

**State of Wisconsin**

**2008**

**La Crosse Boiling Water Reactor**

**Environmental Radioactivity Survey**

**Wisconsin Department of Health Services  
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# State of Wisconsin DHS

2008

## 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 2008 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.

There were no program modifications for 2008.

## Laboratory Services and Quality Assurance

The analysis of the samples is performed under contract with the State Laboratory of Hygiene (SLH). SLH 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.

SLH participates in the Environmental Resource Associates' Proficiency Testing program and has performed satisfactorily over the report period. Proficiency testing results are available from the 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:

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

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.

Sample site	Distance and direction (miles)	Location description
LAC-1	15.0 N	La Crosse State Office Building
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 beginning 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 2008.

Sample Type	Collection and Frequency	Site locations	Number of Samples Collected	Number of Sample Deviations	Required Analyses
air particulate	BW	1, 2	51	1	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/SA	2, 3, 4	6	0	GA, GB, GI
fish	G/Q	3	8	0	GI
vegetation	G/SA	5, 6	4	0	GA, GB, GI
soil	G/SA	5, 6	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. WI DHS missing sample or non-routine analysis report for 2008.

Sample type	Date	Site	Explanation
air particulate	12/19/08	LAC-1	No gross beta data available. Inspection of filter #21292 revealed that the filter was positioned off-center in the filter holder resulting in air leakage past the filter.

