

**State of Wisconsin**  
**2010**  
**La Crosse Boiling Water Reactor**  
**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**

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# State of Wisconsin DHS

2010

## LACBWR Environmental Radioactivity Survey

### Introduction

Wisconsin Public Health Statutes 254.41 mandates the 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 La Crosse boiling water reactor (LACBWR) for the calendar year January - December 2010 and provides a description and results of this environmental monitoring program.

### WI DHS LACBWR 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 (TLD), surface water, fish, bottom sediments, 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, the 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 shutdown the LACBWR facility. Their NRC licensee 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 WI 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 and 2000. 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 La Crosse boiling water reactor (LACBWR) for the calendar year of January - December, 1999.

Due to funding restrictions and the future relocation of the spent fuel to the LACBWR Independent Spent Fuel Storage Installation (ISFSI), the following program modifications were implemented beginning in the 3<sup>rd</sup> quarter of 2010.

Air particulate sites: The WI DHS control site (LAC-1) was discontinued.

Fish: The sampling frequency was reduced from quarterly to twice per year with samples to be collected in the 2<sup>nd</sup> and 3<sup>rd</sup> quarters of the year.

Bottom sediment: The sampling frequency was reduced from twice per year to an annual sample to be collected in the spring or early summer.

## 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 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 5-11 are "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 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:

<u>Example</u>	<u>Nuclide</u>	<u>Activity reported</u>
1	<sup>137</sup> Cs	< 10 pCi/liter
2	<sup>137</sup> 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 LACBWR environmental monitoring sampling sites.

<u>Sample site</u>	<u>Distance and direction (miles)</u>	<u>Location description</u>
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	2.0 E	Radio tower, Mound Ridge road
LAC-T3	0.5 SSE	Trailer court, Hwy 35
LAC-T4	15.0 N	La Crosse State Office Building

Table 2. Sample collection summary and required analyses for 2010.

<u>Sample Type</u>	<u>Collection and Frequency</u>	<u>Site locations</u>	<u>Number of Samples Collected</u>	<u>Number of Sample Deviations</u>	<u>Required Analyses</u>
air particulate	C/BW	1 *a , 2	39	0	GA, GB, GI
TLD	G/Q	T1-T4	16	0	direct exposure
surface water	G/Q	2, 3	8	0	GA, GB, GI, Sr, H
bottom sediment	G/A *a	2, 3, 4	6	0	GA, GB, GI
fish	G/SA *a	3	6	0	GI
vegetation	G/SA	5, 6	4	0	GA, GB, GI
soil	G/SA	5, 6	4	0	GA, GB, GI

\*a – see Program Modification section.

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 2010.

Sample type	Date	Site	Explanation
There were no missing samples or non-routine analyses.			

