State of Wisconsin

2011

Zion

Environmental Radioactivity Survey

Wisconsin Department of Health Services
Division of Public Health
Bureau of Environmental and Occupational Health
Radiation Protection Section
P.O. Box 2659
Madison, Wisconsin 53701
P-00000 (08/2012)

Table of Contents

	Page
Introduction	1
WI DHS Zion Environmental Monitoring Sampling Program	1
Japan Fukushima Daiichi Event	1
Program Modifications	1
Laboratory Services and Quality Assurance	2
Detection Limits	2
Reporting of Sampling Analysis Results	2
Sample Collection Summary	3
Zion Environmental Monitoring Sampling Sites	3
Japan Fukushima Daiichi Summary	5
Results and Discussion – Japan Fukushima Daiichi event	5
Results & Discussion for the Zion Environmental Monitoring Program	7
References	8
Sample Activity Summary	9

List of Tables

		Page
Table 1.	WI DHS Zion environmental monitoring sampling sites.	3
Table 2.	Sample collection summary and required analyses.	3
Table 3.	Missing sample report and listing of non-routine analyses.	4
Table 4.	WI DHS environmental monitoring programs.	4
Table 5.	Sample activity summary for the WI DHS Zion environmental monitoring program.	9
Table 6.	WI DHS air particulate gross beta results from the Zion environmental monitoring program.	11
Table 7.	WI DHS gamma isotopic results from the quarterly composites of air particulate filters for the Zion environmental monitoring program.	11
Table 8.	WI DHS TLD results from the Zion environmental monitoring program.	12
Table 9.	WI DHS analysis results for surface water samples collected for the Zion environmental monitoring program.	12
Table 10.	WI DHS analysis results for vegetation and soil samples collected for the Zion environmental monitoring program.	13
Table 11.	WI DHS gamma isotopic analysis results from the weekly composites of air particulate filters collected from all WI DHS environmental monitoring programs for the Japan Fukushima Daiichi event.	14
Table 12.	Special precipitation analyses requested by WI DHS from all environmental monitoring programs for the Japan Fukushima event.	15
Table 13.	WI DHS gamma isotopic analysis results from the air cartridges collected from all WI DHS environmental monitoring programs for the Japan Fukushima event.	16
Table 14.	WI DHS analysis results for additional milk samples collected for the Japan Fukushima event.	17

List of Figures

Figure 1.	WI DHS environmental monitoring sites for the Zion environmental monitoring program.	4

State of Wisconsin DHS

2011

Zion Environmental Radioactivity Survey

Introduction

Wisconsin Public Health Statues 254.41 mandates the Wisconsin (WI) Department of Health Services (DHS) to conduct environmental radiation monitoring around the nuclear power facilities that impact Wisconsin. This environmental monitoring report is for the Zion nuclear facility for the calendar year January - December 2011 and provides a description and results of this environmental monitoring program.

WI DHS Zion Environmental Monitoring Sampling Program

The WI DHS environmental monitoring program consists of the collection of various types of samples from the air, water and terrestrial exposure pathways. The sampling program included samples of air, ambient gamma radiation as measured by thermoluminescent dosimeters (TLD), surface water, soil and vegetation that are collected from selected locations at planned sampling intervals.

Table 1 is a listing of presently used sampling sites that have been renumbered after eliminating sample sites that have been discontinued. Sampling sites that have been discontinued were last listed as sampling sites in WI DHS's environmental monitoring report for the Zion nuclear plant for the calendar year of January - December, 2000. Table 2 provides a listing of types of samples collected, collection frequency, sites where samples are collected, the number of samples collected, number of samples that were missed or had sample or analysis deviations and a listing of the required analyses. Table 3 provides an explanation of missing samples or non-routine sample analyses. Figure 1 is a map showing the location of each environmental sampling site.

Japan Fukushima Daiichi Event

On March 11, 2011 an underwater earthquake and resulting tsunami caused extensive damage to the Fukushima Daiichi nuclear reactor complex in Japan. Radioactive material was released to the atmosphere and the prevailing wind patterns carried the radioactive materials in the direction of the United States. A summary and discussion of the WI DHS's response to that event are included later in this report.

Program Modifications

In January 1998 ComEd announced that it was permanently closing the Zion nuclear power station and initiated the process of decommissioning the Zion station. In response to this and due to other funding restrictions, the Zion environmental monitoring program was reviewed and modified in 1998 and 2000.

Due to funding restrictions, additional program modifications were implemented beginning in the 3rd quarter of 2010.

There were no further program modifications in 2011.

Laboratory Services and Quality Assurance

The analysis of the samples is performed under contract with the Wisconsin State Laboratory of Hygiene (WSLH). WSLH maintains a quality assurance program. Analytical procedures provide for routine replicate analyses to verify methods and instrument operation. Traceable sources are used to regularly calibrate the counters and daily performance checks are made between calibrations. In addition, quality control charts are maintained on the counters.

WSLH participates in the Environmental Resource Associates' Proficiency Testing program and has performed satisfactorily over the report period. Proficiency testing results are available from the Wisconsin State Laboratory of Hygiene.

Detection Limits

Detection limits, required by WI DHS, will be expressed as a lower limit of detection (LLD). The required WI DHS LLD as indicated in Table 5 under the heading "LLD" is an "a priori" estimate of the capability for detecting an activity concentration by a given measurement system, procedure, and type of sample. Counting statistics of the appropriate instrument background are used to compute the LLD for each specific analysis. Using 4.66 times the standard deviation (s_b) of the instrument background, the LLD for each specific analysis is defined at the 95% Confidence Level.

