

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-00443 (04/2020)

La Crosse Boiling Water Reactor Environmental Monitoring Survey

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) 2017. 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

For 2017, all sample results from the LACBWR environmental monitoring area were less than state and federal standards or guidelines.

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 2017, such as the 2011 Japan Fukushima Daiichi incident, that required additional environmental monitoring.
- There were no radioactive incidents related to food consumed in Wisconsin and no health problem 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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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) 2017. It provides descriptions and results of this 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 Cesium 137 (Cs-137) Spill

On February 23, 2017 during decommission activities at LaCrosse Boiling Water Reactor there was an inadvertent release of 400 gallons of contaminated water over a 16 hour period. The contaminated water siphoned into a holding berm near the reactor, which spilled onto an asphalt surface and made its way to discharge pipes leading to the Mississippi River. Preliminary analysis by LaCrosse Solutions Radiation Protection Manager and NRC Region 3 Inspector, who was on site, determined that the water was contaminated with Cs-137. The concentration of the Cs-137 ranged from 1.1e-06 $\mu\text{Ci/ml}$ to 2.861e-06 $\mu\text{Ci/ml}$. The concentration levels exceed the 10CFR20 Table 2 limit for Cs-137 water effluent. The contaminated water made its way to a 10 inch discharge pipe, then to a 60 inch discharge pipe that emptied into the Mississippi River.

LaCrosse Solutions notified the NRC of the Cs-137 on February 24, 2017. A copy of the NRC event report can be found in appendix C of this document. Wisconsin Department of Natural Resources were notified on February 27, 2017 at 12:45 hours regarding the spill. Wisconsin Department of Health – Radiation Protection Section were notified by email on February 24 at 15:04 hours. The email was not opened until February 27th, at which time the decision was made to take a water sample at LAC-4. The water sample was collected on February 28th and did not detect any Cs-137 that could be attributed to the spill on February 23, 2017.

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.

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 daily 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 (MAPER) for environmental matrix analysis. Proficiency testing results are available from the WSLH.

Detection Limits

Detection limits, required by DHS, are 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.
- 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 5-12 is an 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 \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. 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-10	0.6 N	South of Lock & Dam #8
LAC-19	0.6 SSW	Island across from the boat launch
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	49	0	GA, GB, GI ^w
TLD	G/Q	LAC T1-T4	16	0	direct exposure
surface water	G/A	LAC 4	3	0	GA ^{u,v} , GB ^{u,v} , GI, Sr, H
bottom sediment	G/A	LAC 3, 10, 19	6	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	4	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. DHS missing sample or non-routine analysis report for 2017.

Sample type	Date	Site	Explanation
air particulate	08/16/17	LAC-2	Air pump was off due to ground fault interruption trip, low volume
air particulate	08/30/17	LAC-2	Air pump was off due to ground fault interruption trip, low volume
air particulate	09/13/17	LAC-2	Air pump was off due to ground fault interruption trip, low volume
air particulate	09/27/17	LAC-2	Air pump was off due to ground fault interruption trip, low volume
air particulate	10/11/17	LAC-2	Air pump was off due to ground fault interruption trip, low volume
air particulate	12/06/17	LAC-2	Air pump was off due to ground fault interruption trip, low volume
air particulate	12/20/17	LAC-2	Air pump was off due to ground fault interruption trip, low volume
air particulate	05/10/17	LAC-7	Air pump was off due to ground fault interruption trip, low volume
air particulate	05/24/17	LAC-7	Air pump was off due to ground fault interruption trip, low volume
air particulate	09/13/17	LAC-7	Air pump was off due to ground fault interruption trip, low volume
air particulate	11/08/19	LAC-7	Air pump was off due to ground fault interruption trip, low volume