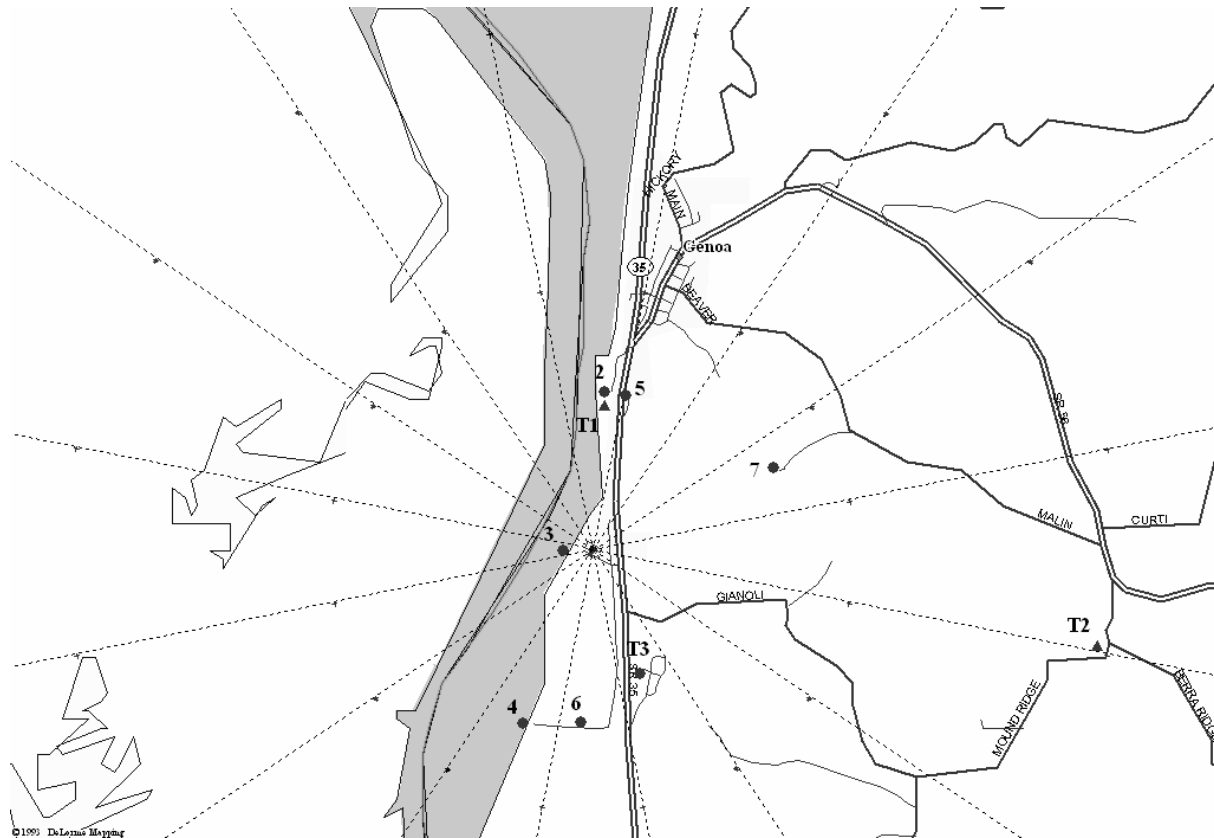


Figure 1. LACBWR environmental monitoring sampling sites.

## 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 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 2008 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  $14.3 \pm 2.3$  milliroentgens. The average quarterly exposure for 2008 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 except for one sample with a reported analysis for  $\text{Cs}^{137}$  of  $41 \pm 11$  pCi/kilogram.

### 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	51 / 51	gross beta	0.010 - 0.051
			gamma isotopic	
	0.020	8 / 8	Be-7	0.048 - 0.085
	0.002	8 / 0	Mn-54	< 0.0005
	0.002	8 / 0	Co-58	< 0.0006
	0.005	8 / 0	Fe-59	< 0.0014
	0.002	8 / 0	Co-60	< 0.0007
	0.005	8 / 0	Zn-65	< 0.0014
	0.002	8 / 0	Nb-95	< 0.0008
	0.005	8 / 0	Zr-95	< 0.0011
	0.002	8 / 0	Ru-103	< 0.0006
	0.015	8 / 0	Ru-106	< 0.0044
	0.020	8 / 0	I-131	< 0.0024
	0.002	8 / 0	Cs-134	< 0.0006
	0.002	8 / 0	Cs-137	< 0.0005
	0.030	8 / 0	Ba-140	< 0.0039
0.020	8 / 0	La-140	< 0.0021	
0.002	8 / 0	Ce-141	< 0.0008	
0.005	8 / 0	Ce-144	< 0.0028	
direct exposure (mR/Std Qtr)	1.0 <sup>c</sup>	16 / 16	direct exposure	9.6 – 18.3
surface water (pCi/liter)	3.0	8 / 5	gross beta (sol)	< 3.0 – 4.0
	3.0	8 / 0	gross beta (insol)	< 2.4
	3.0	8 / 3	gross alpha (sol)	< 3.0 – 4.0
	3.0	8 / 0	gross alpha (insol)	< 1.6
	300	8 / 0	H-3	< 300
	2.0	8 / 0	Sr-89	< 0.5
	1.0	8 / 0	Sr-90	< 0.4
			gamma isotopic	
	10	8 / 0	Mn-54	< 9
	15	8 / 0	Co-58	< 9
	30	8 / 0	Fe-59	< 20
	15	8 / 0	Co-60	< 12
	30	8 / 0	Zn-65	< 24
	15	8 / 0	Nb-95	< 10
	30	8 / 0	Zr-95	< 16
	15	8 / 0	I-131	< 14
	15	8 / 0	Cs-134	< 10
	15	8 / 0	Cs-137	< 9
	60	8 / 0	Ba-140	< 42
15	8 / 0	La-140	< 15	

