State of Wisconsin

2013

La Crosse Boiling Water Reactor

Environmental Radioactivity Survey

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State of Wisconsin, Department of Health Services

2013

La Crosse Boiling Water Reactor Environmental Monitoring Survey

Executive Summary

Section 254.41 of the Wisconsin Statutes mandates the State of Wisconsin, Department of Health Services to conduct environmental radiation monitoring around the nuclear power facilities that affect Wisconsin. This environmental monitoring report is for the La Crosse Boiling Water Reactor (LACBWR) nuclear generating plant for the calendar year January - December 2013. It provides a description and results of this environmental monitoring program.

The Wisconsin Department of Health Services' environmental monitoring program consists of the collection of various types of samples from the air, water and terrestrial exposure pathways, sample analysis and interpretation of the data. The sampling program included samples of air, ambient gamma radiation, surface water, fish, bottom sediment, soil and vegetation that are collected from selected locations at planned sampling intervals.

Program Summary

For 2013, all sample results from the LACBWR environmental monitoring area were less than state and federal standards or guidelines.

The Wisconsin Department of Health Services' environmental monitoring programs provide an ongoing baseline of radioactivity measurements to assess any Wisconsin health concerns from the operation of nuclear power generating facilities in or near Wisconsin or other radiological incidents that may occur within Wisconsin or worldwide. These monitoring programs show the following:

- Environmental radioactivity levels have been trending downward in the time period since the 1950's-1960's atmospheric nuclear testing and such radiological incidents as the Chernobyl nuclear reactor incident.
- There were no incidents during 2013, such as the 2011 Japan Fukushima Daiichi incident, that required additional environmental monitoring.
- There is no radioactive problem in types of food consumed in Wisconsin and no health problem related to radioactivity for Wisconsin citizens.

The Department's ongoing environmental monitoring programs will continue to provide assurances to the citizens of Wisconsin that the environment surrounding the LACBWR nuclear power facility and other monitoring areas will continue to be evaluated.

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Introduction

Section 254.41 of the Wisconsin statutes mandates the Wisconsin Department of Health Services (DHS) to conduct environmental radiation monitoring around the nuclear power facilities that affect Wisconsin. This environmental monitoring report is for the La Crosse boiling water reactor (LACBWR) for the calendar year January - December 2013. It provides a description and results of this environmental monitoring program.

Wisconsin DHS LACBWR Environmental Monitoring Sampling Program

The Wisconsin 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, fish, soil and vegetation that are collected from selected locations at planned sampling intervals.

Table 1 is a listing of sampling sites and includes a description, direction and distance from the monitored power plant. Table 2 provides a listing of the types of samples collected, sites where samples are collected, number of samples collected, number of samples that were missed or had noted problems 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.

Program Modifications

On April 30, 1987, Dairyland Power Cooperative permanently shut down the LACBWR facility. Their USNRC (United States Nuclear Regulatory Commission) license was amended to a possess-but-not-operate status on August 4, 1987 and they are now in the process of decommissioning the LACBWR facility. Since any severe accident involving the stored spent fuel will have little offsite consequences, the Wisconsin DHS environmental radioactivity monitoring program was modified in June 1988. These modifications included the elimination of precipitation, shoreline sediment and well water samples as well as a reduction in vegetation, soil and some surface water sampling.

In response to this and considering other funding restrictions, the LACBWR environmental monitoring program was reviewed and further modified in 1998, 1999, 2000 and 2013. 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 Wisconsin DHS' environmental monitoring report for the La Crosse boiling water reactor (LACBWR) for the calendar year January - December 1999 and January – December 2012.

Due to funding restrictions and the relocation of the spent fuel to the LACBWR Independent Spent Fuel Storage Installation (ISFSI), program modifications were implemented beginning in the third quarter of 2013.

Air particulate: Sampling site LAC-2 was discontinued. All air particulate sampling has ended for the LACBWR environmental monitoring program.

