La Crosse Boiling Water Reactor Environmental Radioactivity Survey

2018

WISCONSIN DEPARTMENT *of* HEALTH SERVICES

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

P-00443 (06/2021)

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) 2018. 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 2018, there was a single instance of tritium exceeding Maximum Contamination Levels (MCLs) on-site. The elevated MCLs triggered additional monitoring samples taken off-site to determine if the plume had moved off-site. The additional monitoring samples did not reveal any elevated tritium.

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 was one incidents during in February, which required additional environmental monitoring for tritium. During routine monitoring by LaCrosse Solutions, they discovered that tritium concentrations were above Maximum Contamination Levels (MCLs) of 20,000 pCi/Liter for drinking water as stated in NUREG-1301. As a result of the elevated tritium levels, the Wisconsin Department of Health – Radiation Protection Section collected additional samples outside of the protected area. The samples did not contain any elevated tritium levels outside of the protected area.
- 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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La Crosse Boiling Water Reactor (LACBWR)
Environmental Radioactivity Survey, 2018

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) 2018. 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 Groundwater Tritium Plume (H^3)

On February 14, 2018 during routine environmental monitoring at La Crosse Boiling Water Reactor, LaCrosse Solutions discovered that monitoring 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, and Page 64 table 3.12-2. LaCrosse Solutions notified the Nuclear Regulatory Commission (NRC) on March 12, 2018 regarding the elevated level of tritium and that Haley & Aldrich would be conducting further testing of the groundwater.

LaCrosse Solutions notified the state of Wisconsin Dept. of Health – Radiation Protection Section – Environmental Monitoring on February 26, 2018. In the email, LaCrosse Solutions stated that they had elevated tritium readings at two wells on-site near the reactor building. In addition, they stated that they were working with Haley & Aldrich to develop a plan to further assess the situation.

On March 6, 2018 Dairyland Cooperative directed their employees working at the coal plant next to LACBWR to stop drinking well water and drink bottle water. The well used for drinking water by LACBWR employees comes from a deeper well depth compare to the well with the tritum. Testing for tritum from the drinking water well did not detect any radionuclides levels above background.

Wisconsin Dept. of Health – Radiation Protection Section – Environmental Monitoring took water samples on March 1, 2018 from existing groundwater and surface water sites (LAC-4, LAC-7, LAC-8, and LAC-9).

Haley & Aldrich notified Wisconsin Department of Natural Resources (DNR) on March 14, 2018 and proposed a dye tracer study. The proposal was accepted by DNR and the dye was introduced on July 12, 2018. One pound of Rhodamine WT (RWT) followed by 230 gallons of unchlorinated water. The groundwater monitoring wells, river, and supply wells were monitored weekly for 5 weeks for RWT. DNR required monthly samples until the trailing edge of the RWT plume had migrated past the most down gradient supply well (#5 or WUWN:AK187).

Based upon LaCrosse Solution's groundwater testing results, tritium concentrations continued to decrease below the drinking water MCLs starting in March through October. All wells tested by Wisconsin Dept. of Health –

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

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 LaCosse 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. 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 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 (MAPEP) 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. 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-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	51	1	GA, GB, GI[w]
TLD	G/Q	LAC T1-T4	16	0	direct exposure
surface water	G/A	LAC 4	3	1	GA[u,v], GB[u,v], GI, Sr, H
bottom sediment	G/A	LAC 3, 10, 19	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	10	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 2018.

