

LaCrosse Boiling Water Reactor Environmental Radioactivity Survey 2019



**WISCONSIN DEPARTMENT
of HEALTH SERVICES**

**Division of Public Health
Bureau of Environmental and Occupational Health
Radiation Protection Section**

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Executive Summary

Wisconsin Stat. § 254.41 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) nuclear generating plant for the calendar year (January – December) 2019. It provides descriptions and results of this environmental monitoring program.

The DHS 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 includes samples of air particulates, ambient gamma radiation, surface water, well water, sediment, soil, and vegetation that are collected from selected locations at planned sampling intervals.

Program Summary

The DHS environmental monitoring programs provide an ongoing baseline of radioactivity measurements to assess any 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 1950s-1960s atmospheric nuclear testing and such radiological incidents as the Chernobyl nuclear reactor incident of 1986.
- There were no incidents during 2019, which required additional environmental monitoring for tritium concentrations.
- There were no radioactive incidents related to food consumed in Wisconsin and no recorded health problems related to radioactivity for Wisconsin citizens.

The DHS 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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La Crosse Boiling Water Reactor (LACBWR) Environmental Radioactivity Survey, 2019

Introduction

Wisconsin Stat. § 254.41 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) 2019. This report provides descriptions and results of the environmental monitoring program.

Wisconsin DHS LACBWR Environmental Monitoring Sampling Program

The DHS environmental monitoring program consists of the collection of various types of air particulate samples from the air, water and terrestrial exposure pathways. The sampling program includes samples of ambient gamma radiation as measured by thermoluminescent dosimeters (TLD), surface water, well water, sediment, 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 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.

On-Site Groundwater Tritium Plume (H³)

On February 14, 2018 during routine environmental monitoring at La Crosse Boiling Water Reactor, LaCrosse Solutions discovered well MW-203A contained 24,200 pCi/Liter of tritium. The tritium level exceeded the Maximum Contamination Levels (MCLs) of 20,000 pCi/Liter for drinking water as stated in NUREG-1301, Supplement No 1, Page 64 table 3.12-2. La Crosse Solutions notified the Nuclear Regulatory Commission (NRC) on March 12, 2018 regarding the elevated level of tritium and that Haley & Aldrich conducted testing of groundwater.

Radiation Protection Section – Environmental Monitoring sample sites never experienced tritium concentrations above normal background throughout the monitoring period of 2018 and 2019.

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. On August 7, 1991 the Nuclear Regulatory Commission approved LACBWR's SAFSTOR (deferred decontamination) decommissioning plan. On June 1, 2017 LACBWR transferred their license to LaCrosse Solutions for the purpose of completing decommissioning of LACBWR.

Active decommission of the LACBWR started in the third quarter of 2017. In response to the active decommissioning, air particulate and well water samples were added to the routine environmental monitoring program for LACBWR. Table 2 shows the sample site location and frequency of the sample collection.

In response to tritium being detected in ground water wells on February 14, 2018, the Wisconsin Department of Health – Radiation Protection Section – Environmental Monitoring Program increased the number of samples taken from existing sample sites to monitor for tritium during 2018 and through 2019. In addition, samples were taken from a residence that was approximately 215 meters away from the reactor, which was designated LAC-9.

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 instrumentation and conduct performance checks. Instrumentation quality control charts are maintained and available upon written request.

WSLH participates in the Environmental Resource Associates' Proficiency Testing program and has performed satisfactorily over the report period. In addition, WSLH participates in the Multi Analytical Performance Evaluation program (MAPEP) for environmental matrix analysis. Proficiency testing results are available from the WSLH.

ATI Environmental Inc. Midwest Laboratory participates in the National Environmental Laboratory Accreditation Conference Standards (2003) for a variety of radiological analyses during the reporting period.

Detection Limits

Detection limits, requested by DHS, are expressed as a lower limit of detection (LLD). The 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.
t	is the elapsed time, for environmental samples, 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 are 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 5-13 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 DHS LLD, indicating that the required DHS LLD has been met.

An actual activity value is 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 ± 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. Wisconsin DHS LACBWR environmental monitoring sampling sites.

Sample site	Distance and direction (miles)	Location description
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	0.7 SSE	Edgewood Trailer Court
LAC-8	1.15 NNE	Genoa Post Office
LAC-9	0.4SE	House number E-450
LAC-T1	0.6 N	Lock & Dam #8
LAC-T2	0.5 SSE	Edgewood 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)

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, 7	52	2	GA, GB, GI ^w
TLD	G/Q	LAC T1-T4	16	0	direct exposure
surface water	G/A	LAC 4	2	0	GA ^{u,v} , GB ^{u,v} , GI, Sr, H
bottom sediment	G/A	LAC 2, 3, 4	3	0	GA,GB,GI
vegetation	G/A	LAC 5, 6	4	0	GA, GB, GI
soil	G/A	LAC 5, 6	4	0	GA, GB, GI
well water	G/BA	LAC 7, 8, 9	8	0	GA ^u , GB ^u , H

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

^u = Soluble

^v = Insoluble

^w = A quarterly composite for each site

Table 3. Wisconsin DHS missing sample or non-routine analysis report for 2019.