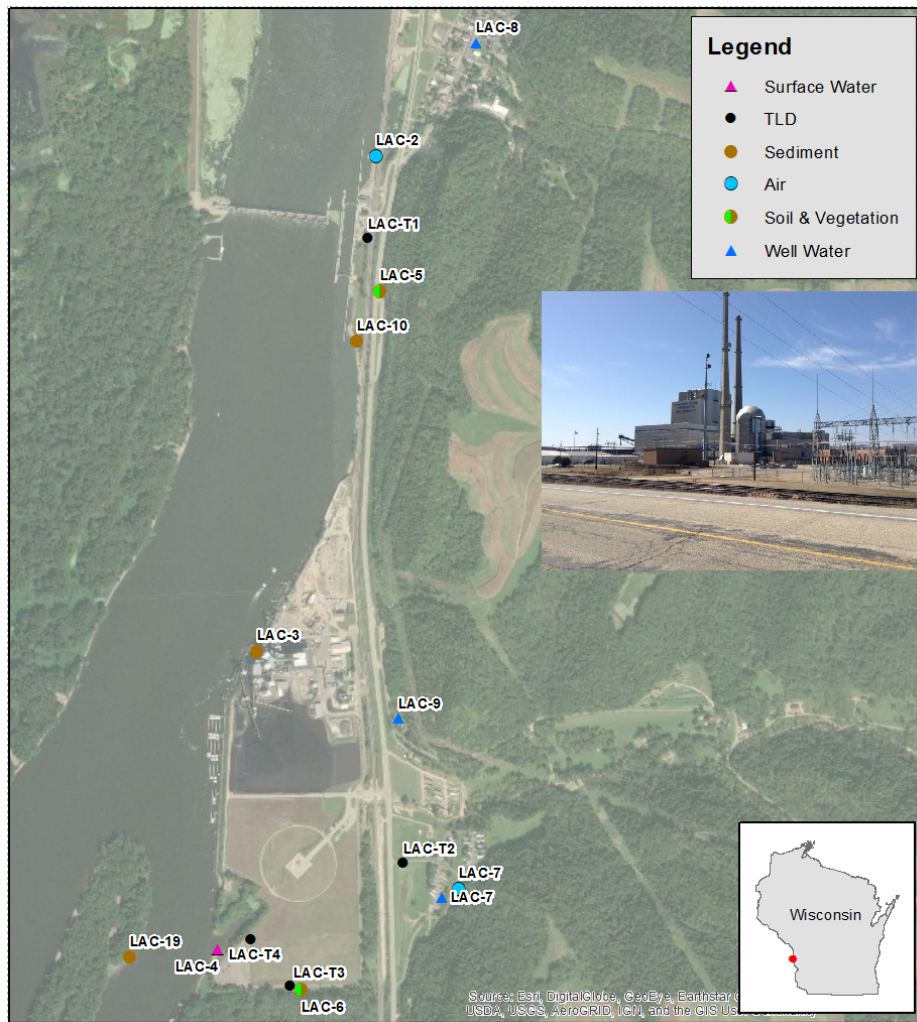


Figure 1. Wisconsin DHS environmental monitoring sampling sites for the LACBWR monitoring program.

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.

All 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 2017 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 18.7 ± 2.0 milliroentgens. The average quarterly exposure for 2017 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 detected three samples with activity slightly above background levels. 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.

The gamma isotopic analysis detected gross beta and beryllium-7 above the LLD at both sites. Also, naturally occurring potassium-40 (^{40}K) was above the LLD at both sites. 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 only gross beta 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. Three locations had gross beta counts above the LLD. The gamma isotopic analysis of the bottom sediment samples taken at all three sites detected small activities for cesium-137 (^{137}Cs). The reported activities 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 near the effluent discharge. All other sediment samples show no influence by LACBWR facility.

Well Water

Table 4 provides a summary of reported activities in the well water samples. Table 12 provides results from individual sample analyses.

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 DHS LACBWR environmental monitoring program.