TLD: Sampling sites LAC-T2 and LAC-T4 were discontinued. The TLD sites were renumbered to better reflect their present positioning. Quarterly monitoring will be continued at the remaining four (4) sites.

Surface water: Surface water sampling at the two (2) sites was changed from quarterly to annual.

Bottom sediment: Sampling site LAC-2, LAC-3 and LAC-4 were discontinued. All bottom sediment sampling has ended for the LACBWR environmental monitoring program.

Fish: Fish sampling was changed from semi-annual to annual.

Soil and vegetation: Soil and vegetation sampling was changed from semi-annual to annual.

Laboratory Services and Quality Assurance

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 Wisconsin DHS, will be expressed as a lower limit of detection (LLD). The required DHS LLD as indicated in Table 4 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 4 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 4 under the heading “Range” and in Tables 5-10 is an “a posteriori” calculations 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 Wisconsin DHS LLD indicating that the required 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 $\pm$). Examples and explanations of data reporting are:

Example	Nuclide	Activity reported
1	^{137}Cs	< 10 pCi/liter
2	^{137}Cs	15 $\pm$ 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. WisconsinI DHS LACBWR environmental monitoring sampling sites.

Sample site	Distance and direction (miles)	Location description
LAC-1	15.0 N	La Crosse State Office Building (discontinued July 2010)
LAC-2	0.6 N	Lock & Dam #8
LAC-3	0.1 WSW	Discharge channel
LAC-4	0.7 SSW	Boat launch area
LAC-5	0.6 NNE	Hwy 35 parking lot
LAC-6	0.7 S	Boat launch access road
LAC-7	0.8 ENE	Philip Malin farm (discontinued January 2001)
LAC-T1	0.6 N	Lock & Dam #8
LAC-T2	0.5 SSE	Trailer court, Hwy 35
LAC-T3	0.2 S	ISFSI outer fence (outside on fence)
LAC-T4	0.2 W	ISFSI outer fence (outside on fence)
previous LAC-T2	2.0 E	Radio tower, Mound Ridge road (discontinued 3rd quarter)
previous LAC-T3	0.5 SSE	Trailer court, Hwy 35
previous LAC-T4	15.0 N	La Crosse State Office Building (discontinued 3rd quarter)
previous LAC-T5	0.2 S	ISFSI outside fence - west
previous LAC-T6	0.2 S	ISFSI outside fence - west

Table 2. Sample collection summary and required analyses.

Sample Type	Collection and Frequency	LAC Site locations	Number of Samples Collected	Number of Sample Deviations	Required Analyses
air particulate	C/BW	LAC -2 discontinued 3rd qtr	13	1	GA, GB, GI
TLD	G/Q	LAC T1-T6	20	0	direct exposure
surface water	G/A	LAC 2, 3	4	0	GA, GB, GI, Sr, H
bottom sediment	G/A	discontinued			
fish	G/A	3	2	0	GI
vegetation	G/A	LAC 5, 6	2	0	GA, GB, GI
soil	G/A	LAC 5, 6	2	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. WI DHS missing sample or non-routine analysis report for 2013.

Sample type	**Date**	**Site**	**Explanation**
Air particulate	03/04/13	LAC -2	Gross beta activity data is not available due to an improperly placed air filter.

Figure 1. Wisconsin DHS environmental monitoring sampling sites for the LACBWR monitoring program.

Results and Discussion for the LACBWR Environmental Monitoring Program

Air Particulate

A summary of reported activities by Wisconsin DHS for air particulate samples is included in Table 4. Results from the individual sample analyses are listed in Tables 5 and 6.

From the bi-weekly and quarterly gross beta activities listed in Table 5 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 LACBWR 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 4. Beryllium-7 (^{7}Be), detected in all composites, is a naturally occurring radioisotope that is constantly produced through nuclear reactions between cosmic rays and nuclei in the atmosphere. It is detected in air composites from other areas of Wisconsin on a routine basis Influence by the LACBWR facility on air quality is not evident from air particulate analysis.