Sample type	Date	Site	Explanation
Air Particulate	10/23/19	LAC-2	The lab did not provide the results
Air Particulate	10/23/19	LAC-7	The lab did not provide the results
Surface Water	06/18/19	LAC-4	Sr-89 fell out of acceptable range
Surface Water	06/18/19	LAC-4	Analyzed 180 days past hold time
Surface Water	09/10/19	LAC-4	Sr-90 QC matrix spike failed
Surface Water	09/10/19	LAC-4	Analyzed 180 days past hold time
Surface Water	09/10/19	LAC-4	Gross alpha and beta spikes did not meet the acceptance criteria
Soil	06/18/19	LAC-5	Analyzed 180 days after hold time
Soil	06/18/19	LAC-6	Analyzed 180 days after hold time
Soil	06/18/19	LAC-6	Detection limit for Nb-95 was not met
Soil	09/10/19	LAC-6	Analyzed 180 days after hold time
Vegetation	06/18/19	LAC-5	Analyzed 180 days after hold time
Vegetation	06/18/19	LAC-6	Analyzed 180 days after hold time
Shoreline Sediment	04/23/19	LAC-2	Analyzed 180 days after hold time
Shoreline Sediment	04/23/19	LAC-3	Analyzed 180 days after hold time
Shoreline Sediment	04/23/19	LAC-3	Detection limit for Nb-95 was not met
Shoreline Sediment	04/23/19	LAC-4	Analyzed 180 days after hold time
Shoreline Sediment	04/23/19	LAC-4	Detection limit for Nb-95 was not met

Environmental Monitoring Sites LaCrosse Bioling Water Reactor (LACBWR)