Sample type (units)	LLD	Number of samples ^a	Analysis	Range
Air particulate	0.005	47 / 47	Gross Beta	0.011 - 0.247
quarterly composite (pCi/m³)	0.020	8 / 0	Barium 140	< 0.01
	0.002	8 / 8	Beryllium 7	0.0514 - 0.0996
	0.002	8 / 0	Cerium 141	< 0.001
	0.005	8 / 0	Cerium 144	< 0.003
	0.002	8 / 0	Cesium 134	< 0.0004
	0.005	8 / 0	Cesium 137	< 0.0006
	0.002	8 / 0	Cobalt 58	< 0.0005
	0.005	8 / 0	Cobalt 60	< 0.0006
	0.020	8 / 0	Iodine 131	< 0.0200
	0.015	8 / 0	Iron 59	< 0.0009
	0.020	8 / 0	Lanthanum 140	< 0.0039
	0.002	8 / 0	Manganese 54	< 0.0004
	0.002	8 / 0	Niobium 95	< 0.0005
	0.030	8 / 0	Ruthenium 103	< 0.0005
	0.020	8 / 0	Ruthenium 106	< 0.0044
	0.002	8 / 0	Zinc 65	< 0.0009
	0.005	8 / 0	Zirconium 95	< 0.0009
Direct Exposure (TLD) (mR/Std Qtr)	1.0 ^b	16 / 16	Direct Exposure	15.7 - 22.9
Surface Water (pCi/liter)	3	3 / 1	Gross Alpha	< 1.57 - 3.84
	3	3 / 0	Gross Alpha Sus Sol	0.68 - 1.16
	3	3 / 1	Gross Beta	< 3.07 - 7.51
	3	3 / 0	Gross Beta Sus Sol	< 1.96
	60	3 / 0	Barium 140	< 42.8
	15	3 / 0	Cesium 134	< 9.2
	15	3 / 0	Cesium 137	< 11.3
	15	3 / 0	Cobalt 58	< 8.43
	15	3 / 0	Cobalt 60	< 4.43
	15	3 / 0	Iodine 131	< 18.2
	30	3 / 0	Iron 59	< 19.7
	15	3 / 0	Lanthanum 140	< 14
	10	3 / 0	Manganese 54	< 9.98
	15	3 / 0	Niobium 95	< 9.65
	2	3 / 0	Strontium 89	< 0.7
	1	3 / 1	Strontium 90	< 0.35 - 1.03
	300	3 / 0	Tritium	< 213
	30	3 / 0	Zinc 65	< 17.9
	30	3 / 0	Zirconium 95	< 17.6
Well water (pCi/liter)	5.0	4 / 0	Gross Alpha	< 2.22 - 1.56
	3.0	4 / 0	Gross Beta	< 1.79 - 1.41
	300	4 / 0	Tritium	< 214

