Dose Assessment Topics (Identified by PAB)

NRC Comment (PAB 1): Additional information is required to evaluate the dose contribution from the Insignificant Radionuclides given the uncertainty in mixture percentages.

Basis: The NRC staff considers radionuclides and exposure pathways that contribute no greater than 10 percent of the dose criteria established for decommissioning (i.e., 2.5 millirem per year (mrem/yr)) to be insignificant contributors. NUREG-1757, "Consolidated Decommissioning Guidance," Volume 2, "Characterization, Survey, and Determination of Radiological Criteria," Appendix O, "Lessons Learned and Questions and Answers to Clarify License Termination Guidance and Plans," Question 2, states that "it is incumbent on the licensee to have adequate characterization data to support and document the determination that some radionuclides may be deselected from further detailed consideration in planning the Final Status Survey (FSS). Radionuclides that are undetected may also be considered insignificant, as long as the minimum detectable concentrations (MDCs) are sufficient to conclude that the dose contribution is less than 10 percent of the dose criterion (i.e., with the assumption that the radionuclides are present at the MDC concentrations)."

LACBWR Reference RS-TD-31319-001, Revision 1, describes how "the radionuclide mixture fractions for the initial suite radionuclides were determined by calculating the mean concentration of each radionuclide in the 12 cores collected from the first 1.27 cm (0.5 in) of concrete...A mean mixture fraction was then calculated for each radionuclide by dividing the mean activity for each radionuclide by the summation of all mean activities." The maximum percentage insignificant contribution (IC) dose determined by the licensee assuming the mean concentration of the 12 cores is three percent. Of the 12 cores, 6 are from the Reactor Building, 3 are from the Piping Tunnel, and 3 are from the Waste Treatment Building (WTB). In an email to the NRC on April 25, 2017, the licensee informed the staff that the WTB and the Piping Tunnel will now be removed as part of decommissioning. Therefore, additional justification is necessary as to why the average of the 12 concrete core samples is still representative of the end state of the site.

Page 6-40 of the LTP states that "to account for any additional, unspecified variability and to provide confidence that [hard to detect] (HTD) analyses that may occur during Continuing Characterization will not result in an IC dose exceeding the selected IC dose, a margin will be applied to the maximum individual IC percentage calculated using the Table 6-3 [Initial Suite of Potential Radionuclides and Mixture Fractions] mixture by increasing the percentage to 5 percent."

Attachment 6 of RS-TD-31319-001, Revision 1, shows the insignificant radionuclide dose contribution (in terms of mrem/yr) assuming the concentration present in each of the 20 pucks analyzed from the 12 concrete cores. RS-TD-31319-001 states that "these IC doses are calculated separately for each core using the [derived concentration guideline levels] (DCGLs) applicable to the basement where the core was collected and are a direct representation of IC dose from the data. The maximum, mean, and 95 percent [upper confidence limit] (UCL) of the 20 individual core IC doses were, 0.395 mrem/yr, 0.043 mrem/yr, and 0.060 mrem/yr, respectively. All of these values are below the maximum IC dose of 0.752 mrem/yr calculated using the mean mixture fraction (Table 15)."

In Attachment 6 of RS-TD-31319-001, Revision 1, the concentration in the pucks is converted from picocuries per gram (pCi/g) to picocuries per square meter (pCi/m^2), but the conversion factor is not fully explained. The conversion factor is 2.35x10^4, which appears to be derived from the concrete density of 2.35 grams per cubic centimeter (g/cm^3), or 2.35 grams per square centimeter (g/cm^2) per unit depth (where 1 centimeter (cm) is equal to 0.393 inch (in)), converted to g/m^2. Note that the 12 cores used to find the mean mixture fractions represented the first 1.27 cm (0.5 in) of concrete, and that additional cores were taken which found contamination to a depth in the range of 1.27 cm – 5.08 cm (0.5 in to 2 in). If one were to assume that contamination exists deeper than 1 cm into the concrete in the buildings where the initial cores were taken, the conversion factor would be impacted.

In addition, there appears to be enough variation in the mixture fractions to warrant further investigation. For example, in Sample No. B1001101-CJ-FC-005-CV 0-1/2, taken from the Reactor Building, there were just as many or more radionuclides above the MDC (bold values in the table below) than for the other Reactor Building Samples, but this sample had a lower Cesium-137 (Cs-137) value. This results in mixture fractions that are quite different from the average mixture percentages without placing undue emphasis on the MDC levels. If one were to calculate the *relative* dose of the insignificant radionuclides in this sample, the percentage is 4 percent, which is greater than the most limiting value calculated, but is still less than the 5 percent margin imposed by the licensee.

However, if one were to also account for Neptunium-237 (Np-237) at the average MDC for the 12 cores (0.044 pCi/g), the insignificant contributor percentage would be greater than 5 percent; in fact, it would be closer to 10 percent. The NRC staff acknowledges that the total insignificant dose contribution calculated using the concentrations for this core (4.688x10^{-2} mrem/yr) is much less than 1.25 mrem/yr. However, assuming that this same mixture percentage may exist in other areas of the Reactor Building but scaled up to concentrations that would in total be equivalent to 25 mrem/yr, the Insignificant Contributor assignment of 5 percent may not adequately account for the dose contribution of the insignificant radionuclides.

There also appears to be differences between the buildings where the samples were taken that warrant further explanation and investigation. For example, samples from the Reactor Building and the WTB had more positive detections for insignificant radionuclides and higher Cs-137 levels than the Piping Tunnel samples. Furthermore, there was one sample from the WTB that had significantly greater Cs-137 levels than the any other sample in the WTB, Reactor Building or Piping Tunnel (Sample No. B1002101-CJ-FC-002-CV 0-1/2). It is difficult to tell if this sample is unduly influencing the average mixture percentages given that the overall number of cores (12) is low. For example, if this sample is removed and the mean mixture fractions are recalculated, the maximum insignificant contribution is approximately 4 percent not including Np-237, and 8.1 percent including Np-237.