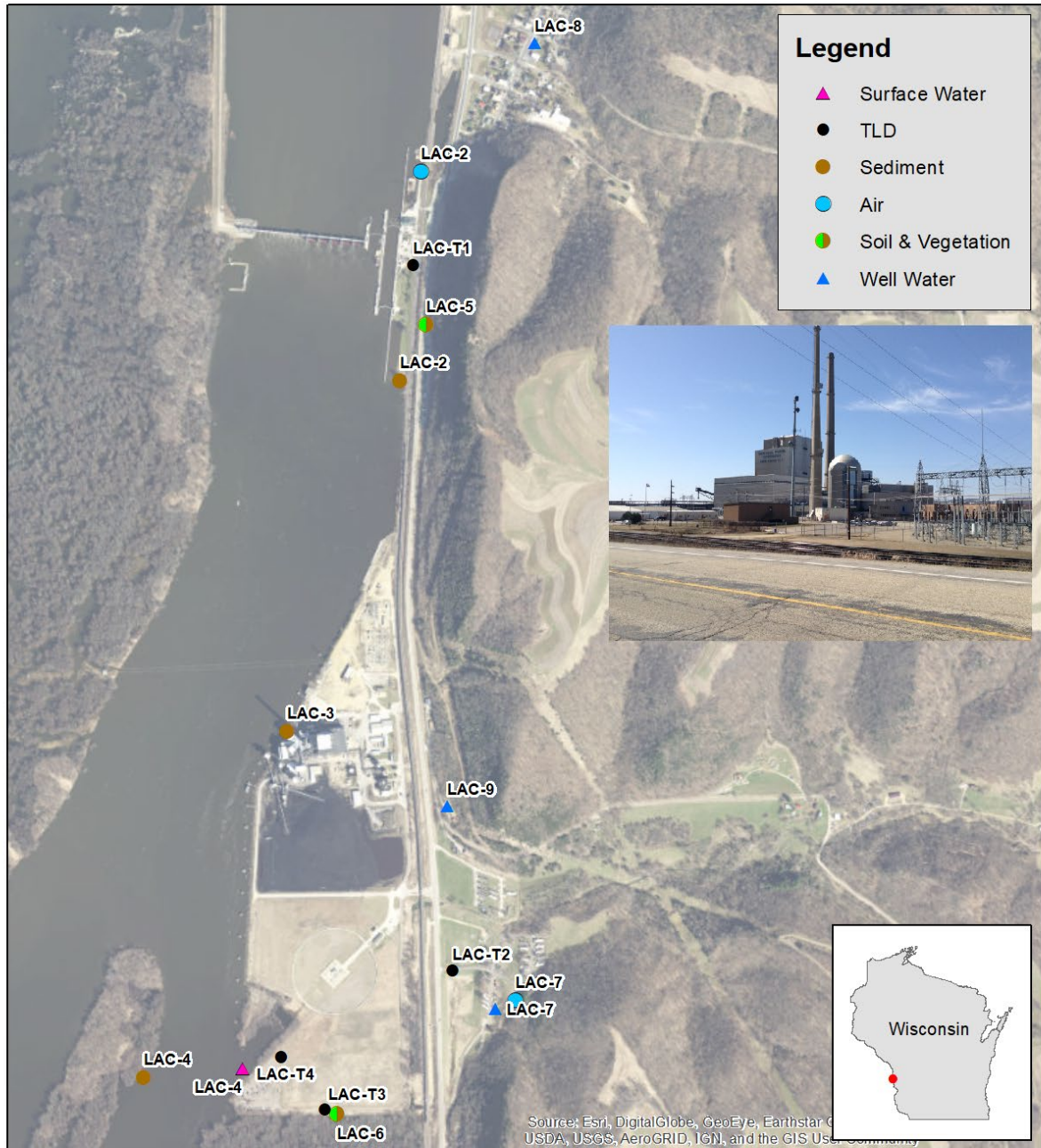


Figure 1. Wisconsin DHS environmental monitoring sampling sites for the LACBWR monitoring program.

Results and Discussion for the LACBWR Environmental Monitoring Program

Air Particulate

Table 4 provides a summary of reported activities by DHS for air particulate samples. Table 5 provides results from the individual sample analyses.

Many samples in Table 5 had gross beta activity above the LLD. The gross beta values were comparable to the gross beta activity at the other nuclear plant across the state.

The gamma isotopic analysis of the quarterly air particulate filter composites detected only trace amounts of Beryllium-7 (^7Be). All other radioisotopes were below their respective LLD. Beryllium-7 (^7Be) was detected in all composites, and is a naturally occurring radioisotope that is constantly produced through nuclear reactions between cosmic rays and nuclei in the atmosphere.

Ambient Gamma Radiation - Thermoluminescent Dosimeters (TLDs)

Table 4 provides a summary of reported activities by DHS for ambient gamma radiation. Table 7 provides results from the individual sample analyses.

Ambient gamma radiation (TLD) data for 2019 from the 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 16.3 ± 1.3 milliroentgens. The average quarterly exposure for 2019 was at background levels and was comparable to other areas within Wisconsin. Influence by the LACBWR facility is not evident from air ambient gamma radiation analysis.

Surface Water

Table 4 provides a summary of reported activities by DHS for surface water samples. Table 11 provides results from the individual sample analysis.

The gamma isotopic analysis did not detect any samples above the LLD. The surface water samples uniformly showed activities below state or federal standards. Influence by the LACBWR facility is not evident from surface water sample analysis.

Vegetation

Table 4 provides a summary of reported activities by DHS for vegetation samples. Table 9 provides results from the individual sample.

Analysis of the vegetation samples showed no unusual activities, even though gross beta was above the LLD the values were consistent with previous years. The gamma isotopic analysis detected naturally occurring potassium-40 (^{40}K) and beryllium-7 (^7Be) above the LLD, but the values were consistent with previous years samples. Influence by the LACBWR facility is not evident from vegetation sample analysis. All samples with values above the LLD were below state or federal standards. All other gamma emitting isotopes measured below detection levels.

Soil

Table 4 provides a summary of reported activities by DHS for soil samples. Table 10 provides results from the individual sample analyses.

Analysis of the soil samples showed no unusual activities. In table 4, the gamma isotopic analysis detected all gross beta, one gross alpha sample and one Cesium 137 sample was above the LLD. The naturally occurring radioisotope potassium-40 (^{40}K) was detected above the LLD in all samples. 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.

Bottom Sediments

Table 4 provides a summary of reported activities by DHS for bottom sediment samples. Table 8 provides results from the individual sample analyses.

The naturally occurring radioisotope potassium-40 (^{40}K) was detected in all samples. All three locations had gross beta counts and one gross alpha counts above the LLD. The gamma isotopic analysis of the bottom sediment samples taken at one site detected small activities for cesium-137 (^{137}Cs). The reported activity for cesium-137 (^{137}Cs) can be attributed to past effluent discharges from the LACBWR facility and have also been detected in previous years. 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 analysis of bottom sediment sample. The only influence by LACBWR is attributed to past effluent discharge.

Well Water

Table 4 provides a summary of reported activities in the well water samples. Table 12 provides results from individual sample analyses. The sample in table 13 were collected as part of the monitoring related to the elevated tritium readings from February 14, 2018. The sample results in table 13 show nothing unusual and are at background.

The well water samples showed no unusual gross alpha, gross beta, or tritium (^3H) activities, and all activities were below the LLD. The measured activities were all below state and federal standards. Influence by LACBWR is not evident from well water sample analysis.