Ambient Gamma Radiation - Thermoluminescent Dosimeters (TLDs)

A summary of reported activities by Wisconsin DHS for ambient gamma radiation is included in Table 4. Results from the individual sample analyses are listed in Table 7.

Ambient gamma radiation (TLD) data for 2013 from the Wisconsin DHS network was comparable for all sites. Significant differences in exposure were not noticed at different distances from the LACBWR facility. The average quarterly exposure from the four sites located within Wisconsin was 15.0 $\pm$ 2.9 milliroentgens. The average quarterly exposure for 2013 is at background levels and is comparable to other areas within Wisconsin. Influence by the LACBWR facility is not evident from air ambient gamma radiation analysis.

Fish

A summary of reported activities by Wisconsin DHS for fish samples is included in Table 4. Results from the individual sample analyses are listed in Table 8.

The fish samples showed no unusual activities. Naturally occurring potassium-40 (^{40}K) was reported in all samples. All other radioisotopes were below their respective lower limit of detection. Influence by the LACBWR facility is not evident from fish sample analysis.

Surface Water

A summary of reported activities by Wisconsin DHS for surface water samples is included in Table 4. Results from the individual sample analyses are listed in Table 9.

The surface water samples showed no unusual activities. All detected activities are at background levels and are comparable to data from previous years. The surface water samples uniformly show activities below state or federal standards. Influence by the LACBWR facility is not evident from surface water sample analysis.

Vegetation

A summary of reported activities by Wisconsin DHS for vegetation samples is included in Table 4. Results from the individual sample analyses are listed in Table 10.

Analysis of the vegetation samples showed no unusual activities. The gamma isotopic analysis detected only small amounts of naturally occurring potassium-40 (^{40}K) and beryllium-7 (^{7}Be) listed in Table 4. Influence by the LACBWR facility is not evident from vegetation sample analysis.

Soil

A summary of reported activities by Wisconsin DHS for soil samples is included in Table 4. Results from the individual sample analyses are listed in Table 10.

Analysis of the soil samples showed no unusual activities. The gamma isotopic analysis detected only small amounts of the radionuclides listed in Table 4. The naturally occurring radioisotope potassium-40 (^{40}K) was detected in all samples. The reported activities for cesium-137 (^{137}Cs) were also detected in previous years and can be attributed to residual fallout from previous atmospheric nuclear weapons tests. Naturally occurring radioisotopes from the uranium-238 (^{238}U) and thorium-232 (^{232}Th) decay series are commonly detected but have not been quantified or reported. Influence by the LACBWR 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 LACBWR facility are less than the limits as stated in these Federal regulations.

The Wisconsin 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 LACBWR facility are less than the limits as stated in Wis. Adm. Code section DHS 157.23.

References

State of Wisconsin, Wisconsin Administrative Code, ch. 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 4. Sample activity summary for the Wisconsin DHS LACBWR environmental monitoring program.