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

Sample type (units)	LLD	Number of samples ^a	Analysis	Range
Soil (pCi/kg dry)	15000	4 / 0	Gross Alpha	< 5150 - 12600
	6000	4 / 4	Gross Beta	13500 - 37100
	80	4 / 0	Cesium 134	< 34.3
	80	4 / 0	Cesium 137	< 29.5 - 76.3
	90	4 / 0	Cobalt 58	< 56.3
	90	4 / 0	Cobalt 60	< 50.4
	600	4 / 0	Iron 59	< 179
	60	4 / 0	Manganese 54	< 49.2
	100	4 / 0	Niobium 95	< 83.3
	800	4 / 4	Potassium 40	10300 - 43500
	300	4 / 0	Zinc 65	< 144
	250	4 / 0	Zirconium 95	< 107
	Vegetation (pCi/kg wet)	5000	4 / 0	Gross Alpha
4000		4 / 4	Gross Beta	4030 - 14600
350		4 / 0	Barium 140	< 121
600		4 / 4	Beryllium 7	1120 - 3040
80		4 / 0	Cesium 134	< 21.7
90		4 / 0	Cesium 137	< 20.7
100		4 / 0	Cobalt 58	< 26.4
100		4 / 0	Cobalt 60	< 30.1
80		4 / 0	Iodine 131	< 59.3
200		4 / 0	Iron 59	< 58
100		4 / 0	Lanthanum 140	< 40.8
90		4 / 0	Manganese 54	< 25.8
100		4 / 0	Niobium 95	< 21.3
2000		4 / 4	Potassium 40	4670 - 6380
250		4 / 0	Zinc 65	< 70.6
200		4 / 0	Zirconium 95	< 48.5
Bottom Sediment (pCi/kg dry)	13000	6 / 0	Gross Alpha	< 4510 - 9740
	6000	6 / 3	Gross Beta	2160 - 15400
	60	6 / 0	Cesium 134	< 28.2
	90	6 / 2	Cesium 137	< 24.7 - 230
	600	6 / 0	Cobalt 58	< 47.9
	90	6 / 0	Cobalt 60	< 27.3
	300	6 / 0	Iron 59	< 124
	100	6 / 0	Manganese 54	< 40
	250	6 / 0	Niobium 95	< 94.5
	80	6 / 6	Potassium 40	4140 - 16400
	80	6 / 0	Zinc 65	< 83.9
	200	6 / 0	Zirconium 95	< 83.5

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

b - 1.0 mR / TLD.

Table 5. 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

Collection date	Volume m ³	Air particulate
1st Qtr		
01/04/17	1046	0.031 ± 0.001
01/18/17	993	0.022 ± 0.001
02/01/17	1047	0.023 ± 0.001
02/15/17	1013	0.023 ± 0.001
03/01/17	1024	0.019 ± 0.001
03/15/17	1025	0.017 ± 0.001
03/29/17	983	0.013 ± 0.001
mean +- s.d.		0.021 ± 0.006

2nd Qtr

04/12/17	991	0.014 ± 0.001
04/26/17	995	0.013 ± 0.001
05/10/17	949	0.015 ± 0.001
05/24/17	968	0.014 ± 0.001
06/07/17	956	0.016 ± 0.001
06/21/17	843	0.015 ± 0.001
mean +- s.d.		0.014 ± 0.001

3rd Qtr

07/05/17	742	0.019 ± 0.001
07/19/17	630	0.016 ± 0.001
08/02/17	628	0.018 ± 0.002
08/16/17	259	0.023 ± 0.003
08/30/17	422	0.021 ± 0.002
09/13/17	402	0.032 ± 0.002
09/27/17	401	0.021 ± 0.002
mean +- s.d.		0.021 ± 0.005

4th Qtr

10/11/17	398	0.021 ± 0.002
10/25/17	980	0.014 ± 0.001
11/08/17	980	0.007 ± 0.001
12/06/17	9	< 0.111
12/20/17	9	< 0.112
mean +- s.d.		0.004 ± 0.025

LAC-7 (12000 series); Edgewood Trailer Court

Collection date	Volume m ³	Air particulate
1st Qtr		
01/04/17	1044	0.030 ± 0.001
01/18/17	983	0.022 ± 0.001
02/01/17	1027	0.024 ± 0.001
02/15/17	982	0.022 ± 0.001
03/01/17	995	0.019 ± 0.001
03/15/17	1005	0.018 ± 0.001
03/29/17	976	0.013 ± 0.001
mean +- s.d.		0.021 ± 0.006

2nd Qtr

04/12/17	970	0.015 ± 0.001
04/26/17	979	0.013 ± 0.001
05/10/17	460	0.018 ± 0.002
05/24/17	546	< 0.002
06/07/17	898	0.017 ± 0.001
06/21/17	750	0.014 ± 0.001
mean +- s.d.		0.013 ± 0.006

3rd Qtr

07/05/17		
07/19/17	928	0.016 ± 0.001
08/02/17	947	0.018 ± 0.001
08/16/17	966	0.020 ± 0.001
08/30/17	988	0.020 ± 0.001
09/13/17	532	0.037 ± 0.002
09/27/17	977	0.020 ± 0.001
mean +- s.d.		0.022 ± 0.008

