |
| NNE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| NE | 0 | 0 | 2 | 0 | 2 | 1 | 5 |
| ENE | 0 | 1 | 0 | 0 | 1 | 0 | 2 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| SE | 0 | 3 | 5 | 1 | 0 | 0 | 9 |
| SSE | 0 | 0 | 6 | 3 | 0 | 0 | 9 |
| S | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| SSW | 0 | 1 | 4 | 0 | 1 | 2 | 8 |
| SW | 0 | 0 | 2 | 1 | 3 | 0 | 6 |
| WSW | 0 | 0 | 1 | 16 | 7 | 4 | 28 |
| W | 0 | 2 | 3 | 17 | 6 | 6 | 34 |
| WNW | 0 | 5 | 5 | 11 | 9 | 1 | 31 |
| NW | 0 | 1 | 9 | 20 | 5 | 0 | 35 |
| NNW | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 18 | 40 | 70 | 34 | 14 | 176 |

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: 246

Zion Nuclear Station

Period of Record: January - March 2013
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 1 | 0 | 0 | 0 | 3 | 4 |
| NNE | 0 | 2 | 0 | 0 | 0 | 1 | 3 |
| NE | 0 | 1 | 1 | 0 | 0 | 1 | 3 |
| ENE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| E | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| ESE | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SE | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| SSE | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| S | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| SSW | 0 | 1 | 1 | 1 | 2 | 1 | 6 |
| SW | 0 | 1 | 0 | 1 | 1 | 0 | 3 |
| WSW | 0 | 0 | 1 | 4 | 3 | 2 | 10 |
| W | 0 | 1 | 1 | 4 | 2 | 3 | 11 |
| WNW | 0 | 0 | 7 | 2 | 1 | 0 | 10 |
| NW | 0 | 1 | 8 | 10 | 1 | 0 | 20 |
| NNW | 0 | 0 | 5 | 0 | 0 | 0 | 5 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 9 | 29 | 25 | 10 | 11 | 84 |

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 9
Hours of missing stability measurements in all stability classes: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 0 | 2 | 4 | 2 | 8 |
| NNE | 0 | 1 | 1 | 1 | 2 | 1 | 6 |
| NE | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| ENE | 0 | 1 | 0 | 0 | 2 | 0 | 3 |
| E | 0 | 0 | 0. | 1 | 0 | 0 | 1 |
| ESE | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| SE | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SSE | 0 | 0 | 2 | 0 | 2 | 0 | 4 |
| S | 0 | 0 | 3 | 2 | 0 | 0 | 5 |
| SSW | 0 | 0 | 3 | 1 | 2 | 2 | 8 |
| SW | 0 | 2 | 1 | 2 | 1 | 2 | 8 |
| WSW | 0 | 2 | 5 | 7 | 4 | 4 | 22 |
| W | 0 | 1 | 1 | 8 | 2 | 5 | 17 |
| WNW | 0 | 2 | 6 | 9 | 5 | 1 | 23 |
| NW | 0 | 1 | 9 | 5 | 3 | 0 | 18 |
| NNW | 0 | 2 | 6 | 2 | 0 | 0 | 10 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 13 | 42 | 40 | 27 | 17 | 139 |

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 9
Hours of missing stability measurements in all stability classes: 246

Zion Nuclear Station

Period of Record: January - March 2013
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 1 | 4 | 4 | 11 | 26 | 5 | 51 |
| NNE | 0 | 2 | 2 | 5 | 7 | 15 | 31 |
| NE | 2 | 1 | 4 | 2 | 1 | 7 | 17 |
| ENE | 0 | 3 | 0 | 4 | 4 | 7 | 18 |
| E | 0 | 4 | 5 | 6 | 8 | 6 | 29 |
| ESE | 0 | 2 | 1 | 2 | 3 | 4 | 12 |
| SE | 1 | 2 | 2 | 6 | 8 | 1 | 20 |
| SSE | 0 | 1 | 4 | 21 | 26 | 8 | 60 |
| S | 0 | 1 | 8 | 31 | 21 | 0 | 61 |
| SSW | 0 | 4 | 8 | 20 | 9 | 0 | 41 |
| SW | 0 | 6 | 6 | 40 | 15 | 10 | 77 |
| WSW | 3 | 2 | 13 | 43 | 17 | 12 | 90 |
| W | 3 | 6 | 29 | 80 | 16 | 16 | 150 |
| WNW | 1 | 4 | 42 | 61 | 19 | 5 | 132 |
| NW | 0 | 3 | 46 | 60 | 12 | 1 | 122 |
| NNW | 0 | 1 | 33 | 60 | 11 | 0 | 105 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 11 | 46 | 207 | 452 | 203 | 97 | 1016 |

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 55
Hours of missing stability measurements in all stability classes: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 0 | 1 | 2 | 4 | 0 | 7 |
| NNE | 0 | 0 | 1 | 0 | 7 | 0 | 8 |
| NE | 0 | 2 | 1 | 0 | 2 | 1 | 6 |
| ENE | 1 | 5 | 2 | 3 | 2 | 0 | 13 |
| E | 1 | 2 | 3 | 1 | 3 | 0 | 10 |
| ESE | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| SE | 0 | 3 | 1 | 6 | 1 | 1 | 12 |
| SSE | 0 | 0 | 4 | 5 | 7 | 5 | 21 |
| S | 0 | 4 | 4 | 15 | 8 | 0 | 31 |
| SSW | 0 | 3 | 4 | 19 | 4 | 0 | 30 |
| SW | 0 | 2 | 9 | 13 | 3 | 0 | 27 |
| WSW | 0 | 1 | 3 | 6 | 0 | 0 | 10 |
| W | 0 | 0 | 9 | 15 | 1 | 0 | 25 |
| WNW | 0 | 6 | 8 | 20 | 0 | 0 | 34 |
| NW | 0 | 3 | 10 | 16 | 0 | 0 | 29 |
| NNW | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2 | 33 | 63 | 122 | 42 | 7 | 269 |

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 16
Hours of missing stability measurements in all stability classes: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 1 | 0 | 0 | 0 | 0 | 1 |
| NNE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 2 | 0 | 0 | 1 | 0 | 3 |
| E | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| ESE | 0 | 3 | 1 | 0 | 1 | 0 | 5 |
| SE | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| SSE | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| S | 0 | 2 | 0 | 3 | 5 | 1 | 11 |
| SSW | 2 | 1 | 1 | 3 | 1 | 0 | 8 |
| SW | 0 | 0 | 1 | 6 | 0 | 0 | 7 |
| WSW | 1 | 0 | 0 | 1 | 0 | 0 | 2 |
| W | 0 | 0 | 2 | 3 | 1 | 0 | 6 |
| WNW | 0 | 1 | 2 | 3 | 2 | 0 | 8 |
| NW | 1 | 3 | 2 | 4 | 1 | 0 | 11 |
| NNW | 0 | 0 | 3 | 0 | 0 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 5 | 17 | 15 | 24 | 12 | 1 | 74 |

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 9
Hours of missing stability measurements in all stability classes: 246

Zion Nuclear Station

Period of Record: January - March 2013
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 | 0 | 0 | 0 | 0 | 0 | 1 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| ENE | 0 | 0 | 1 | 0 | 1 | 0 | 2 |
| E | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| ESE | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| SE | 2 | 2 | 2 | 0 | 0 | 0 | 6 |
| SSE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S | 0 | 2 | 3 | 2 | 2 | 1 | 10 |
| SSW | 2 | 1 | 1 | 3 | 1 | 0 | 8 |
| SW | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| WSW | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| W | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| WNW | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| NW | 0 | 3 | 1 | 2 | 0 | 0 | 6 |
| NNW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 12 | 15 | 13 | 7 | 4 | 1 | 52 |