The LLD for each radioisotope listed in Table 5 has been calculated from the following equation:

$$LLD = \frac{4.66\ s_b}{E * V * 2.22 * Y * S * \exp(-dt)}$$

Where:

LLD	is the "a priori" lower limit of detection as defined above, as picocuries per unit mass or volume,
s_b	is the standard deviation of the background counting rate or of the counting rate of blank sample as appropriate, as counts per minute,
E	is the counting efficiency, as counts per disintegration,
V	is the sample size in units of mass or volume,
2.22	is the number of disintegrations per minute per picocurie,
Y	is the fractional radiochemical yield, when applicable,
S	is the self-absorption correction factor,
d	is the radioactive decay constant for the particular radionuclide, and
t	for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting.

Typical values for E, V, Y and dt have been used to calculate the LLD.

Reporting of Sample Analysis Results

Results for specific analyses will be reported as either a "less than" (<) value or an actual activity value. The reporting of results in Table 5 under the heading "Range" and in Tables 6-10 is "a posteriori" calculation based on the actual analysis performed using the actual sample values for E, V, Y and dt. Typically the reported "less than" (<) results are lower than the required WI DHS LLD indicating that the required WI DHS LLD has been met.

An actual activity value will be accompanied by an uncertainty term for that analysis. The uncertainty term is a plus or minus counting uncertainty term at the 2 sigma (95%) confidence interval and is printed as (+- or ±). Examples and explanations of data reporting are:

Example	Nuclide	Activity reported
1	^{137}Cs	< 10 pCi/liter
2	^{137}Cs	15 ± 3 pCi/liter

In example 1 we can be 95% confident that the sample activity, if any, is less than the LLD of 10 pCi/liter. In example 2 we can be 95% confident that the actual sample activity is greater than the LLD for that analysis and is between 12 and 18 pCi/liter.

Table 1. WI DHS Zion environmental monitoring sampling sites.

Sample site	Distance and direction (miles)	Location description
ZI-1	3.8 N	Chiwaukee Prairie.
ZI-2	8.5 NW	Pleasant Prairie, Roger Prange Municipal Center
ZI-3	10.0 N	Water intake - 4700 feet from shore.
ZI-4	5.9 NW	Junction of Highway 31 and County ML.
ZI-T41	4.7 NW	Junction of 122th Street and 39th Avenue
ZI-T42	3.8 N	Chiwaukee Prairie.
ZI-T43	10.1 N	Kenosha Water Utility

Table 2. Sample collection summary and required analyses.

Sample Type	Collection and Frequency	Site locations	Number of Samples Collected	Number of Samples Deviations	Required Analyses
air particulate	C/BW	1	26	1	GA, GB, GI
TLD	C/Q	T41 - T43	12	1	direct exposure
surface water	G/SA	3	2	0	GA, GB, GI, Sr, H
vegetation	G/A	1, 4	4	0	GA, GB, GI
Soil	G/A	1, 4	4	0	GA, GB, GI

Collection type: C/ = continuous; G/ = grab

Frequency: /W = weekly; /M = monthly; /Q = quarterly; /A = annually; /BW = bi-weekly; /SA = semi-annually

Required analyses: GA = gross alpha; GB = gross beta; GI = gamma isotopic; Sr = strontium; H = tritium

Table 3. Missing sample report and listing of non-routine analyses.

Sample type	Date	Site	Explanation
air particulate	07/13/11	ZI-1	The air site was not operating for approximately 2 days and 7 hours during the indicated sampling period.
TLD	2nd quarter	T-43	No data; TLD lost in the field.

Table 4. WI DHS environmental monitoring programs.

Program name	Abbreviation	Area of the state
Point Beach – Kewaunee	PBK	Northeast Wisconsin, Kewaunee and Manitowoc Counties
Prairie Island	PRI	Northwest Wisconsin, Pierce County
LACBWR	LAC	West central Wisconsin, Vernon County
Zion	ZI	Southeast Wisconsin, Kenosha County