Sample type	Date	Site	Explanation
Beta Analysis	01/03/18	LAC-2	Low air volume
Beta Analysis	01/31/18	LAC-7	Low air volume
Beta Analysis	02/14/18	LAC-2	Low air volume
Beta Analysis	02/28/18	LAC-2	Low air volume
Beta Analysis	03/28/18	LAC-2	Low air volume
Beta Analysis	05/09/18	LAC-2	Low air volume
Beta Analysis	06/06/18	LAC-2	power off on the pump, no data
Beta Analysis	06/20/18	LAC-2	Low air volume
Beta Analysis	07/03/18	LAC-2	Low air volume
Beta Analysis	07/17/18	LAC-2	Low air volume
Beta Analysis	08/01/18	LAC-2	Low air volume
Beta Analysis	09/26/18	LAC-2	Low air volume
Beta Analysis	10/10/18	LAC-2	Low air volume
Beta Analysis	10/24/18	LAC-2	Low air volume
Beta Analysis	11/07/18	LAC-7	Low air volume
Beta Analysis	11/15/18	LAC-7	Low air volume
Surface Water	03/01/20	LAC-4	Analysis only for H3 as a result of elevated H3 onsite
Surface Water	04/10/20	LAC-4	Analysis only for H3 as a result of elevated H3 onsite
Surface Water	05/17/18	LAC-4	Lab error – with chemically derived Iodine
Surface Water	09/05/18	LAC-4	Lab error
Well Water	03//018	LAC-7	Analysis only for H3 as a result of elevated H3 onsite
Well Water	04/20/18	LAC-7	Analysis only for H3 as a result of elevated H3 onsite
Well Water	03/01/18	LAC-8	Analysis only for H3 as a result of elevated H3 onsite
Well Water	04/20/18	LAC-8	Analysis only for H3 as a result of elevated H3 onsite
Well Water	4/10/18	LAC-9	Analysis only for H3 as a result of elevated H3 onsite
Well Water	05/17/18	LAC-9	Analysis only for H3 as a result of elevated H3 onsite