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: 246

Zion Nuclear Station

Period of Record: April - June 2013
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 1 | 2 | 5 | 3 | 0 | 11 |
| NNE | 0 | 0 | 36 | 11 | 1 | 0 | 48 |
| NE | 0 | 4 | 13 | 0 | 0 | 0 | 17 |
| ENE | 0 | 8 | 4 | 0 | 0 | 0 | 12 |
| E | 0 | 5 | 4 | 4 | 0 | 0 | 13 |
| ESE | 0 | 1 | 6 | 0 | 0 | 0 | 7 |
| SE | 0 | 1 | 9 | 1 | 0 | 0 | 11 |
| SSE | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| S | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| SSW | 0 | 0 | 5 | 4 | 0 | 0 | 9 |
| SW | 0 | 0 | 5 | 13 | 0 | 0 | 18 |
| WSW | 0 | 0 | 7 | 4 | 0 | 0 | 11 |
| W | 0 | 0 | 14 | 2 | 0 | 0 | 16 |
| WNW | 0 | 6 | 24 | 0 | 0 | 0 | 30 |
| NW | 0 | 1 | 18 | 2 | 0 | 0 | 21 |
| NNW | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 28 | 151 | 47 | 4 | 0 | 230 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 0 | 6 | 8 | 0 | 0 | 14 |
| NNE | 0 | 5 | 7 | 4 | 0 | 0 | 16 |
| NE | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 0 | 4 | 3 | 0 | 0 | 0 | 7 |
| SE | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| SSE | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| S | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSW | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SW | 0 | 0 | 6 | 3 | 0 | 0 | 9 |
| WSW | 0 | 0 | 1 | 0 | 1 | 0 | 2 |
| W | 0 | 0 | 3 | 2 | 0 | 0 | 5 |
| WNW | 0 | 3 | 4 | 1 | 0 | 0 | 8 |
| NW | 0 | 1 | 3 | 2 | 0 | 0 | 6 |
| NNW | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 20 | 38 | 20 | 1 | 0 | 79 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 1 | 2 | 9 | 10 | 1 | 0 | 23 |
| NNE | 0 | 9 | 8 | 7 | 0 | 0 | 24 |
| NE | 0 | 8 | 0 | 0 | 0 | 0 | 8 |
| ENE | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| E | 2 | 7 | 0 | 0 | 0 | 0 | 9 |
| ESE | 0 | 1 | 0 | 2 | 0 | 0 | 3 |
| SE | 0 | 6 | 1 | 0 | 0 | 0 | 7 |
| SSE | 0 | 0 | 5 | 0 | 0 | 0 | 5 |
| S | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSW | 0 | 1 | 2 | 1 | 0 | 0 | 4 |
| SW | 0 | 2 | 4 | 3 | 0 | 0 | 9 |
| WSW | 0 | 0 | 7 | 5 | 0 | 0 | 12 |
| W | 0 | 0 | 3 | 3 | 0 | 0 | 6 |
| WNW | 0 | 1 | 4 | 0 | 0 | 0 | 5 |
| NW | 0 | 1 | 3 | 0 | 0 | 0 | 4 |
| NNW | 0 | 0 | 3 | 1 | 0 | 0 | 4 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 4 | 40 | 49 | 32 | 1 | 0 | 126 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 3 | 25 | 90 | 39 | 9 | 0 | 166 |
| NNE | 7 | 34 | 60 | 39 | 1 | 0 | 141 |
| NE | 10 | 21 | 16 | 3 | 0 | 0 | 50 |
| ENE | 7 | 17 | 9 | 8 | 2 | 0 | 43 |
| E | 4 | 12 | 6 | 1 | 0 | 0 | 23 |
| ESE | 4 | 16 | 4 | 0 | 0 | 0 | 24 |
| SE | 2 | 16 | 8 | 0 | 0 | 0 | 26 |
| SSE | 0 | 12 | 23 | 3 | 1 | 0 | 39 |
| S | 1 | 8 | 24 | 1 | 0 | 0 | 34 |
| SSW | 0 | 11 | 20 | 13 | 1 | 0 | 45 |
| SW | 0 | 11 | 16 | 5 | 3 | 0 | 35 |
| WSW | 2 | 11 | 27 | 13 | 0 | 0 | 53 |
| W | 3 | 8 | 19 | 3 | 0 | 0 | 33 |
| WNW | 2 | 12 | 13 | 1 | 0 | 0 | 28 |
| NW | 2 | 14 | 13 | 0 | 0 | 0 | 29 |
| NNW | 0 | 12 | 9 | 0 | 0 | 0 | 21 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 47 | 240 | 357 | 129 | 17 | 0 | 790 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 26 | 10 | 0 | 0 | 0 | 39 |
| NNE | 11 | 24 | 8 | 1 | 0 | 0 | 44 |
| NE | 9 | 15 | 4 | 0 | 0 | 0 | 28 |
| ENE | 14 | 7 | 1 | 1 | 0 | 0 | 23 |
| E | 4 | 15 | 7 | 2 | 1 | 0 | 29 |
| ESE | 4 | 7 | 0 | 0 | 0 | 0 | 11 |
| SE | 6 | 12 | 1 | 0 | 0 | 0 | 19 |
| SSE | 3 | 16 | 28 | 6 | 2 | 0 | 55 |
| S | 7 | 46 | 26 | 7 | 0 | 0 | 86 |
| SSW | 11 | 24 | 13 | 1 | 0 | 0 | 49 |
| SW | 6 | 16 | 7 | 3 | 0 | 0 | 32 |
| WSW | 3 | 10 | 0 | 0 | 0 | 0 | 13 |
| W | 1 | 10 | 2 | 0 | 0 | 0 | 13 |
| WNW | 7 | 10 | 2 | 0 | 0 | 0 | 19 |
| NW | 4 | 6 | 0 | 0 | 0 | 0 | 10 |
| NNW | 2 | 7 | 2 | 0 | 0 | 0 | 11 |
| Variable | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 96 | 251 | 111 | 21 | 3 | 0 | 482 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 9 | 7 | 0 | 0 | 0 | 19 |
| NNE | 10 | 7 | 1 | 0 | 0 | 0 | 18 |
| NE | 6 | 5 | 0 | 0 | 0 | 0 | 11 |
| ENE | 8 | 5 | 1 | 0 | 0 | 0 | 14 |
| E | 4 | 6 | 3 | 0 | 0 | 0 | 13 |
| ESE | 4 | 6 | 0 | 0 | 0 | 0 | 10 |
| SE | 4 | 16 | 0 | 0 | 0 | 0 | 20 |
| SSE | 2 | 7 | 9 | 2 | 2 | 0 | 22 |
| S | 8 | 29 | 23 | 9 | 0 | 0 | 69 |
| SSW | 11 | 16 | 2 | 0 | 0 | 0 | 29 |
| SW | 10 | 4 | 0 | 1 | 0 | 0 | 15 |
| WSW | 11 | 0 | 0 | 0 | 0 | 0 | 11 |
| W | 8 | 1 | 0 | 0 | 0 | 0 | 9 |
| WNW | 3 | 2 | 0 | 0 | 0 | 0 | 5 |
| NW | 9 | 3 | 0 | 0 | 0 | 0 | 12 |
| NNW | 4 | 3 | 0 | 0 | 0 | 0 | 7 |
| Variable | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 106 | 119 | 46 | 12 | 2 | 0 | 285 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 0 | 0 | 0 | 0 | 0 | 2 |
| NNE | 5 | 1 | 0 | 0 | 0 | 0 | 6 |
| NE | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| ENE | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| E | 5 | 4 | 0 | 1 | 0 | 0 | 10 |
| ESE | 3 | 8 | 1 | 0 | 0 | 0 | 12 |
| SE | 3 | 7 | 3 | 0 | 0 | 0 | 13 |
| SSE | 2 | 5 | 9 | 1 | 0 | 0 | 17 |
| S | 4 | 18 | 21 | 5 | 0 | 0 | 48 |
| SSW | 12 | 6 | 0 | 0 | 0 | 0 | 18 |
| SW | 4 | 2 | 0 | 0 | 0 | 0 | 6 |
| WSW | 9 | 0 | 0 | 0 | 0 | 0 | 9 |
| W | 2 | 10 | 0 | 0 | 0 | 0 | 12 |
| WNW | 12 | 5 | 0 | 0 | 0 | 0 | 17 |
| NW | 3 | 1 | 0 | 0 | 0 | 0 | 4 |
| NNW | 5 | 1 | 0 | 0 | 0 | 0 | 6 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 77 | 70 | 34 | 7 | 0 | 0 | 188 |

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: 3

Zion Nuclear Station

Period of Record: April - June 2013
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 | 6 | 7 | 7 | 22 |
| NNE | 0 | 0 | 16 | 18 | 4 | 2 | 40 |
| NE | 0 | 5 | 14 | 3 | 0 | 0 | 22 |
| ENE | 0 | 3 | 1 | 2 | 1 | 0 | 7 |
| E | 0 | 1 | 4 | 0 | 4 | 0 | 9 |
| ESE | 0 | 1 | 3 | 3 | 0 | 0 | 7 |
| SE | 0 | 1 | 5 | 6 | 3 | 0 | 15 |
| SSE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| SSW | 0 | 0 | 0 | 6 | 4 | 0 | 10 |
| SW | 0 | 0 | 0 | 6 | 10 | 0 | 16 |
| WSW | 0 | 0 | 2 | 6 | 2 | 2 | 12 |
| W | 0 | 0 | 2 | 11 | 2 | 0 | 15 |
| WNW | 0 | 0 | 7 | 23 | 1 | 1 | 32 |
| NW | 0 | 0 | 2 | 14 | 4 | 0 | 20 |
| NNW | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 11 | 59 | 104 | 43 | 13 | 230 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 3 | 8 | 5 | 17 |
| NNE | 0 | 1 | 6 | 5 | 2 | 0 | 14 |
| NE | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| ESE | 0 | 0 | 5 | 0 | 0 | 0 | 5 |
| SE | 0 | 1 | 6 | 1 | 0 | 0 | 8 |
| SSE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSW | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| SW | 0 | 0 | 1 | 4 | 3 | 0 | 8 |
| WSW | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| W | 0 | 0 | 0 | 1 | 4 | 1 | 6 |
| WNW | 0 | 0 | 2 | 5 | 1 | 0 | 8 |
| NW | 0 | 0 | 2 | 2 | 1 | 1 | 6 |
| NNW | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 2 | 26 | 25 | 19 | 7 | 79 |

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

Zion Nuclear Station

Period of Record: April - June 2013
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 2 | 3 | 4 | 13 | 8 | 30 |
| NNE | 0 | 4 | 11 | 4 | 2 | 0 | 21 |
| NE | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| ENE | 1 | 2 | 1 | 0 | 0 | 0 | 4 |
| E | 0 | 4 | 0 | 0 | 0 | 0 | 4 |
| ESE | 0 | 2 | 3 | 1 | 1 | 0 | 7 |
| SE | 0 | 3 | 4 | 1 | 1 | 0 | 9 |
| SSE | 0 | 0 | 2 | 1 | 0 | 0 | 3 |
| S | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSW | 0 | 0 | 1 | 1 | 2 | 0 | 4 |
| SW | 0 | 0 | 1 | 4 | 3 | 0 | 8 |
| WSW | 0 | 0 | 1 | 4 | 5 | 2 | 12 |
| W | 0 | 0 | 0 | 2 | 3 | 2 | 7 |
| WNW | 0 | 0 | 1 | 3 | 0 | 0 | 4 |
| NW | 0 | 0 | 1 | 3 | 2 | 0 | 6 |
| NNW | 0 | 0 | 1 | 3 | 0 | 0 | 4 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 18 | 32 | 31 | 32 | 12 | 126 |

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

Zion Nuclear Station

Period of Record: April - June 2013
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 4 | 14 | 55 | 61 | 39 | 173 |
| NNE | 1 | 13 | 20 | 38 | 29 | 12 | 113 |
| NE | 0 | 6 | 16 | 17 | 10 | 1 | 50 |
| ENE | 2 | 10 | 22 | 8 | 9 | 3 | 54 |
| E | 0 | 11 | 12 | 3 | 1 | 0 | 27 |
| ESE | 0 | 8 | 7 | 5 | 2 | 0 | 22 |
| SE | 0 | 8 | 16 | 20 | 0 | 2 | 46 |
| SSE | 0 | 2 | 10 | 22 | 2 | 1 | 37 |
| S | 0 | 1 | 5 | 9 | 4 | 0 | 19 |
| SSW | 0 | 2 | 4 | 17 | 15 | 3 | 41 |
| SW | 0 | 3 | 9 | 19 | 4 | 2 | 37 |
| WSW | 0 | 2 | 5 | 21 | 10 | 11 | 49 |
| W | 0 | 2 | 6 | 18 | 9 | 0 | 35 |
| WNW | 0 | 3 | 8 | 16 | 4 | 0 | 31 |
| NW | 0 | 2 | 4 | 25 | 1 | 0 | 32 |
| NNW | 0 | 5 | 9 | 10 | 0 | 0 | 24 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 3 | 82 | 167 | 303 | 161 | 74 | 790 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 13 | 7 | 3 | 1 | 28 |
| NNE | 0 | 3 | 16 | 15 | 3 | 0 | 37 |
| NE | 1 | 2 | 12 | 5 | 0 | 1 | 21 |
| ENE | 2 | 3 | 8 | 6 | 1 | 2 | 22 |
| E | 1 | 7 | 7 | 6 | 6 | 6 | 33 |
| ESE | 2 | 5 | 16 | 6 | 1 | 0 | 30 |
| SE | 2 | 11 | 11 | 12 | 4 | 0 | 40 |
| SSE | 1 | 8 | 15 | 26 | 3 | 10 | 63 |
| S | 0 | 10 | 14 | 29 | 10 | 3 | 66 |
| SSW | 0 | 4 | 10 | 14 | 9 | 0 | 37 |
| SW | 0 | 1 | 12 | 18 | 4 | 1 | 36 |
| WSW | 0 | 3 | 5 | 7 | 0 | 1 | 16 |
| W | 0 | 2 | 1 | 7 | 1 | 0 | 11 |
| WNW | 0 | 1 | 1 | 9 | 3 | 0 | 14 |
| NW | 0 | 2 | 4 | 4 | 0 | 0 | 10 |
| NNW | 0 | 4 | 6 | 8 | 0 | 0 | 18 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 9 | 70 | 151 | 179 | 48 | 25 | 482 |