Dose to an Average Individual

Federal regulations 10 C.F.R. § 20, 10 C.F.R. § 50 Appendix I and 40 C.F.R. § 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.

DHS limits for permissible levels of radiation exposure from external sources in unrestricted areas are defined in Wis. Admin. Code § DHS 157.23. Doses resulting from gaseous and liquid effluent releases from the LACBWR facility are less than the limits as stated in Wis. Admin. Code § DHS 157.23.

References

Off-Site Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, NUREG-1301, Generic Letter 89-01, Supplement No. 1, April 1991.

Wisconsin Admin. Code § DHS 157.23

U.S. Environmental Protection Agency (EPA), Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, Federal Guidance Report No. 11, EPA-520/1-88-020 (Office of Radiation Programs Washington, DC), September 1988.

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.

Sample Activity Summary

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 quarterly composite (pCi/m ³)	0.005	50 / 44	Gross Beta	<0.001 - 0.0136
			gamma isotopic	
	0.020	8 / 0	Barium 140	< 0.0038
	0.002	8 / 8	Beryllium 7	0.0609 - 0.118
	0.002	8 / 0	Cerium 141	< 0.0005
	0.005	8 / 0	Cerium 144	< 0.0014
	0.002	8 / 0	Cesium 134	< 0.0003
	0.005	8 / 0	Cesium 137	< 0.0003 - 0.0009
	0.002	8 / 0	Cobalt 58	< 0.0004
	0.005	8 / 0	Cobalt 60	< 0.0005
	0.020	8 / 0	Iodine 131	< 0.0018
	0.015	8 / 0	Iron 59	< 0.0007
	0.020	8 / 0	Lanthanum 140	< 0.0014
	0.002	8 / 0	Manganese 54	< 0.0009
	0.002	8 / 0	Niobium 95	< 0.0004
	0.030	8 / 0	Ruthenium 103	< 0.0003
	0.020	8 / 0	Ruthenium 106	< 0.0026
	0.002	8 / 0	Zinc 65	< 0.0007
	0.005	8 / 0	Zirconium 95	< 0.0007
Direct Exposure (TLD) (mR/Std Qtr)	1.0 ^b	16 / 16	Direct Exposure	14 - 19.2
Surface Water (pCi/liter)	3	2 / 0	Gross Alpha	1.24 - 1.46
	3	1 / 0	Gross Alpha Sus Sol	< 0.811
	3	2 / 1	Gross Beta	2.96 - 3.29
	3	1 / 0	Gross Beta Sus Sol	1.65
	300	2 / 0	Tritium	< 224
	2	2 / 1	Strontium 89	< 2.85
	1	2 / 0	Strontium 90	< 0.465
			gamma isotopic	
	350	2 / 0	Barium 140	< 41.2
	80	2 / 0	Cesium 134	< 9.75
	90	2 / 0	Cesium 137	< 12
	600	2 / 0	Cobalt 58	< 8.3
	100	2 / 0	Cobalt 60	< 10.8
	80	2 / 0	Iodine 131	< 12.7
	200	2 / 0	Iron 59	< 16.4
	100	2 / 0	Lanthanum 140	< 13.4
	90	2 / 0	Manganese 54	< 9.03
	100	2 / 0	Niobium 95	< 9.76
	250	2 / 0	Zinc 65	< 16.7
	200	2 / 0	Zirconium 95	< 18

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

Sample type (units)	LLD	Number of samples ^{*a}	Analysis	Range
Well water (pCi/liter)	5.0	8 / 0	Gross Alpha	< 1.98 – 1.92
	3.0	8 / 0	Gross Beta	< 2.2 – 2.10
	300	11 / 0	Tritium	< 243
Soil (pCi/kg dry)	15000	4 / 1	Gross Alpha	< 5750 - 20400
	6000	4 / 4	Gross Beta	13900 - 44800
	80	4 / 0	Cesium 134	< 21.5
	80	4 / 1	Cesium 137	12.9 - 84.3
	90	4 / 0	Cobalt 58	< 35.5
	90	4 / 0	Cobalt 60	< 25.9
	600	4 / 0	Iron 59	< 238
	60	4 / 0	Manganese 54	< 22.8
	100	4 / 0	Niobium 95	< 292
	800	4 / 4	Potassium 40	8980 - 42400
	300	4 / 0	Zinc 65	< 63.4
	250	4 / 0	Zirconium 95	< 86.7
Vegetation (pCi/kg wet)	5000	4/0	Gross Alpha	< 2650
	4000	4/2	Gross Beta	2430 - 7630
	350	4/0	Barium 140	< 139
	600	4/4	Beryllium 7	1590 - 2680
	80	4/0	Cesium 134	< 25.4
	90	4/0	Cesium 137	< 31.9
	100	4/0	Cobalt 58	< 27.2
	100	4/0	Cobalt 60	< 30.1
	80	4/0	Iodine 131	< 53.1
	200	4/0	Iron 59	< 50.6
	100	4/0	Lanthanum 140	< 39.8
	90	4/0	Manganese 54	< 25.8
	100	4/0	Niobium 95	< 24.7
	2000	4/4	Potassium 40	3200 - 5790
	250	4/0	Zinc 65	< 45.8
	200	4/0	Zirconium 95	< 43
Bottom Sediment (pCi/kg dry)	15000	3 / 1	Gross Alpha	< 6610 - 15200
	6000	3 / 3	Gross Beta	6180 - 19900
	80	3 / 0	Cesium 134	< 4.69
	80	3 / 1	Cesium 137	23 - 111
	90	3 / 0	Cobalt 58	< 33.6
	90	3 / 0	Cobalt 60	< 4.77
	600	3 / 0	Iron 59	< 262
	90	3 / 0	Manganese 54	< 9.35