Concrete Core Sample No. B1001101-CJ-FC-005-CV 0-1/2 (Reactor Building)

Isotope	Activity (pCi/g)	Activity (pCi/m2)	Reactor Building Groundwater (mrem/yr)	Reactor Building Drilling Spoils (mrem/yr)	Reactor Building Excavation (mrem/yr)
H-3	**2.266**	5.32E+04	5.97E-05	1.38E-10	1.01E-07
C-14	1.409	3.31E+04	8.36E-04	1.51E-10	4.96E-08
Fe-55	2.934	6.89E+04	4.03E-05	6.07E-11	6.84E-08
Ni-59	**2.59**	6.09E+04	3.76E-06	3.04E-11	2.37E-08
Co-60	**39.572**	9.30E+05	1.09E-01	3.92E-02	7.33E-01
Ni-63	**213.849**	5.03E+06	8.43E-04	6.38E-09	5.35E-06
Sr-90	**29.256**	6.88E+05	8.34E-01	5.12E-05	1.05E-03
Nb-94	0.531	1.25E+04	2.04E-04	3.59E-04	6.25E-03
Tc-99	0.562	1.32E+04	3.43E-04	1.49E-09	6.64E-05
Cs-137	**58.907**	1.38E+06	5.84E-02	1.42E-02	2.40E-01
Eu-152	0.972	2.28E+04	6.38E-05	4.53E-04	8.11E-03
Eu-154	3.887	9.13E+04	3.62E-04	1.92E-03	3.50E-02
Eu-155	0.35	8.23E+03	5.10E-06	6.00E-06	7.40E-05
Np-237[1]	0.044	1.03E+03	5.97E-02	3.78E-06	5.88E-04
Pu-238	**0.68**	1.60E+04	1.26E-02	6.23E-07	9.53E-05
Pu-239/240	**0.489**	1.15E+04	1.02E-02	4.94E-07	7.62E-05
Pu-241	**7.226**	1.70E+05	2.89E-03	1.02E-06	4.65E-05
Am-241	**1.578**	3.71E+04	1.77E-02	9.34E-06	3.40E-04
Am-243	**0.047**	1.12E+03	5.33E-04	3.87E-06	6.03E-05
Cm-243/244	**0.103**	2.43E+03	2.84E-04	5.19E-06	8.48E-05

	Groundwater	Drilling Spoils	Excavation
Sum Dose (mrem/yr)	1.108	0.056	1.026
Sum IC Dose (mrem/yr)	0.107	0.003	0.051
Percent Relative IC Dose	10%	5%	5%
Percent IC Dose of 25 mrem	0.4%	0.0%	0.2%
Sum Dose w/o Np-237 (mrem/yr)	1.048	0.056	1.025
Sum IC Dose w/o Np-237 (mrem/yr)	0.047	0.003	0.050
Percent Relative IC Dose w/o Np-237	4%	5%	5%
Percent IC Dose w/o Np-237 of 25 mrem	0.2%	0.0%	0.2%

[1]Np-237 concentration is assumed to be at the average MDC for the 12 cores.

Path Forward:

a. Explain the basis for the conversion factor of 2.35×10^4 used to convert pCi/g to pCi/m^2 assumed in Attachment 6 of RS-TD-31319-001, Revision 1, and how it incorporates an appropriate depth of contamination assumed for the concrete.

b. Evaluate the range of mixture percentages in the 12 concrete cores (20 pucks) in order to determine whether a conservative mixture percentage with regard to the HTD radionuclides is applied. Assess the *relative* contribution to dose of the insignificant radionuclides (including Np-237) assuming the mixture fractions from the individual cores, as shown in the example above. In cases where the percent Relative IC Dose exceeds the assumed 5 percent IC Dose Contribution, explain how the surveys that will be conducted will ensure that the IC dose will remain below 1.25 mrem/yr; otherwise, increase the IC contribution assumption.

c. Provide additional justification for why the average of the core samples taken from the Piping Tunnel, WTB, and Reactor Building is representative of what will remain on site at the end state of decommissioning given that the WTB and Piping Tunnel will now be removed. Evaluate the statistical differences in mixture fractions of the initial suite of radionuclides between the buildings. Determine the potential insignificant dose contribution (including Np-237) using a mixture fraction for data specific to the Reactor Building and any other structure for which continuing characterization data may now be available. This evaluation should focus on the differences in samples between buildings where insignificant radionuclides were positively detected. The licensee should discuss how the assumed IC dose of 5 percent is protective for all basements and structures which will remain, whether it would be more appropriate to increase this assumption for all basements, and/or whether it is appropriate to identify different IC contributions for different areas of the LACBWR site.

LACBWR Response (PAB 1a) – The conversion factor was calculated for a nominal 1 cm thickness in concrete over a surface area of 1 m^2. To more closely link the assumed depth to the core data, the calculations provided in Revision 4 of RS-TD-313196-001 (submitted with these RAI responses) were revised to replace the nominal 1 cm thickness with the 1.27 cm core thickness. The 1.27 cm thickness is a reasonable assumption for calculating volumetric activity because 98% of the total activity in the two core layers analyzed (0 cm -1.27 cm depth and 1.27 cm - 2.54 cm depth) was found in the 0-1.27 cm core layer. Less than 2% of the activity was found in the 1.27 cm - 2.54 cm core layer. An insignificant percentage of activity was found below 2.54 cm.

The conversion factor and equation for the original conversion factor was:

$$2.35x10^4 \ = 1\,\frac{pCi}{g} * \ 1\,cm * 1\,m^2 * \ 1x10^4\,\frac{cm^2}{m^2} * 2.35\,\frac{g}{cm^3}$$

The revised conversion factor and equation used in RS-TD-313196-001, Revision 4 is:

$$2.98x10^4 = 1\,\frac{pCi}{g} * \ 1.27\,cm * 1\,m^2 * \ 1x10^4\,\frac{cm^2}{m^2} * 2.35\,\frac{g}{cm^3}$$

LACBWR Response (PAB 1b) – The initial submittal of the LTP included the analysis of 20 concrete core pucks collected from 12 locations in the Reactor Building (Rx Bldg), Waste Treatment Building (WTB), and Pipe Tunnels (collected in 2015) as documented in Revision 1 to RS-TD-313196-001. In that analysis, we evaluated the average activity concentrations and, from this, determined the IC dose percentages. This approach did not provide reasonable assurance that the relative IC dose percentage would not exceed 5%. Since that submittal and since the communications of concerns about the adequacy of the limited number of samples, we have collected an additional 18 concrete core samples from 18 discrete locations in the Rx Bldg and Waste Gas Tank Vault (WGTV). An alternate analysis was subsequently performed in Revisions 2 and 3 to RS-TD-313196-001 using all 38 samples. The results of our analysis are summarized below but the full analysis is provided in Revision 4 to RS-TD-313196-001. We have also changed the IC dose percentage criteria from 5% to 10%.