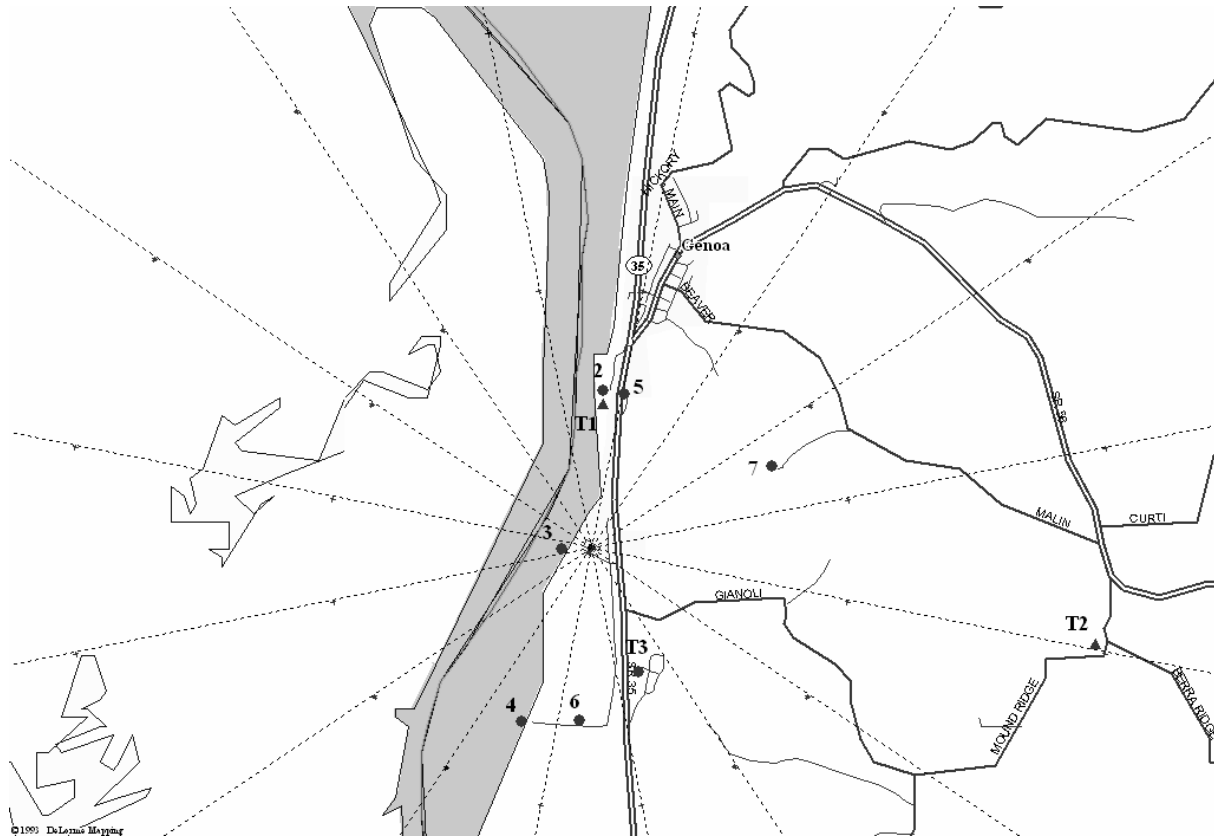


Figure 1. LACBWR environmental monitoring sampling sites.

## Results And Discussion

### Air Particulate

A summary of reported activities by WI 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 due to distance from the LACBWR facility. With no significant differences due to distance from the LACBWR facility an increase in gross beta activity attributable to LACBWR 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. All other radioisotopes were below their respective lower limit of detection. Naturally occurring beryllium-7 ( $^7\text{Be}$ ), 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 LACBWR facility on air quality is not evident from air particulate analysis.

### Direct Radiation - Thermoluminescent Dosimeters (TLD's)

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

Direct radiation (TLD) data for 2010 from the WI 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  $14.2 \pm 2.8$  milliroentgens. The average quarterly exposure for 2010 is at background levels and is comparable to other areas within Wisconsin.

### Fish

A summary of reported activities by WI 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 ( $^{40}\text{K}$ ) was reported in all samples. All other radioisotopes were below their respective lower limit of detection.

### Surface Water

A summary of reported activities by WI 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.

### Bottom sediments

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

The naturally occurring radioisotope potassium-40 ( $^{40}\text{K}$ ) was detected in all samples. The gamma isotopic analysis of the bottom sediment samples taken at site LAC-3 and LAC-4 detected small activities for cesium-137 ( $^{137}\text{Cs}$ ). The reported activities for cesium-137 ( $^{137}\text{Cs}$ ) can be attributable to past effluent discharges from the LACBWR facility and have also been detected in previous years. Naturally occurring radioisotopes such as radium-226 ( $^{226}\text{Ra}$ ), bismuth-214 ( $^{214}\text{Bi}$ ), lead-214 ( $^{214}\text{Pb}$ ), actinium-228 ( $^{228}\text{Ac}$ ), bismuth-212 ( $^{212}\text{Bi}$ ) and lead-212 ( $^{212}\text{Pb}$ ) from the naturally occurring uranium-238 ( $^{238}\text{U}$ ) and thorium-232 ( $^{232}\text{Th}$ ) decay series are commonly detected but have not been quantified or reported.

### Vegetation

A summary of reported activities by WI DHS for vegetation samples is included in Table 4. Results from the individual sample analyses are listed in Table 11.

Analysis of the vegetation samples showed no unusual activities. The gamma isotopic analysis detected only small amounts of naturally occurring potassium-40 ( $^{40}\text{K}$ ) and beryllium-7 ( $^7\text{Be}$ ) listed in Table 4.