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

Zion Nuclear Station

Period of Record: April - June 2013
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 1 | 3 | 6 | 3 | 0 | 0 | 13 |
| NNE | 0 | 1 | 9 | 5 | 0 | 0 | 15 |
| NE | 2 | 3 | 9 | 1 | 0 | 0 | 15 |
| ENE | 0 | 1 | 7 | 0 | 0 | 1 | 9 |
| E | 1 | 5 | 3 | 1 | 3 | 1 | 14 |
| ESE | 0 | 5 | 6 | 5 | 2 | 0 | 18 |
| SE | 0 | 4 | 5 | 5 | 1 | 1 | 16 |
| SSE | 0 | 8 | 12 | 8 | 7 | 5 | 40 |
| S | 0 | 8 | 16 | 21 | 11 | 1 | 57 |
| SSW | 3 | 2 | 14 | 21 | 5 | 0 | 45 |
| SW | 0 | 5 | 6 | 3 | 1 | 0 | 15 |
| WSW | 0 | 2 | 3 | 2 | 0 | 0 | 7 |
| W | 2 | 3 | 3 | 0 | 0 | 0 | 8 |
| WNW | 0 | 2 | 1 | 0 | 1 | 0 | 4 |
| NW | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| NNW | 1 | 3 | 0 | 1 | 0 | 0 | 5 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 10 | 57 | 102 | 76 | 31 | 9 | 285 |

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

Zion Nuclear Station

Period of Record: April - June 2013
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 | 0 | 8 | 0 | 0 | 0 | 8 |
| NNE | 2 | 3 | 0 | 0 | 0 | 0 | 5 |
| NE | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 1 | 2 | 2 | 1 | 0 | 1 | 7 |
| ESE | 1 | 3 | 0 | 4 | 2 | 3 | 13 |
| SE | 0 | 1 | 1 | 0 | 5 | 5 | 12 |
| SSE | 0 | 1 | 12 | 5 | 4 | 2 | 24 |
| S | 0 | 3 | 7 | 10 | 19 | 2 | 41 |
| SSW | 1 | 1 | 12 | 10 | 3 | 0 | 27 |
| SW | 1 | 1 | 6 | 7 | 0 | 0 | 15 |
| WSW | 0 | 1 | 2 | 1 | 0 | 0 | 4 |
| W | 2 | 1 | 6 | 0 | 0 | 0 | 9 |
| WNW | 1 | 1 | 2 | 1 | 0 | 0 | 5 |
| NW | 1 | 2 | 2 | 2 | 0 | 0 | 7 |
| NNW | 1 | 2 | 3 | 2 | 0 | 0 | 8 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 11 | 24 | 65 | 43 | 33 | 13 | 189 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 9 | 10 | 0 | 0 | 19 |
| NNE | 0 | 7 | 34 | 4 | 0 | 0 | 45 |
| NE | 0 | 50 | 16 | 0 | 0 | 0 | 66 |
| ENE | 0 | 39 | 13 | 0 | 0 | 0 | 52 |
| E | 0 | 37 | 7 | 1 | 0 | 0 | 45 |
| ESE | 0 | 30 | 2 | 0 | 0 | 0 | 32 |
| SE | 0 | 26 | 4 | 0 | 0 | 0 | 30 |
| SSE | 0 | 4 | 19 | 0 | 0 | 0 | 23 |
| S | 0 | 1 | 4 | 2 | 0 | 0 | 7 |
| SSW | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| SW | 0 | 6 | 20 | 6 | 0 | 0 | 32 |
| WSW | 0 | 11 | 20 | 3 | 0 | 0 | 34 |
| W | 0 | 15 | 7 | 0 | 0 | 0 | 22 |
| WNW | 0 | 6 | 5 | 0 | 0 | 0 | 11 |
| NW | 0 | 0 | 16 | 0 | 0 | 0 | 16 |
| NNW | 0 | 3 | 5 | 0 | 0 | 0 | 8 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 236 | 182 | 26 | 0 | 0 | 444 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 3 | 1 | 0 | 0 | 5 |
| NNE | 0 | 7 | 7 | 1 | 0 | 0 | 15 |
| NE | 0 | 5 | 0 | 0 | 0 | 0 | 5 |
| ENE | 1 | 8 | 4 | 0 | 0 | 0 | 13 |
| E | 0 | 4 | 3 | 0 | 0 | 0 | 7 |
| ESE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| SE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| SSE | 0 | 2 | 8 | 1 | 0 | 0 | 11 |
| S | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| SSW | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SW | 0 | 4 | 7 | 1 | 0 | 0 | 12 |
| WSW | 0 | 2 | 1 | 4 | 0 | 0 | 7 |
| W | 0 | 6 | 2 | 0 | 0 | 0 | 8 |
| WNW | 0 | 4 | 2 | 0 | 0 | 0 | 6 |
| NW | 0 | 2 | 4 | 0 | 0 | 0 | 6 |
| NNW | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 53 | 45 | 8 | 0 | 0 | 107 |

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

Zion Nuclear Station

Period of Record: July - September 2013
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 10 | 5 | 0 | 0 | 0 | 15 |
| NNE | 1 | 6 | 6 | 0 | 0 | 0 | 13 |
| NE | 1 | 9 | 1 | 0 | 0 | 0 | 11 |
| ENE | 0 | 5 | 5 | 0 | 0 | 0 | 10 |
| E | 0 | 6 | 0 | 0 | 0 | 0 | 6 |
| ESE | 1 | 6 | 0 | 0 | 0 | 0 | 7 |
| SE | 1 | 7 | 1 | 0 | 0 | 0 | 9 |
| SSE | 0 | 5 | 26 | 2 | 0 | 0 | 33 |
| S | 0 | 4 | 4 | 0 | 0 | 0 | 8 |
| SSW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW | 0 | 3 | 2 | 1 | 0 | 0 | 6 |
| WSW | 0 | 2 | 7 | 2 | 0 | 0 | 11 |
| W | 1 | 5 | 0 | 0 | 0 | 0 | 6 |
| WNW | 1 | 8 | 0 | 0 | 0 | 0 | 9 |
| NW | 1 | 2 | 2 | 0 | 0 | 0 | 5 |
| NNW | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 7 | 80 | 61 | 5 | 0 | 0 | 153 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 5 | 23 | 11 | 4 | 0 | 0 | 43 |
| NNE | 6 | 23 | 28 | 4 | 0 | 0 | 61 |
| NE | 5 | 22 | 17 | 2 | 0 | 0 | 46 |
| ENE | 5 | 15 | 6 | 0 | 0 | 0 | 26 |
| E | 6 | 19 | 12 | 0 | 0 | 0 | 37 |
| ESE | 7 | 23 | 3 | 0 | 0 | 0 | 33 |
| SE | 3 | 24 | 5 | 0 | 0 | 0 | 32 |
| SSE | 2 | 26 | 48 | 13 | 0 | 0 | 89 |
| S | 3 | 38 | 13 | 0 | 0 | 0 | 54 |
| SSW | 1 | 35 | 12 | 0 | 0 | 0 | 48 |
| SW | 3 | 29 | 36 | 2 | 0 | 0 | 70 |
| WSW | 3 | 22 | 23 | 1 | 0 | 0 | 49 |
| W | 0 | 27 | 4 | 0 | 0 | 0 | 31 |
| WNW | 2 | 6 | 0 | 1 | 0 | 0 | 9 |
| NW | 2 | 13 | 4 | 0 | 0 | 0 | 19 |
| NNW | 3 | 7 | 11 | 0 | 0 | 0 | 21 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 56 | 352 | 233 | 27 | 0 | 0 | 668 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 23 | 20 | 4 | 0 | 0 | 0 | 47 |
| NNE | 13 | 11 | 2 | 0 | 0 | 0 | 26 |
| NE | 2 | 5 | 0 | 0 | 0 | 0 | 7 |
| ENE | 0 | 8 | 0 | 0 | 0 | 0 | 8 |
| E | 4 | 5 | 0 | 1 | 0 | 0 | 10 |
| ESE | 1 | 3 | 0 | 0 | 0 | 0 | 4 |
| SE | 3 | 17 | 1 | 0 | 0 | 0 | 21 |
| SSE | 4 | 9 | 10 | 0 | 0 | 0 | 23 |
| S | 7 | 37 | 3 | 0 | 0 | 0 | 47 |
| SSW | 15 | 45 | 2 | 0 | 0 | 0 | 62 |
| SW | 13 | 34 | 15 | 0 | 0 | 0 | 62 |
| WSW | 8 | 25 | 11 | 0 | 0 | 0 | 44 |
| W | 13 | 22 | 0 | 0 | 0 | 0 | 35 |
| WNW | 6 | 20 | 0 | 0 | 0 | 0 | 26 |
| NW | 11 | 21 | 1 | 0 | 0 | 0 | 33 |
| NNW | 7 | 19 | 0 | 0 | 0 | 0 | 26 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 130 | 301 | 49 | 1 | 0 | 0 | 481 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 6 | 0 | 0 | 0 | 0 | 10 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| E | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| ESE | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| SE | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SSE | 1 | 3 | 1 | 0 | 0 | 0 | 5 |
| S | 6 | 4 | 2 | 0 | 0 | 0 | 12 |
| SSW | 16 | 13 | 0 | 0 | 0 | 0 | 29 |
| SW | 19 | 16 | 0 | 0 | 0 | 0 | 35 |
| WSW | 17 | 8 | 1 | 0 | 0 | 0 | 26 |
| W | 18 | 12 | 0 | 0 | 0 | 0 | 30 |
| WNW | 12 | 10 | 0 | 0 | 0 | 0 | 22 |
| NW | 17 | 21 | 0 | 0 | 0 | 0 | 38 |
| NNW | 3 | 9 | 0 | 0 | 0 | 0 | 12 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 119 | 102 | 5 | 0 | 0 | 0 | 226 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| SSE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| S | 4 | 3 | 0 | 0 | 0 | 0 | 7 |
| SSW | 5 | 1 | 0 | 0 | 0 | 0 | 6 |
| SW | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| WSW | 14 | 8 | 0 | 0 | 0 | 0 | 22 |
| W | 26 | 20 | 0 | 0 | 0 | 0 | 46 |
| WNW | 25 | 11 | 0 | 0 | 0 | 0 | 36 |
| NW | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| NNW | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 80 | 49 | 0 | 0 | 0 | 0 | 129 |

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

Zion Nuclear Station

Period of Record: July - September 2013
Stability Class - Extremely Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 11 | 9 | 0 | 20 |
| NNE | 0 | 8 | 22 | 24 | 5 | 0 | 59 |
| NE | 0 | 14 | 45 | 3 | 1 | 0 | 63 |
| ENE | 0 | 21 | 23 | 5 | 1 | 0 | 50 |
| E | 0 | 18 | 20 | 0 | 0 | 0 | 38 |
| ESE | 0 | 9 | 16 | 0 | 0 | 0 | 25 |
| SE | 0 | 4 | 34 | 10 | 0 | 0 | 48 |
| SSE | 0 | 0 | 7 | 3 | 0 | 0 | 10 |
| S | 0 | 0 | 2 | 1 | 3 | 0 | 6 |
| SSW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW | 0 | 0 | 7 | 15 | 1 | 1 | 24 |
| WSW | 0 | 1 | 14 | 15 | 7 | 1 | 38 |
| W | 0 | 2 | 15 | 7 | 2 | 0 | 26 |
| WNW | 0 | 0 | 7 | 6 | 0 | 0 | 13 |
| NW | 0 | 0 | 3 | 13 | 1 | 0 | 17 |
| NNW | 0 | 2 | 1 | 4 | 0 | 0 | 7 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 79 | 216 | 117 | 30 | 2 | 444 |