In the updated analysis, we provided 3 different methods of calculating the activity fractions as compared to Revision 1 to RS-TD-313196-001. These three methods are summarized as follows:

1. The first was to calculate the radionuclide activity fraction, $fA_{i,j,k}$, for each sample, j, each radionuclide, i, within each population, k, from the reported radionuclide activity concentrations, $C_{i,j,k}$, using Equation 1 and then calculating the average activity fraction, $fA_{i,j,k}$, for each radionuclide, i, and population, k, of N samples using Equation 2.

$$fA_{i,j,k} = \frac{C_{i,j,k}}{\sum(j)C_{i,j,k}} \qquad \text{Equation 1}$$

$$fA_{i,k} = \frac{\sum(j)fA_{i,j,i}}{N} \qquad \text{Equation 2}$$

2. The second was to calculate the 75th percentile of the population of samples from Equation 1 above. Once the 75th percentile fraction were calculated for each radionuclide, $f_{i,k,.75}$, data set was re-normalized to determine the percentile-based activity fractions, $fA_{i,k,.75}$ using Equation 3.

$$fA_{i,k,.75} = \frac{f_{i,j,k,.75}}{\sum(j)fA_{i,j,k,.75}} \qquad \text{Equation 3}$$

3. The third was to calculate the individual radionuclide ratios to Cs-137 for each sample, $R_{i,Cs\text{-}137,j}$, calculate the 75th percentile for the sample group, $R_{i,Cs\text{-}137,k,.75}$ then renormalize to determine the activity fractions, $f_RA_{i,k,.75}$ using Equation 4.

$$f_RA_{i,k,.75} = \frac{R_{i,Cs-137,k,.75}}{\sum(i)R_{i,Cs-137,k,.75}} \qquad \text{Equation 4}$$

These three methods differ from the analysis method performed for 12 cores results in Revision 1 to RS-TD-313196-001 where the radionuclide ratios effectively represented activity-weighted averages which provided a higher weighting to those samples with higher activity. The analyses described above remove the activity weighting and give equal statistical weight to each of the sample results. Also, our analysis applies the actual reported activity concentrations in the calculation of activity fractions regardless of whether the reported activity was less that detectability criteria. We believe this approach is statistically appropriate for a population of 38 sample results for each radionuclide.

The evaluation provides the activity fractions of the three methods for the three-potential source-terms of Soils, the Rx Bldg., and the WGTV separately, for the IC dose analysis. The IC dose analysis shows that there is an insignificant difference in the methods 2 and 3 above, and Method 2 was chosen as a conservative approach. This analysis shows that the IC dose fraction ranges from 0.3% to 2.56% (not including negative reported concentrations or the presence of Np-237) where the highest fraction is from using the 75th percentiles of the average reported fractions.

Our analysis then includes the possible presence of Np-237 since its DCGL is the lowest of the initial suite of radionuclides. It is important to note here that Np-237 was not detected in any of the 38 samples from both characterization campaigns. In fact, the average reported concentration was very close to zero (slightly negative). However, we included a possible contribution from Np-237 by applying the maximum MDC value from all 38 analysis results and re-casting the IC dose analysis. This final analysis evaluated the additional contribution from Np-237 (despite the lack of detection of this radionuclide) for each of the methods used in determining the nuclide fractions and shows that the IC dose fraction could range from 0.71% to 7.3% depending on the method applied where the 7.3% contribution is from using the 75th percentile of the activity average fractions. The compares well to the IC fraction of 7.14% for the method using the activity fractions to Cs-137.

In the final analysis, the administrative adjustment of 10% for the IC dose contribution sufficiently bounds the IC dose fractions from each source and for each statistical analysis method. We believe this adjustment sufficiently bounds the IC dose fraction such that all surveys will adequately account for the presence of IC radionuclides

LACBWR Response (PAB 1c) – As described in our response to PAB 1b, we have recently collected an additional 18 concrete cores samples from 18 different locations within the Rx Bldg. and the WGTV. When combined with the previous 20 sample results, we now have a total of 38 samples collected from the pipe tunnel, the WGTV, WTB and the Rx Bldg. Also, as noted above, the analysis of these 38 results is provided in Revision 4 to RS-TD-313196-001. This analysis establishes three radionuclide mixtures: soils, WGTV, and Rx Bldg. The soil mixture is a combination of all 38 samples since there is no reliable indicator of the origination of potential residual radioactivity in site soils and is likely best represented by the aggregate of the mixtures using radionuclide fractions.

In Revision 4 to RS-TD-313196-001, we evaluated each of the three radionuclide mixtures using three statistical methods as described in our response to PAB 1b above. This evaluation includes the IC dose contribution and includes Np-237 despite the lack of positive detections for this radionuclide. Also, as noted above, we have increased the IC dose contribution from 5% to 10% and we provide a statistical evaluation in Revision 4 to RS-TD-313196-001 that shows that the 10% criteria is reasonable and bounding for different areas of the LACBWR site.

NRC Comment (PAB 2): **Additional information is needed to evaluate whether Neptunium-237 should be considered a radionuclide of concern (ROC).**

Basis: NUREG-1757, Volume 2, Appendix O, Question 2, states that "it is incumbent on the licensee to have adequate characterization data to support and document the determination that some radionuclides may be deselected from further detailed consideration in planning the FSS." From the information presented in the LTP, it is unclear whether Np-237 should be included in the initial suite of radionuclides and/or the radionuclides of concern. Np-237 appears on Page 2-49 of the LACBWR LTP, Table 2-7 (Initial Suite of Radionuclides); however, it is not listed in Table 6-3 (Initial Suite of Potential Radionuclides and Mixture Fractions).