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	8 / 8	gamma isotopic K-40	3100 - 4390
	50	8 / 0	Mn-54	< 27
	60	8 / 0	Co-58	< 41
	130	8 / 0	Fe-59	< 130
	60	8 / 0	Co-60	< 46
	130	8 / 0	Zn-65	< 100
	50	8 / 0	Nb-95	< 49
	100	8 / 0	Zr-95	< 70
	50	8 / 0	Cs-134	< 43
	60	8 / 1	Cs-137	< 31
bottom sediment (pCi/kg dry)	6000	6 / 4	gross beta	< 5000 - 20000
	13000	6 / 3	gross alpha	< 10000 - 17000
	800	6 / 6	gamma isotopic K-40	5400 - 17400
	60	6 / 0	Mn-54	< 33
	90	6 / 0	Co-58	< 60
	600	6 / 0	Fe-59	< 180
	90	6 / 0	Co-60	< 39
	300	6 / 0	Zn-65	< 170
	100	6 / 0	Nb-95	< 100
	250	6 / 0	Zr-95	< 90
	80	6 / 0	Cs-134	< 47
	80	6 / 4	Cs-137	< 34 - 192
vegetation (pCi/kg wet)	5000	4 / 0	gross alpha	< 3000
	4000	4 / 4	gross beta	4500 - 8700
	600	4 / 4	gamma isotopic Be-7	560 - 1640
	2000	4 / 4	K-40	3700 - 4500
	90	4 / 0	Mn-54	< 70
	100	4 / 0	Co-58	< 60
	200	4 / 0	Fe-59	< 120
	100	4 / 0	Co-60	< 46
	250	4 / 0	Zn-65	< 130
	100	4 / 0	Nb-95	< 60
	200	4 / 0	Zr-95	< 110
	80	4 / 0	I-131	< 80
	80	4 / 0	Cs-134	< 55
	90	4 / 0	Cs-137	< 60
	350	4 / 0	Ba-140	< 230
	100	4 / 0	La-140	< 100

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	20000 - 41000
	13000	4 / 3	gross alpha	< 8000 - 19000
			gamma isotopic	
	800	4 / 4	K-40	13800 - 33100
	60	4 / 0	Mn-54	< 43
	90	4 / 0	Co-58	< 40
	600	4 / 0	Fe-59	< 110
	90	4 / 0	Co-60	< 47
	300	4 / 0	Zn-65	< 230
	100	4 / 0	Nb-95	< 46
	250	4 / 0	Zr-95	< 70
	80	4 / 0	Cs-134	< 70
	80	4 / 2	Cs-137	< 46 - 207

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
01/14/08	943	0.038 +- 0.002	01/14/08	1004	0.044 +- 0.002
01/28/08	983	0.039 +- 0.002	01/28/08	1045	0.041 +- 0.002
02/11/08	946	0.031 +- 0.002	02/11/08	1034	0.032 +- 0.002
02/25/08	962	0.030 +- 0.002	02/25/08	1053	0.031 +- 0.002
03/10/08	942	0.027 +- 0.002	03/10/08	1032	0.030 +- 0.002
03/25/08	986	0.018 +- 0.002	03/25/08	1087	0.018 +- 0.002
1st Qtr			1st Qtr		
mean +- s.d.		0.030 +- 0.008	mean +- s.d.		0.033 +- 0.009
04/07/08	841	0.019 +- 0.002	04/08/08	951	0.017 +- 0.002
04/21/08	898	0.013 +- 0.001	04/21/08	1007	0.013 +- 0.001
05/05/08	873	0.019 +- 0.002	05/05/08	997	0.018 +- 0.002
05/19/08	828	0.013 +- 0.002	05/19/08	983	0.014 +- 0.001
06/02/08	980	0.011 +- 0.001	06/02/08	973	0.010 +- 0.001
06/16/08	804	0.014 +- 0.002	06/16/08	923	0.014 +- 0.001
06/30/08	728	0.014 +- 0.002	06/30/08	907	0.016 +- 0.002
2nd Qtr			2nd Qtr		
mean +- s.d.		0.015 +- 0.003	mean +- s.d.		0.014 +- 0.003
07/14/08	760	0.013 +- 0.002	07/14/08	887	0.014 +- 0.002
07/28/08	749	0.021 +- 0.002	07/28/08	884	0.020 +- 0.002
08/11/08	751	0.017 +- 0.002	08/11/08	881	0.018 +- 0.002
08/25/08	745	0.022 +- 0.002	08/25/08	870	0.024 +- 0.002
09/08/08	754	0.023 +- 0.002	09/08/08	861	0.024 +- 0.002
09/22/08	744	0.023 +- 0.002	09/22/08	863	0.028 +- 0.002
3rd Qtr			3rd Qtr		
mean +- s.d.		0.020 +- 0.004	mean +- s.d.		0.021 +- 0.005
10/06/08	785	0.026 +- 0.002	10/07/08	922	0.031 +- 0.002
10/21/08	822	0.020 +- 0.002	10/21/08	865	0.022 +- 0.002
11/03/08	787	0.027 +- 0.002	11/03/08	864	0.029 +- 0.002
11/17/08	846	0.020 +- 0.002	11/17/08	918	0.022 +- 0.002
12/01/08	896	0.026 +- 0.002	a 12/19/08	973	
12/15/08	916	0.024 +- 0.002	12/16/08	985	0.031 +- 0.002
12/29/08	924	0.040 +- 0.002	12/29/08	853	0.051 +- 0.003
4th Qtr			4th Qtr		
mean +- s.d.		0.026 +- 0.007	mean +- s.d.		0.031 +- 0.011