Sample type (units)	LLD	Number of samples [a]	Analysis	Range
Air Particulate	0.003	12 / 12	gross beta	0.012 - 0.050
(pCi/m^3)			gamma isotopic	
	0.020	2 / 2	Be-7	0.039 - 0.063
	0.002	2 / 0	Mn-54	< 0.0003
	0.002	2 / 0	Co-58	< 0.0003
	0.005	2 / 0	Fe-59	< 0.0007
	0.002	2 / 0	Co-60	< 0.0003
	0.005	2 / 0	Zn-65	< 0.0006
	0.002	2 / 0	Nb-95	< 0.0004
	0.005	2 / 0	Zr-95	< 0.0007
	0.002	2 / 0	Ru-103	< 0.0004
	0.015	2 / 0	Ru-106	< 0.0018
	0.020	2 / 0	I-131	< 0.0019
	0.002	2 / 0	Cs-134	< 0.0003
	0.002	2 / 0	Cs-137	< 0.0003
	0.030	2 / 0	Ba-140	< 0.0024
	0.020	2 / 0	La-140	< 0.0009
	0.002	2 / 0	Ce-141	< 0.0005
	0.005	2 / 0	Ce-144	< 0.0017
Direct Exposure	1.0 [c]	20 / 20	direct exposure	10.3 – 21.8
(mR/Std Qtr)				
Surface Water	3.0	4 / 4	gross beta (sol)	2.0 – 4.8
(pCi/liter)	3.0	4 / 0	gross beta (insol)	< 2.4
	3.0	4 / 2	gross alpha (sol)	< 2.3 – 1.0
	3.0	4 / 2	gross alpha (insol)	< 1.1 – 1.1
	300	4 / 0	H-3	< 260
	2.0	4 / 0	Sr-89	< 1.5
	1.0	4 / 0	Sr-90	< 0.4
			gamma isotopic	
	10	4 / 0	Mn-54	< 9
	15	4 / 0	Co-58	< 9
	30	4 / 0	Fe-59	< 16
	15	4 / 0	Co-60	< 13
	30	4 / 0	Zn-65	< 19
	15	4 / 0	Nb-95	< 9
	30	4 / 0	Zr-95	< 16
	15	4 / 0	I-131	< 11
	15	4 / 0	Cs-134	< 9
	15	4 / 0	Cs-137	< 12
	60	4 / 0	Ba-140	< 37
	15	4 / 0	La-140	< 15

Table 4. Sample activity summary for the Wisconsin DHS LACBWR environmental monitoring program, continued.

Sample type (units)	LLD	Number of samples [a]	Analysis	Range
soil	6000	2 / 2	gross beta	11900 – 30400
(pCi/kg dry)	13000	2 / 2	gross alpha	7910 – 16200
			gamma isotopic	
	800	2 / 2	K-40	13200 – 33600
	60	2 / 0	Mn-54	< 26
	90	2 / 0	Co-58	< 25
	600	2 / 0	Fe-59	< 64
	90	2 / 0	Co-60	< 30
	300	2 / 0	Zn-65	< 74
	100	2 / 0	Nb-95	< 27
	250	2 / 0	Zr-95	< 48
	80	2 / 0	Cs-134	< 21
	80	2 / 1	Cs-137	< 24 - 106
Vegetation	5000	2 / 0	gross alpha	< 960
(pCi/kg wet)	4000	2 / 2	gross beta	3570 – 4140
			gamma isotopic	
	600	2 / 2	Be-7	690 – 1250
	2000	2 / 2	K-40	4240 – 4510
	90	2 / 0	Mn-54	< 18
	100	2 / 0	Co-58	< 16
	200	2 / 0	Fe-59	< 37
	100	2 / 0	Co-60	< 23
	250	2 / 0	Zn-65	< 38
	100	2 / 0	Nb-95	< 20
	200	2 / 0	Zr-95	< 31
	80	2 / 0	I-131	< 24
	80	2 / 0	Cs-134	< 18
	90	2 / 0	Cs-137	< 22
	350	2 / 0	Ba-140	< 73
	100	2 / 0	La-140	< 25
fish			gamma isotopic	
(pCi/kg wet)	800	2 / 2	K-40	2660 – 3500
	50	2 / 0	Mn-54	< 6
	60	2 / 0	Co-58	< 8
	130	2 / 0	Fe-59	< 22
	60	2 / 0	Co-60	< 7
	130	2 / 0	Zn-65	< 16
	50	2 / 0	Nb-95	< 13
	100	2 / 0	Zr-95	< 14
	50	2 / 0	Cs-134	< 5
	60	2 / 0	Cs-137	< 7

a - Number of analysis / number of analyses detected above the Wisconsin DHS LLD.
b – LLD activities expressed in units of pCi/liter.
c - 1.0 mR / TLD.