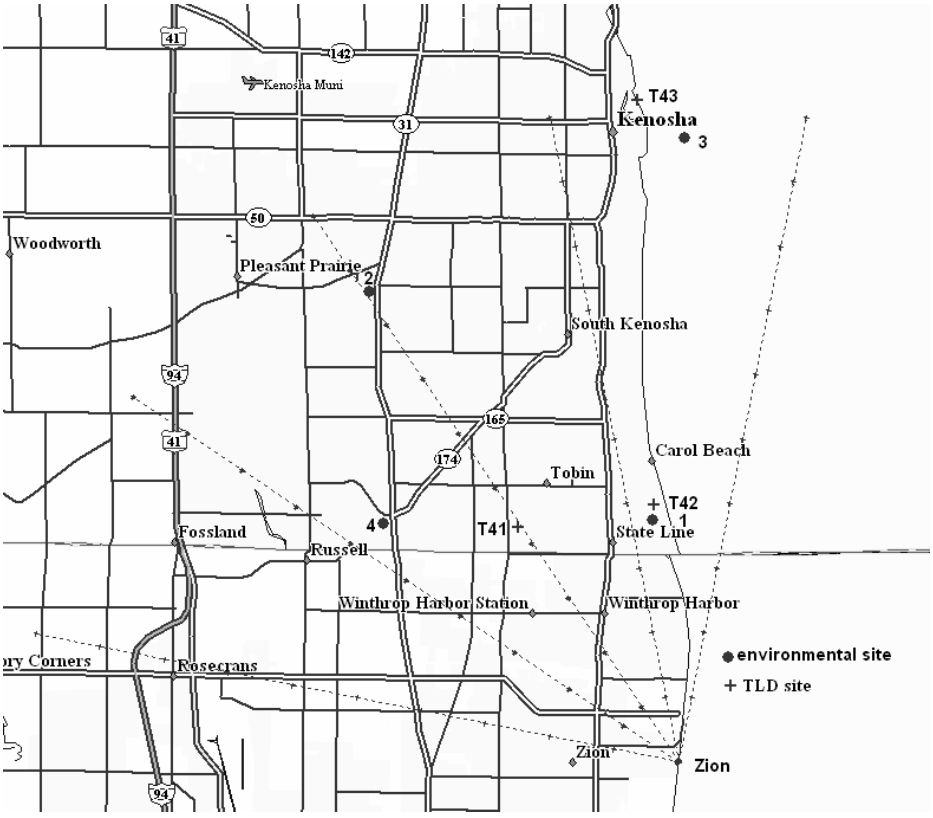

Figure 1. WI DHS environmental monitoring sites for the Zion environmental monitoring program.

Japan Fukushima Daiichi Summary

On March 11, 2011 an underwater earthquake and resulting tsunami caused extensive damage to the Fukushima Daiichi nuclear reactor complex in Japan. Radioactive material was released to the atmosphere and the prevailing wind patterns carried the radioactive materials in the direction of the United States. The State of Wisconsin (WI), Department of Health Services (DHS) placed its four environmental monitoring programs on heightened alert and the Wisconsin State Laboratory of Hygiene (WSLH) was requested to place special emphasis on the analysis of samples that could be collected to monitor any radioactivity detected from the Fukushima Daiichi accident. Small amounts of radioactivity due to the Fukushima Daiichi accident were first detected in air iodine cartridge and precipitation samples collected during the time period of 03/07/2011 – 03/24/2011 and continued to be detected through 04/22/2011. After 04/22/2011 the sample types were again typical background samples that have been reported in years prior to March 2011 with radioisotopes of concern less than the required LLDs for those radioisotopes.

Samples that were collected included: air particulate filters, air iodine cartridges, precipitation and milk. Samples were collected according to the normal WI DHS environmental monitoring program's collection schedule. Additional samples collected included two milk samples from the Dominion Energy Kewaunee, Inc., Kewaunee Power Station monitoring program and two milk samples in southern Wisconsin from Dane and Green Counties.

Results and Discussion – Japan Fukushima Daiichi event

The majority of the samples collected are from the Point Beach – Kewaunee Environmental Monitoring Program and the Prairie Island Environmental Monitoring Program as they are the two largest programs maintained by the WI DHS. The LACBWR (La Crosse Boiling Water Reactor) Environmental Monitoring Program and the Zion Environmental Monitoring Program are smaller programs with limited types of samples collected. The four programs are in different areas of the state of Wisconsin and Table 4 provides a listing of the program, abbreviation of the program and area of the state.

Radioisotopes detected in the following discussion were from different environmental monitoring programs and areas within Wisconsin. This would indicate that the detected activities are not from an individual nuclear power plant monitored by WI DHS but are the result of radioactive material transported from the Japan Fukushima Daiichi event. It is noted that the radioisotope activities detected are very small and are only slightly greater than the Lower Limit of Detection (LLD) that is required by WI DHS for sample analysis by WSLH. In certain sample analysis WI DHS requested lower LLDs than normal in order to detect the reported radioisotope activities.

The sample types analyzed and any detected radioactivity were performed to verify that radiation from the Japan Fukushima Daiichi event did not present a radioactive problem in types of food consumed in Wisconsin or a health problem for Wisconsin citizens.

Air Particulate Filter - Japan Fukushima Daiichi event

Air particulates (filters) are usually quarterly composited from individual sites in the WI DHS programs. For the Japan Fukushima Daiichi event the air filters from all sites and all programs were composited together on a weekly basis and given a gamma isotopic analysis to a lower LLD. The analysis results are presented in Table 7 and Table 11. Radioisotopes reported included iodine-131 (^{131}I), cesium-134 (^{134}Cs) and cesium-137 (^{137}Cs) which were the primary radioisotopes released from the Japan Fukushima Daiichi event. Please note in Table 11 that the reported radioisotope activities are approximately 10 times lower than the usual required LLD that is also listed in the table. The sample sites are listed in the table and indicate that this was a state-wide event and the reported activities are due to the Japan Fukushima Daiichi event. The other radioisotope detected is Beryllium-7 (^{7}Be) that is a naturally occurring radioisotope. Beryllium-7 (^{7}Be) is constantly produced through nuclear reactions

between cosmic rays and nuclei in the atmosphere and is detected in air composites from other areas of the state on a routine basis.

The United States Environmental Protection Agency (USEPA) maintains a nationwide RadNet program to monitor air, precipitation, drinking water and pasteurized milk. Additional information on the RadNet program can be found by following the link www.epa.gov/radnet. A RadNet air monitoring site is located in Madison, WI and is jointly operated by WSLH and WI DHS who exchange an air filter on a twice a week basis. During the time period of the Japan Fukushima Daiichi event, the air filter was given a gamma isotopic analysis by WSLH prior to the filter being sent to the USEPA National Air and Radiation Environmental Laboratory. During the time period of 03/22/2011 – 04/22/2011 small activities for iodine-131 (^{131}I), cesium-134 (^{134}Cs) and cesium-137 (^{137}Cs) were detected. The detected activities were consistent with the analysis results from the weekly air filter composites from the four WI DHS monitoring programs. This again would indicate a statewide distribution of the radioisotopes from the Japan Fukushima Daiichi event.