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

Zion Nuclear Station

Period of Record: July - September 2013
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 2 | 2 | 1 | 0 | 5 |
| NNE | 0 | 3 | 7 | 4 | 3 | 0 | 17 |
| NE | 0 | 3 | 1 | 0 | 0 | 0 | 4 |
| ENE | 0 | 4 | 5 | 3 | 1 | 0 | 13 |
| E | 0 | 3 | 0 | 3 | 0 | 0 | 6 |
| ESE | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| SE | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| SSE | 0 | 0 | 3 | 5 | 1 | 0 | 9 |
| S | 0 | 0 | 1 | 2 | 1 | 0 | 4 |
| SSW | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| SW | 0 | 0 | 4 | 6 | 1 | 0 | 11 |
| WSW | 0 | 0 | 2 | 2 | 2 | 2 | 8 |
| W | 0 | 1 | 4 | 1 | 1 | 0 | 7 |
| WNW | 0 | 2 | 3 | 1 | 0 | 0 | 6 |
| NW | 0 | 0 | 2 | 6 | 0 | 0 | 8 |
| NNW | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 19 | 39 | 36 | 11 | 2 | 107 |

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

Zion Nuclear Station

Period of Record: July - September 2013
Stability Class - Slightly Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 4 | 8 | 3 | 1 | 0 | 16 |
| NNE | 0 | 7 | 4 | 5 | 0 | 0 | 16 |
| NE | 0 | 5 | 2 | 1 | 0 | 0 | 8 |
| ENE | 0 | 2 | 2 | 3 | 2 | 0 | 9 |
| E | 0 | 3 | 2 | 0 | 0 | 0 | 5 |
| ESE | 1 | 4 | 2 | 0 | 0 | 0 | 7 |
| SE | 0 | 4 | 5 | 3 | 1 | 0 | 13 |
| SSE | 0 | 1 | 18 | 9 | 1 | 0 | 29 |
| S | 0 | 1 | 6 | 1 | 1 | 0 | 9 |
| SSW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW | 0 | 1 | 1 | 1 | 1 | 0 | 4 |
| WSW | 0 | 0 | 1 | 8 | 2 | 1 | 12 |
| W | 0 | 3 | 4 | 1 | 0 | 0 | 8 |
| WNW | 0 | 0 | 5 | 3 | 0 | 0 | 8 |
| NW | 0 | 1 | 0 | 3 | 0 | 0 | 4 |
| NNW | 0 | 1 | 2 | 2 | 0 | 0 | 5 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 37 | 62 | 43 | 9 | 1 | 153 |

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

Zion Nuclear Station

Period of Record: July - September 2013
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 1 | 3 | 8 | 13 | 6 | 1 | 32 |
| NNE | 0 | 6 | 16 | 24 | 13 | 2 | 61 |
| NE | 1 | 9 | 16 | 15 | 6 | 2 | 49 |
| ENE | 1 | 6 | 13 | 10 | 1 | 0 | 31 |
| E | 3 | 11 | 11 | 10 | 0 | 0 | 35 |
| ESE | 1 | 16 | 12 | 7 | 0 | 0 | 36 |
| SE | 1 | 14 | 9 | 16 | 2 | 0 | 42 |
| SSE | 0 | 7 | 31 | 32 | 12 | 0 | 82 |
| S | 0 | 5 | 28 | 31 | 0 | 1 | 65 |
| SSW | 0 | 1 | 9 | 7 | 3 | 0 | 20 |
| SW | 0 | 3 | 18 | 41 | 5 | 0 | 67 |
| WSW | 0 | 6 | 11 | 30 | 7 | 0 | 54 |
| W | 0 | 1 | 19 | 20 | 1 | 0 | 41 |
| WNW | 0 | 3 | 5 | 4 | 0 | 0 | 12 |
| NW | 0 | 1 | 7 | 3 | 1 | 1 | 13 |
| NNW | 1 | 2 | 5 | 20 | 0 | 0 | 28 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 9 | 94 | 218 | 283 | 57 | 7 | 668 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 5 | 18 | 0 | 0 | 27 |
| NNE | 1 | 8 | 18 | 9 | 0 | 0 | 36 |
| NE | 1 | 10 | 12 | 3 | 0 | 0 | 26 |
| ENE | 0 | 9 | 3 | 6 | 0 | 0 | 18 |
| E | 2 | 5 | 5 | 2 | 1 | 1 | 16 |
| ESE | 0 | 3 | 1 | 2 | 4 | 0 | 10 |
| SE | 0 | 5 | 9 | 8 | 0 | 0 | 22 |
| SSE | 2 | 2 | 14 | 10 | 0 | 0 | 28 |
| S | 0 | 5 | 23 | 21 | 2 | 0 | 51 |
| SSW | 1 | 4 | 16 | 15 | 0 | 0 | 36 |
| SW | 2 | 3 | 12 | 44 | 5 | 0 | 66 |
| WSW | 0 | 3 | 9 | 27 | 7 | 0 | 46 |
| W | 0 | 2 | 8 | 16 | 0 | 0 | 26 |
| WNW | 0 | 2 | 13 | 10 | 0 | 0 | 25 |
| NW | 0 | 1 | 7 | 20 | 0 | 0 | 28 |
| NNW | 0 | 1 | 7 | 12 | 0 | 0 | 20 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 9 | 67 | 162 | 223 | 19 | 1 | 481 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 5 | 3 | 13 | 0 | 0 | 22 |
| NNE | 2 | 6 | 11 | 1 | 0 | 0 | 20 |
| NE | 0 | 4 | 2 | 0 | 0 | 0 | 6 |
| ENE | 1 | 5 | 2 | 0 | 0 | 0 | 8 |
| E | 0 | 7 | 1 | 0 | 0 | 0 | 8 |
| ESE | 0 | 3 | 4 | 0 | 0 | 0 | 7 |
| SE | 2 | 4 | 2 | 0 | 0 | 0 | 8 |
| SSE | 0 | 3 | 4 | 3 | 0 | 0 | 10 |
| S | 0 | 1 | 10 | 5 | 0 | 0 | 16 |
| SSW | 0 | 2 | 16 | 10 | 0 | 0 | 28 |
| SW | 0 | 3 | 14 | 12 | 0 | 0 | 29 |
| WSW | 1 | 3 | 6 | 8 | 0 | 0 | 18 |
| W | 0 | 2 | 3 | 4 | 1 | 0 | 10 |
| WNW | 0 | 1 | 1 | 6 | 1 | 0 | 9 |
| NW | 2 | 0 | 2 | 5 | 0 | 0 | 9 |
| NNW | 1 | 1 | 4 | 12 | 0 | 0 | 18 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 10 | 50 | 85 | 79 | 2 | 0 | 226 |

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

Zion Nuclear Station

Period of Record: July - September 2013
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 | 4 | 0 | 0 | 0 | 6 |
| NNE | 1 | 5 | 1 | 0 | 0 | 0 | 7 |
| NE | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| ENE | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| E | 0 | 6 | 2 | 0 | 0 | 0 | 8 |
| ESE | 2 | 8 | 3 | 0 | 0 | 0 | 13 |
| SE | 0 | 4 | 3 | 0 | 0 | 0 | 7 |
| SSE | 1 | 3 | 2 | 0 | 0 | 0 | 6 |
| S | 1 | 0 | 2 | 0 | 0 | 0 | 3 |
| SSW | 4 | 3 | 5 | 4 | 0 | 0 | 16 |
| SW | 0 | 2 | 5 | 6 | 0 | 0 | 13 |
| WSW | 1 | 8 | 3 | 5 | 0 | 0 | 17 |
| W | 2 | 7 | 0 | 5 | 0 | 0 | 14 |
| WNW | 0 | 3 | 0 | 1 | 0 | 0 | 4 |
| NW | 1 | 0 | 0 | 4 | 0 | 0 | 5 |
| NNW | 1 | 0 | 0 | 2 | 0 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 15 | 54 | 32 | 27 | 0 | 0 | 128 |

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

Zion Nuclear Station

Period of Record: October - December 2013
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 | 0 | 0 | 0 | 0 |
| NNE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| NE | 0 | 3 | 1 | 0 | 0 | 0 | 4 |
| ENE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| E | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| ESE | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| SE | 0 | 6 | 0 | 0 | 0 | 0 | 6 |
| SSE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| S | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW | 0 | 0 | 9 | 8 | 0 | 0 | 17 |
| WSW | 0 | 4 | 18 | 8 | 0 | 0 | 30 |
| W | 0 | 2 | 16 | 7 | 0 | 0 | 25 |
| WNW | 0 | 2 | 15 | 2 | 0 | 0 | 19 |
| NW | 0 | 0 | 16 | 0 | 0 | 0 | 16 |
| NNW | 0 | 0 | 0 | 3 | 0 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 23 | 76 | 28 | 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: 3

Zion Nuclear Station

Period of Record: October - December 2013
Stability Class - Moderately Unstable - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| NNE | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| 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 | 2 | 0 | 0 | 0 | 0 | 2 |
| SE | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| SSE | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| S | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| SSW | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SW | 0 | 1 | 9 | 7 | 0 | 0 | 17 |
| WSW | 0 | 3 | 10 | 0 | 0 | 0 | 13 |
| W | 0 | 5 | 10 | 2 | 0 | 0 | 17 |
| WNW | 0 | 2 | 7 | 1 | 0 | 0 | 10 |
| NW | 0 | 0 | 6 | 1 | 0 | 0 | 7 |
| NNW | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 22 | 48 | 13 | 0 | 0 | 83 |

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

Zion Nuclear Station

Period of Record: October - December 2013
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 | 3 | 0 | 0 | 0 | 3 |
| NNE | 1 | 5 | 3 | 0 | 0 | 0 | 9 |
| NE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ENE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| E | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| ESE | 0 | 1 | 0 | 3 | 0 | 0 | 4 |
| SE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| SSE | 0 | 2 | 5 | 1 | 4 | 0 | 12 |
| S | 0 | 5 | 1 | 0 | 0 | 0 | 6 |
| SSW | 0 | 1 | 3 | 0 | 0 | 0 | 4 |
| SW | 0 | 4 | 14 | 3 | 0 | 0 | 21 |
| WSW | 0 | 6 | 4 | 5 | 0 | 0 | 15 |
| W | 0 | 10 | 16 | 3 | 0 | 0 | 29 |
| WNW | 1 | 5 | 9 | 1 | 0 | 0 | 16 |
| NW | 0 | 5 | 10 | 1 | 0 | 0 | 16 |
| NNW | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 3 | 51 | 69 | 18 | 4 | 0 | 145 |