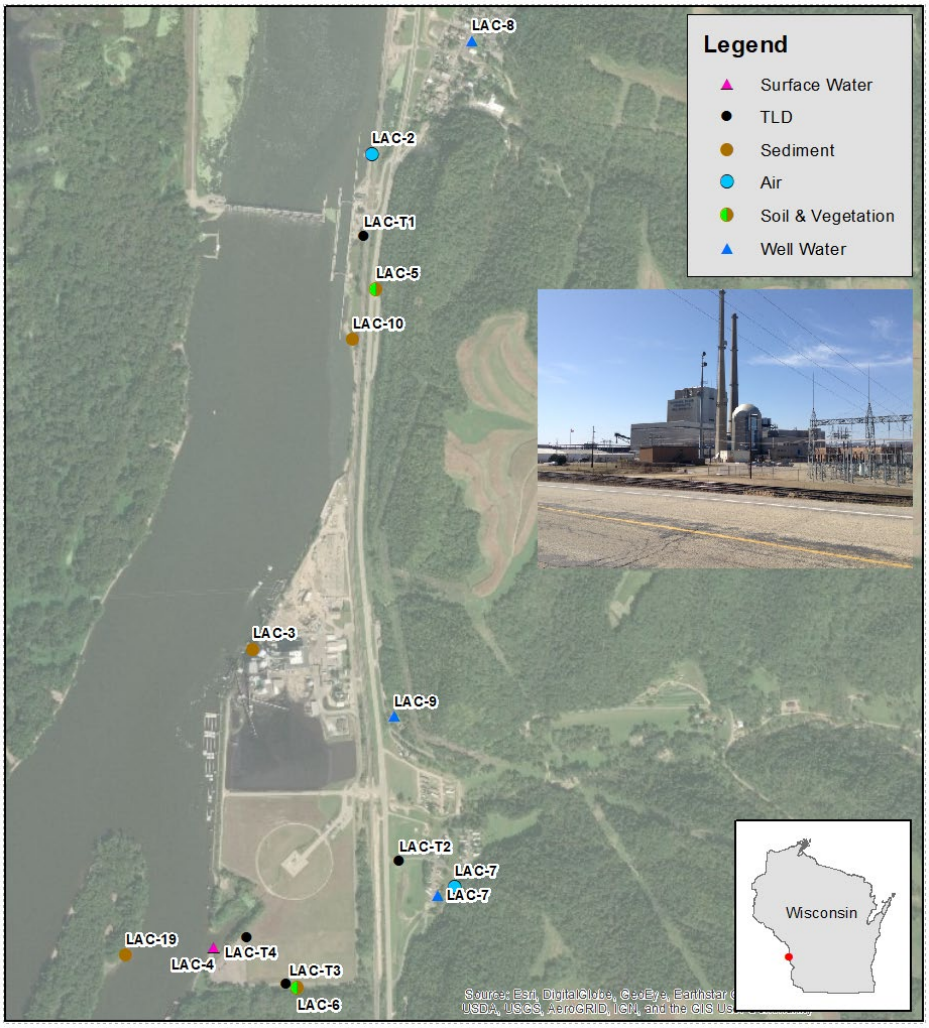

Figure 1. Wisconsin DHS environmental monitoring sampling sites for the LACBWR monitoring program.

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 2018 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 17.2 $\pm$ 1.0 milliroentgens. The average quarterly exposure for 2018 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. Additional water samples collected in response to the on-site elevated tritium levels did not find tritium levels 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.

The gamma isotopic analysis detected gross beta and beryilium-7 above the LLD. Also, naturally occurring potassium-40 (^{40}K) was above the LLD. 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 samples and one sample of Cesium 137 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. One location had gross beta 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 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 Wisconsin DHS LACBWR environmental monitoring program.

Sample type (units)	LLD	Number of samples *[a]	Analysis	Range
Air particulate	0.005	43 / 43	Gross Beta	<0.112 - 0.247
			gamma isotopic	
quarterly composite	0.020	7 / 0	Barium 140	< 0.003
(pCi/m^3)	0.002	7 / 7	Beryllium 7	0.0447 - 0.0233
	0.002	7 / 0	Cerium 141	< 0.0008
	0.005	7 / 0	Cerium 144	< 0.0026
	0.002	7 / 0	Cesium 134	< 0.0006
	0.005	7 / 0	Cesium 137	< 0.0005
	0.002	7 / 0	Cobalt 58	< 0.0006
	0.005	7 / 0	Cobalt 60	< 0.0006
	0.020	7 / 0	Iodine 131	< 0.0018
	0.015	7 / 0	Iron 59	< 0.0010
	0.020	7 / 0	Lanthanum 140	< 0.0013
	0.002	7 / 0	Manganese 54	< 0.0006
	0.002	7 / 0	Niobium 95	< 0.0006
	0.030	7 / 0	Ruthenium 103	< 0.0037
	0.020	7 / 0	Ruthenium 106	< 0.0038
	0.002	7 / 0	Zinc 65	< 0.0012
	0.005	7 / 0	Zirconium 95	< 0.0009
Direct Exposure (TLD)	1.0 [b]	16 / 16	Direct Exposure	15.7 – 19.2
(mR/Std Qtr)				
Surface Water	3	1 / 0	Gross Alpha	1.77 ± 0.52
(pCi/liter)	3	1 / 0	Gross Alpha Sus Sol	< 0.92
	3	1 / 1	Gross Beta	6.05 ± 0.67
	3	1 / 0	Gross Beta Sus Sol	1.62 ± 0.71
	0.5	0 / 0	Iodine 131	*c
	300	3 / 0	Tritium	< 231
	2	1 / 0	Strontium 89	< 0.22
	1	1 / 0	Strontium 90	0.23 ± 0.09
			gamma isotopic	
	350	1 / 0	Barium 140	< 38.7
	80	1 / 0	Cesium 134	< 7.99
	90	1 / 0	Cesium 137	< 11.6
	600	1 / 0	Cobalt 58	< 8.35
	100	1 / 0	Cobalt 60	< 8.88
	80	1 / 0	Iodine 131	< 12.8
	200	1 / 0	Iron 59	< 15.1
	100	1 / 0	Lanthanum 140	< 12.2
	90	1 / 0	Manganese 54	< 8.42
	100	1 / 0	Niobium 95	< 9.85
	250	1 / 0	Zinc 65	< 17.7
	200	1 / 0	Zirconium 95	< 12.2