a - No gross beta data available. Inspection of filter #21292 revealed that the filter was positioned off-center in the filter holder resulting in air leakage past the filter.

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	0.056 +- 0.002	0.076 +- 0.003	0.076 +- 0.003	0.057 +- 0.004
Mn-54	< 0.0002	< 0.0005	< 0.0004	< 0.0005
Co-58	< 0.0002	< 0.0006	< 0.0005	< 0.0006
Fe-59	< 0.0006	< 0.0014	< 0.0010	< 0.0008
Co-60	< 0.0002	< 0.0005	< 0.0005	< 0.0007
Zn-65	< 0.0004	< 0.0012	< 0.0012	< 0.0008
Nb-95	< 0.0003	< 0.0008	< 0.0004	< 0.0005
Zr-95	< 0.0004	< 0.0011	< 0.0009	< 0.0008
Ru-103	< 0.0002	< 0.0006	< 0.0005	< 0.0005
Ru-106	< 0.0013	< 0.0039	< 0.0044	< 0.0043
I-131	< 0.0013	< 0.0020	< 0.0016	< 0.0011
Cs-134	< 0.0002	< 0.0006	< 0.0004	< 0.0005
Cs-137	< 0.0002	< 0.0005	< 0.0004	< 0.0005
Ba-140	< 0.0022	< 0.0039	< 0.0032	< 0.0026
La-140	< 0.0012	< 0.0018	< 0.0013	< 0.0012
Ce-141	< 0.0002	< 0.0008	< 0.0006	< 0.0007
Ce-144	< 0.0005	< 0.0028	< 0.0014	< 0.0028
Site: LAC-2				
Be-7	0.058 +- 0.002	0.048 +- 0.002	0.085 +- 0.003	0.053 +- 0.003
Mn-54	< 0.0003	< 0.0004	< 0.0005	< 0.0005
Co-58	< 0.0003	< 0.0005	< 0.0004	< 0.0004
Fe-59	< 0.0008	< 0.0010	< 0.0014	< 0.0008
Co-60	< 0.0003	< 0.0005	< 0.0006	< 0.0003
Zn-65	< 0.0008	< 0.0012	< 0.0014	< 0.0007
Nb-95	< 0.0004	< 0.0006	< 0.0006	< 0.0004
Zr-95	< 0.0006	< 0.0010	< 0.0007	< 0.0004
Ru-103	< 0.0003	< 0.0004	< 0.0004	< 0.0003
Ru-106	< 0.0022	< 0.0030	< 0.0038	< 0.0022
I-131	< 0.0024	< 0.0012	< 0.0018	< 0.0006
Cs-134	< 0.0003	< 0.0004	< 0.0004	< 0.0003
Cs-137	< 0.0003	< 0.0003	< 0.0004	< 0.0003
Ba-140	< 0.0034	< 0.0027	< 0.0039	< 0.0015
La-140	< 0.0016	< 0.0014	< 0.0021	< 0.0002
Ce-141	< 0.0005	< 0.0004	< 0.0005	< 0.0004
Ce-144	< 0.0015	< 0.0011	< 0.0012	< 0.0014

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:	01/08/08	04/08/08	07/08/08	10/08/08
Date Removed:	04/08/08	07/08/08	10/07/08	01/14/09
Days in the Field:	91	91	91	98
Individual quarterly date is reported as: mR / Standard Quarter + 2 sigma counting error.				
LAC-T1	13.6 +- 0.9	14.3 +- 0.7	13.9 +- 1.1	16.1 +- 0.7
LAC-T2	11.6 +- 0.7	9.6 +- 0.6	11.3 +- 0.5	11.5 +- 0.6
LAC-T3	15.0 +- 0.6	16.0 +- 0.7	16.3 +- 0.6	18.3 +- 0.6
LAC-T4	14.4 +- 0.8	14.8 +- 0.9	15.4 +- 0.9	17.0 +- 0.8