Np-237 also appears in the Historical Site Assessment (HSA) in the list of the initial suite of radionuclides and in Reference LC-RS-PN-164017-001. The HSA does not include Np-237 in the list of radionuclides considered for discounting. However, the HSA identifies Np-237 as an additional radionuclide in NUREG/CR-3474, "Low-Level Radioactive Waste Classification, Characterization, and Assessment: Waste Streams and Neutron-Activated Metals," to be considered in the initial suite.

From the description of the process described in RS-TD-31319-001, Revision 1, it is not clear why Np-237 would not be included in the initial suite of radionuclides. Radionuclides with half lives of two or more years identified in NUREG/CR-4289, "Residual Radionuclide Contamination Within and Around Commercial Nuclear Power Plants," as being present in boiling water reactors (BWRs) were compared with the list of radionuclides in NUREG/CR-3474, and those which were not already in the initial suite were added Np-237 was identified in samples from the Dresden Generating Station (BWR) in NUREG/CR-4289 and its half-life is greater than 2 years, so it seems that Np-237 should have been included in the initial suite of radionuclides during this step for the LACBWR site.

It appears that the licensee is relying on the activities estimated for the spent fuel inventory from LACBWR, as listed in Table 5 of RS-TD-31319-001 (LAC-TR-138 Report, Spent Fuel Inventory Radionuclides), to discount Np-237. This reference states that the "radioactivity inventory in the 333 spent fuel assemblies was performed by using the computer program Fact 1 and hand calculations performed by Dr. S. Raffety (Nuclear Engineer) during July of 1987. Activity in the fuel assemblies' hardware is based on neutron activation of this hardware. All activity values have been decay corrected to January 1988." The associated table shows that Np-237 was less than 0.01 percent of the total activity. However, the licensee does not adequately explain why the LACBWR spent fuel inventory would be representative of the end state of the facility during decommissioning. In addition, this approach is not consistently applied to all radionuclides, since several of the radionuclides that were also below 0.01 percent relative activity were included in the initial suite for other reasons (e.g., tritium (H-3), Niobium-94 (Nb-94), Europium-154 (Eu-154), and Americium-243 (Am-243)).

The NRC staff also noted that the licensee calculated dose-to-source ratios (DSRs) for Np-237 for the soil model and basement fill model (BFM), and these are shown in the RESRAD output sheets. The Kd factor assigned for Np-237 in these RESRAD analyses is 5 cubic centimeters per gram (cm^3/g), based on the mean sand soil Kd values (Sheppard and Thibault, Table A-1, 1990). The licensee analyzed for Np-237 in the 12 concrete cores, although it was not measured above the MDC in any of the cores. However, there are still onsite areas which the licensee has not characterized.

Path Forward:

a. Analyze the significance of Np-237 as a potential radionuclide of concern, as it was analyzed for the initial suite of radionuclides. This analysis should incorporate an appropriate Kd value for the radionuclide in accordance with the guidance from NUREG/CR-6697, "Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes." In other words, if the Kd is a sensitive parameter for Np-237, it should be assigned the 25th percentile value as opposed to the mean value.

b. Describe any additional commitments for sampling for Np-237 during continuing characterization activities and/or FSS that would be used to show that the dose contribution from Np-237 is not significant.

LACBWR Response (PAB 2a) – Np-237 was added to the initial suite and included in the uncertainty analyses that were rerun using the conceptual model which was revised in response to HYDRO-1 and PAB 6, i.e., groundwater elevation of 629 foot and combining the saturated and unsaturated zones into one model. The appropriate Kd values were selected based on the uncertainty analysis results. Np-237 was also included in the evaluation of IC dose and the selection of Radionuclides of Concern (ROC).

LACBWR Response (PAB 2b) – For continuing characterization, 10% of all media samples collected in a survey unit during continuing characterization will be analyzed for HTD radionuclides. In addition, a minimum of one sample beyond the 10% minimum will be selected at random, also for HTD radionuclide analysis. All samples will first be analyzed by the on-site gamma spectroscopy system. The sample(s) selected for HTD analysis to meet the 10% requirement will be from the highest gamma activity of the sample population; however additional samples (above 10%) will be sent if they exhibit sufficient activity such that the HTD ROC's will likely be detectable by the laboratory using the nominal surrogate ratios and MDCs. In the absence of detectable gamma activity, locations will be selected based on the potential for the presence of activity using HSA information or other process knowledge data. All samples selected for HTD analysis during continuing characterization will be analyzed for the full suite of radionuclides from Table 5-1. Additional discussion is provided in the response to PAB 5a, 5b and 5c.

NRC Comment (PAB 3): **Provide additional support for why Europium-152 (Eu-152) and Europium-154 (Eu-154) are considered insignificant.**

Basis: NUREG-1757, Volume 2, Appendix O, Question 2, states that "it is incumbent on the licensee to have adequate characterization data to support and document the determination that some radionuclides may be deselected from further detailed consideration in planning the FSS." Table 13 of RS-TD-31319-001, Revision 1, states that "the presence of Eu-152 in this sample [Reactor Biological Shield Activation Survey] as well as another concrete sample (10 CFR 61 [Licensing Requirements for Land Disposal of Radioactive Waste] analysis of the Lower Cavity Shield Block concrete) confirms that Eu-152 should be included in the Radionuclides of Concern. With a 13.6 year half-life, Eu-152 would still be a constituent in activated concrete sections at LACBWR that may be handled in any dismantlement activities in 2015." It is unclear why the licensee is not following the guidance established in this quote from RS-TD-31319-001, Revision 1.

The NRC staff notes that Eu-152 and Eu-154 were not found above MDC levels in the 12 concrete core samples. However, there are areas of the LACBWR site that have not yet been characterized, including the underlying concrete in the Reactor Building basement that will be exposed after liner removal. Chapter 2 of the LACBWR LTP states that most of the activated concrete will be removed from the Reactor Building. Specifically, "after the thermal shield is removed, the remainder of the interior concrete will be removed, completely exposing the steel liner. Subsequent to interior concrete removal, the remaining portion of the steel liner will be removed...The remaining structural concrete outside the liner below the 636 foot elevation (i.e., the concrete "bowl" below the 636 foot elevation, concrete pile cap and piles) will remain and be subjected to a FSS in accordance with LTP Chapter 5." Since this concrete in the Reactor Building has yet to be characterized, the basis for not including Eu-152 and Eu-154 as radionuclides of concern is not clear.