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	5.0	4 / 4	Gross Alpha	1 - 2.3
(pCi/liter)	3.0	4 / 1	Gross Beta	1.77 - 3.24
	300	10 / 0	Tritium	< 232
Soil	15000	4 / 0	Gross Alpha	6960 - 11900
(pCi/kg dry)	6000	4 / 4	Gross Beta	15700 - 46800
	80	4 / 0	Cesium 134	< 35.3
	80	4 / 1	Cesium 137	< 38.3 - 207
	90	4 / 0	Cobalt 58	< 41.9
	90	4 / 0	Cobalt 60	< 32
	600	4 / 0	Iron 59	< 114
	60	4 / 0	Manganese 54	< 35.8
	100	4 / 0	Niobium 95	< 70.5
	800	4 / 4	Potassium 40	9680 - 50000
	300	4 / 0	Zinc 65	< 78.9
	250	4 / 0	Zirconium 95	< 91.5
Vegetation	5000	4 / 0	Gross Alpha	< 1040 - 1590
(pCi/kg wet)	4000	4 / 2	Gross Beta	3360 - 5980
	350	4 / 0	Barium 140	< 98.6
	600	4 / 2	Beryllium 7	403 - 5340
	80	4 / 0	Cesium 134	< 21.5
	90	4 / 0	Cesium 137	< 23.3
	100	4 / 0	Cobalt 58	< 21
	100	4 / 0	Cobalt 60	< 26
	80	4 / 0	Iodine 131	< 39.1
	200	4 / 0	Iron 59	< 48.5
	100	4 / 0	Lanthanum 140	< 43.3
	90	4 / 0	Manganese 54	< 27.6
	100	4 / 0	Niobium 95	< 25.5
	2000	4 / 4	Potassium 40	3650 - 6660
	250	4 / 0	Zinc 65	< 52.4
	200	4 / 0	Zirconium 95	< 37.9
Bottom Sediment	15000	3 / 0	Gross Alpha	< 3840 - 12400
(pCi/kg dry)	6000	3 / 1	Gross Beta	5540 - 21300
	80	3 / 0	Cesium 134	< 13.5
	80	3 / 1	Cesium 137	< 11.6 - 279
	90	3 / 0	Cobalt 58	< 29.4
	90	3 / 0	Cobalt 60	< 12.8
	600	3 / 0	Iron 59	< 117
	90	3 / 0	Manganese 54	< 16
	100	3 / 0	Niobium 95	< 97.2
	800	3 / 3	Potassium 40	6160 - 18900
	300	3 / 0	Zinc 65	< 38.2

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

Sample type (units)	LLD	Number of samples *[a]	Analysis	Range
	200	3 / 0	Zirconium 95	< 62.1
Bottom Sediment	15000	3 / 0	Gross Alpha	< 3840 - 12400
(pCi/kg dry)	6000	3 / 1	Gross Beta	5540 - 21300
	80	3 / 0	Cesium 134	< 13.5
	80	3 / 1	Cesium 137	< 11.6 - 279
	90	3 / 0	Cobalt 58	< 29.4
	90	3 / 0	Cobalt 60	< 12.8
	600	3 / 0	Iron 59	< 117
	90	3 / 0	Manganese 54	< 16
	100	3 / 0	Niobium 95	< 97.2
	800	3 / 3	Potassium 40	6160 - 18900
	300	3 / 0	Zinc 65	< 38.2
	200	3 / 0	Zirconium 95	< 62.1

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/m^3

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

1st Qtr Collection End Date	Volume m^3	Air Particulate
01/03/18	9 *a	< 0.112
01/17/18	568.3	0.0219 ± 0.0016
01/31/18	1137.2	0.0304 ± 0.0012
02/14/18	114 *b	0.247 ± 0.0112
02/28/18	109 *b	0.025 ± 0.0012
03/14/18	1688.1	0.0132 ± 0.0006
03/28/18	102 *b	0.177 ± 0.0047
	mean +- s.d.	0.086 ± 0.1