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: 3

Zion Nuclear Station

Period of Record: October - December 2013
Stability Class - Neutral - 250Ft-33Ft Delta-T (F)
Winds Measured at 35 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 2 | 17 | 12 | 6 | 0 | 0 | 37 |
| NNE | 1 | 12 | 24 | 0 | 0 | 0 | 37 |
| NE | 0 | 5 | 5 | 5 | 0 | 0 | 15 |
| ENE | 3 | 4 | 2 | 10 | 0 | 0 | 19 |
| E | 1 | 3 | 4 | 12 | 0 | 0 | 20 |
| ESE | 1 | 3 | 5 | 7 | 0 | 0 | 16 |
| SE | 3 | 20 | 8 | 0 | 0 | 0 | 31 |
| SSE | 0 | 21 | 27 | 21 | 7 | 0 | 76 |
| S | 1 | 17 | 29 | 8 | 0 | 0 | 55 |
| SSW | 7 | 25 | 34 | 14 | 0 | 0 | 80 |
| SW | 7 | 22 | 65 | 48 | 3 | 0 | 145 |
| WSW | 3 | 51 | 61 | 12 | 0 | 0 | 127 |
| W | 7 | 79 | 98 | 26 | 3 | 0 | 213 |
| WNW | 7 | 48 | 37 | 2 | 0 | 0 | 94 |
| NW | 5 | 38 | 40 | 4 | 0 | 0 | 87 |
| NNW | 5 | 25 | 22 | 2 | 0 | 0 | 54 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 53 | 390 | 473 | 177 | 13 | 0 | 1106 |

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 29
Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: October - December 2013
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 | 0 | 4 | 1 | 0 | 0 | 0 | 5 |
| NNE | 2 | 5 | 5 | 0 | 0 | 0 | 12 |
| NE | 4 | 2 | 0 | 0 | 0 | 0 | 6 |
| ENE | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| E | 2 | 0 | 5 | 0 | 0 | 0 | 7 |
| ESE | 1 | 0 | 2 | 0 | 0 | 0 | 3 |
| SE | 3 | 10 | 1 | 0 | 0 | 0 | 14 |
| SSE | 8 | 13 | 10 | 3 | 0 | 0 | 34 |
| S | 7 | 37 | 21 | 2 | 0 | 0 | 67 |
| SSW | 3 | 29 | 10 | 0 | 0 | 0 | 42 |
| SW | 5 | 32 | 4 | 6 | 1 | 0 | 48 |
| WSW | 14 | 35 | 4 | 0 | 0 | 0 | 53 |
| W | 4 | 61 | 7 | 0 | 0 | 0 | 72 |
| WNW | 6 | 37 | 0 | 0 | 0 | 0 | 43 |
| NW | 6 | 28 | 6 | 0 | 0 | 0 | 40 |
| NNW | 3 | 5 | 4 | 0 | 0 | 0 | 12 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 70 | 298 | 80 | 11 | 1 | 0 | 460 |

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

Zion Nuclear Station

Period of Record: October - December 2013
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 | 0 | 0 | 0 | 0 | 0 | 6 |
| NNE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| NE | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| ENE | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| SE | 4 | 2 | 0 | 0 | 0 | 0 | 6 |
| SSE | 1 | 4 | 3 | 0 | 0 | 0 | 8 |
| S | 10 | 23 | 9 | 1 | 0 | 0 | 43 |
| SSW | 18 | 7 | 0 | 0 | 0 | 0 | 25 |
| SW | 4 | 5 | 0 | 0 | 0 | 0 | 9 |
| WSW | 6 | 7 | 0 | 0 | 0 | 0 | 13 |
| W | 12 | 12 | 0 | 0 | 0 | 0 | 24 |
| WNW | 6 | 8 | 0 | 0 | 0 | 0 | 14 |
| NW | 8 | 3 | 0 | 0 | 0 | 0 | 11 |
| NNW | 6 | 3 | 0 | 0 | 0 | 0 | 9 |
| Variable | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| Total | 90 | 76 | 12 | 1 | 0 | 0 | 179 |

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

Zion Nuclear Station

Period of Record: October - December 2013
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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| E | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ESE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SE | 0 | 4 | 0 | 0 | 0 | 0 | 4 |
| SSE | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| S | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| SSW | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| SW | 6 | 5 | 0 | 0 | 0 | 0 | 11 |
| WSW | 4 | 1 | 0 | 0 | 0 | 0 | 5 |
| W | 11 | 6 | 0 | 0 | 0 | 0 | 17 |
| WNW | 11 | 7 | 0 | 0 | 0 | 0 | 18 |
| NW | 5 | 2 | 0 | 0 | 0 | 0 | 7 |
| NNW | 2 | 1 | 0 | 0 | 0 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 42 | 28 | 2 | 0 | 0 | 0 | 72 |

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

Zion Nuclear Station

Period of Record: October - December 2013
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 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 3 | 0 | 1 | 0 | 0 | 4 |
| 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 | 4 | 5 | 0 | 0 | 0 | 9 |
| SSE | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| S | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SSW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SW | 0 | 0 | 3 | 5 | 6 | 1 | 15 |
| WSW | 0 | 0 | 10 | 8 | 5 | 0 | 23 |
| W | 0 | 0 | 4 | 11 | 8 | 6 | 29 |
| WNW | 0 | 0 | 4 | 12 | 0 | 3 | 19 |
| NW | 0 | 0 | 1 | 16 | 1 | 0 | 18 |
| NNW | 0 | 0 | 0 | 0 | 3 | 0 | 3 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 9 | 29 | 53 | 23 | 10 | 124 |

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

Zion Nuclear Station

Period of Record: October - December 2013
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 | 3 | 1 | 0 | 0 | 4 |
| NNE | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| NE | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| ESE | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| SE | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| SSE | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| S | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| SSW | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| SW | 0 | 1 | 2 | 7 | 6 | 0 | 16 |
| WSW | 0 | 0 | 3 | 5 | 1 | 0 | 9 |
| W | 0 | 0 | 5 | 9 | 4 | 1 | 19 |
| WNW | 0 | 0 | 2 | 6 | 0 | 1 | 9 |
| NW | 0 | 0 | 2 | 5 | 1 | 0 | 8 |
| NNW | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 7 | 21 | 36 | 14 | 2 | 80 |

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

Zion Nuclear Station

Period of Record: October - December 2013
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 | 4 | 2 | 0 | 0 | 6 |
| NNE | 0 | 3 | 1 | 2 | 0 | 0 | 6 |
| NE | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| ENE | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| E | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| ESE | 0 | 2 | 1 | 0 | 3 | 0 | 6 |
| SE | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| SSE | 0 | 1 | 6 | 3 | 1 | 3 | 14 |
| S | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| SSW | 0 | 0 | 3 | 0 | 0 | 0 | 3 |
| SW | 0 | 2 | 6 | 9 | 2 | 0 | 19 |
| WSW | 0 | 0 | 2 | 6 | 6 | 0 | 14 |
| W | 0 | 1 | 11 | 11 | 4 | 2 | 29 |
| WNW | 0 | 1 | 6 | 10 | 1 | 2 | 20 |
| NW | 0 | 0 | 7 | 7 | 2 | 0 | 16 |
| NNW | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 13 | 49 | 54 | 20 | 7 | 144 |

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: 3

Zion Nuclear Station

Period of Record: October - December 2013
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 | 1 | 0 | 13 | 9 | 6 | 2 | 31 |
| NNE | 0 | 2 | 9 | 22 | 14 | 0 | 47 |
| NE | 0 | 1 | 1 | 4 | 4 | 4 | 14 |
| ENE | 1 | 3 | 3 | 2 | 11 | 1 | 21 |
| E | 0 | 2 | 1 | 7 | 10 | 0 | 20 |
| ESE | 1 | 1 | 2 | 8 | 9 | 0 | 21 |
| SE | 1 | 2 | 14 | 18 | 10 | 0 | 45 |
| SSE | 0 | 1 | 16 | 14 | 18 | 15 | 64 |
| S | 0 | 2 | 9 | 15 | 20 | 1 | 47 |
| SSW | 1 | 5 | 28 | 19 | 11 | 5 | 69 |
| SW | 0 | 8 | 14 | 50 | 47 | 15 | 134 |
| WSW | 0 | 3 | 27 | 63 | 13 | 7 | 113 |
| W | 1 | 10 | 48 | 90 | 32 | 17 | 198 |
| WNW | 2 | 8 | 28 | 48 | 12 | 0 | 98 |
| NW | 0 | 6 | 26 | 49 | 14 | 0 | 95 |
| NNW | 1 | 2 | 13 | 25 | 4 | 1 | 46 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 9 | 56 | 252 | 443 | 235 | 68 | 1063 |

Hours of calm in this stability class: 0
Hours of missing wind measurements in this stability class: 72
Hours of missing stability measurements in all stability classes: 3

Zion Nuclear Station

Period of Record: October - December 2013
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 | 0 | 1 | 0 | 0 | 0 | 1 |
| NNE | 0 | 2 | 2 | 5 | 1 | 0 | 10 |
| NE | 0 | 3 | 4 | 3 | 0 | 0 | 10 |
| ENE | 0 | 2 | 0 | 1 | 0 | 0 | 3 |
| E | 0 | 1 | 1 | 4 | 1 | 0 | 7 |
| ESE | 0 | 2 | 3 | 0 | 3 | 0 | 8 |
| SE | 0 | 1 | 2 | 4 | 6 | 0 | 13 |
| SSE | 0 | 1 | 6 | 17 | 8 | 5 | 37 |
| S | 1 | 4 | 9 | 18 | 11 | 3 | 46 |
| SSW | 0 | 5 | 11 | 25 | 2 | 0 | 43 |
| SW | 0 | 1 | 13 | 26 | 7 | 1 | 48 |
| WSW | 1 | 2 | 21 | 24 | 1 | 0 | 49 |
| W | 0 | 3 | 16 | 45 | 0 | 0 | 64 |
| WNW | 0 | 2 | 6 | 30 | 0 | 0 | 38 |
| NW | 0 | 2 | 21 | 24 | 0 | 0 | 47 |
| NNW | 0 | 2 | 17 | 10 | 4 | 0 | 33 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2 | 33 | 133 | 236 | 44 | 9 | 457 |

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

Zion Nuclear Station

Period of Record: October - December 2013
Stability Class - Moderately Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 2 | 3 | 1 | 0 | 0 | 6 |
| NNE | 0 | 3 | 4 | 0 | 0 | 0 | 7 |
| NE | 0 | 4 | 2 | 0 | 0 | 0 | 6 |
| ENE | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| E | 1 | 1 | 3 | 0 | 0 | 0 | 5 |
| ESE | 0 | 1 | 6 | 1 | 2 | 0 | 10 |
| SE | 1 | 2 | 4 | 2 | 2 | 0 | 11 |
| SSE | 0 | 2 | 9 | 10 | 3 | 0 | 24 |
| S | 1 | 8 | 14 | 12 | 5 | 1 | 41 |
| SSW | 0 | 1 | 5 | 6 | 1 | 0 | 13 |
| SW | 0 | 1 | 4 | 3 | 0 | 0 | 8 |
| WSW | 0 | 0 | 2 | 2 | 2 | 0 | 6 |
| W | 0 | 1 | 4 | 7 | 0 | 0 | 12 |
| WNW | 0 | 1 | 7 | 9 | 0 | 0 | 17 |
| NW | 0 | 2 | 2 | 3 | 0 | 0 | 7 |
| NNW | 0 | 0 | 1 | 3 | 0 | 0 | 4 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 3 | 30 | 70 | 60 | 15 | 1 | 179 |