4th Qtr

10/11/17	982	0.018 ± 0.001
10/25/17	988	0.014 ± 0.001
11/08/17	420	0.075 ± 0.003
12/06/17	1022	0.023 ± 0.001
12/20/17	1046	0.032 ± 0.001
mean +- s.d.		0.032 ± 0.025



Table 6. 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/m³

Site: LAC-2	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter
Barium 140	< 0.0022	< 0.0025	< 0.0020	< 0.0100
Beryllium 7	0.063 ± 0.0052	0.100 ± 0.0073	0.055 ± 0.0034	0.051 ± 0.0033
Cerium 141	< 0.0006	< 0.0004	< 0.0007	< 0.0004
Cerium 144	< 0.0018	< 0.0014	< 0.0021	< 0.0005
Cesium 134	< 0.0003	< 0.0003	< 0.0003	< 0.0001
Cesium 137	< 0.0004	< 0.0004	< 0.0002	< 0.0002
Cobalt 58	< 0.0003	< 0.0003	< 0.0003	< 0.0002
Cobalt 60	< 0.0003	< 0.0004	< 0.0002	< 0.0001
Iodine 131	< 0.0011	< 0.0009	< 0.0009	< 0.0200
Iron 59	< 0.0007	< 0.0007	< 0.0007	< 0.0005
Lanthanum 140	< 0.0005	< 0.0009	< 0.0006	< 0.0039
Manganese 54	< 0.0003	< 0.0003	< 0.0003	< 0.0002
Niobium 95	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Ruthenium 103	< 0.0003	< 0.0004	< 0.0003	< 0.0003
Ruthenium 106	< 0.0028	< 0.0028	< 0.0025	< 0.0010
Zinc 65	< 0.0007	< 0.0008	< 0.0006	< 0.0002
Zirconium 95	< 0.0005	< 0.0005	< 0.0005	< 0.0003
Site: LAC-7				
Barium 140	< 0.0019	< 0.0031	< 0.0031	< 0.0019
Beryllium 7	0.063 ± 0.0052	0.083 ± 0.0072	0.0764 ± 0.0061	0.064 ± 0.0039
Cerium 141	< 0.0006	< 0.0009	< 0.0010	< 0.0002
Cerium 144	< 0.0018	< 0.0028	< 0.0030	< 0.0003
Cesium 134	< 0.0003	< 0.0004	< 0.0004	< 0.0001
Cesium 137	< 0.0004	< 0.0006	< 0.0048	< 0.0001
Cobalt 58	< 0.0003	< 0.0004	< 0.0046	< 0.0001
Cobalt 60	< 0.0004	< 0.0006	< 0.0052	< 0.0001
Iodine 131	< 0.0010	< 0.0018	< 0.0015	< 0.0022
Iron 59	< 0.0006	< 0.0009	< 0.0095	< 0.0002
Lanthanum 140	< 0.0007	< 0.0010	< 0.0092	< 0.0008
Manganese 54	< 0.0003	< 0.0004	< 0.0004	< 0.0001
Niobium 95	< 0.0003	< 0.0005	< 0.0006	< 0.0001
Ruthenium 103	< 0.0003	< 0.0005	< 0.0005	< 0.0001
Ruthenium 106	< 0.0028	< 0.0040	< 0.0044	< 0.0005
Zinc 65	< 0.0007	< 0.0009	< 0.0009	< 0.0001
Zirconium 95	< 0.0005	< 0.0008	< 0.0009	< 0.0002