Air Iodine Cartridge - Japan Fukushima Daiichi event

Air iodine cartridge analysis results are listed in Table 13. The samples are from the Point Beach – Kewaunee and the Prairie Island monitoring programs. The analysis results are also available in the 2011 environmental reports for those two programs.

From Table 13, iodine-131 (^{131}I) was detected in both programs for the time period of 03/07/2011 – 03/24/2011 and continued to be detected through 04/22/2011. The detected activities were small at only 2-5 times the usual reported LLD activities for iodine-131. After 04/22/2011 the sample results were again typical background samples that have been reported in years prior to March 2011 with radioisotopes of concern less than the required LLDs for those radioisotopes.

Precipitation - Japan Fukushima Daiichi event

Precipitation analysis results are listed in Table 12. The samples are from the Point Beach – Kewaunee and the Prairie Island monitoring programs. The analysis results are also available in the 2011 environmental reports for those two programs.

From Table 12 the only radioisotope detected was iodine-131 (^{131}I) for samples collected in both programs from late March through mid-April. As in other samples analyzed, the detected activities were small at only 2-4 times the usually detected LLD reported activities.

Milk - Japan Fukushima Daiichi event

The dairy industry is recognized as being important for the Wisconsin economy as well as a potential food chain item. The normal monthly samples are from the Point Beach – Kewaunee and the Prairie Island monitoring programs. The analysis results for those samples are available in the 2011 environmental reports for those two programs. Additional samples collected included two milk samples from the Dominion Energy Kewaunee, Inc., Kewaunee Power Station monitoring program and two milk samples in southern Wisconsin from Dane and Green Counties. Milk analysis results are listed in Table 14.

The analysis of the milk samples detected no unusual activities. Naturally occurring potassium-40 (^{40}K) was detected in all samples. The detected activities for strontium-90 (^{90}Sr), attributable to residual fallout from previous atmospheric nuclear weapons testing, were also detected in previous years at similar activity levels. Iodine-131 (^{131}I) was chemically tested for in order to provide a lower LLD than what is available from a gamma isotopic analysis. Iodine-131 (^{131}I) was not detected in any of the milk samples collected during this time period or in any of the milk samples collected in 2011 before and after this time period.

Results and Discussion for the Zion Environmental Monitoring Program

Air Particulate

A summary of reported activities by WI DHS for air particulate samples is included in Table 5. Results from the individual sample analyses are listed in Tables 6 and 7.

From the bi-weekly and quarterly gross beta activities listed in Table 6 it may be noted that there are no significant differences from gross beta activities in the three other WI DHS environmental monitoring programs. With no significant differences, an increase in gross beta activity attributable to the Zion facility is not evident.

The gamma isotopic analysis of the quarterly air particulate filter composites detected only small amounts of the radioisotopes listed in Table 7. Beryllium-7 (^{7}Be), detected in all composites, is constantly produced through nuclear reactions between cosmic rays and nuclei in the atmosphere and is detected in air composites from other areas of the state.

Influence by the Zion facility on air quality is not evident from air particulate analysis.

Ambient Gamma Radiation – Thermoluminescent Dosimeters (TLDs)

A summary of reported activities by WI DHS for ambient gamma radiation is included in Table 5. Results from the individual sample analyses are listed in Table 8.

There was no indication that the Japan Fukushima Daiichi event effected the 1st or 2nd quarters TLD measurements. Ambient gamma radiation (TLD) data for 2011 from the WI DHS network was comparable for all sites. Significant differences in exposure were not noticed at different distances from the Zion nuclear facility. The average quarterly exposure from the three sites located within Wisconsin was 13.5 $\pm$ 1.2 milliroentgens. The average yearly exposure is at background levels and is comparable to other areas within Wisconsin.

Influence by the Zion facility is not evident from air ambient gamma radiation analysis.

Surface Water

A summary of reported activities by WI DHS for surface water samples is included in Table 5. Results from the individual sample analyses are listed in Table 9.

There was no indication that the Japan Fukushima Daiichi event had any effect on surface water sample analysis. The surface water samples showed no unusual activities and are at background levels comparable to previous years. From the gamma isotopic analysis, all radioisotopes were below their respective minimum detectable concentration. All reported activities for gross beta, gross alpha and tritium (^{3}H) are at background levels. The surface water samples uniformly show activities well below state or federal standards.

Influence by the Zion facility is not evident from surface water sample analysis.

Vegetation

A summary of reported activities by WI DHS for vegetation samples is included in Table 5. Results from the individual sample analyses are listed in Table 10.

There was no indication that the Japan Fukushima Daiichi event had any effect on vegetation sample analysis. Analysis of the vegetation samples showed no unusual activities. The gamma isotopic analysis detected only small amounts of the naturally occurring radioisotopes beryllium-7 (^{7}Be) and

potassium-40 (^{40}K) listed in Table 5. All other radioisotopes were below their respective minimum detectable concentration.

Influence by the Zion facility is not evident from vegetation sample analysis.

Soil

A summary of reported activities by WI DHS for soil samples is included in Table 5. Results from the individual sample analyses are listed in Table 10.

There was no indication that the Japan Fukushima Daiichi event had any effect on soil sample analysis. Analysis of the soil samples showed no unusual activities. The gamma isotopic analysis detected only small amounts of the radionuclides listed in Table 5. Potassium-40 (^{40}K) is a naturally occurring radioisotope. The reported activities for cesium-137 (^{137}Cs) were also detected in previous years and are attributable to fallout from previous atmospheric nuclear tests. Naturally occurring radioisotopes such as radium-226 (^{226}Ra), bismuth-214 (^{214}Bi), lead-214 (^{214}Pb), actinium-228 (^{228}Ac), bismuth-212 (^{212}Bi) and lead-212 (^{212}Pb) from the naturally occurring uranium-238 (^{238}U) and thorium-232 (^{232}Th) decay series are commonly detected but have not been quantified or reported.