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

Zion Nuclear Station

Period of Record: October - December 2013
Stability Class - Extremely Stable - 250Ft-33Ft Delta-T (F)
Winds Measured at 250 Feet

Wind Speed (in mph)

| Wind Direction | 1-3 | 4-7 | 8-12 | 13-18 | 19-24 | > 24 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 7 | 1 | 0 | 0 | 8 |
| NNE | 0 | 2 | 3 | 1 | 0 | 0 | 6 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| E | 0 | 1 | 2 | 0 | 0 | 0 | 3 |
| ESE | 0 | 0 | 3 | 0 | 1 | 3 | 7 |
| SE | 0 | 0 | 5 | 0 | 0 | 0 | 5 |
| SSE | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| S | 0 | 1 | 4 | 0 | 2 | 0 | 7 |
| SSW | 0 | 1 | 0 | 1 | 0 | 0 | 2 |
| SW | 0 | 0 | 0 | 3 | 2 | 0 | 5 |
| WSW | 0 | 2 | 1 | 0 | 0 | 0 | 3 |
| W | 0 | 1 | 2 | 1 | 0 | 0 | 4 |
| WNW | 0 | 1 | 0 | 4 | 0 | 0 | 5 |
| NW | 2 | 1 | 1 | 3 | 0 | 0 | 7 |
| NNW | 0 | 3 | 1 | 0 | 0 | 0 | 4 |
| Variable | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2 | 17 | 31 | 14 | 5 | 3 | 72 |

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

# 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 2013

**Prepared By**

Teledyne Brown Engineering
Environmental Services

ZIONSOLUTIONS LLC
An EnergySolutions Company

Zion Nuclear Power Station
Zion, IL 60099

**May 2014**

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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 eighth 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 2013. During that time period, 435 analyses were performed on 51 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.

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

Strontium-90 was not detected in any of the samples analyzed in 2013.

Tritium was not detected in any of the groundwater or surface water samples analyzed in 2013. In the case of tritium, Zion*Solutions* specified that its laboratories achieve a lower limit of detection 10 times lower than that required by federal regulation.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples during all four quarters of sampling in 2013. Gross Alpha (dissolved) was detected in two of 44 groundwater locations. The concentration ranged from 0.7 to 1.1 pCi/L. Gross Alpha (suspended) was

not detected in any of the groundwater locations. Gross Beta (dissolved) was detected at all thirty-six groundwater locations. The concentrations ranged from 2.9 to 17.2 pCi/L. Gross Beta (suspended) was not detected in any of the groundwater locations.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on surface water samples during all four quarters of sampling in 2013. Gross Alpha (dissolved) and Gross Alpha (suspended) was not detected in any of the surface water locations. Gross Beta (dissolved) was detected at one surface water locations. The concentrations ranged from 3.1 to 3.5 pCi/L. Gross Beta (suspended) was not detected in any of the surface water locations. Dissolved Gross Alpha and Dissolved Gross Beta are detectable in samples from background isotopes. A more detailed discussion on the concentration range and where these isotopes come from is explained later in this section.

Iron-55 and Nickel-63 analyses were performed in 2013 on 48 samples from 11 groundwater and one surface water locations. All results were less than their respective LLDs.

## II. Introduction

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

This report covers those analyses performed by Teledyne Brown Engineering (TBE) and Environmental Inc. (Midwest Labs) on samples collected in 2013.

### 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 2013.

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

1. Concentrations of gamma emitters in groundwater and surface water.

2. Concentrations of strontium in groundwater and surface water.

3. Concentrations of tritium in groundwater and surface water.

4. Concentration of gross alpha and gross beta in groundwater and surface water.

5. Concentrations of Iron-55 in groundwater and surface water.

6. Concentrations of Nickel-63 in groundwater and surface water.

B. Data Interpretation

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

1. Lower Limit of Detection and Minimum Detectable Concentration

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

2. Laboratory Measurements Uncertainty

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

Statistically, the exact value of a measurement is expressed as a range with a stated level of confidence. The convention is to report results with a 95% level of confidence. The uncertainty comes from calibration standards, sample volume or weight measurements, sampling uncertainty and other factors. 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 2012 have ranged from non-detect to 660 pCi/L. Groundwater was collected from one off-site well on a quarterly basis. Gamma isotopic, radiostrontium and tritium analyses were performed on all samples. Strontium-89, strontium-90, tritium and gamma emitters were below their respective LLDs.

1. Background Concentrations of Tritium

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

   a. Tritium Production

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

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

b. Precipitation Data

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

c. Surface Water Data

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

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

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

cannot be distinguished as different from background at this concentration.

IV. Results and Discussion

A. Groundwater and Surface Water Results

Groundwater and Surface Water

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

Tritium

Samples from all locations were analyzed for tritium activity (Table B–I.1, Appendix B) (Table B–II.1, Appendix B). Tritium was 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 2013.

Gross Alpha and Gross Beta (Dissolved and Suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples during all four quarters of sampling in 2013. Gross Alpha (dissolved) was detected in two of 44 groundwater locations. The concentration ranged from 0.7 to 1.1 pCi/L. Gross Alpha (suspended) was not detected in any of the groundwater locations. Gross Beta (dissolved) was detected at all thirty-six groundwater locations. The concentrations ranged from 2.9 to 17.2 pCi/L. Gross Beta (suspended) was not detected in any of the groundwater locations.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on surface water samples during all four quarters of sampling in 2013. Gross Alpha (dissolved) and Gross Alpha (suspended) was not detected in any of the surface water locations. Gross Beta (dissolved) was detected at one surface water locations. The concentrations

ranged from 3.1 to 3.5 pCi/L. Gross Beta (suspended) was not detected in any of the surface water locations.
Although Gross Beta was detected, this data is at or near background levels and consistent with environmental data (Table B–I.1, Appendix B).

Gamma Emitters

Naturally occurring K-40 was detected in two of 47 samples analyzed. The concentration ranged from 77 to 83 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, 2013.

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

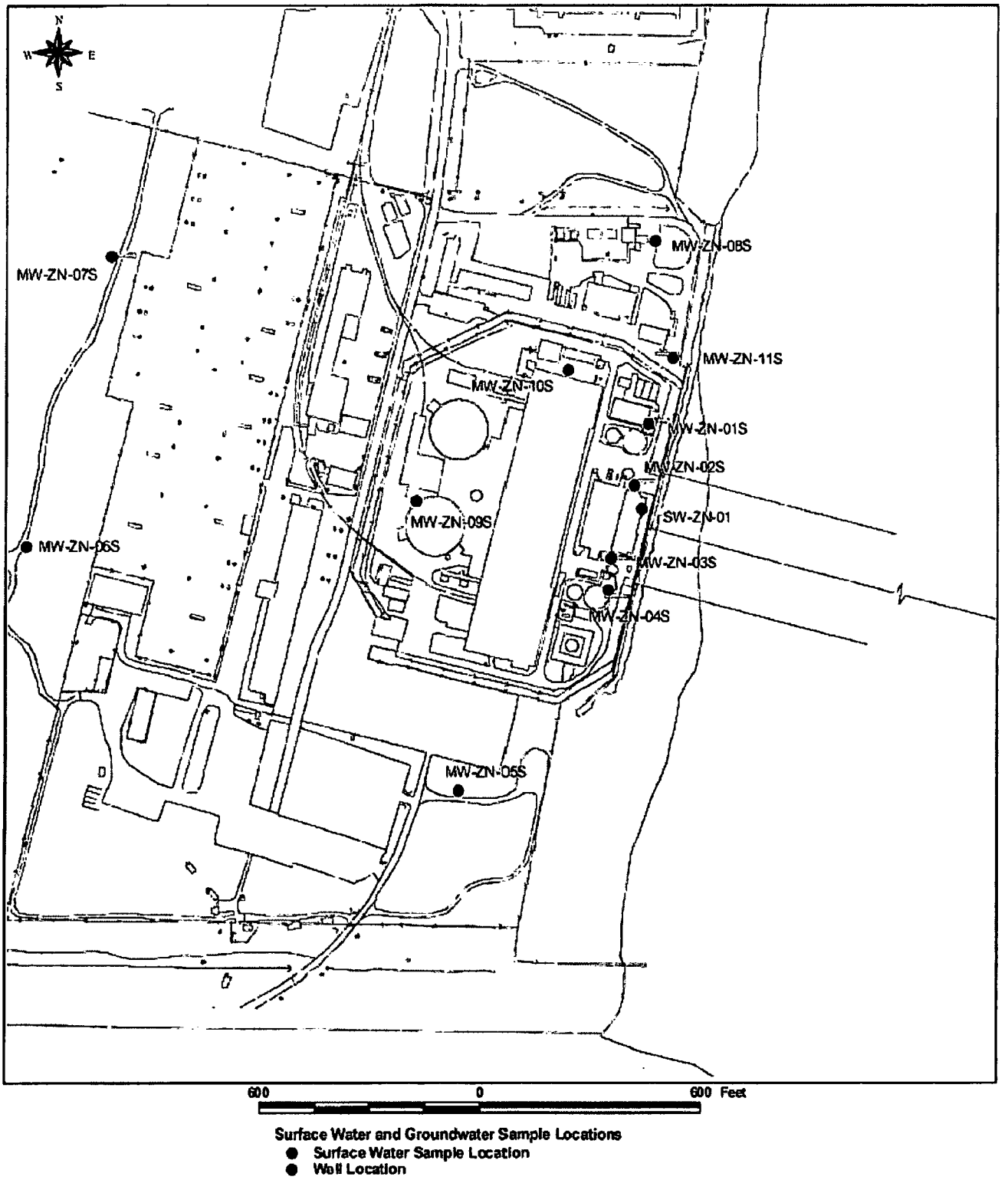


**Figure A-1**

Radiological Ground Water Protection Program
Groundwater and Surface Water Locations of the Zion Station, 2013