2nd Qtr Collection End Date	Volume m^3	Air Particulate
04/11/18	101 b	0.193 ± 0.0049
04/25/18	977.4	0.0176 ± 0.001
05/09/18	93 b	0.176 ± 0.0112
05/23/18	895.1	0.0148 ± 0.001
06/06/18	*a	*a
06/20/18	85 b	0.167 ± 0.0052
	mean +- s.d.	0.114 ± 0.09

3rd Qtr Collection End Date	Volume m^3	Air Particulate
07/03/18	79 *b	0.175 ± 0.0055
07/17/18	59 *b	0.223 ± 0.0073
08/01/18	88 *b	0.189 ± 0.0053
08/15/18	804.1	0.0295 ± 0.0014
08/29/18	790.9	0.0303 ± 0.0015
09/12/18	790.3	0.0147 ± 0.0011
09/26/18	79 *b	0.0210 ± 0.0013
	mean +- s.d.	0.098 ± 0.094

4th Qtr Collection End Date	Volume m^3	Air Particulate
10/10/18	79 *b	0.124 ± 0.0049
10/24/18	82 *b	0.153 ± 0.0116
11/07/18	810.3	0.0208 ± 0.0012
11/15/18	455.3	0.0261 ± 0.002
12/05/18	1179.7	0.0304 ± 0.0011
12/19/18	826.1	0.0593 ± 0.0019
	mean +- s.d.	0.069 ± 0.057

LAC-7 (12000 series); Edgewood Trailer Court

1st Qtr Collection date	Volume m^3	Air Particulate
01/03/18	1045.6	0.0315 ± 0.0013
01/17/18	1024.8	0.0272 ± 0.0012
01/31/18	759 b	0.0363 ± 0.0016
02/14/18	1016.5	0.0274 ± 0.0012
02/28/18	992.3	0.0261 ± 0.0012
03/14/18	982.7	0.0242 ± 0.0012
03/28/18	986.1	0.0197 ± 0.0011
	mean +- s.d.	0.028 ± 0.006

2nd Qtr Collection date	Volume m^3	Air Particulate
04/11/18	976.9	0.0206 ± 0.0011
04/25/18	963.2	0.018 ± 0.0011
05/09/18	804.6	0.0187 ± 0.0012
05/23/18	806.4	0.0144 ± 0.0011
06/06/18	780.4	0.0208 ± 0.0013
06/20/18	586.4	0.0173 ± 0.0015
	mean +- s.d.	0.019 ± 0.003

3rd Qtr Collection date	Volume m^3	Air Particulate
07/03/18	712.6	0.0164 ± 0.0013
07/17/18	828.2	0.0201 ± 0.0012
08/01/18	605.9	0.0116 ± 0.0013
08/15/18	877.2	0.028 ± 0.0013
08/29/18	890	0.0272 ± 0.0013
09/12/18	899.1	0.0125 ± 0.001
09/26/18	898.9	0.0172 ± 0.0011
	mean +- s.d.	0.019 ± 0.007

4th Qtr Collection date	Volume m^3	Air Particulate
10/10/18	938	0.010 ± 0.001
10/24/18	931.6	0.012 ± 0.0009
11/07/18	613 *b	0.0109 ± 0.0013
11/15/18	480 *b	0.0225 ± 0.0018
12/05/18	1200	0.025 ± 0.001
12/19/18	820.2	0.0475 ± 0.0017
	mean +- s.d.	0.022 ± 0.015