Influence by the Zion facility is not evident from soil sample analysis.

Dose to an Average Individual

Federal regulations 10 CFR 20, 10 CFR 50 Appendix I and 40 CFR 190 restrict the annual exposure of the population from all parts of the nuclear fuel cycle, including nuclear power plants. Doses resulting from gaseous and liquid effluent releases from the Zion nuclear generating facilities are less than the limits as stated in these Federal regulations.

The WI DHS limits for permissible levels of radiation exposure from external sources in unrestricted areas are defined in the Wis. Adm. Code section DHS 157.23. Doses resulting from gaseous and liquid effluent releases from the Zion nuclear generating facilities are less than the limits as stated in Wis. Adm. Code section DHS 157.23.

References

State of Wisconsin, Wisconsin Administrative Code, DHS 157.23

U.S. Environmental Protection Agency, Environmental Radiation Requirements for Normal Operations of Activities in the Uranium Fuel Cycle, EPA 520/4-76-016, 40 CFR Part 190, November 1976.

U.S. Nuclear Regulatory Commission, Title 10, Part 20.

U.S. Nuclear Regulatory Commission, Title 10, Part 50, Appendix I.

Table 5. Sample activity summary for the WI DHS Zion environmental monitoring program for 2011.

Sample type (units)	LLD	Number of samples [a]	Analysis	Range
Air particulate	0.005	26 / 26	gross beta	0.012 - 0.035
(pCi/m^3)			gamma isotopic	
	0.020	4 / 4	Be-7	0.060 - 0.097
	0.002	4 / 0	Mn-54	< 0.0005
	0.002	4 / 0	Co-58	< 0.0004
	0.005	4 / 0	Fe-59	< 0.0010
	0.002	4 / 0	Co-60	< 0.0004
	0.005	4 / 0	Zn-65	< 0.0009
	0.002	4 / 0	Nb-95	< 0.0005
	0.005	4 / 0	Zr-95	< 0.0006
	0.002	4 / 0	Ru-103	< 0.0004
	0.015	4 / 0	Ru-106	< 0.0038
	0.020	4 / 0	I-131	< 0.0026
	0.002	4 / 0	Cs-134	< 0.0005
	0.002	4 / 0	Cs-137	< 0.0004
	0.030	4 / 0	Ba-140	< 0.0035
	0.020	4 / 0	La-140	< 0.0014
	0.002	4 / 0	Ce-141	< 0.0006
	0.005	4 / 0	Ce-144	< 0.0014
Ambient gamma	1.0 [b]	11 / 11	ambient gamma	12.0 -16.3
(mR/Std Qtr)				
Vegetation	5000	2 / 0	gross alpha	< 1870
(pCi/kg wet)	4000	2 / 2	gross beta	5800 - 8800
			gamma isotopic	
	600	2 / 2	Be-7	1100 - 1760
	2000	2 / 2	K-40	4380 – 4620
	90	2 / 0	Mn-54	< 20
	100	2 / 0	Co-58	< 15
	200	2 / 0	Fe-59	< 33
	100	2 / 0	Co-60	< 18
	250	2 / 0	Zn-65	< 33
	100	2 / 0	Nb-95	< 14
	200	2 / 0	Zr-95	< 25
	80	2 / 0	I-131	< 14
	80	2 / 0	Cs-134	< 14
	90	2 / 0	Cs-137	< 16
	350	2 / 0	Ba-140	< 42
	100	2 / 0	La-140	< 22

Table 5. Sample activity summary for the WI DHS Zion environmental monitoring program for 2011.

Sample type (units)	LLD	Number of samples [a]	Analysis	Range
Surface water	3.0	2 / 2	gross beta (sol)	1.4 – 1.7
(pCi/liter)	3.0	2 / 0	gross beta (insol)	< 1.2
	3.0	2 / 0	gross alpha (sol)	< 1.7
	3.0	2 / 0	gross alpha (insol)	< 0.9
	300	2 / 0	H-3	< 181
	2.0	2 / 0	Sr-89	< 0.4
	1.0	2 / 1	Sr-90	< 0.4 – 0.4
			gamma isotopic	
	15	2 / 0	Mn-54	< 9
	15	2 / 0	Co-58	< 8
	30	2 / 0	Fe-59	< 15
	15	2 / 0	Co-60	< 10
	30	2 / 0	Zn-65	< 16
	15	2 / 0	Nb-95	< 8
	30	2 / 0	Zr-95	< 17
	15	2 / 0	I-131	< 15
	15	2 / 0	Cs-134	< 8
	15	2 / 0	Cs-137	< 9
	60	2 / 0	Ba-140	< 36
	15	2 / 0	La-140	< 12
Soil	6000	2 / 2	gross beta	14800 - 27900
(pCi/kg dry)	10000	2 / 0	gross alpha	< 9050
			gamma isotopic	
	800	2 / 2	K-40	8600 - 17100
	60	2 / 0	Mn-54	< 24
	90	2 / 0	Co-58	< 22
	600	2 / 0	Fe-59	< 48
	90	2 / 0	Co-60	< 23
	300	2 / 0	Zn-65	< 49
	100	2 / 0	Nb-95	< 20
	250	2 / 0	Zr-95	< 35
	80	2 / 0	Cs-134	< 21
	80	2 / 2	Cs-137	90 - 150

a - Number of analyses / number of analyses detected above the WI DHS LLD.
b - 1.0 mR/TLD.