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

	1st quarter	2nd quarter	3rd quarter	4th quarter
Date Placed:	01/18/17	04/19/17	07/11/17	10/11/17
Date Removed:	04/19/17	07/11/17	10/11/17	01/10/18
Days in the Field:	91	83	92	91
Individual quarterly date is reported as: mR / Standard Quarter + 2 sigma counting error.				
LAC-T1	16.1 +- 2.1	16.4 +- 0.9	18.1 +- 2.0	18.2 +- 1.0
LAC-T2	19.1 +- 2.1	20.6 +- 1.3	21.8 +- 1.2	17.4 +- 1.2
LAC-T3	17.8 +- 1.0	18.6 +- 1.1	20.5 +- 1.1	20.2 +- 0.7
LAC-T4	18.1 +- 1.4	15.7 +- 1.1	22.9 +- 1.6	17.7 +- 0.9
Quarterly average +- s.d.	17.8 +- 1.2	16.9 +- 1.5	20.8 +- 2.1	18.4 +- 1.3

ND = No Data, TLD lost in the field



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

Measurements in units of pCi/kilogram (dry)

Collection date:	4/18/17	4/18/17	4/18/17	10/17/17	10/17/17	10/24/17
Site:	LAC-10 upstream	LAC-3 Discharge	LAC-19 downstream	LAC-10 upstream	LAC-3 Discharge	LAC-19 downstream
gross alpha	9740 ± 3230	< 3670	< 3600	< 3710	< 4510	4520 ± 3000
gross beta	¹⁵⁴⁰ ± 1290	6370 ± 1020	4740 ± 1010	4960 ± 1100	2160 ± 1170	7890 ± 1140
Cesium 134	< 12.4	< 10.9	< 12.1	< 17.2	< 23.7	< 28.2
Cesium 137	123 ± 11.8	< 16.1	< 14.8	< 24.7	230 ± 34.6	47.7 ± 19.6
Cobalt 58	< 31.5	< 26.7	< 32.6	< 26.3	< 39.7	< 47.9
Cobalt 60	< 14.6	< 11.9	< 11.9	< 14.8	< 27.3	< 18.8
Iron 59	< 121	< 117	< 119	< 121	< 87	< 124
Manganese 54	< 18	< 14.4	< 19.6	< 25.1	< 30	< 40
Niobium 95	< 93.9	< 83.2	< 94.5	< 60.9	< 56.7	< 86.2
Potassium 40	¹⁶⁴⁰ ± 2630	6530 ± 1080	4140 ± 741	5210 ± 1020	5990 ± 1150	7200 ± 1390
Zinc 65	< 39.5	< 34	< 44.4	< 42.2	< 66.5	< 83.9
Zirconium 95	< 65.6	< 52.8	< 72.3	< 66.5	< 71.9	< 83.5

Table 9. 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 date:	05/24/17	05/24/17	08/23/17	08/23/17
Gross Alpha	< 2780	< 2050	< 1040	< 1910
Gross Beta	14600 ± 1120	10300 ± 784	7270 ± 386	4030 ± 505
Barium 140	< 90.1	< 121	< 68.6	< 111
Beryllium 7	1290 ± 152	1120 ± 184	1440 ± 108	3040 ± 208
Cesium 134	< 16.5	< 21.7	< 8.06	< 12.9
Cesium 137	< 20.4	< 20.7	< 7.59	< 14.4
Cobalt 58	< 16	< 26.4	< 8.33	< 14.4
Cobalt 60	< 24.1	< 30.1	< 7.92	< 14
Iodine 131	< 36.8	< 42.8	< 36.7	< 59.3
Iron 59	< 39.1	< 58	< 19.4	< 32.3
Lanthanum 140	< 18.4	< 40.8	< 19.1	< 28.3
Manganese 54	< 16.9	< 25.8	< 7.91	< 13.1
Niobium 95	< 21.3	< 20.8	< 9.95	< 16.7
Potassium 40	4890 ± 856	4670 ± 901	6380 ± 1100	5410 ± 879
Zinc 65	< 38.8	< 70.6	< 18.7	< 31.1
Zirconium 95	< 30.7	< 48.5	< 14.7	< 25.8