*a – power off on the pump, no data

*b – low air volume

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	**1st quarter**	**2nd quarter**	**3rd quarter**	**4th quarter**
Barium 140	< 0.0028	< 0.0018	< 0.0024	0.0028
Beryllium 7	0.0947 ± 0.0097	0.233 ± 0.0134	0.135 ± 0.0112	0.0905 ± 0.0006
Cerium 141	< 0.0006	< 0.0003	< 0.0006	0.0004
Cerium 144	< 0.0022	< 0.0008	< 0.002	0.001
Cesium 134	< 0.0005	< 0.0001	< 0.0004	0.0002
Cesium 137	< 0.0004	< 0.0001	< 0.0004	0.0011 ± 0.0002
Cobalt 58	< 0.0005	< 0.0001	< 0.0004	0.0002
Cobalt 60	< 0.0005	< 0.0001	< 0.0004	0.0003
Iodine 131	< 0.0011	< 0.0011	< 0.0015	0.0018
Iron 59	< 0.0007	< 0.0003	< 0.001	0.0005
Lanthanum 140	< 0.0011	< 0.0005	< 0.0012	0.0012
Manganese 54	< 0.0006	< 0.0001	< 0.0003	0.0002
Niobium 95	< 0.0005	< 0.0001	< 0.0005	0.0003
Ruthenium 103	< 0.0006	< 0.0001	< 0.0004	0.0003
Ruthenium 106	< 0.0037	< 0.0011	< 0.0027	0.0019
Zinc 65	< 0.0012	< 0.0002	< 0.0009	0.0004
Zirconium 95	< 0.0009	< 0.0002	< 0.0008	0.0005
Site: LAC-7				
Barium 140	< 0.0028	< 0.0018	< 0.0024	< 0.0023
Beryllium 7	0.0947 ± 0.0097	0.233 ± 0.0134	0.135 ± 0.0112	0.0447 ± 0.0039
Cerium 141	< 0.0006	< 0.0003	< 0.0006	< 0.0003
Cerium 144	< 0.0022	< 0.0008	< 0.002	< 0.0009
Cesium 134	< 0.0005	< 0.0001	< 0.0004	< 0.0002
Cesium 137	< 0.0004	< 0.0001	< 0.0004	< 0.0001
Cobalt 58	< 0.0005	< 0.0001	< 0.0004	< 0.0001
Cobalt 60	< 0.0005	< 0.0001	< 0.0004	< 0.0002
Iodine 131	< 0.0011	< 0.0011	< 0.0015	< 0.0017
Iron 59	< 0.0007	< 0.0003	< 0.001	< 0.0005
Lanthanum 140	< 0.0011	< 0.0005	< 0.0012	< 0.0012
Manganese 54	< 0.0006	< 0.0001	< 0.0003	< 0.0001
Niobium 95	< 0.0005	< 0.0001	< 0.0005	< 0.0003
Ruthenium 103	< 0.0006	< 0.0001	< 0.0004	< 0.0002
Ruthenium 106	< 0.0037	< 0.0011	< 0.0027	< 0.0016
Zinc 65	< 0.0012	< 0.0002	< 0.0009	< 0.0004
Zirconium 95	< 0.0009	< 0.0002	< 0.0008	< 0.0004

Radioisotopes other than those reported were not detected.

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

	1st quarter	2nd quarter	3rd quarter	4th quarter
Date Placed:	01/10/18	04/10/18	07/10/18	10/09/18
Date Removed:	04/10/18	07/10/18	10/09/18	01/08/18
Days in the Field:	89	91	91	91
Location:	Individual quarterly date is reported as: mR / Standard Quarter + 2 sigma counting error.			
TLD sites located near La Crosse Boiling Water Reactor				
LAC-T1	16.6 ± 2	16.2 ± 1	16.2 ± 1.7	16.6 ± 1.7
LAC-T2	17.4 ± 0.9	15.7 ± 0.9	17.7 ± 0.9	17.1 ± 0.8
LAC-T3	18.3 ± 0.7	18 ± 0.7	18.8 ± 0.6	19.2 ± 0.7
LAC-T4	16.8 ± 0.9	15.7 ± 0.9	17.6 ± 0.8	17.1 ± 1.7
Quarterly average +- s.d.	17.3 ± 0.8	16.4 ± 1.1	17.6 ± 1.1	17.5 ± 1.2