# 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, 2013**

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 | 03/11/13 | | < 188 | < 0.8 | < 1.0 | < 0.7 | 9.6 ± 1.3 | < 1.6 |
| MW-ZN-01S | 05/20/13 | | < 174 | < 0.6 | < 1.0 | < 0.8 | 7.3 ± 1.2 | < 1.5 |
| MW-ZN-01S | 09/10/13 | | < 196 | < 0.8 | < 1.6 | < 0.7 | 9.1 ± 1.3 | < 1.5 |
| MW-ZN-01S | 10/08/13 | | < 182 | < 0.7 | < 0.8 | < 1.1 | 8.8 ± 1.2 | < 1.6 |
| MW-ZN-02S | 03/12/13 | | < 188 | < 0.7 | < 0.9 | < 0.7 | 17.2 ± 1.4 | < 1.6 |
| MW-ZN-02S | 05/20/13 | | < 174 | < 0.6 | 1.1 ± 0.7 | < 0.7 | 14.8 ± 1.4 | < 1.6 |
| MW-ZN-02S | 09/10/13 | | < 192 | < 0.8 | < 1.2 | < 0.7 | 14.9 ± 1.3 | < 1.5 |
| MW-ZN-02S | 10/08/13 | | < 197 | < 0.6 | < 0.6 | < 1.1 | 13.7 ± 1.2 | < 1.6 |
| MW-ZN-03S | 03/12/13 | | < 183 | < 0.8 | < 1.0 | < 0.7 | 7.8 ± 1.2 | < 1.6 |
| MW-ZN-03S | 05/20/13 | | < 177 | < 0.6 | < 1.1 | < 0.7 | 8.0 ± 1.3 | < 1.6 |
| MW-ZN-03S | 09/11/13 | | < 196 | < 1.0 | < 1.8 | < 0.7 | 9.2 ± 1.3 | < 1.5 |
| MW-ZN-03S | 10/08/13 | | < 170 | < 0.7 | < 1.0 | < 1.1 | 9.5 ± 1.3 | < 1.6 |
| MW-ZN-04S | 03/12/13 | | < 186 | < 0.6 | < 1.1 | < 0.7 | 11.2 ± 1.3 | < 1.6 |
| MW-ZN-04S | 05/20/13 | | < 175 | < 0.7 | < 1.1 | < 0.7 | 8.0 ± 1.3 | < 1.6 |
| MW-ZN-04S | 09/11/13 | | < 192 | < 0.9 | < 1.9 | < 0.7 | 11.5 ± 1.4 | < 1.5 |
| MW-ZN-04S | 09/16/13 | | < 197 | | | | | |
| MW-ZN-04S | 10/08/13 | | < 166 | < 0.5 | < 0.9 | < 0.4 | 10.4 ± 1.3 | < 1.5 |
| MW-ZN-05S | 03/14/13 | | < 187 | < 0.7 | < 1.0 | < 0.7 | 4.2 ± 1.0 | < 1.6 |
| MW-ZN-05S | 05/22/13 | | < 178 | < 0.7 | < 1.1 | < 0.7 | 2.9 ± 1.1 | < 1.6 |
| MW-ZN-05S | 09/10/13 | | < 195 | < 0.9 | < 1.2 | < 0.8 | 5.2 ± 1.2 | < 1.4 |
| MW-ZN-05S | 10/07/13 | | < 168 | < 0.6 | < 0.8 | < 0.4 | 5.5 ± 1.1 | < 1.5 |
| MW-ZN-06S | 03/14/13 | | < 189 | < 0.6 | < 1.0 | < 0.5 | 4.9 ± 1.1 | < 1.7 |
| MW-ZN-06S | 05/21/13 | | < 175 | < 0.5 | < 1.1 | < 0.7 | 4.1 ± 1.2 | < 1.6 |
| MW-ZN-06S | 09/09/13 | | < 196 | < 0.9 | < 1.1 | < 0.8 | 6.5 ± 1.3 | < 1.4 |
| MW-ZN-06S | 10/07/13 | | < 170 | < 0.5 | < 0.8 | < 0.4 | 4.7 ± 1.1 | < 1.5 |
| MW-ZN-07S | 03/14/13 | | < 189 | < 0.6 | < 1.1 | < 0.6 | 3.5 ± 1.1 | < 1.8 |
| MW-ZN-07S | 05/21/13 | | < 177 | < 0.7 | < 1.3 | < 0.7 | < 3.4 | < 1.6 |
| MW-ZN-07S | 09/09/13 | | < 193 | < 0.8 | < 1.9 | < 0.8 | 5.9 ± 1.3 | < 1.4 |
| MW-ZN-07S | 09/16/13 | | < 197 | | | | | |
| MW-ZN-07S | 09/18/13 | | < 196 | | | | | |
| MW-ZN-07S | 10/07/13 | | < 198 | < 0.5 | < 0.9 | < 0.4 | 4.1 ± 1.1 | < 1.8 |
| MW-ZN-08S | 03/15/13 | | < 190 | < 0.8 | < 1.1 | < 0.5 | 5.7 ± 1.2 | < 1.7 |
| MW-ZN-08S | 05/21/13 | | < 175 | < 0.6 | < 1.0 | < 0.8 | 3.2 ± 1.1 | < 1.7 |
| MW-ZN-08S | 09/09/13 | | < 195 | < 0.8 | < 1.1 | < 0.8 | 6.2 ± 1.2 | < 1.4 |
| MW-ZN-08S | 10/07/13 | | < 168 | < 0.7 | < 0.7 | < 0.4 | 3.4 ± 1.0 | < 1.5 |
| MW-ZN-09S | 03/13/13 | | < 188 | < 0.6 | < 1.0 | < 0.5 | 8.4 ± 1.2 | < 1.7 |
| MW-ZN-09S | 05/20/13 | | < 184 | < 0.6 | < 0.8 | < 0.9 | 7.9 ± 1.1 | < 1.7 |
| MW-ZN-09S | 09/10/13 | | < 198 | < 0.9 | < 1.0 | < 0.8 | 8.6 ± 1.2 | < 1.4 |
| MW-ZN-09S | 10/09/13 | | < 171 | < 0.6 | < 1.0 | < 1.1 | 10.1 ± 1.2 | < 1.7 |
| MW-ZN-10S | 03/12/13 | | < 188 | < 0.8 | < 1.0 | < 0.6 | 11.7 ± 1.4 | < 1.8 |
| MW-ZN-10S | 05/20/13 | | < 182 | < 0.7 | < 1.0 | < 0.8 | 8.4 ± 1.2 | < 1.7 |
| MW-ZN-10S | 09/10/13 | | < 193 | < 0.7 | < 1.3 | < 0.4 | 9.0 ± 1.3 | < 1.5 |
| MW-ZN-10S | 10/08/13 | | < 170 | < 0.6 | < 1.1 | < 1.1 | 10.3 ± 1.3 | < 1.7 |
| MW-ZN-11S | 03/14/13 | | < 185 | < 0.8 | < 1.0 | < 0.7 | 8.5 ± 1.3 | < 1.8 |
| MW-ZN-11S | 05/21/13 | Original | < 180 | < 0.6 | 0.7 ± 0.5 | < 0.6 | 6.8 ± 1.2 | < 1.4 |
| MW-ZN-11S | 05/21/13 | Recount | | | < 2.0 | | | |
| MW-ZN-11S | 09/09/13 | | < 195 | < 0.9 | < 1.6 | < 0.4 | 8.8 ± 1.3 | < 1.5 |
| MW-ZN-11S | 10/07/13 | | < 167 | < 0.6 | < 1.0 | < 1.1 | 8.2 ± 1.2 | < 1.7 |

**TABLE B-I.2** **CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2013**

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 | 03/11/13 | < 55 | < 64 | < 6 | < 6 | < 13 | < 6 | < 12 | < 6 | < 10 | < 5 | < 6 | < 43 | < 14 |
| MW-ZN-01S | 05/20/13 | < 31 | < 52 | < 3 | < 4 | < 7 | < 3 | < 7 | < 4 | < 6 | < 3 | < 4 | < 27 | < 9 |
| MW-ZN-01S | 09/10/13 | < 53 | < 54 | < 5 | < 8 | < 20 | < 6 | < 10 | < 7 | < 14 | < 5 | < 5 | < **138** | < **39** |
| MW-ZN-01S | 10/08/13 | < 62 | < 104 | < 6 | < 7 | < 16 | < 4 | < 10 | < 8 | < 12 | < 5 | < 6 | < **114** | < **47** |
| MW-ZN-02S | 03/12/13 | < 41 | < 38 | < 4 | < 4 | < 9 | < 4 | < 7 | < 5 | < 7 | < 4 | < 4 | < 34 | < 8 |
| MW-ZN-02S | 05/20/13 | < 39 | < 32 | < 4 | < 5 | < 10 | < 4 | < 7 | < 4 | < 7 | < 4 | < 4 | < 28 | < 8 |
| MW-ZN-02S | 09/10/13 | < 60 | < 117 | < 6 | < 7 | < 17 | < 6 | < 12 | < 8 | < 13 | < 5 | < 6 | < **131** | < **52** |
| MW-ZN-02S | 10/08/13 | < 68 | < 100 | < 5 | < 6 | < 18 | < 6 | < 13 | < 6 | < 11 | < 5 | < 6 | < **109** | < **36** |
| MW-ZN-03S | 03/12/13 | < 45 | 83 ± 52 | < 5 | < 5 | < 9 | < 4 | < 9 | < 5 | < 8 | < 5 | < 5 | < 36 | < 10 |
| MW-ZN-03S | 05/20/13 | < 32 | < 72 | < 3 | < 4 | < 8 | < 4 | < 5 | < 4 | < 7 | < 3 | < 4 | < 27 | < 6 |
| MW-ZN-03S | 09/11/13 | < 57 | < 100 | < 5 | < 6 | < 17 | < 5 | < 9 | < 6 | < 11 | < 4 | < 6 | < **125** | < **42** |
| MW-ZN-03S | 10/08/13 | < 67 | < 55 | < 6 | < 7 | < 16 | < 6 | < 13 | < 7 | < 15 | < 5 | < 6 | < **119** | < **33** |
| MW-ZN-04S | 03/12/13 | < 50 | < 75 | < 4 | < 5 | < 13 | < 4 | < 8 | < 6 | < 9 | < 3 | < 4 | < **119** | < **44** |
| MW-ZN-04S | 05/20/13 | < 46 | < 47 | < 5 | < 6 | < 12 | < 6 | < 13 | < 6 | < 10 | < 5 | < 6 | < 38 | < 13 |
| MW-ZN-04S | 09/11/13 | < 73 | < 46 | < 5 | < 7 | < 17 | < 5 | < 10 | < 7 | < 14 | < 5 | < 6 | < **132** | < **27** |
| MW-ZN-04S | 10/08/13 | < 66 | < 99 | < 5 | < 7 | < 14 | < 5 | < 12 | < 8 | < 12 | < 5 | < 5 | < **112** | < **40** |
| MW-ZN-05S | 03/14/13 | < 50 | < 52 | < 7 | < 7 | < 15 | < 6 | < 13 | < 7 | < 12 | < 5 | < 6 | < 46 | < 14 |
| MW-ZN-05S | 05/22/13 | < 43 | < 36 | < 4 | < 5 | < 9 | < 4 | < 7 | < 5 | < 7 | < 4 | < 4 | < 29 | < 7 |
| MW-ZN-05S | 09/10/13 | < 56 | < 88 | < 4 | < 5 | < 13 | < 4 | < 10 | < 6 | < 10 | < 4 | < 4 | < **105** | < **33** |
| MW-ZN-05S | 10/07/13 | < 73 | < 104 | < 5 | < 6 | < 16 | < 6 | < 11 | < 8 | < 14 | < 5 | < 6 | < **123** | < **37** |
| MW-ZN-06S | 03/14/13 | < 51 | < 41 | < 5 | < 5 | < 13 | < 4 | < 10 | < 5 | < 10 | < 5 | < 5 | < 36 | < 11 |
| MW-ZN-06S | 05/21/13 | < 38 | < 41 | < 4 | < 4 | < 11 | < 4 | < 8 | < 5 | < 7 | < 4 | < 4 | < 31 | < 9 |
| MW-ZN-06S | 09/09/13 | < 61 | < 74 | < 5 | < 8 | < 16 | < 6 | < 9 | < 6 | < 14 | < 5 | < 5 | < **131** | < **35** |
| MW-ZN-06S | 10/07/13 | < 55 | < 77 | < 4 | < 6 | < 16 | < 4 | < 10 | < 7 | < 11 | < 4 | < 5 | < **102** | < **30** |
| MW-ZN-07S | 03/14/13 | < 52 | < 43 | < 5 | < 5 | < 11 | < 4 | < 9 | < 5 | < 9 | < 4 | < 5 | < 36 | < 10 |
| MW-ZN-07S | 05/21/13 | < 42 | < 52 | < 5 | < 4 | < 12 | < 5 | < 10 | < 6 | < 9 | < 5 | < 6 | < 40 | < 14 |
| MW-ZN-07S | 09/09/13 | < 58 | < 73 | < 5 | < 6 | < 16 | < 4 | < 9 | < 7 | < 12 | < 4 | < 5 | < **143** | < **49** |
| MW-ZN-07S | 10/07/13 | < 61 | < 101 | < 6 | < 6 | < 18 | < 5 | < 10 | < 7 | < 14 | < 4 | < 6 | < **120** | < **34** |
| MW-ZN-08S | 03/15/13 | < 39 | 77 ± 46 | < 3 | < 4 | < 7 | < 5 | < 10 | < 4 | < 7 | < 3 | < 4 | < 30 | < 12 |
| MW-ZN-08S | 05/21/13 | < 48 | < 37 | < 5 | < 5 | < 9 | < 4 | < 9 | < 5 | < 9 | < 4 | < 5 | < 33 | < 11 |
| MW-ZN-08S | 09/09/13 | < 50 | < 33 | < 4 | < 6 | < 12 | < 4 | < 7 | < 6 | < 10 | < 4 | < 4 | < **118** | < **51** |
| MW-ZN-08S | 10/07/13 | < 58 | < 92 | < 4 | < 6 | < 17 | < 5 | < 10 | < 5 | < 10 | < 5 | < 4 | < **94** | < **33** |
| MW-ZN-09S | 03/13/13 | < 49 | < 113 | < 5 | < 6 | < 9 | < 4 | < 8 | < 3 | < 7 | < 4 | < 5 | < 37 | < 11 |