### Soil

A summary of reported activities by WI DHS for soil samples is included in Table 4. Results from the individual sample analyses are listed in Table 11.

Analysis of the soil samples showed no unusual activities. The naturally occurring radioisotopes potassium-40 ( $^{40}\text{K}$ ) was detected in all samples. The reported activities for cesium-137 ( $^{137}\text{Cs}$ ) were also detected in previous years and are attributable to residual fallout from previous atmospheric nuclear weapons tests. Naturally occurring radioisotopes such as radium-226 ( $^{226}\text{Ra}$ ), bismuth-214 ( $^{214}\text{Bi}$ ), lead-214 ( $^{214}\text{Pb}$ ), actinium-228 ( $^{228}\text{Ac}$ ), bismuth-212 ( $^{212}\text{Bi}$ ) and lead-212 ( $^{212}\text{Pb}$ ) from the naturally occurring uranium-238 ( $^{238}\text{U}$ ) and thorium-232 ( $^{232}\text{Th}$ ) decay series are commonly detected but have not been quantified or reported.

### 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 WI DHS limits for permissible levels of radiation exposure from external sources in unrestricted areas are defined in the Wis. Adm. Code section HFS 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 HFS 157.23.

## **References**

State of Wisconsin, Wisconsin Administrative Code, HFS 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 WI DHS LACBWR environmental monitoring program.

Sample type (units)	LLD	Number of samples <sup>a</sup>	Analysis	Range
air particulate (pCi/m <sup>3</sup> )	0.003	39 / 39	gross beta	0.010 - 0.036
			gamma isotopic	
	0.020	6 / 6	Be-7	0.064 - 0.126
	0.002	6 / 0	Mn-54	< 0.0006
	0.002	6 / 0	Co-58	< 0.0006
	0.005	6 / 0	Fe-59	< 0.0013
	0.002	6 / 0	Co-60	< 0.0007
	0.005	6 / 0	Zn-65	< 0.0015
	0.002	6 / 0	Nb-95	< 0.0008
	0.005	6 / 0	Zr-95	< 0.0011
	0.002	6 / 0	Ru-103	< 0.0005
	0.015	6 / 0	Ru-106	< 0.0048
	0.020	6 / 0	I-131	< 0.0020
	0.002	6 / 0	Cs-134	< 0.0005
	0.002	6 / 0	Cs-137	< 0.0005
	0.030	6 / 0	Ba-140	< 0.0047
0.020	6 / 0	La-140	< 0.0020	
0.002	6 / 0	Ce-141	< 0.0010	
0.005	6 / 0	Ce-144	< 0.0028	
direct exposure (mR/Std Qtr)	1.0 <sup>c</sup>	16 / 16	direct exposure	8.4 – 19.5
surface water (pCi/liter)	3.0	8 / 7	gross beta (sol)	< 2.4 – 6.2
	3.0	8 / 2	gross beta (insol)	< 2.4 – 5.9
	3.0	8 / 7	gross alpha (sol)	< 1.3 – 6.3
	3.0	8 / 2	gross alpha (insol)	< 1.3 – 6.6
	300	8 / 0	H-3	< 185
	2.0	8 / 0	Sr-89	< 1.4
	1.0	8 / 1	Sr-90	< 0.4 – 0.3
			gamma isotopic	
	10	8 / 0	Mn-54	< 10
	15	8 / 0	Co-58	< 11
	30	8 / 0	Fe-59	< 20
	15	8 / 0	Co-60	< 12
	30	8 / 0	Zn-65	< 27
	15	8 / 0	Nb-95	< 11
	30	8 / 0	Zr-95	< 18
	15	8 / 0	I-131	< 13
	15	8 / 0	Cs-134	< 11
	15	8 / 0	Cs-137	< 10
60	8 / 0	Ba-140	< 43	
15	8 / 0	La-140	< 11	

Table 4. Sample activity summary for the WI DHS LACBWR environmental monitoring program.