Table 10. 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 date:	05/24/17	05/24/17	08/23/17	08/23/17
Gross Alpha	7070 ± 3450	11600 ± 4230	< 5150	12600 ± 3900
Gross Beta	37100 ± 1870	13700 ± 1350	29400 ± 1690	13500 ± 1240
Cesium 134	< 34.3	< 21.1	< 14.8	< 17.5
Cesium 137	76.3 ± 21.8	< 29.5	45.3 ± 7.98	< 17.6
Cobalt 58	< 56.3	< 30.3	< 33.4	< 34.1
Cobalt 60	< 50.4	< 26.1	< 17.6	< 18.4
Iron 59	< 179	< 77.9	< 132	< 102
Manganese	< 49.2	< 26.8	< 18.9	< 19
Niobium 95	< 78.6	< 53.1	< 83.3	< 77.9
Potassium 40	43500 ± 7070	12800 ± 2110	36700 ± 5840	10300 ± 1680
Zinc 65	< 144	< 58.3	< 51.9	< 44.5
Zirconium 95	< 107	< 64.4	< 67	< 65.4

Table 11. 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	LAC-4
Collection date:	02/28/17	05/24/17	08/23/17
Gross Alpha	< 1.53	< 1.57	3.84 ± 1.41
Gross Alpha Sus	1.16 ± 1.15	0.676 ± 0.516	0.927 ± 0.611
Gross Beta	2.39 ± 1.32	< 3.07	7.51 ± 1.51
Gross Beta Sus Sol	< 1.96	< 0.796	< 1.04
Barium 140	< 6.54	< 42.8	< 31.3
Cesium 134	< 2.01	< 9.2	< 4.86
Cesium 137	< 1.81	< 11.3	< 4.56
Cobalt 58	< 1.39	< 8.43	< 4.78
Cobalt 60	< 2.09	< 10.9	< 4.43
Iodine 131	< 2.06	< 18.2	< 13.8
Iron 59	< 3.44	< 19.7	< 9.88
Lanthanum 140	< 2.22	< 14	< 11.2
Manganese 54	< 1.57	< 9.98	< 4.43
Niobium 95	< 1.66	< 9.65	< 5.34
Strontium 89	< 0.703	< 0.413	< 0.223
Strontium 90	1.03 ± 0.584	< 0.347	0.188 ± 0.084
Tritium	< 207	< 206	< 213
Zinc 65	< 3.92	< 17.9	< 9.75
Zirconium 95	< 2.75	< 17.6	< 8.52

Radioisotopes other than those reported were not detected.

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



Measurements in units of pCi/liter

	LAC-7	LAC-8	LAC-7	LAC-8
Collection date:	05/24/17	05/24/17	08/23/17	08/23/17
gross alpha	< 1.3	1.56 +- 1.1	< 1.5	< 2.2
gross beta	< 1.6	< 1.7	< 1.8	1.41 +- 0.8
H-3	< 206	< 206	< 214	< 214

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

Sample Point	Location Description
LAC-2	Lock & Dam #8
LAC-3	Discharge sample location (bottom sediment)
LAC-4	Boat launch area
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-10	Upstream sample location (bottom sediment)
LAC-19	Downstream sample location (bottom sediment)
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)

Appendix C – [NRC Event Notification Report #52575](#)

TOP

Power Reactor	Event Number: 52575
Facility: LACROSSE	Notification Date: 02/24/2017
Region: 3 State: WI	Notification Time: 14:40 [ET]
Unit: [1] [] []	Event Date: 02/24/2017
RX Type: [1] AC (ALLIS CHAMBERS)	Event Time: 12:45 [CST]
NRC Notified By: CHERYL OLSON	Last Update Date: 02/24/2017
HQ OPS Officer: JEFF ROTTON	
Emergency Class: NON EMERGENCY	Person (Organization):
10 CFR Section:	MARK JEFFERS (R3DO)
50.72(b)(2)(xi) - OFFSITE NOTIFICATION	NMSS_EVENTS_NOTIFIC (EMAI)