Table 6. WI DHS air particulate gross beta analysis results from the Zion environmental monitoring program.

Measurements in units of pCi/m^3

Site: ZI-1; Chiwaukee Prairie

collection date	volume m^3	air particulate	collection date	volume m^3	air particulate
01/10/11	937	0.031 +- 0.002	07/13/11 *a	922	0.020 +- 0.002
01/26/11	1346	0.025 +- 0.001	07/25/11	858	0.024 +- 0.002
02/07/11	945	0.023 +- 0.002	08/08/11	1000	0.023 +- 0.002
02/21/11	1200	0.020 +- 0.001	08/22/11	1021	0.020 +- 0.002
03/07/11	1184	0.021 +- 0.001	09/06/11	1081	0.025 +- 0.002
03/21/11	1124	0.019 +- 0.001	09/19/11	934	0.020 +- 0.002
04/04/11	1131	0.021 +- 0.002	10/05/11	1190	0.018 +- 0.001
1st Qtr mean +- s.d.		0.023 +- 0.004	3rd Qtr mean +- s.d.		0.021 +- 0.003
04/18/11	1125	0.020 +- 0.001	10/18/11	1105	0.035 +- 0.002
05/02/11	1086	0.012 +- 0.001	10/31/11	1089	0.018 +- 0.001
05/16/11	1058	0.014 +- 0.001	11/14/11	1200	0.028 +- 0.002
06/01/11	1210	0.012 +- 0.001	11/28/11	1225	0.022 +- 0.001
06/14/11	982	0.018 +- 0.002	12/12/11	1186	0.025 +- 0.002
06/28/11	1041	0.014 +- 0.001	12/27/11	1285	0.030 +- 0.002
2nd Qtr mean +- s.d.		0.015 +- 0.003	4th Qtr mean +- s.d.		0.026 +- 0.006

* a - The air site was not operating for approximately 2 days and 7 hours during the indicated sampling period.

Table 7. WI DHS gamma isotopic analysis results from the quarterly composites of air particulate filters collected from the Zion environmental monitoring program.

Measurements in units of pCi/m^3

Site: ZI-1	1st quarter	2nd quarter	3rd quarter	4th quarter
Be-7	0.060 +- 0.007	0.062 +- 0.007	0.097 +- 0.005	0.069 +- 0.008
Mn-54	< 0.0003	< 0.0003	< 0.0002	< 0.0005
Co-58	< 0.0004	< 0.0002	< 0.0002	< 0.0003
Fe-59	< 0.0006	< 0.0005	< 0.0004	< 0.0010
Co-60	< 0.0004	< 0.0003	< 0.0002	< 0.0003
Zn-65	< 0.0007	< 0.0007	< 0.0003	< 0.0009
Nb-95	< 0.0003	< 0.0004	< 0.0003	< 0.0005
Zr-95	< 0.0005	< 0.0005	< 0.0003	< 0.0006
Ru-103	< 0.0003	< 0.0004	< 0.0003	< 0.0004
Ru-106	< 0.0023	< 0.0020	< 0.0015	< 0.0038
I-131	< 0.0011	< 0.0011	< 0.0026	< 0.0015
Cs-134	< 0.0004	< 0.0005	< 0.0002	< 0.0003
Cs-137	< 0.0003	0.0008 +- 0.0004	< 0.0002	< 0.0003
Ba-140	< 0.0024	< 0.0030	< 0.0030	< 0.0035
La-140	< 0.0010	< 0.0014	< 0.0010	< 0.0014
Ce-141	< 0.0005	< 0.0006	< 0.0005	< 0.0004
Ce-144	< 0.0013	< 0.0014	< 0.0010	< 0.0010

Radioisotopes other than those reported were not detected.

Table 8. WI DHS TLD network for the Zion environmental monitoring program.

	1st quarter	2nd quarter	3rd quarter	4th quarter
Date Placed:	01/04/11	04/04/11	07/11/11	10/03/11
Date Removed:	04/04/11	07/11/11	10/03/11	01/03/12
Days in the Field:	90	98	84	92
	Individual quarterly date is reported as : mR / Standard Quarter + 2 sigma counting error.			
T-41	14.4 +- 0.7	14.1 +- 0.6	16.3 +- 1.0	13.7 +- 0.6
T-42	12.5 +- 0.4	12.2 +- 0.5	14.2 +- 0.7	12.0 +- 0.5
T-43	12.6 +- 0.5	ND	13.7 +- 0.8	13.3 +- 0.7

ND - No data; TLD lost in the field.

Table 9. WI DHS analysis results for surface water samples collected for the Zion environmental monitoring program.

Measurements in units of pCi/liter

ZI-3

Collection date:	04/07/11	10/04/11
gross alpha-sol	< 1.5	< 1.7
gross beta-sol	1.4 +- 0.8	1.7 +- 0.8
gross alpha-insol	< 0.9	< 0.9
gross beta-insol	< 1.2	< 1.0
H-3	< 181	< 178
Sr-89	< 0.4	< 0.4
Sr-90	0.4 +- 0.2	< 0.4
gamma isotopic		
Mn-54	< 9	< 1
Co-58	< 8	< 1
Fe-59	< 15	< 2
Co-60	< 10	< 1
Zn-65	< 16	< 2
Nb-95	< 8	< 1
Zr-95	< 17	< 1
I-131	< 15	< 7
Cs-134	< 8	< 1
Cs-137	< 9	< 1
Ba-140	< 36	< 10
La-140	< 12	< 4

Radioisotopes other than those reported were not detected.