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

Sample type (units)	Sample type (units)	Sample type (units)	Sample type (units)	Sample type (units)
	100	3 / 0	Niobium 95	< 387
	800	3 / 3	Potassium 40	7480 - 17100
	300	3 / 0	Zinc 65	< 18.8
	200	3 / 0	Zirconium 95	< 83.4

a - Number of analyses / number of analyses detected above the WI DHS LLD.

b - LLD activities expressed in units of pCi/liter.

c - mR/TLD

d – Samples not analyzed due to laboratory error and delays, see result and discussion section.



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

Measurements in units of pCi/m³

LAC-2 (2100 series); Lock & Dam #8

1st Qtr		
Collection End Date	Volume m ³	Air Particulate
01/02/19	561.3	0.047 ± 0.0022
01/16/19	625.2	0.0178 ± 0.0014
02/01/19	981.9	0.0299 ± 0.0013
02/13/19	749.8	0.0024 ± 0.0001
02/27/19	880.3	< 0.0011
03/13/19	996.7	0.0266 ± 0.0012
03/27/19	827	0.0201 ± 0.0012
mean +- s.d.		0.0240 ± 0.0148

2nd Qtr		
Collection End Date	Volume m ³	Air Particulate
04/10/19	830.2	0.0015 ± 0.0007
04/24/19	796.3	0.0136 ± 0.0011
05/08/19	789.4	0.0139 ± 0.0011
05/22/19	*c	0.0404 ± 0.0775
06/05/19	746.8	0.0134 ± 0.0012
06/19/19	73.6	0.1980 ± 0.0136
mean +- s.d.		0.0406 ± 0.0774

3rd Qtr		
Collection End Date	Volume m ³	Air Particulate
07/03/19	714	0.0153 ± 0.0012
07/17/19	696.8	0.0219 ± 0.0014
08/01/19	*c	0.0213 ± 0.0014
08/14/19	*c	0.0314 ± 0.0018
08/28/19	671.2	0.0213 ± 0.0014
09/11/19	1334	0.0120 ± 0.0007
09/25/19	374.2	0.0314 ± 0.0025
mean +- s.d.		0.0221 ± 0.0073

4th Qtr		
Collection End Date	Volume m ³	Air Particulate
10/09/19	652.7	0.0163 ± 0.0013
10/23/19	*c	*c
11/06/19	719.7	0.0247 ± 0.0014
11/20/19	702.1	0.0348 ± 0.0017
12/05/19	745	0.0187 ± 0.0013
12/18/19	668.5	0.0459 ± 0.0019
mean +- s.d.		0.0184 ± 0.0176

LAC-7 (12000 series); Edgewood Trailer Court

1st Qtr		
Collection date	Volume m ³	Air Particulate
01/02/19	818.1	0.0263 ± 0.0014
01/16/19	831	0.00279 ± 0.0001
02/01/19	963.9	0.0247 ± 0.0012
02/13/19	719.6	0.0195 ± 0.0013
02/27/19	828.7	0.028 ± 0.0014
03/13/19	812.6	0.0272 ± 0.0014
03/27/19	796.5	0.0158 ± 0.0012
mean +- s.d.		0.0206 ± 0.009

2nd Qtr		
Collection date	Volume m ³	Air Particulate
04/10/19	790.7	0.0151 ± 0.0011
04/24/19	767.4	0.0117 ± 0.0011
05/08/19	*c	0.0108 ± 0.001
05/22/19	*c	0.00919 ± 0.001
06/05/19	761.7	0.012 ± 0.0011
06/19/19		0.0152 ± 0.0012
mean +- s.d.		0.0123 ± 0.0023

3rd Qtr		
Collection date	Volume m ³	Air Particulate
07/03/19	*c	0.0104 ± 0.0011
07/17/19	723.8	0.0167 ± 0.0013
08/01/19	*c	0.0156 ± 0.0012
08/14/19	*c	0.0235 ± 0.0015
08/28/19	713.8	0.0155 ± 0.0012
09/11/19	1372.7	0.00906 ± 0.0006
09/25/19	79.8	0.00825 ± 0.0034
mean +- s.d.		0.0141±0.0053