Sample type (units)	LLD	Number of samples <sup>a</sup>	Analysis	Range
fish (pCi/kg wet)	800	6 / 6	gamma isotopic K-40	2600 – 3620
	50	6 / 0	Mn-54	< 10
	60	6 / 0	Co-58	< 11
	130	6 / 0	Fe-59	< 30
	60	6 / 0	Co-60	< 12
	130	6 / 0	Zn-65	< 23
	50	6 / 0	Nb-95	< 15
	100	6 / 0	Zr-95	< 19
	50	6 / 0	Cs-134	< 10
	60	6 / 0	Cs-137	< 10
	bottom sediment (pCi/kg dry)	6000	6 / 6	gross beta
13000		6 / 4	gross alpha	< 11600 - 25100
800		6 / 6	gamma isotopic K-40	4800 - 17000
60		6 / 0	Mn-54	< 28
90		6 / 0	Co-58	< 40
600		6 / 0	Fe-59	< 134
90		6 / 0	Co-60	< 26
300		6 / 0	Zn-65	< 68
100		6 / 0	Nb-95	< 76
250		6 / 0	Zr-95	< 87
80		6 / 0	Cs-134	< 26
80	6 / 3	Cs-137	< 20 - 280	
vegetation (pCi/kg wet)	5000	4 / 0	gross alpha	< 3400
	4000	4 / 4	gross beta	7600 - 8900
	600	4 / 4	gamma isotopic Be-7	860 - 1620
	2000	4 / 4	K-40	3640 - 6330
	90	4 / 0	Mn-54	< 36
	100	4 / 0	Co-58	< 30
	200	4 / 0	Fe-59	< 70
	100	4 / 0	Co-60	< 37
	250	4 / 0	Zn-65	< 73
	100	4 / 0	Nb-95	< 30
	200	4 / 0	Zr-95	< 60
	80	4 / 0	I-131	< 40
	80	4 / 0	Cs-134	< 35
	90	4 / 0	Cs-137	< 36
	350	4 / 0	Ba-140	< 125
100	4 / 0	La-140	< 46	

Table 4. Sample activity summary for the WI DHS LACBWR environmental monitoring program.

Sample type (units)	LLD	Number of samples <sup>a</sup>	Analysis	Range
soil (pCi/kg dry)	6000	4 / 4	gross beta	21700 - 38700
	13000	4 / 2	gross alpha	< 11000 - 23000
			gamma isotopic	
	800	4 / 4	K-40	13600 - 29700
	60	4 / 0	Mn-54	< 33
	90	4 / 0	Co-58	< 27
	600	4 / 0	Fe-59	< 67
	90	4 / 0	Co-60	< 34
	300	4 / 0	Zn-65	< 76
	100	4 / 0	Nb-95	< 30
	250	4 / 0	Zr-95	< 55
	80	4 / 0	Cs-134	< 26
	80	4 / 2	Cs-137	< 29 – 250

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

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

Measurements in units of pCi/m <sup>3</sup>					
Site: LAC-1; LaCrosse State office building			Site: LAC-2; Lock & Dam #8		
collection date	volume m <sup>3</sup>	air particulate	collection date	volume m <sup>3</sup>	air particulate
01/11/10	918	0.031 +- 0.002	01/11/10	1002	0.033 +- 0.002
01/25/10	800	0.021 +- 0.002	01/25/10	960	0.036 +- 0.002
02/08/10	895	0.029 +- 0.002	02/08/10	1070	0.028 +- 0.002
02/22/10	900	0.021 +- 0.002	02/22/10	1054	0.020 +- 0.002
03/08/10	891	0.029 +- 0.002	03/08/10	1067	0.027 +- 0.002
03/22/10	861	0.018 +- 0.002	03/22/10	1005	0.017 +- 0.002
1st Qtr			1st Qtr		
mean +- s.d.		0.025 +- 0.005	mean +- s.d.		0.027 +- 0.007
04/05/10	858	0.020 +- 0.002	04/05/10	1013	0.021 +- 0.002
04/19/10	843	0.017 +- 0.002	04/19/10	1015	0.018 +- 0.002
05/03/10	816	0.019 +- 0.002	05/03/10	1041	0.019 +- 0.002
05/17/10	835	0.011 +- 0.002	05/17/10	1062	0.011 +- 0.001
06/01/10	782	0.019 +- 0.002	06/01/10	1122	0.016 +- 0.001
06/21/10	1049	0.012 +- 0.001	06/21/10	1606	0.010 +- 0.001
06/28/10	341	0.015 +- 0.003	06/28/10	510	0.016 +- 0.002
2nd Qtr			2nd Qtr		
mean +- s.d.		0.016 +- 0.004	mean +- s.d.		0.016 +- 0.004
			07/12/10	1093	0.013 +- 0.001
			07/26/10	1056	0.018 +- 0.002
			08/09/10	1072	0.024 +- 0.002
			08/23/10	1114	0.025 +- 0.002
			09/07/10	1164	0.018 +- 0.001
			09/20/10	1025	0.014 +- 0.001
			10/01/10	878	0.017 +- 0.002
3rd Qtr			3rd Qtr		
mean +- s.d.			mean +- s.d.		0.018 +- 0.005
			10/18/10	1332	0.026 +- 0.001
			11/01/10	1112	0.021 +- 0.002
			11/15/10	1125	0.019 +- 0.001
			11/29/10	1149	0.024 +- 0.002
			12/14/10	1256	0.027 +- 0.002
			12/28/10	1165	0.025 +- 0.002
4th Qtr			4th Qtr		
mean +- s.d.			mean +- s.d.		0.024 +- 0.003