Table 10. WI DHS analysis results for vegetation and soil samples collected for the Zion environmental monitoring program.

Vegetation	**Vegetation**		**Soil**	
	pCi/kilogram (wet)		pCi/kilogram (dry)	
Site:	ZI-1	ZI-4	ZI-1	ZI-4
Collection date:	08/30/11	08/30/11	08/30/11	08/30/11
gross alpha	< 4540	< 1870	< 9030	< 9050
gross beta	8800 +- 1600	5800 +- 700	14800 +- 3300	27900 +- 3700
gamma isotopic				
Be-7	1760 +- 230	1100 +- 170		
K-40	4620 +- 850	4380 +- 790	8600 +- 1400	17100 +- 3300
Mn-54	< 20	< 16	< 18	< 24
Co-58	< 15	< 10	< 16	< 22
Fe-59	< 33	< 29	< 34	< 48
Co-60	< 16	< 18	< 19	< 23
Zn-65	< 31	< 33	< 41	< 49
Nb-95	< 14	< 13	< 17	< 20
Zr-95	< 25	< 23	< 26	< 35
I-131	< 14	< 14		
Cs-134	< 14	< 14	< 16	< 21
Cs-137	< 16	< 12	90 +- 20	150 +- 30
Ba-140	< 41	< 42		
La-140	< 22	< 11		

Soil: Naturally occurring radioisotopes such as radium-226 (^{226}Ra), bismuth-214 (^{214}Bi), lead-214 (^{214}Pb), actinium-228 (^{228}Ac), bismuth-212 (^{212}Bi), lead-212 (^{212}Pb) from the naturally occurring uranium-238 (^{238}U) and thorium-232 (^{232}Th) decay series are commonly detected but have not been quantified or reported.

Radioisotopes other than those reported were not detected

Table 11. WI DHS gamma isotopic analysis results from the weekly composites of air particulate filters collected from all WI DHS environmental monitoring programs for the Japan Fukushima Daiichi event.

Measurements in units of pCi/m^3

Sites:	Normal Required LLD	PBK-1,4,7,8,17,18	PBK-4,8,18 & LAC-1; PRI-1,6,9	PBK-1,4,7,17,18	PBK-1,7,8,17
Collection start		02/28/11	03/07/11	03/16/11	03/24/11
Collection stop		03/18/11	03/24/11	03/28/11	04/01/11
Be-7	0.020	0.106 +- 0.005	0.071 +- 0.004	0.114 +- 0.006	0.165 +- 0.010
Mn-54	0.002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
Co-58	0.002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
Fe-59	0.005	< 0.0001	< 0.0001	< 0.0004	< 0.0004
Co-60	0.002	< 0.0001	< 0.0001	< 0.0002	< 0.0003
Zn-65	0.005	< 0.0001	< 0.0001	< 0.0004	< 0.0005
Nb-95	0.002	< 0.0001	< 0.0001	< 0.0002	< 0.0003
Zr-95	0.005	< 0.0001	< 0.0001	< 0.0003	< 0.0004
Ru-103	0.002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
Ru-106	0.015	< 0.0007	< 0.0003	< 0.0018	< 0.0023
I-131	0.020	0.0002 +- 0.0002	0.0029 +- 0.0002	0.0156 +- 0.0008	0.0158 +- 0.0010
Cs-134	0.002	< 0.0001	0.0002 +- 0.0001	0.0011 +- 0.0001	0.0011 +- 0.0001
Cs-137	0.002	< 0.0001	0.0002 +- 0.0001	0.0015 +- 0.0002	0.0010 +- 0.0003
Ba-140	0.030	< 0.0005	< 0.0002	< 0.0009	< 0.0011
La-140	0.020	< 0.0003	< 0.0001	< 0.0003	< 0.0007
Ce-141	0.002	< 0.0001	< 0.0001	< 0.0003	< 0.0003
Ce-144	0.005	< 0.0003	< 0.0002	< 0.0013	< 0.0009

Radioisotopes other than those reported were not detected.

Table 12. Special precipitation analyses requested by WI DHS from all environmental monitoring programs for the Japan Fukushima event.

Measurements in units of pCi/liter

Site:	**PRI-1**	**PRI-9**	**PRI-1**	**PRI-1**	**PRI-9**
Collection start:	03/07/11	03/07/11	03/24/11	04/08/11	04/08/11
Collection stop:	03/24/11	03/24/11	04/08/11	04/18/11	04/18/11
gamma isotopic					
Mn-54	< 3	< 2	< 3	< 6	< 7
Co-58	< 3	< 2	< 2	< 6	< 6
Fe-59	< 6	< 4	< 5	< 13	< 11
Co-60	< 4	< 2	< 3	< 6	< 6
Zn-65	< 6	< 5	< 4	< 11	< 12
Nb-95	< 3	< 2	< 3	< 7	< 6
Zr-95	< 5	< 3	< 5	< 11	< 9
I-131	22 +- 4	15 +- 5	12 +- 4	< 13	< 14
Cs-134	< 3	< 2	< 3	< 8	< 8
Cs-137	< 3	< 2	< 2	< 7	< 6
Ba-140	< 12	< 10	< 11	< 33	< 30
La-140	< 6	< 3	< 4	< 10	< 9