4th Qtr		
Collection date	Volume m ³	Air Particulate
10/09/19	657.3	0.0118 ± 0.0012
10/23/19	*c	*c
11/06/19	683.1	0.015 ± 0.0013
11/20/19	671.6	0.0276 ± 0.0016
12/05/19	694.3	0.0134 ± 0.0012
12/18/19	644	0.0318 ± 0.0017
mean +- s.d.		0.0199 ± 0.0091

*a – power off on the pump, no data

*b – low air volume

*c – lab did not return the data



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-2	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter
Barium 140	< 0.0021	< 0.0038	< 0.0023	0.0013
Beryllium 7	0.0704 ± 0.0061	0.118 ± 0.0091	0.0835 ± 0.0055	0.0701 ± 0.0044
Cerium 141	< 0.0004	< 0.0005	< 0.0003	0.0002
Cerium 144	< 0.0011	< 0.0014	< 0.0006	0.0005
Cesium 134	< 0.0002	< 0.0003	< 0.0001	0.0001
Cesium 137	< 0.0002	0.0008 ± 0.0002 ¹	0.0009 ± 0.0001 ¹	0.0001
Cobalt 58	< 0.0002	< 0.0004	< 0.0001	0.0001
Cobalt 60	< 0.0002	< 0.0005	< 0.0001	0.0001
Iodine 131	< 0.0012	< 0.0017	< 0.0018	0.0008
Iron 59	< 0.0005	< 0.0007	< 0.0003	0.0003
Lanthanum 140	< 0.0009	< 0.0013	< 0.0009	0.0006
Manganese 54	< 0.0002	< 0.0003	< 0.0001	0.0001
Niobium 95	< 0.0003	< 0.0004	< 0.0002	0.0002
Ruthenium 103	< 0.0002	< 0.0003	< 0.0001	0.0001
Ruthenium 106	< 0.002	< 0.0026	< 0.0011	0.0008
Zinc 65	< 0.0004	< 0.0007	< 0.0002	0.0002
Zirconium 95	< 0.0004	< 0.0007	< 0.0003	0.0002

Site: LAC-7				
Barium 140	< 0.0021	< 0.0026	< 0.0021	< 0.0020
Beryllium 7	0.0708 ± 0.006	0.0791 ± 0.007	0.0756 ± 0.0045	0.0609 ± 0.0037
Cerium 141	< 0.0003	< 0.0004	< 0.0003	< 0.0002
Cerium 144	< 0.0011	< 0.0013	< 0.0006	< 0.0004
Cesium 134	< 0.0003	< 0.0003	< 0.0001	< 0.0001
Cesium 137	< 0.0002	< 0.0003	< 0.0001	< 0.0008
Cobalt 58	< 0.0002	< 0.0003	< 0.0001	< 0.0001
Cobalt 60	< 0.0002	< 0.0003	< 0.0001	< 0.0001
Iodine 131	< 0.0011	< 0.0014	< 0.0018	< 0.0018
Iron 59	< 0.0004	< 0.0005	< 0.0002	< 0.0002
Lanthanum 140	< 0.001	< 0.0014	< 0.0006	< 0.0009
Manganese 54	< 0.0002	< 0.0003	ND	< 0.0009
Niobium 95	< 0.0003	< 0.0003	< 0.0001	< 0.0002
Ruthenium 103	< 0.0002	< 0.0003	< 0.0001	< 0.0001
Ruthenium 106	< 0.0015	< 0.0022	< 0.0009	< 0.0008
Zinc 65	< 0.0005	< 0.0006	< 0.0002	< 0.0002
Zirconium 95	< 0.0005	< 0.0006	< 0.0002	< 0.0002

Radioisotopes other than those reported were not detected.

ND – No data

¹ – After receiving results >MDA sample was reanalyzed and gave results which remained >MDA.

² – After receiving results >MDA sample was reanalyzed and gave results <MDA.



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

	1st quarter	2nd quarter	3rd quarter	4th quarter
Date Placed:	01/08/19	04/09/19	07/10/19	10/09/19
Date Removed:	04/09/19	07/10/19	10/09/19	01/22/20
Days in the Field:	90	92	91	105
Location:	Individual quarterly date is reported as: mR / Standard Quarter + 2 sigma counting error.			
TLD sites located near LaCrosse Boiling Water Reactor				
LAC-T1	14.0 ± 2.1	15.3 ± 0.9	16.6 ± 1.7	15.5 ± 0.9
LAC-T2	15.1 ± 1.1	16.2 ± 0.9	17.1 ± 0.8	17.4 ± 1.0
LAC-T3	14.4 ± 0.9	17.8 ± 0.7	19.2 ± 0.7	19.0 ± 0.5
LAC-T4	14.8 ± 1.1	16.2 ± 0.7	17.1 ± 1.7	16.7 ± 0.9
Quarterly average +- s.d.	14.5 ± 0.4	16.3 ± 1	17.5 ± 1.1	17.1 ± 1.4
ND = No Data, TLD lost in the field				