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

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Measurements in units of pCi/m<sup>3</sup>

Site: LAC-1	1st quarter	2nd quarter	3 <sup>rd</sup> quarter	4th quarter
Be-7	0.109 +- 0.007	0.119 +- 0.009		
Mn-54	< 0.0006	< 0.0002		
Co-58	< 0.0006	< 0.0002		
Fe-59	< 0.0013	< 0.0005		
Co-60	< 0.0004	< 0.0003		
Zn-65	< 0.0015	< 0.0004		
Nb-95	< 0.0008	< 0.0003		
Zr-95	< 0.0011	< 0.0003		
Ru-103	< 0.0004	< 0.0002		
Ru-106	< 0.0048	< 0.0016		
I-131	< 0.0019	< 0.0018		
Cs-134	< 0.0005	< 0.0002		
Cs-137	< 0.0005	< 0.0002		
Ba-140	< 0.0047	< 0.0023		
La-140	< 0.0013	< 0.0008		
Ce-141	< 0.0010	< 0.0004		
Ce-144	< 0.0028	< 0.0010		

Site: LAC-2	1st quarter	2nd quarter	3 <sup>rd</sup> quarter	4th quarter
Be-7	0.100 +- 0.006	0.126 +- 0.011	0.073 +- 0.007	0.064 +- 0.007
Mn-54	< 0.0004	< 0.0004	< 0.0002	< 0.0004
Co-58	< 0.0005	< 0.0004	< 0.0002	< 0.0004
Fe-59	< 0.0013	< 0.0009	< 0.0006	< 0.0009
Co-60	< 0.0007	< 0.0005	< 0.0003	< 0.0004
Zn-65	< 0.0009	< 0.0007	< 0.0007	< 0.0006
Nb-95	< 0.0006	< 0.0005	< 0.0004	< 0.0004
Zr-95	< 0.0009	< 0.0006	< 0.0006	< 0.0007
Ru-103	< 0.0005	< 0.0004	< 0.0003	< 0.0005
Ru-106	< 0.0041	< 0.0034	< 0.0024	< 0.0038
I-131	< 0.0020	< 0.0015	< 0.0018	< 0.0013
Cs-134	< 0.0005	< 0.0005	< 0.0004	< 0.0005
Cs-137	< 0.0004	< 0.0003	< 0.0002	< 0.0004
Ba-140	< 0.0033	< 0.0028	< 0.0029	< 0.0026
La-140	< 0.0020	< 0.0017	< 0.0017	< 0.0011
Ce-141	< 0.0008	< 0.0005	< 0.0004	< 0.0007
Ce-144	< 0.0024	< 0.0013	< 0.0010	< 0.0024

Radioisotopes other than those reported were not detected.