Section 5.5.1.2 of the LACBWR LTP states that "all contaminated concrete will be removed from the Reactor Building basement. Once the concrete and the liner are removed, it is anticipated that the residual radioactivity source term in the remaining Reactor Building basement structure will be minimal. Continuing Characterization of the Reactor Building Basement will be performed after concrete and liner removal to confirm assumption that minimal residual radioactivity will remain. The Continuing Characterization Plans and Reports will be provided for NRC information." It is unclear how this claim of entire removal of contaminated concrete is justified and how this assumption impacts the overall classification of the Reactor Building. (See PAB-13 on basement classification and survey coverage).

Path Forward:

a. Describe continuing characterization plans for verifying that the doses from Eu-52 and Eu-154 are insignificant, or treat these as radionuclides of concern in appropriate areas during FSS activities at LACBWR.

LACBWR Response (PAB 3a) – Eu-152 and Eu-154 will be included as ROC for all media including basements, soil, buried pipe and above grade buildings.

NRC Comment (PAB 4): Additional information is required to evaluate the dose from the Alternate Gardener Scenario.

Basis: NUREG-1757, Volume 2, Revision 1, Page 5-24 states that "if the licensee evaluated scenarios based on reasonably foreseeable land uses, the licensee needs to provide either a quantitative analysis of or a qualitative argument discounting the need to analyze all scenarios generated from the less likely but plausible land uses. The results of these analyses will be used by the staff to evaluate the degree of sensitivity of dose to overall scenario assumptions (and the associated parameter assumptions). The reviewer will consider both the magnitude and time of the peak dose from these scenarios. If peak doses from the less likely but plausible land use scenarios are significant, the licensee would need to provide greater assurance that the scenario is unlikely to occur, especially during the period of peak dose."

1. The LACBWR LTP states that the "reasonably foreseeable scenario" for the La Crosse site is industrial use, while residential land use is categorized as "less likely but plausible" in accordance with the NUREG-1757, Table 5.1 definitions. Section 6.15 of the LACBWR LTP describes the alternate scenario calculations for a Resident Gardner (the "less likely but plausible scenario").

The following scenarios were evaluated by the licensee:

1. Soil Conceptual Model for Resident Gardener with two source term assumptions:
2. Assuming the maximum concentrations from characterization (0.68 mrem/yr).
3. Applying Industrial Soil DCGLs and assuming a mixture percentage of ROCs so in total the concentrations are equivalent to 25 mrem/yr for industrial use (32.44 mrem/yr).
4. Waste Treatment Building Groundwater + WTB Drilling Spoils for Resident Gardner (In situ) (0.091 mrem/yr).
5. Excavation of the WTB surface concentrations assuming that the radionuclides homogeneously mix with all the fill volume of the WTB for the Resident Gardener (43.38 mrem/yr).

The primary reasons the Resident Gardener calculations provided in the LACBWR LTP are not adequate are as follows:

- The impact of uncertainty in the radionuclide mixture fractions on dose is not evaluated.
- The parameter values are not fully explained, and the licensee did not perform a separate sensitivity analysis to define parameters or find new sensitive parameters.
- The calculations are only for the three ROCs, and not the entire suite of radionuclides.
- Doses are only estimated for the WTB basement, and no other basements. Given that the WTB DCGLs were not the highest for all basements, and that the WTB will no longer remain, this is no longer relevant.
- The excavation of concrete with surface contamination unrealistically and non-conservatively assumes full mixing with the fill volume.

Reference RS-TD-313196-004 states that the alternate scenario dose assessments included the ROC at their respective mixture fractions as listed in Table 22. However, Table 22 of RS-TD-313196-004 is titled "Soil Area Factors." This is a typo and should be clarified to point to the correct table, which the NRC staff assumes is Table 6-20, titled "ROC and Insignificant Radionuclide Mixture Fractions," of the LTP.

Reference RS-TD-313196-004, Attachment 14, provides the details of the Alternate Scenario Calculations. In Attachment 14, a table titled "Calculation of Soil Concentrations Resulting in 25 mrem/yr in Industrial Scenario" contains the following notes: "Note 1: The concentrations in this column were determined in an iterative manner by adjusting the Cs-137 concentration until the check calculation equals 25 mrem/yr. Note 2: [Strontium-90] (Sr-90) value is mean Sr-90/Cs-137 ratio calculated from Sr-90 ratio in each of the 20 cores analyzed for HTD Reference TSD RS-TD-313196-001, Revision 2." It appears that a hypothetical maximum concentration was applied based on the ratio of Sr-90/Cs-137 in the 12 concrete cores (20 pucks). However, the sensitivity of dose due to uncertainty in the mixture percentage is not evaluated.

Chapter 6 of the LACBWR LTP describes how the Resident Gardener soil dose was calculated with the RESRAD deterministic parameters used for the Industrial Use soil dose assessment with limited metabolic and behavioral parameter changes (from NUREG/CR-5512, "Residual Radioactive Contamination from Decommissioning"). The parameters changes are:

- Contaminated Zone Thickness – 0.15 meter
- Inhalation Rate – 8400 cubic meters per year
- Fraction of Time Spent Indoors – 0.649
- Fraction of Time Spent Outdoors – 0.124
- Fruit, Vegetable, and Grain Consumption – 112 kilograms per year
- Leafy Vegetable Consumption – 21.4 kilograms per year
- Drinking Water Intake – 478 liters per year
- Depth of Roots – 1.22 meters

Since the Resident Gardener Scenario involves different dose pathways, the sensitivity of parameters may not remain the same as in the Industrial Scenario. Furthermore, the licensee only analyzes Cobalt-60 (Co-60), Cs-137, and Sr-90 as contaminants for the alternate scenario. This alternate scenario should be conducted with the full initial suite of radionuclides

Reference RS-TD-313196-004, Revision 1, states that "the WTB was used for the assessment since it is projected to contain the majority of residual radioactivity at license termination." The WTB DCGLs do not represent the highest DCGLs proposed, and the WTB is no longer going to remain on site; therefore, the Alternative Scenario Dose should be assessed for each set of DCGLs proposed for the remaining basements (i.e., Reactor Building, Waste Gas Tank Vault (WGTV), and Remaining Structures) to ensure the limiting dose is assessed.