Table 5. Wisconsin DHS air particulate gross beta analysis results from the LACBWR environmental monitoring program.

Measurements in units of pCi/m^3

Site: LAC-2; Lock & Dam #8

Collection date	volume m^3	Air particulate	Collection date	volume m^3	Air particulate
01/07/13	878	0.050 +- 0.002			
01/22/13	1226	0.026 +- 0.001	04/15/13	1040	0.014 +- 0.001
02/04/13	1018	0.034 +- 0.002	04/29/13	1119	0.016 +- 0.001
02/18/13	1135	0.024 +- 0.002	05/14/13	1184	0.015 +- 0.001
03/04/13	1150	*a	05/28/13	1092	0.013 +- 0.001
03/18/13	1125	0.018 +- 0.001	06/10/13	1034	0.012 +- 0.001
04/02/13	1208	0.017 +- 0.001	06/24/13	1015	0.015 +- 0.001
1st Qtr mean +- s.d.		0.028 +- 0.012	2nd Qtr mean +- s.d.		0.014 +- 0.001

*a - 03/04/13 Gross beta activity data is not available due to an improperly placed air filter.

Table 6. Wisconsin DHS gamma isotopic analysis results from the quarterly composites of air particulate filters collected from the LACBWR environmental monitoring program.

Measurements in units of pCi/m^3

Site: LAC-1	1st quarter	2nd quarter	3rd quarter	4th quarter
Be-7	0.039 +- 0.005	0.063 +- 0.007		
Mn-54	< 0.0002	< 0.0003		
Co-58	< 0.0002	< 0.0003		
Fe-59	< 0.0005	< 0.0007		
Co-60	< 0.0002	< 0.0003		
Zn-65	< 0.0005	< 0.0006		
Nb-95	< 0.0003	< 0.0004		
Zr-95	< 0.0004	< 0.0007		
Ru-103	< 0.0002	< 0.0004		
Ru-106	< 0.0014	< 0.0018		
I-131	< 0.0019	< 0.0010		
Cs-134	< 0.0002	< 0.0003		
Cs-137	< 0.0002	< 0.0003		
Ba-140	< 0.0024	< 0.0015		
La-140	< 0.0009	< 0.0003		
Ce-141	< 0.0004	< 0.0005		
Ce-144	< 0.0009	< 0.0017		

Radioisotopes other than those reported were not detected.

Table 7. Wisconsin DHS TLD network for the LACBWR environmental monitoring program.

	1st quarter	2nd quarter	3rd quarter	4th quarter
Date Placed:	01/08/13	04/09/13	07/09/13	10/08/13
Date Removed:	04/09/13	07/09/13	10/08/13	01/23/14
Days in the Field:	91	91	91	107
Individual quarterly date is reported as: mR / Standard Quarter + 2 sigma counting error.				
LAC-T1	13.8 +- 1.4	14.7 +- 0.9	14.9 +- 1.7	11.7 +- 0.6
LAC-T2	16.6 +- 1.2	16.0 +- 1.7	16.5 +- 0.9	16.1 +- 0.7
LAC-T3 (previous T5)	19.3 +- 2.3	17.5 +- 1.4	21.8 +- 2.9	14.1 +- 0.8
LAC-T4 (previous T6)	15.9 +- 0.8	14.3 +- 0.7	17.4 +- 1.1	13.2 +- 0.8
previous LAC-T2	10.4 +- 0.6	10.3 +- 0.8	discontinued	discontinued
previous LAC-T4	14.7 +- 1.0	11.6 +- 0.9	discontinued	discontinued

Table 8. Wisconsin DHS analysis results for fish samples collected for the LACBWR environmental monitoring program.