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

Measurements in units of pCi/kilogram (dry)

Location	LAC-2 upstream	LAC-3 Discharge	LAC-4 downstream
Collection date	04/23/19	04/23/19	04/23/19
gross alpha	5800 ± 3770	< 6610	15200 ± 4920
gross beta	6180 ± 1310	9330 ± 1370	19900 ± 1560
gamma isotopic			
Cesium 134	< 3.29	< 2.24	< 4.69
Cesium 137	31.9 ± 3.12	23 ± 1.93	111 ± 7.23
Cobalt 58	< 16.1	< 15.7	< 33.6
Cobalt 60	< 3.48	< 2.41	< 4.77
Iron 59	< 93.2	< 119	< 262
Manganese 54	< 6.45	< 3.78	< 9.35
Niobium 95	< 100	< 164	< 387
Potassium 40	7480 ± 1190	7710 ± 1220	17100 ± 2710
Zinc 65	< 13	< 9.19	< 18.8
Zirconium 95	< 33.4	< 36.3	< 83.4

Table 9. Wisconsin DHS analysis results for vegetation 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 Start	06/18/19	06/18/19	09/10/19	09/10/19
Gross Alpha	< 2480	< 2650	< 1240	< 2040
Gross Beta	7630 ± 798	2430 ± 540	3620 ± 314	4230 ± 388
gamma isotopic				
Barium 140	< 82.0	< 62.2	< 92.6	< 139
Beryllium 7	2130 ± 228	1590 ± 181	2520 ± 246	2680 ± 263
Cesium 134	< 13.6	< 12	< 15.9	< 25.4
Cesium 137	< 15.8	< 10.2	< 15.1	< 31.9
Cobalt 58	< 19.8	< 14.3	< 15.8	< 27.2
Cobalt 60	< 20.1	< 13.1	< 18.9	< 30.1
Iodine 131	< 23.7	< 23.8	< 34.4	< 53.1
Iron 59	< 33.6	< 29.6	< 37.3	< 50.6
Lanthanum 140	< 25.5	< 13.8	< 26.9	< 39.8
Manganese 54	< 18.8	< 14.2	< 17.4	< 25.8
Niobium 95	< 16.7	< 15.8	< 19.8	< 24.7
Potassium 40	5790 ± 1020	3200 ± 588	5100 ± 914	3920 ± 724
Zinc 65	< 34.5	< 27.4	< 45.8	< 43.1
Zirconium 95	< 28.8	< 21.0	< 36.3	< 43.0

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



Soil - Measurements in units of pCi/kilogram (dry)				
Site:	LAC-5	LAC-6	LAC-5	LAC-6
Collection Start	06/19/19	06/19/19	09/10/19	09/10/19
Gross Alpha	13900 ± 4200	12400 ± 3510	13100 ± 3580	< 7270
Gross Beta	14800 ± 1380	14700 ± 1240	18500 ± 1370	11600 ± 1570
gamma isotopic				
Cesium 134	< 20.9	< 11.2	< 7.2	< 7.61
Cesium 137	75.2 ± 14.3	293 ± 24.6	106 ± 8.73	159 ± 12.9
Cobalt 58	< 29.1	< 19	< 21	< 23.5
Cobalt 60	< 25.9	< 12.6	< 7.36	< 8.1
Iron 59	< 82.3	< 50.8	< 94.9	< 108
Manganese 54	< 27.9	< 15.6	< 15.2	< 10.9
Niobium 95	< 50.8	< 32.3	< 94.3	< 141
Potassium 40	15900 ± 2580	12400 ± 2010	15500 ± 2460	12300 ± 1960
Zinc 65	< 56.2	< 34.8	< 23.4	< 28.2
Zirconium 95	< 60.7	< 38.9	< 50.1	< 54.1

Table 11. Wisconsin DHS analysis results for surface water supplies collected for the LACBWR environmental monitoring program.