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

	1st quarter	2nd quarter	3rd quarter	4th quarter
Date Placed:	01/12/10	04/12/10	07/13/10	10/11/10
Date Removed:	04/12/10	07/13/10	10/11/10	01/10/11
Days in the Field:	90	92	90	91
Individual quarterly date is reported as : mR / Standard Quarter + 2 sigma counting error.				
LAC-T1	12.5 +- 1.3	12.0 +- 0.6	16.1 +- 1.3	14.4 +- 0.8
LAC-T2	11.5 +- 1.3	8.4 +- 0.9	14.3 +- 0.6	10.4 +- 0.7
LAC-T3	15.1 +- 0.9	14.7 +- 0.9	19.5 +- 1.3	16.6 +- 0.6
LAC-T4	14.3 +- 1.0	13.6 +- 0.9	18.2 +- 1.0	15.6 +- 0.9

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

Measurements in units of pCi/kilogram (wet)				
Collection date:	03/18/10	03/18/10	05/25/10	05/25/10
Type	northern & perch	carp	pike	carp
gamma isotopic				
K-40	2600 +- 200	2800 +- 200	3600 +- 600	3400 +- 600
Mn-54	< 7	< 8	< 6	< 7
Co-58	< 10	< 10	< 8	< 10
Fe-59	< 28	< 25	< 25	< 30
Co-60	< 6	< 9	< 6	< 8
Zn-65	< 21	< 19	< 14	< 20
Nb-95	< 15	< 15	< 14	< 15
Zr-95	< 17	< 17	< 16	< 19
Cs-134	< 7	< 8	< 6	< 7
Cs-137	< 8	< 9	< 6	< 7
Collection date:	08/14/10	09/22/10		
Type	carp	northern		
gamma isotopic				
K-40	2800 +- 500	2800 +- 500		
Mn-54	< 4	< 10		
Co-58	< 8	< 11		
Fe-59	< 26	< 28		
Co-60	< 5	< 12		
Zn-65	< 12	< 23		
Nb-95	< 13	< 15		
Zr-95	< 14	< 19		
Cs-134	< 5	< 10		
Cs-137	< 9	< 10		

Radioisotopes other than those reported were not detected.

Table 9. WI 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:	01/12/10	04/12/10	07/13/10	10/11/10
gross alpha-sol	2.6 +- 1.6	5.7 +- 2.1	4.4 +- 1.6	3.9 +- 2.1
gross beta-sol	3.9 +- 0.9	6.2 +- 1.0	4.7 +- 0.7	4.9 +- 1.2
gross alpha-insol	< 0.9	< 1.3	< 1.3	< 1.4
gross beta-insol	< 1.8	< 2.4	< 2.4	< 1.4
H-3	< 185	< 181	< 180	< 180
Sr-89	< 0.3	< 1.0	< 0.5	< 0.4
Sr-90	< 0.4	< 0.3	< 0.4	< 0.2
gamma isotopic				
Mn-54	< 8	< 10	< 9	< 2
Co-58	< 8	< 10	< 11	< 2
Fe-59	< 12	< 18	< 20	< 4
Co-60	< 10	< 12	< 8	< 3
Zn-65	< 15	< 27	< 18	< 5
Nb-95	< 8	< 11	< 10	< 2
Zr-95	< 16	< 18	< 16	< 3
I-131	< 12	< 13	< 13	< 3
Cs-134	< 9	< 11	< 11	< 2
Cs-137	< 10	< 9	< 10	< 2
Ba-140	< 38	< 43	< 35	< 8
La-140	< 10	< 11	< 11	< 3

LAC-3; discharge channel

Collection date:	01/12/10	04/12/10	07/13/10	10/11/10
gross alpha-sol	5.5 +- 2.4	< 1.3	6.3 +- 2.1	3.5 +- 2.1
gross beta-sol	2.5 +- 1.1	< 2.4	4.6 +- 0.7	4.8 +- 1.2
gross alpha-insol	< 0.9	6.6 +- 2.3	< 1.3	2.0 +- 1.2
gross beta-insol	< 1.8	5.9 +- 1.0	< 2.4	2.1 +- 1.1
H-3	< 185	< 181	< 180	< 180
Sr-89	< 0.3	< 1.4	< 0.5	< 0.4
Sr-90	< 0.3	< 0.2	< 0.4	0.3 +- 0.2
gamma isotopic				
Mn-54	< 7	< 6	< 8	< 7
Co-58	< 7	< 6	< 5	< 7
Fe-59	< 13	< 9	< 13	< 13
Co-60	< 7	< 8	< 8	< 8
Zn-65	< 13	< 11	< 20	< 17
Nb-95	< 7	< 6	< 7	< 6
Zr-95	< 15	< 10	< 13	< 8
I-131	< 8	< 8	< 8	< 8
Cs-134	< 7	< 6	< 9	< 7
Cs-137	< 7	< 6	< 8	< 6
Ba-140	< 28	< 26	< 31	< 25
La-140	< 9	< 9	< 10	< 9

Radioisotopes other than those reported were not detected.