Measurements in units of pCi/kilogram (wet)		
Collection date:	05/29/13	05/29/13
Type	carp	northern pike
gamma isotopic		
K-40	2660 +- 450	3500 +- 570
Mn-54	< 6	< 5
Co-58	< 8	< 7
Fe-59	< 22	< 20
Co-60	< 6	< 7
Zn-65	< 16	< 13
Nb-95	< 13	< 11
Zr-95	< 12	< 14
Cs-134	< 5	< 5
Cs-137	< 5	< 7

Radioisotopes other than those reported were not detected.

Table 9. Wisconsin DHS analysis results for surface water samples collected for the LACBWR environmental monitoring program.

Measurements in units of pCi/liter

LAC-2; Lock & Dam #8

Collection date:	01/08/13	04/09/13
gross alpha-sol	< 2.3	1.0 +- 0.7
gross beta-sol	2.0 +- 1.2	4.1 +- 0.8
gross alpha-insol	< 1.1	0.9 +- 0.6
gross beta-insol	< 2.4	< 1.1
H-3	< 260	< 250
Sr-89	< 1.5	< 0.4
Sr-90	< 0.4	< 0.3
gamma isotopic		
Mn-54	< 9	< 7
Co-58	< 9	< 7
Fe-59	< 14	< 13
Co-60	< 10	< 8
Zn-65	< 19	< 11
Nb-95	< 8	< 7
Zr-95	< 9	< 11
I-131	< 10	< 9
Cs-134	< 9	< 5
Cs-137	< 7	< 6
Ba-140	< 26	< 27
La-140	< 15	< 13

LAC-3; discharge channel

Collection date:	01/08/13	04/09/13
gross alpha-sol	< 2.2	1.0 +- 0.7
gross beta-sol	3.4 +- 1.3	4.8 +- 0.9
gross alpha-insol	< 1.1	1.1 +- 0.6
gross beta-insol	< 2.4	< 1.3
H-3	< 260	< 250
Sr-89	< 1.4	< 0.4
Sr-90	< 0.3	< 0.3
gamma isotopic		
Mn-54	< 9	< 9
Co-58	< 9	< 8
Fe-59	< 16	< 13
Co-60	< 13	< 10
Zn-65	< 16	< 16
Nb-95	< 9	< 7
Zr-95	< 16	< 9
I-131	< 11	< 8
Cs-134	< 9	< 8
Cs-137	< 12	< 6
Ba-140	< 37	< 23
La-140	< 9	< 11

Radioisotopes other than those reported were not detected.

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

Vegetation - Measurements in units of pCi/kilogram (wet)

Site:	LAC-5	LAC-6
Collection date:	06/11/13	06/11/13
gross alpha	< 720	< 960
gross beta	4140 +- 310	3570 +- 340
gamma isotopic		
Be-7	1250 +- 80	690 +- 60
K-40	4510 +- 410	4240 +- 400
Mn-54	< 14	< 18
Co-58	< 16	< 15
Fe-59	< 33	< 37
Co-60	< 19	< 23
Zn-65	< 37	< 38
Nb-95	< 16	< 20
Zr-95	< 24	< 31
I-131	< 21	< 24
Cs-134	< 13	< 18
Cs-137	< 19	< 22
Ba-140	< 57	< 73
La-140	< 15	< 25

Soil - Measurements in units of pCi/kilogram (dry)

Site:	LAC-5	LAC-6
Collection date:	06/11/13	06/11/13
gross alpha	7910 +- 2980	16200 +- 3160
gross beta	30400 +- 1590	11900 +- 1060
gamma isotopic		
K-40	33600 +- 2760	13200 +- 1110
Mn-54	< 26	< 22
Co-58	< 25	< 19
Fe-59	< 64	< 42
Co-60	< 30	< 26
Zn-65	< 74	< 53
Nb-95	< 27	< 23
Zr-95	< 48	< 42
Cs-134	< 21	< 20
Cs-137	106 +- 9	< 24

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.