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-10 upstream	LAC-3 Discharge	LAC-19 downstream
Collection date:	04/24/18	04/24/18	04/24/18
gross alpha	4570 ± 2830	< 3840	12400 ± 3330
gross beta	5540 ± 1050	5910 ± 973	21300 ± 1360
gamma isotopic			
Cesium 134	< 13.5	< 11.8	< 11
Cesium 137	< 11.6	279 ± 23.6	68.4 ± 10.1
Cobalt 58	< 28.2	< 24	< 29.4
Cobalt 60	< 12.8	< 12.2	< 12.8
Iron 59	< 100	< 98.8	< 117
Manganese 54	< 15	< 14.9	< 16
Niobium 95	< 94	< 84	< 97.2
Potassium 40	7410 ± 1210	6160 ± 1020	18900 ± 3030
Zinc 65	< 36.5	< 36.1	< 38.2
Zirconium 95	< 56.3	< 60.4	< 62.1

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	05/17/18	05/17/18	09/05/18	09/05/18
Gross Alpha	< 781	< 1030	< 1040	1590 ± 635
Gross Beta	5980 ± 299	3360 ± 293	5220 ± 305	3560 ± 277
gamma isotopic				
Cesium 134	< 11.6	< 21.5	< 85	< 55.4
Barium 140	< 55.1	< 98.6	4870 ± 408	5340 ± 407
Beryllium 7	577 ± 103	403 ± 126	< 17.4	< 13.2
Cesium 137	< 14.9	< 23.3	< 19.1	< 12
Cobalt 58	< 16.2	< 21	< 16.5	< 15.2
Cobalt 60	< 14.9	< 26	< 19.9	< 14
Iodine 131	< 19.6	< 39.1	< 28.9	< 22.7
Iron 59	< 34.9	< 48.5	< 31.8	< 28.7
Lanthanum 140	< 24.6	< 43.3	< 30.5	< 20.1
Manganese 54	< 14.7	< 27.6	< 19.5	< 14.2
Niobium 95	< 18.2	< 25.5	< 21	< 16.3
Potassium 40	6660 ± 1140	5020 ± 925	5560 ± 1010	3650 ± 661
Zinc 65	< 36.8	< 52.4	< 41.1	< 35.7
Zirconium 95	< 24.8	< 32.2	< 37.9	< 18

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	05/17/18	05/17/18	09/05/18	09/05/18
Gross Alpha	6960 ± 2930	9470 ± 3620	8730 ± 3980	11900 ± 3540
Gross Beta	32600 ± 1570	15700 ± 1260	46800 ± 1810	17400 ± 1320
gamma isotopic				
Cesium 134	< 20.4	< 35.3	< 25.2	< 23.8
Cesium 137	207 ± 25.1	< 35.9	< 38.3	< 32.5
Cobalt 58	< 28.2	< 41.9	< 30.4	< 28.4
Cobalt 60	< 23.8	< 30.1	< 32	< 31.3
Iron 59	< 84	< 114	< 84.6	< 62.9
Manganese 54	< 26.8	< 35.8	< 27.7	< 27.4
Niobium 95	< 47.6	< 70.5	< 32	< 36
Potassium 40	32700 ± 5260	13000 ± 2220	50000 ± 7980	9680 ± 1680
Zinc 65	< 68.6	< 75.9	< 78.9	< 65.8
Zirconium 95	< 60	< 91.5	< 54.5	< 63.1

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	LAC-4	LAC-4
Collection Start	3/1/2018	4/10/2018	05/17/18	09/05/18
Gross Alpha	*b	*b	1.77 ± 0.52	*a
Gross Alpha Sus Sol	*b	*b	< 0.92	*a
Gross Beta	*b	*b	6.05 ± 0.67	*a
Gross Beta Sus Sol	*b	*b	1.62 ± 0.71	*a
Iodine 131	*b	*b	*a	*a
Tritium	< 213	< 214	< 231	*a
Strontium 89	*b	*b	< 0.22	*a
Strontium 90	*b	*b	0.23 ± 0.09	*a
Barium 140	*b	*b	< 38.7	*a
Gamma isotopic				
Cesium 134	*b	*b	< 7.99	*a
Cesium 137	*b	*b	< 11.6	*a
Cobalt 58	*b	*b	< 8.35	*a
Cobalt 60	*b	*b	< 8.88	*a
Iodine 131	*b	*b	< 12.8	*a
Iron 59	*b	*b	< 15.1	*a
Lanthanum 140	*b	*b	< 12.2	*a
Manganese 54	*b	*b	< 8.42	*a
Niobium 95	*b	*b	< 9.85	*a
Zinc 65	*b	*b	< 17.7	*a
Zirconium 95	*b	*b	< 12.2	*a