The drilling spoils dose for the WTB is the (Maximum Concentration (pCi/g) divided by the Drilling Spoils DCGL for Industrial Use for the WTB (pCi/g per 25 mrem/yr))*(the ratio of the Adjusted Industrial Soil DCGL to the WTB Resident Gardener Soil Concentration corresponding to 25 mrem/yr). RS-TD-313196-004, Revision 1, Attachment 14, has the following basis for the Drilling Spoils adjustment: "The dose adjustment factor for the alternate scenario dose calculation for drilling spoils is based on the ratio of the LACBWR Adjusted Soil DCGL to the Resident Gardener Alternate Scenario concentration corresponding to 25 mrem/yr. This is conservative because the actual dose from the Resident Gardener scenario from drilling spoils would be less than the ratio of full area dose because the Resident Gardener area factors would be greater than the industrial scenario area factors due to the effect of source area on plant ingestion dose." Instead of multiplying by the ratio of the Soil DCGLs, a more transparent and defensible analysis would involve running the soil Resident Gardener RESRAD model with a reduced area of 0.457 m^2 in order to find the concentrations equivalent to 25 mrem/yr. Then the maximum concentrations could be divided by this concentration to find the drilling spoils dose without the need to multiply by an adjustment ratio.

The licensee provides the following explanation for the evaluation of the excavation doses under the Resident Gardener Scenario: "Because the BFM Excavation conceptual model is based on the limitation that the excavated concrete would not exceed the soil DCGLs, the maximum Resident Gardener dose from excavated concrete would be the same as that calculated for soil. However, the dose from concrete would be less since plants cannot be grown in concrete." The estimate of excavation doses for the Resident Gardener are non-conservative for the same reasons they are non-conservative for the Industrial Use Scenario. (See PAB-7 on the Excavation Scenario.)

To derive the Excavation DCGLs, the licensee starts with the Surface Soil DCGL concentrations in pCi/g and finds the total Curies associated with the total volume of concrete in the basement. This activity is homogeneously distributed over the entire surface area of the basement. So, in essence, the intruder is assumed to excavate all the surfaces and total volume of concrete in a basement, and homogeneously mix it to obtain a concentration in pCi/g. The concrete is assumed to act like soil, which is a conservative assumption. However, this analysis dilutes, to an unrealistic extent, the source term. The licensee also performs a second excavation analysis where the intruder is assumed to excavate the fill material. The fill material is assumed to be at concentrations derived by homogeneously mixing the WTB Surface DCGLs for the Industrial Scenario across the entire fill volume. This is also non-conservative because realistically, the source term will not evenly distribute across the entire fill volume. Therefore, the excavation scenario for the Resident Gardner should be reevaluated using more reasonable dilution assumptions.

Path Forward:

a. Describe the technical basis for the hypothetical maximum concentrations assumed for the Resident Gardener Scenario. Analyze the sensitivity of the dose to the uncertainty in the radionuclide mixture fractions, and thus maximum concentrations, assumed. Alternatively, describe how the maximum concentrations assumed reflect the actual maximum concentrations per radionuclide that will be allowed to be left at the site at license termination.

b. Show that sensitive parameters for the Resident Gardener Scenario are defined according to the guidance in NUREG-1757 and NUREG/CR-6697. Perform a Sensitivity Analysis for the Resident Gardener Scenario to identify sensitive parameters and determine their appropriate values.

c. Reevaluate the Resident Gardener Groundwater Dose for each set of $DCGL_b$s and Soil DCGLs proposed for the full initial suite of radionuclides (i.e., Soil, Reactor Building, WGTV, and Remaining Structures). The analysis should provide a technical basis for the maximum hypothetical concentrations assumed that takes into account uncertainty in the mixture percentages and applies a conservative mixture percentage. (For undetected radionuclides, the concentration assumed may be based on the MDC value for each radionuclide).

   The analysis should also incorporate any relevant parameter changes resulting from analyses related to other RAI responses (e.g., groundwater elevation). For example, for the Reactor

Building, a Resident Gardener Dose should be calculated for a conceptual model that models the Reactor Building as one building, using an appropriate value for groundwater elevation. The analysis should assign appropriate values for the sensitive parameters identified.

d. Reevaluate the Resident Gardener Drilling Spoils Dose by running RESRAD using a method similar to that implemented to calculate the Drilling Spoils DSRs for the industrial scenario, with the decreased contaminated zone area of 0.457 m^2, but with the appropriate sensitive parameters and pathways turned on for the Resident Gardener. Use those revised DSRs to calculate a drilling spoils dose assuming the maximum concentration, which considers a conservative mixture percentage for the radionuclides.

e. Reevaluate the Excavation Resident Gardener Dose using the revised Resident Gardener Soil DSRs and a concentration that assumes the Industrial Surface $DCGL_{b,}$ at a conservative mixture percentage. The analysis should consider a reasonably conservative dilution with fill volume as opposed to full mixing with the entire fill volume (See PAB-7 related to check calculations for the Excavation DCGLs). The analysis should be done for each set of $DCGL_b$ (or the most limiting concentration across basements).

f. Calculate the dose attributable to the insignificant radionuclides from the revised Resident Gardener Scenarios for the basement and Soil DCGLs for the Groundwater, Drilling Spoils, and Excavation Scenarios. Compare any differences to the insignificant radionuclides identified for the Industrial Use Scenario and assumed dose percentage contribution of insignificant radionuclides (5 percent). Discuss how the surveys during continuing characterization and FSS will ensure that the percentage assumed is adequate.

LACBWR Response (PAB 4a) - The uncertainty in radionuclide mixture fractions is discussed in response to PAB 1b and 1c. The sensitivity of Resident Gardener Scenario maximum concentrations and dose to the uncertainty in the radionuclide mixture fractions is conservatively addressed by applying the 75th percentile of the “Cs Ratio” mixture in the calculations. In addition, the Resident Gardener “Alternate Scenario DCGL” values assigned to the ROC used to calculate the dose were adjusted by an Insignificant Contributor (IC) dose that was calculated specifically for the Resident Gardener scenario using the 75th percentile Cs Ratio mixture.