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:	03/31/08	03/31/08	05/22/08	05/22/08
Type	walleye	carp	carp	pike
gamma isotopic				
K-40	3400 +- 300	3100 +- 200	3600 +- 200	3600 +- 160
Mn-54	< 24	< 27	< 21	< 19
Co-58	< 41	< 24	< 29	< 26
Fe-59	< 90	< 90	< 130	< 90
Co-60	< 46	< 42	< 16	< 18
Zn-65	< 100	< 70	< 70	< 45
Nb-95	< 42	< 47	< 38	< 45
Zr-95	< 40	< 70	< 53	< 42
Cs-134	< 30	< 43	< 16	< 21
Cs-137	< 31	41 +- 11	< 17	< 15
Collection date:	08/20/08	08/20/08	10/23/08	10/23/08
Type	walleye	carp	walleye	carp
gamma isotopic				
K-40	3500 +- 200	3200 +- 140	4391 +- 127	3394 +- 99
Mn-54	< 25	< 13	< 4	< 4
Co-58	< 22	< 17	< 7	< 7
Fe-59	< 90	< 60	< 28	< 24
Co-60	< 31	< 15	< 4	< 4
Zn-65	< 60	< 43	< 12	< 10
Nb-95	< 49	< 32	< 18	< 16
Zr-95	< 60	< 33	< 14	< 12
Cs-134	< 19	< 12	< 3	< 3
Cs-137	< 18	< 12	< 7	< 6

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 #2

Collection date:	01/08/08	04/08/08	07/08/08	10/07/08
gross alpha-sol	< 2.0	< 2.0	< 3.0	< 3.0
gross beta-sol	3.0 +- 2.0	4.0 +- 2.0	< 1.3	< 3.0
gross alpha-insol	< 1.0	< 1.1	< 1.6	< 1.2
gross beta-insol	< 2.4	< 2.4	< 1.7	< 2.4
H-3	< 300	< 180	< 180	< 180
Sr-89	< 0.3	< 0.4	< 0.5	< 0.3
Sr-90	< 0.4	< 0.3	< 0.4	< 0.3
gamma isotopic				
Mn-54	< 6	< 5	< 9	< 7
Co-58	< 6	< 5	< 8	< 7
Fe-59	< 10	< 13	< 19	< 15
Co-60	< 7	< 6	< 10	< 5
Zn-65	< 13	< 13	< 24	< 15
Nb-95	< 6	< 6	< 10	< 8
Zr-95	< 9	< 9	< 16	< 11
I-131	< 6	< 7	< 14	< 9
Cs-134	< 6	< 5	< 9	< 7
Cs-137	< 6	< 6	< 9	< 5
Ba-140	< 22	< 24	< 42	< 23
La-140	< 9	< 12	< 13	< 10

LAC-3; discharge channel

Collection date:	01/08/08	04/08/08	07/08/08	10/07/08
gross alpha-sol	4.0 +- 3.0	< 2.1	3.0 +- 2.0	2.0 +- 1.6
gross beta-sol	< 3.0	4.0 +- 2.0	2.8 +- 1.0	3.1 +- 1.3
gross alpha-insol	< 1.0	< 1.1	< 1.5	< 1.2
gross beta-insol	< 2.4	< 2.4	< 1.5	< 2.4
H-3	< 300	< 180	< 180	< 180
Sr-89	< 0.3	< 0.4	< 0.5	< 0.3
Sr-90	< 0.3	< 0.3	< 0.4	< 0.3
gamma isotopic				
Mn-54	< 9	< 7	< 6	< 8
Co-58	< 9	< 9	< 5	< 7
Fe-59	< 20	< 17	< 11	< 13
Co-60	< 9	< 12	< 5	< 12
Zn-65	< 22	< 21	< 13	< 16
Nb-95	< 9	< 8	< 5	< 7
Zr-95	< 16	< 13	< 9	< 11
I-131	< 13	< 12	< 7	< 8
Cs-134	< 10	< 8	< 6	< 7
Cs-137	< 8	< 9	< 5	< 8
Ba-140	< 39	< 37	< 22	< 24
La-140	< 15	< 10	< 7	< 14