*a – lab error not reported

*b – analysis not requested

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-8	LAC-7	LAC-8
Collection Start	05/17/18	05/17/18	09/05/18	09/05/18
Gross Alpha	1.59 ± 0.64	2.3 ± 0.71	1 ± 0.577	2.02 ± 0.762
Gross Beta	2.11 ± 0.661	3.24 ± 0.584	1.77 ± 0.526	1.99 ± 0.558
Tritium	< 231	< 231	< 229	< 229

Table 13 Wisconsin DHS analysis results for Tritium in well water samples collected for the LACBWR environmental monitoring program.

Measurements in units of pCi/liter						
Site:	LAC-7	LAC-7	LAC-8	LAC-8	LAC-9	LAC-9
Collection Start	3/1/2018	4/20/2018	3/1/2018	4/20/2018	4/10/2018	05/17/18
Tritium	< 213	< 232	< 213	< 214	< 214	< 231

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-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-9	House Number E-450		
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)		

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.

Appendix C – Nuclear Regulatory Commission (NRC) Event Notification Report #53254

This NRC report is related to the tritium plume only on-site at La Crosse Boiling Water Reactor.

TOP

Power Reactor	Event Number: 53254
Facility: LACROSSE Region: 3 State: WI Unit: [1] [ ] [ ] RX Type: [1] AC (ALLIS CHAMBERS) NRC Notified By: JIM ASHLEY HQ OPS Officer: HOWIE CROUCH	Notification Date: 03/12/2018 Notification Time: 11:59 [ET] Event Date: 03/13/2018 Event Time: [CDT] Last Update Date: 03/12/2018
Emergency Class: NON EMERGENCY 10 CFR Section: 50.72(b)(2)(xi) - OFFSITE NOTIFICATION	Person (Organization): ROBERT ORLIKOWSKI (R3DO)

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

Event Text

PRESS RELEASE PLANNED

"LacrosseSolutions is preparing to issue a short press release related to the detection of tritium above background levels detected in site groundwater sampling wells. Following is a summary of the release:

"The LACBWR [LaCrosse Boiling Water Reactor] site contains a network of industrial groundwater monitoring wells. Analytical results from a routine sampling event on December 28, 2017, indicated above background levels of tritium in the monitoring well closest to the reactor building. All wells sampled in December were resampled on February 14, 2018. From that sampling event, one additional well resulted positive for tritium.

"The monitoring well closest to the reactor building has a tritium concentration equivalent to the EPA limit for drinking water. No other radionuclides were found in the groundwater monitoring wells. EnergySolutions is using Haley & Aldrich, a national environmental consulting firm experienced in this area, to assist EnergySolutions in further testing and development of a groundwater monitoring plan to monitor the source of the tritium.

"On March 6, 2018, Dairyland Power Cooperative directed their employees working at the coal plant next to LACBWR to switch to bottled drinking water instead of well water until more information is known about the source of tritium. This was a prudent and cautious step to address any concerns employees may have. The drinking water wells draw water from a much deeper depth than the groundwater that is approximately equal to the river height. No radionuclides were detected in the drinking water levels above background.

"The State of Wisconsin and the federal Nuclear Regulatory Commission were briefed and are closely following the issue."

The licensee has been communicating with NRC R3 (Edwards) and NRC HQ (Vaaler) since the initial sampling event.