Measurements in units of pCi/liter

Site:	LAC-4	LAC-4
Collection Start	06/18/19	09/10/19
Gross Alpha	1.46 ± 0.756	1.24 ± 0.603
Gross Alpha Sus Sol	< 0.811	*b
Gross Beta	3.29 ± 0.624	2.96 ± 0.680
Gross Beta Sus Sol	1.56 ± 0.891	*b
Strontium 89	< 0.454	< 2.85
Strontium 90	< 0.186	< 0.465
Tritium	< 224	< 223
Gamma isotopic		
Barium 140	< 41.2	< 28.1
Cesium 134	< 9.75	< 6.26
Cesium 137	< 12	< 5.49
Cobalt 58	< 8.3	< 6.23
Cobalt 60	< 10.8	< 6.49
Iodine 131	< 12.7	< 8.64
Iron 59	< 16.4	< 10.1
Lanthanum 140	< 13.4	< 10.1
Manganese 54	< 9.03	< 5.67
Niobium 95	< 9.76	< 7.84
Zinc 65	< 16.7	< 16.5
Zirconium 95	< 18	< 10.2

*a – lab error not reported

*b – lab did not report results

Table 12 Wisconsin DHS analysis results for well water samples collected for the LACBWR environmental monitoring program.



Measurements in units of pCi/liter

Site:	LAC-7	LAC-7	LAC-7	LAC-8
Collection Start	07/10/19	09/23/19	12/17/19	06/18/19
Gross Alpha	1.64 ± 1.08	< 1.89	< 1.79	< 1.55
Gross Beta	2.1 ± 0.843	< 1.9	< 1.88	< 1.28
Tritium	< 224	< 224	< 97.1	< 224

Table 13 (continued) Wisconsin DHS analysis results for well water samples collected for the LACBWR environmental monitoring program.



Measurements in units of pCi/liter

Site:	LAC-8	LAC-8	LAC-9	LAC-9
Collection Start	09/10/19	12/17/19	09/10/19	12/17/19
Gross Alpha	< 1.53	1.92 ± 1.42	< 1.59	< 1.98
Gross Beta	1.7 ± 0.953	< 2.2	< 1.82	< 1.7
Tritium	< 224	< 243	< 224	< 97.1

Table 14 Wisconsin DHS analysis results for only Tritium in well water samples collected for the LACBWR environmental monitoring program.



Measurements in units of pCi/liter

Site:	LAC-7	LAC-8	LAC-9			
Collection Start	04/12/19	04/12/19	04/12/19			
Tritium	< 226	< 226	< 226			

Additional sample collected due to elevated tritium levels from some wells located around the decommissioning area

Appendices

Appendix A – Radionuclide concentration levels needing review by state radiological coordinator (SRC)

If radioactivity concentrations exceed SRC review levels for a given radionuclide, the SRC will be consulted for review and assessment.

Medium	Radionuclide	SRC Review Level
Airborne Particulates or Gas (pCi/m3)	Gross Beta	1
	I-131 (Charcoal)	0.1
	Cs-134	1
	Cs-137	1
Water (pCi/l)	Gross Alpha	10
	Gross Beta	30
	H-3	10,000
	Mn-54	100
	Fe-59	40
	Co-58	100
	Co-60	30
	Zr-Nb-95	40
	Cs-134	10
	Cs-137	20
	Ba-La-140	100
	Sr-89	8
	Sr-90	8
	Zn-65	30
Vegetation (pCi/kg wet)	Gross Beta	30,000
	I-131	100
	Cs-134	200
	Cs-137	200
	Sr-89	1,000
	Sr-90	1,000
Soil, Bottom Sediment (pCi/kg)	Gross Beta	5,000
	Cs-134	5,000
	Cs-137	5,000
	Sr-89	5,000
	Sr-90	5,000

Radionuclides will be monitored by the DHS, Radiation Protection Sections, Environmental Monitoring program and concentrations above the listed levels will be reported to the SRC for further review and assessment.

Appendix B – Sample Point Locations

The sample point locations.

Sample Point	Location Description	Longitude or X	Latitude or Y
LAC-2	Lock & Dam #8		
LAC-2	Upstream sample location (bottom sediment)		
LAC-3	Discharge sample location (bottom sediment)		
LAC-4	Boat launch area		
LAC-4	Downstream sample location (bottom sediment)		
LAC-5	Hwy 35 parking lot		
LAC-6	Boat launch access road		
LAC-7	Edgewood Trailer Court		
LAC-7	Edgewood Trailer Court (Well water)		
LAC-8	Genoa Post Office		
LAC-9	House Number E-450		
LAC-T1	Lock & Dam #8		
LAC-T2	Trailer court, Hwy 35		
LAC-T3	ISFSI outer fence (outside on fence)		
LAC-T4	ISFSI outer fence (outside on fence)		

- a. Radionuclides will be monitored by Wisconsin Dept. of Health Services, Radiation Protection Sections, Environmental Monitoring program and concentrations above the listed levels will be reported to the Wisconsin State Radiological Coordinator (SRC) for further review and assessment.
- b. For drinking water (well water) samples, this is a 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used. (NUREG-1301. Supplement No. 1, page 64, table 3.12-2)
- c. If no drinking water pathway exists, a value of 20 pCi/l may be used. (NUREG-1301. Supplement No. 1, page 64, table 3.12-2)
- d. Drinking Water values from Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980.