**BOLDED VALUES INDICATE LLD COULD NOT BE MET DUE TO AGE OF SAMPLE AT TIME OF RECEIPT AT THE LABORATORY**

**TABLE B-I.2** **CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2013**

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-09S | 05/20/13 | < 50 | < 112 | < 4 | < 5 | < 9 | < 5 | < 9 | < 6 | < 10 | < 4 | < 5 | < 40 | < 13 |
| MW-ZN-09S | 09/10/13 | < 61 | < 42 | < 5 | < 7 | < 18 | < 6 | < 12 | < 8 | < 11 | < 5 | < 5 | **< 149** | **< 43** |
| MW-ZN-09S | 10/09/13 | < 57 | < 93 | < 5 | < 6 | < 14 | < 4 | < 9 | < 6 | < 12 | < 5 | < 5 | **< 106** | **< 38** |
| MW-ZN-10S | 03/12/13 | < 61 | < 142 | < 7 | < 6 | < 12 | < 6 | < 12 | < 8 | < 11 | < 6 | < 6 | < 51 | < 14 |
| MW-ZN-10S | 05/20/13 | < 45 | < 43 | < 5 | < 4 | < 10 | < 4 | < 9 | < 6 | < 10 | < 5 | < 5 | < 33 | < 10 |
| MW-ZN-10S | 09/10/13 | < 60 | < 40 | < 4 | < 5 | < 13 | < 3 | < 8 | < 6 | < 11 | < 4 | < 5 | **< 113** | **< 46** |
| MW-ZN-10S | 10/08/13 | < 54 | < 43 | < 5 | < 7 | < 14 | < 5 | < 10 | < 7 | < 12 | < 4 | < 5 | < 98 | **< 31** |
| MW-ZN-11S | 03/14/13 | < 42 | < 43 | < 5 | < 4 | < 9 | < 5 | < 8 | < 5 | < 8 | < 4 | < 5 | < 32 | < 9 |
| MW-ZN-11S | 05/21/13 | < 48 | < 89 | < 5 | < 5 | < 15 | < 6 | < 8 | < 6 | < 9 | < 5 | < 5 | < 45 | < 15 |
| MW-ZN-11S | 09/09/13 | < 80 | < 61 | < 6 | < 7 | < 19 | < 7 | < 12 | < 7 | < 13 | < 6 | < 5 | **< 152** | **< 60** |
| MW-ZN-11S | 10/07/13 | < 69 | < 38 | < 6 | < 7 | < 18 | < 6 | < 10 | < 7 | < 12 | < 5 | < 5 | **< 132** | **< 39** |

**BOLDED VALUES INDICATE LLD COULD NOT BE MET DUE TO AGE OF SAMPLE AT TIME OF RECEIPT AT THE LABORATORY**

**TABLE B-I.3** **CONCENTRATIONS OF IRON-55 AND NICKEL-63 IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

| SITE | COLLECTION DATE | Fe-55 | Ni-63 |
|---|---|---|---|
| MW-ZN-01S | 03/11/13 | < 167 | < 3.6 |
| MW-ZN-01S | 05/20/13 | < 92 | < 3.6 |
| MW-ZN-01S | 09/10/13 | < 117 | < 4.3 |
| MW-ZN-01S | 10/08/13 | < 128 | < 3.8 |
| MW-ZN-02S | 03/12/13 | < 81 | < 3.6 |
| MW-ZN-02S | 05/20/13 | < 64 | < 3.5 |
| MW-ZN-02S | 09/10/13 | < 199 | < 4.2 |
| MW-ZN-02S | 10/08/13 | < 73 | < 3.8 |
| MW-ZN-03S | 03/12/13 | < 81 | < 3.7 |
| MW-ZN-03S | 05/20/13 | < 96 | < 3.6 |
| MW-ZN-03S | 09/11/13 | < 93 | < 4.3 |
| MW-ZN-03S | 10/08/13 | < 102 | < 3.9 |
| MW-ZN-04S | 03/12/13 | < 81 | < 3.7 |
| MW-ZN-04S | 05/20/13 | < 140 | < 3.6 |
| MW-ZN-04S | 09/11/13 | < 116 | < 4.4 |
| MW-ZN-04S | 10/08/13 | < 161 | < 3.9 |
| MW-ZN-05S | 03/14/13 | < 139 | < 3.5 |
| MW-ZN-05S | 05/22/13 | < 122 | < 3.7 |
| MW-ZN-05S | 09/10/13 | < 91 | < 4.4 |
| MW-ZN-05S | 10/07/13 | < 88 | < 4.0 |
| MW-ZN-06S | 03/14/13 | < 117 | < 3.7 |
| MW-ZN-06S | 05/21/13 | < 146 | < 3.6 |
| MW-ZN-06S | 09/09/13 | < 149 | < 4.4 |
| MW-ZN-06S | 10/07/13 | < 137 | < 4.0 |
| MW-ZN-07S | 03/14/13 | < 95 | < 3.9 |
| MW-ZN-07S | 05/21/13 | < 103 | < 3.7 |
| MW-ZN-07S | 09/09/13 | < 93 | < 4.6 |
| MW-ZN-07S | 10/07/13 | < 61 | < 4.1 |
| MW-ZN-08S | 03/15/13 | < 147 | < 3.7 |
| MW-ZN-08S | 05/21/13 | < 133 | < 3.5 |
| MW-ZN-08S | 09/09/13 | < 122 | < 4.2 |
| MW-ZN-08S | 10/07/13 | < 38 | < 3.8 |
| MW-ZN-09S | 03/13/13 | < 93 | < 3.7 |
| MW-ZN-09S | 05/20/13 | < 83 | < 3.5 |
| MW-ZN-09S | 09/10/13 | < 128 | < 4.2 |
| MW-ZN-09S | 10/09/13 | < 77 | < 4.4 |
| MW-ZN-10S | 03/12/13 | < 147 | < 4.1 |
| MW-ZN-10S | 05/20/13 | < 115 | < 3.5 |
| MW-ZN-10S | 09/10/13 | < 115 | < 4.4 |
| MW-ZN-10S | 10/08/13 | < 132 | < 4.8 |
| MW-ZN-11S | 03/14/13 | < 91 | < 3.8 |
| MW-ZN-11S | 05/21/13 | < 83 | < 3.6 |
| MW-ZN-11S | 09/09/13 | < 138 | < 4.5 |
| MW-ZN-11S | 10/07/13 | < 107 | < 4.2 |

**TABLE B-II.1** **CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR POWER STATION, 2013**

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) |
|---|---|---|---|---|---|---|---|
| SW-ZN-01 | 03/11/13 | < 187 | < 0.7 | < 0.6 | < 0.7 | 3.2 ± 0.8 | < 1.8 |
| SW-ZN-01 | 05/20/13 | < 182 | < 0.5 | < 0.2 | < 0.6 | 3.1 ± 0.8 | < 1.4 |
| SW-ZN-01 | 09/11/13 | < 200 | < 0.9 | < 0.7 | < 0.4 | 3.3 ± 0.9 | < 1.5 |
| SW-ZN-01 | 10/08/13 | < 170 | < 0.7 | < 0.7 | < 1.1 | 3.5 ± 0.8 | < 1.7 |

**TABLE B-II.2** **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2013**

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 | 03/11/13 | < 51 | < 33 | < 4 | < 5 | < 10 | < 4 | < 9 | < 5 | < 9 | < 4 | < 5 | < 42 | < 11 |
| SW-ZN-01 | 05/20/13 | < 46 | < 34 | < 5 | < 4 | < 12 | < 5 | < 9 | < 5 | < 8 | < 4 | < 5 | < 36 | < 7 |
| SW-ZN-01 | 09/11/13 | < 69 | < 80 | < 5 | < 6 | < 14 | < 5 | < 10 | < 8 | < 11 | < 4 | < 5 | **< 139** | **< 46** |
| SW-ZN-01 | 10/08/13 | < 63 | < 35 | < 4 | < 6 | < 12 | < 4 | < 7 | < 6 | < 9 | < 3 | < 4 | **< 102** | **< 24** |

**BOLDED VALUES INDICATE LLD COULD NOT BE MET DUE TO AGE OF SAMPLE AT TIME OF RECEIPT AT THE LABORATORY**

**TABLE B-II.3** **CONCENTRATIONS OF IRON-55 AND NICKEL-63 IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF ZION NUCLEAR STATION, 2013**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

| SITE | COLLECTION DATE | Fe-55 | Ni-63 |
|---|---|---|---|
| SW-ZN-01 | 03/11/13 | < 122 | < 3.8 |
| SW-ZN-01 | 05/20/13 | < 102 | < 3.5 |
| SW-ZN-01 | 09/11/13 | < 115 | < 4.0 |
| SW-ZN-01 | 10/08/13 | < 95 | < 3.8 |