The inputs and calculation results of the hypothetical maximum concentrations applied in the Resident Gardener Scenario is provided in Energy*Solutions* TSD RS-TD-313196-004, “LACBWR Soil DCGL, Basement Concrete DCGL, and Buried Pipe DCGL”, Revision 3, Attachment 13. As an example, the inputs and results of the calculation of the maximum ROC concentrations allowed to remain in the Reactor Building (are reproduced in Table 1. The maximum concentrations (i.e., those corresponding to 25 mrem/yr) were calculated using the BFM $DCGL_B$, the 75th percentile Cs Ratio mixture, and the sum of fractions (SOF) calculation (including all ROC). The same calculation was applied to the WGTV and soil to determine hypothetical maximum concentrations by replacing the DCGLs in Column D with the applicable DCGL.

Table 1 – Copy of Cell Array A15:F22 from Spreadsheet "Calculations in Support of TSD RS-TD-313196-004 Revision 3" worksheet "Alternate Scenario"

	A	B	C	D	E	F
15	**Concentrations Corresponding to 25 mrem/yr in BFM Rx Bldg Based on $DCGL_B$**					
16	**ROC**	**Relative Dose Fraction**	**Normalized Dose Fraction**	**BFM $DCGL_B$ (pCi/m^2)**	**pCi/m^2 corresponding to 25 mrem/yr in BFM (Dose From All ROC Summed)**	**BFM Dose Check (mrem/yr)**
17	Co-60	8.02E-09	2.51E-01	5.86E+06	1.472E+06	6.28
18	Sr-90	3.10E-09	9.71E-02	1.65E+07	1.603E+06	2.43
19	Cs-137	2.05E-08	6.41E-01	2.47E+07	1.583E+07	16.02
20	Eu-152	1.40E-10	4.37E-03	1.35E+07	5.912E+04	0.11
21	Eu-154	2.05E-10	6.41E-03	1.25E+07	8.022E+04	0.16
22	sum	3.19E-08	1.00			25.00

The equations used to calculate the values in each column of Table 1 are provided below:

Equation 1

$$Relative\ Dose\ Fraction_i = \frac{F_i}{DCGL_{B,i}}$$

where:

Relative Dose $Fraction_i$	= Relative Dose Fraction of radionuclide (i)
F_i	= Mixture fraction for radionuclide (i)
$DCGL_{B,i}$	= $DCGL_B$ for radionuclide (i) (clmn 4)

Equation 2

$$Normalized\ Dose\ Fraction_i = \frac{Relative\ Dose\ Fraction_i}{\sum_{i=1}^{n} Relative\ Dose\ Fraction_i}$$

where:

Normalized Dose $Fraction_i$	= Normalized Dose Fraction for radionuclide (i)
Relative Dose $Fraction_i$	= Relative Dose Fraction of radionuclide (i)
Σ Relative Dose $Fraction_i$	= Summation of Relative Dose Fractions for all ROC

Equation 3

$$pCi/m^2\ BFM_i = Normalized\ Dose\ Fraction_i * DCGL_{B.i}$$

where:

pCi/m^2 BFM_i	= pCi/m^2 concentration for each radionuclide (i) that will result in 25 mrem/yr when the sum of fractions approach is applied including all ROC
Normalized Dose $Fraction_i$	= Normalized Dose Fraction for radionuclide (i)
$DCGL_{B,i}$	= $DCGL_B$ for radionuclide (i)

Equation 4

$$BFM\ Dose\ Check\ = \frac{pCi/m^2\ BFM_i}{DCGL_{B,i}} * 25$$

where:

BFM Dose Check	= Check sum to confirm that the SOF calculation will result in 25 mrem/yr using the concentrations in clmn 5
$pCi/m^2\ BFM_i$	= Concentration of radionuclide (i) in clmn 5
$DCGL_{B,i}$	= $DCGL_B$ for radionuclide (i)
25	= 25 mrem/yr dose criteria

LACBWR Response (PAB 4b) - A full uncertainty analysis of the Resident Gardener Scenario, including all radionuclides in the initial suite, was performed using the guidance in NUREG-1757 and NUREG/CR-6697. The uncertainty analysis was performed for soil and the two basements to remain, i.e., Reactor Building and WGTV. The uncertainty analyses methods and results are described in RS-TD-313196-004 "LACBWR Soil DCGL, Basement Concrete DCGL, and Buried Pipe DCGL", Revision 3, Sections 9.1 and 9.2. The results are listed in Tables 31-34.

The information provided in RS-TD-313196-004, Rev. 3, Sections 9.1 and 9.2 will be included in LACBWR LTP Rev. 1.

LACBWR Response (PAB 4c) – Resident Gardener dose was recalculated using the Alternate Scenario DCGLs for Basement Groundwater and Soil that were determined using the parameters selected through uncertainty analysis (see response PAB 4b). The revised Alternate Scenario DCGL calculations assume a groundwater elevation of 629 foot which is the periodic maximum measured in site monitoring wells.

The Alternate Scenario DCGLs used in the Resident Gardener dose assessment were adjusted for an IC dose that was calculated specifically for the Resident Gardener Scenario (including Np-237). See Section 9 and Attachment 13 of RS-TD-313196-004, Rev. 3 for additional details and results. The information provided in RS-TD-313196-004, Rev. 3, Section 9 will be included in LACBWR LTP Rev. 1.

The maximum concentrations applied in the revised Resident Gardener dose assessments are based on the $DCGL_B$ values and soil DCGLs and conservative mixture fractions. See response to PAB 1b and 1c, for discussion of mixture uncertainty and the process for selecting a conservative mixture. The method for calculating the maximum concentrations is described in response to PAB 4a.

The revised Resident Gardener doses are reported in Section 9.4 of RS-TD-313196-004, Rev. 3 which is reproduced below:

> *The Resident Gardener dose, after 30 years decay, was evaluated for soil and basements. The maximum soil dose is 27.07 mrem/yr. The maximum basement doses are 28.4 mrem/yr and 34.9 mrem/yr, for the Reactor Building and WGTV, respectively. These doses are not considered significant and therefore greater assurance that these scenarios will not occur is not necessary. However, adjustments were made to the soil and basement DCGLs to ensure that no Alternate Scenario dose exceeds 25 mrem/yr.*

The information in Section 9 of RS-TD-313196-004, Rev. 3 will be included in LACBWR LTP Rev. 1.