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:	05/22/08	05/22/08	05/22/08	08/20/08	08/20/08	08/20/08
gross alpha	< 8000	10000 +- 8000	14000 +- 9000	< 10000	< 10000	17000 +- 9000
gross beta	< 5000	8000 +- 4000	18000 +- 4000	7000 +- 4000	< 5000	20000 +- 4000
gamma isotopic						
K-40	6400 +- 300	5700 +- 200	14700 +- 500	7000 +- 200	5400 +- 300	17400 +- 500
Mn-54	< 31	< 16	< 26	< 12	< 23	< 33
Co-58	< 48	< 19	< 40	< 19	< 43	< 60
Fe-59	< 160	< 60	< 130	< 57	< 120	< 180
Co-60	< 25	< 14	< 31	< 20	< 39	< 34
Zn-65	< 110	< 40	< 80	< 39	< 120	< 170
Nb-95	< 70	< 50	< 100	< 38	< 60	< 90
Zr-95	< 90	< 41	< 80	< 90	< 90	< 90
Cs-134	< 40	< 15	< 27	< 11	< 36	< 47
Cs-137	< 34	192 +- 10	53 +- 9	< 13	39 +- 10	78 +- 12

Naturally occurring radioisotopes such as radium-226 (<sup>226</sup>Ra), bismuth-214 (<sup>214</sup>Bi), lead-214 (<sup>214</sup>Pb), actinium-228 (<sup>228</sup>Ac), bismuth-212 (<sup>212</sup>Bi), lead-212 (<sup>212</sup>Pb) from the naturally occurring uranium-238 (<sup>238</sup>U) and thorium-232 (<sup>232</sup>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:	06/02/08	06/02/08	09/15/08	09/15/08
gross alpha	< 1800	< 3000	< 2300	< 2000
gross beta	5100 +- 1000	5400 +- 1300	8700 +- 1300	4500 +- 1100
gamma isotopic				
Be-7	560 +- 110	590 +- 130	840 +- 100	1640 +- 100
K-40	4500 +- 300	3700 +- 300	4400 +- 300	4100 +- 200
Mn-54	< 34	< 70	< 40	< 33
Co-58	< 40	< 60	< 37	< 27
Fe-59	< 120	< 100	< 80	< 60
Co-60	< 46	< 42	< 31	< 33
Zn-65	< 130	< 110	< 80	< 80
Nb-95	< 40	< 60	< 39	< 28
Zr-95	< 80	< 110	< 60	< 36
I-131	< 43	< 80	< 31	< 26
Cs-134	< 36	< 55	< 35	< 25
Cs-137	< 43	< 60	< 41	< 28
Ba-140	< 100	< 230	< 130	< 110
La-140	< 100	< 70	< 90	< 30

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

Site:	LAC-5	LAC-6	LAC-5	LAC-6
Collection date:	06/02/08	06/02/08	09/15/08	09/15/08
gross alpha	< 8000	10000 +- 7000	19000 +- 9000	14000 +- 8000
gross beta	41000 +- 5000	21000 +- 4000	36000 +- 5000	20000 +- 4000
gamma isotopic				
K-40	33100 +- 900	13800 +- 600	32400 +- 1090	15200 +- 500
Mn-54	< 21	< 29	< 36	< 43
Co-58	< 19	< 28	< 32	< 40
Fe-59	< 60	< 80	< 97	< 110
Co-60	< 24	< 31	< 35	< 47
Zn-65	< 50	< 70	< 88	< 230
Nb-95	< 27	< 46	< 39	< 44
Zr-95	< 34	< 50	< 47	< 70
Cs-134	< 20	< 30	< 25	< 70
Cs-137	144 +- 9	< 29	207 +- 19	< 46

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.