Table 10. WI DHS analysis results for bottom sediment samples collected for the LACBWR environmental monitoring program.

Measurements in units of pCi/kilogram (dry)

Site	LAC-2	LAC-3	LAC-4	LAC-2	LAC-3	LAC-4
Collection date:	05/25/10	05/25/10	05/25/10	08/11/10	08/11/10	08/11/10
gross alpha	23000 +- 10000	< 11600	25100 +- 10300	7500 +- 4700	< 6500	24700 +- 6300
gross beta	14500 +- 3100	9400 +- 3000	30300 +- 3700	15200 +- 2200	8500 +- 2000	26800 +- 2500
gamma isotopic						
K-40	6100 +- 1200	5100 +- 1000	17000 +- 3330	4800 +- 800	5200 +- 900	15300 +- 2500
Mn-54	< 15	< 14	< 24	< 15	< 16	< 28
Co-58	< 20	< 17	< 35	< 23	< 23	< 40
Fe-59	< 58	< 59	< 124	< 59	< 67	< 134
Co-60	< 16	< 18	< 26	< 12	< 16	< 19
Zn-65	< 30	< 40	< 65	< 37	< 31	< 68
Nb-95	< 33	< 40	< 76	< 49	< 45	< 76
Zr-95	< 37	< 41	< 78	< 46	< 42	< 87
Cs-134	< 12	< 13	< 24	< 13	< 13	< 26
Cs-137	< 13	< 20	280 +- 40	< 16	45 +- 13	140 +- 30

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

Radioisotopes other than those reported were not detected.

Table 11. WI DHS 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	LAC-5	LAC-6
Collection date:	06/07/10	06/07/10	09/07/10	09/07/10
gross alpha	< 2800	< 3000	< 3400	< 2800
gross beta	8400 +- 1000	7600 +- 1000	8800 +- 1100	8900 +- 1000
gamma isotopic				
Be-7	1370 +- 160	860 +- 110	1620 +- 320	1450 +- 280
K-40	4840 +- 480	4720 +- 510	3640 +- 870	6330 +- 1200
Mn-54	< 20	< 36	< 36	< 30
Co-58	< 23	< 29	< 30	< 28
Fe-59	< 44	< 70	< 49	< 61
Co-60	< 28	< 37	< 33	< 31
Zn-65	< 38	< 73	< 67	< 68
Nb-95	< 19	< 28	< 28	< 30
Zr-95	< 39	< 55	< 41	< 60
I-131	< 27	< 36	< 31	< 40
Cs-134	< 20	< 32	< 35	< 33
Cs-137	< 17	< 27	< 34	< 36
Ba-140	< 77	< 125	< 110	< 120
La-140	< 18	< 46	< 30	< 33

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

Site:	LAC-5	LAC-6	LAC-5	LAC-6
Collection date:	06/07/10	06/07/10	09/07/10	09/07/10
gross alpha	< 11000	< 10900	20000 +- 10000	23000 +- 10000
gross beta	36800 +- 3900	23500 +- 3500	38700 +- 3900	21700 +- 3500
gamma isotopic				
K-40	29700 +- 2900	13600 +- 1400	29700 +- 4600	14400 +- 2400
Mn-54	< 27	< 21	< 27	< 33
Co-58	< 27	< 16	< 23	< 22
Fe-59	< 67	< 40	< 59	< 52
Co-60	< 34	< 22	< 28	< 22
Zn-65	< 76	< 40	< 65	< 66
Nb-95	< 28	< 16	< 27	< 30
Zr-95	< 49	< 32	< 44	< 55
Cs-134	< 26	< 15	< 22	< 26
Cs-137	238 +- 17	< 19	250 +- 30	< 29

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

Radioisotopes other than those reported were not detected.