Site:	**PBK-4**	**PBK-1**	**PBK-1**	**PBK-4**	**PBK-1**	**PBK-4**
Collection start:	03/10/11	03/10/11	03/24/11	03/24/11	04/06/11	04/06/11
Collection stop:	03/24/11	03/24/11	04/06/11	04/06/11	04/19/11	04/19/11
gamma isotopic						
Mn-54	< 4	< 2	< 8	< 10	< 6	< 5
Co-58	< 3	< 2	< 8	< 9	< 4	< 5
Fe-59	< 7	< 4	< 14	< 15	< 11	< 10
Co-60	< 4	< 2	< 9	< 9	< 7	< 6
Zn-65	< 9	< 4	< 15	< 24	< 10	< 13
Nb-95	< 4	< 2	< 8	< 13	< 7	< 6
Zr-95	< 6	< 4	< 14	< 19	< 11	< 9
I-131	33 +- 7	29 +- 5	< 8	18 +- 9	< 9	< 8
Cs-134	< 4	< 2	< 8	< 11	< 7	< 7
Cs-137	< 4	< 2	< 8	< 8	< 6	< 6
Ba-140	< 18	< 10	< 27	< 37	< 25	< 23
La-140	< 6	< 3	< 13	< 15	< 9	< 7

Radioisotopes other than those reported were not detected.

Table 13. WI DHS gamma isotopic analysis results from the air cartridges collected from all WI DHS environmental monitoring programs for the Japan Fukushima event.

Measurements in units of pCi/m^3

PBK - Point Beach - Kewaunee monitoring program

PRI - Prairie Island monitoring program

WSLH #	Collection start	Collection end	Location	I-131		
RV01445	02/24/11	03/07/11	PRI-1		<	0.018
RV01446	02/24/11	03/07/11	PRI-9		<	0.013
RV01459	02/28/11	03/09/11	PBK-18		<	0.010
RV01460	02/28/11	03/09/11	PBK-4		<	0.018
RV01470	03/04/11	03/11/11	PBK-17		<	0.013
RV01479	03/09/11	03/14/11	PBK-4		<	0.023
RV01480	03/09/11	03/14/11	PBK-18		<	0.016
RV01500	03/11/11	03/18/11	PBK-17		<	0.009
RV01498	03/14/11	03/21/11	PBK-4	0.015	+-	0.008
RV01499	03/14/11	03/21/11	PBK-18	0.014	+-	0.002
RV01530	03/07/11	03/24/11	PRI-6	0.027	+-	0.007
RV01531	03/07/11	03/24/11	PRI-9	0.022	+-	0.006
RV01532	03/07/11	03/24/11	PRI-1	0.030	+-	0.010
RV01554	03/18/11	03/25/11	PBK-17	0.122	+-	0.021
RV01553	03/21/11	03/28/11	PBK-18	0.116	+-	0.014
RV01555	03/21/11	03/28/11	PBK-4	0.134	+-	0.018
RV01628	03/25/11	04/01/11	PBK-17	0.116	+-	0.014
RV01639	03/28/11	04/05/11	PBK-18	0.082	+-	0.014
RV01638	03/28/11	04/05/11	PBK-4	0.078	+-	0.013
RV01711	03/24/11	04/08/11	PRI-1	0.064	+-	0.013
RV01715	03/24/11	04/08/11	PRI-6	0.068	+-	0.011
RV01713	03/24/11	04/08/11	PRI-9	0.053	+-	0.009
RV01712	04/01/11	04/08/11	PBK-17	0.079	+-	0.020
RV01732	04/05/11	04/13/11	PBK-4	0.025	+-	0.011
RV01733	04/05/11	04/13/11	PBK-18	0.030	+-	0.010
RV01747	04/08/11	04/15/11	PBK-17		<	0.015
RV01760	04/13/11	04/18/11	PBK-4		<	0.011
RV01761	04/13/11	04/18/11	PBK-18		<	0.019
RV01780	04/08/11	04/18/11	PRI-1		<	0.012
RV01782	04/08/11	04/18/11	PRI-6		<	0.015
RV01781	04/08/11	04/18/11	PRI-9		<	0.012
RV01808	04/15/11	04/21/11	PBK-17		<	0.023
RV01811	04/18/11	04/25/11	PBK-18	0.009	+-	0.005
RV01812	04/18/11	04/25/11	PBK-4		<	0.011
RV01849	04/21/11	04/29/11	PBK-17		<	0.010
RV01863	04/25/11	05/02/11	PBK-4		<	0.008
RV01864	04/25/11	05/02/11	PBK-18		<	0.010
RV01873	04/18/11	05/03/11	PRI-1		<	0.007
RV01874	04/18/11	05/03/11	PRI-9		<	0.005

Table 14. WI DHS analysis results for additional milk samples collected for the Japan Fukushima event.

Measurements in units of pCi/liter

Site:	K-38	K-3	Dane County	Green County
Collection date:	04/04/11	04/05/11	04/14/11	04/15/11
I-131	< 0.2	< 0.2	< 0.2	< 0.2
Sr-90	0.8 +- 0.2	0.9 +- 0.2	0.4 +- 0.2	0.5 +- 0.2
gamma isotopic				
K-40	1270 +- 270	1420 +- 280	1320 +- 280	1290 +- 290
Mn-54	< 7	< 7	< 11	< 8
Co-58	< 8	< 6	< 7	< 9
Fe-59	< 15	< 11	< 18	< 18
Co-60	< 7	< 6	< 7	< 9
Zn-65	< 16	< 12	< 26	< 24
Nb-95	< 7	< 6	< 10	< 8
Zr-95	< 7	< 10	< 11	< 12
I-131	< 7	< 7	< 7	< 8
Cs-134	< 6	< 6	< 7	< 9
Cs-137	< 7	< 6	< 8	< 8
Ba-140	< 22	< 24	< 31	< 23
La-140	< 10	< 8	< 10	< 12

Radioisotopes other than those reported were not detected.