Unit	SCRAM Code	RX CRIT	Initial PWR	Initial RX Mode	Current PWR	Current RX Mode
1	N	N	0	Decommissioned	0	Decommissioned

Event Text

OFFSITE NOTIFICATION TO STATE OF WISCONSIN DUE TO INADVERTENT RELEASE OF CONTAMINATED WATER

"The Wisconsin Department of Natural Resources (WDNR) was notified today at 1245 [CST] of an inadvertent release of radioactively contaminated water [as required by the licensee's site permit to report any release of contaminated water into the Mississippi River].

"At approximately 0715 on February 23, 2017, Solutions Management was notified by a Radiation Protection Technician (RPT) that the containment berm of the East (immediately north of Turbine Building) Baker Tank (20,000 gallon storage tank) was full and spilling out of the containment berm. The water that spilled out of the containment berm had pooled to the north of the tank and eventually began draining into the Radiological Controlled Area (RCA) storm sewer drain.

"Upon discovery and initial investigation the RPT ascertained that a sump pump hose which was left in the tank overnight was siphoning into the containment berm. The RPT immediately removed the hose from the water in the Baker Tank to stop the water from siphoning. Once the water was secured actions were taken [to minimize the contamination].

"Approximately 400 gallons had been lost from the tank. The 400 gallons was siphoned from the tank through a garden hose attached to a sump pump which was sitting in the containment berm. Over the course of approximately 16 hours the water siphoning from the tank filled the containment berm which holds a little over 3,100 gallons and spilled on to an asphalt surface. The water then traveled approximately 30 feet over the asphalt surface to the storm sewer which contained inlet protection in accordance with the Storm Water Pollution Prevention Plan. After filtering through the inlet protection the water remained in the storm water drain until the volume was sufficient enough to reach the 10 inch discharge piping (approximately 12 inches). The water traveled approximately 100 feet to the next storm water drain where it remained until the volume was sufficient enough to reach the 10 inch discharge piping (approximately 8 inches). When the manhole was opened, the level of the water was just above the bottom of the 10 inch discharge piping and was flowing slowly. The water leaving the 10 inch discharge piping flowed to a 60 inch discharge pipe that discharges to the Mississippi River.

"Water samples and smear surveys were analyzed, documented and reviewed by the Lacrosse Solutions (Solutions) Radiation Protection Manager (RPM) and NRC Region 3 Inspector Dr. Peter Lee, who was on site performing a routine inspection. Analytical results of the released water showed that it contained only Cs-137 in concentrations ranging from 1.1E-06 uCi/ml to 2.86 E-06 uCi/ml. The concentration levels exceed the 10CFR20 Table 2 limits for effluents (water) for Cs-137 which is 1 E-06 uCi/ml. The concentration levels exceed the 10CFR20 Table 2 limits for effluents (water) for Cs-137 which is 1 E-06 uCi/ml. Although the concentration levels exceed the 10CFR20 Table 2 limits for effluents (water) for Cs-137 they did not exceed the criteria for reportability which is 20 times the Table 2 effluent limit for Cs-137. The smear surveys of the storm sewer piping, manhole vaults taken during entries into the RCA yard drain & Administration Building drain manholes were all considerably less than CA posting criteria. The Standard Dose Calculations used for planned water releases were utilized for the water release assuming no dilution. Using the Standard Dose Calculations it was calculated that 1.05 E-02 mRem was the worst case for organs and 5.72E-03 mRem for total body dose.

"Following the RPM's review, it was determined that the asphalt area of the RCA could be down posted as a CA and the storm drain vault to the north of the Administration Building could be unplugged to allow regular flow of storm water.

"Solution's has issued a Conditions Report (CR) and initiated an investigation to prevent this occurrence from happening again.

"Regulatory reportability limits for liquid effluent releases were not exceed as result of this event."