LACBWR Response (PAB 4d) – The Resident Gardener Drilling Spoils dose was reevaluated using DSRs calculated with the parameter set derived through sensitivity analysis of the resident gardener scenario (see response to PAB 4b) and an area of 0.457 m^2. The revised Resident Gardener Drilling Spoils DSRs were used to calculate drilling spoils dose. The maximum concentrations assumed in the revised dose assessment considered uncertainty in the mixture and applied a conservative mixture percentage as discussed in response to PAB 1b, 1c, and 4a. See Section 9.2.2 of TSD RS-TD-313196-004, Rev. 3 for a detailed discussion of the Resident Gardener Drilling Spoils dose calculation. The conclusion of Section 9.2.2 is reproduced below:

> *The revised Resident Gardener Insitu Drilling Spoils doses (after 30-year decay) for the Reactor Building and WGTV are 0.25 mrem/yr and 0.35 mrem/yr, respectively.*

The information in Section 9 of RS-TD-313196-004, Rev. 3 will be included in LACBWR LTP Rev. 1.

LACBWR Response (PAB 4e) – The revised Resident Gardener Soil DSRs were used to reevaluate the Excavation Resident Gardener Dose. The maximum concentrations applied in the dose assessment were based on the Industrial Use $DCGL_B$ values and a conservative mixture percentage based on the 75th percentile of the Cs Ratio mixture (see response to PAB 1b, 1c, and 4a for basis of mixture and maximum concentrations). The analysis was based on reasonably conservative dilution with partial fill volume as opposed to full mixing with the entire fill volume (see response to PAB7). The analysis was performed separately for the WGTV and Reactor Building sets of $DCGL_B$.

The revised calculations of radionuclide concentrations in excavated concrete and fill are described in Section 3.2 and Section 8, respectively, of RS-TD-313196-004, Rev. 3. The revised calculations of the Excavation Resident Gardener dose for concrete and fill are described in Section 9.2.3, Section 9.3 and Attachment 13 of RS-TD-313196-004, Rev. 3. The conclusions of these sections are reproduced below:

Section 9.2.3:

> *The alternate scenario concrete excavation dose calculations and the corresponding inputs are provided in Attachment 13. The Resident Gardener Concrete Excavation dose (after 30-year decay) for the Reactor Building and WGTV are 20.7 mrem/yr and 25.9 mrem/yr, respectively.*

Section 9.3:

> *The doses from excavated fill (after 30-year decay) were 6.3 mrem/yr and 8.0 mrem/yr for the Reactor Building and WGTV, respectively.*

LACBWR Response (PAB 4f) –

The dose from insignificant contributors was calculated for the revised Resident Gardener scenario for the basements (Reactor Building and WGTV) and soil. See Section 9 of TSD RS-TD-313196-004, Rev. 3 for detailed discussion of the revised uncertainty analysis and results. The Alternate Scenario DCGLs were adjusted using the actual calculated IC dose percentages which were 6.95%, 14.14%, and 0.314% for the Reactor Building, WGTV, and soil, respectively. Note that 7.9% of the 14.14% assigned to the WGTV was due to Np-237 which was assumed to be present at the MDC. As discussed in response to PAB 1b, Np-237 was not detected in any of the 38 core samples collected from basement concrete. The calculated WGTV IC dose could be decreased by approximately an order of magnitude by recounting the WGTV samples to achieve lower Np-237 MDCs but the 14.14% value was conservatively applied. The WGTV core samples will be reanalyzed for Np-237 to achieve a lower MDC and reduce the 7.9% value. However, for conservatism and to avoid unnecessary rework of calculations and document revisions, the 14.14% IC dose will continue to be used to adjust the WGTV Alternate Scenario DCGLs.

The confirmation of the IC dose percentage applied to the Industrial Use compliance scenario that will be made during continuing characterization is assumed to also serve as confirmation of the Alternate Scenario IC dose percentage. If the IC dose assigned to the Industrial Scenario id found to require adjustment, then the IC dose assigned to the Resident Gardener Alternate Scenario will be reevaluated.

NRC Comment (PAB 5): Additional information is needed regarding continuing characterization, specifically when samples will be analyzed for the full initial suite of HTDs.

Basis: In accordance with 10 CFR 50.82, the license termination plan must include a site characterization. NUREG-1700, Revision 1, “Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans,” states that the NRC staff should review the licensee's site characterization plans and site records (as required under 10 CFR 50.75(g)). Section 5.3.4.4 of the LACBWR LTP states that “Continuing Characterization Plans and Reports will be provided to the NRC for information.” The licensee is not committing to submit continuing characterization plans to the NRC for review and/or approval, but only the results.

Chapter 2 of the LACBWR LTP lists the five areas at the La Crosse site that will undergo continuing characterization and states that “the continuing characterization data will be used to confirm the classification of the inaccessible areas and identify areas requiring remediation. At least one sample from each of the inaccessible areas listed above will be analyzed for the full initial radionuclide suite including HTD.” The five areas are as follows:

1. WGTV interior structural surfaces
2. Underlying concrete in the Reactor Building basement after liner removal
3. Soil under the Turbine Building (suspect broken drain line)
4. Soil adjacent to and beneath basement structures
5. Interior of buried pipe that may remain

Given that some of these areas are broadly defined (i.e., soil adjacent to and beneath basement structures, or interior of buried pipe that may remain), more information is necessary for the NRC staff to complete its review of the adequacy of the continuing characterization for these areas, including the technical basis for why a minimum of one sample to be analyzed for the initial suite of radionuclides from each area is sufficient.

In addition, the commitment in Chapter 2 to take at least one sample from each inaccessible area and analyze it for the full suite of radionuclides is not in agreement with commitments in Chapter 5 of the LACBWR LTP. Section 5.1 of the LTP states:

If any continuing characterization sample and/or measurement is taken in soil or buried pipe, and the result indicates a [sum of fractions] (SOF) in excess of 0.5 based on gamma spectroscopy results (and inferring Sr-90), then a sample will be collected at the location of the highest accessible individual measurement and analyzed for HTD radionuclides. In this unlikely situation, if the analysis indicates HTD radionuclides (other than Sr-90) at concentrations exceeding the MDC, then the insignificant contributor dose will be calculated using the core data.

If the insignificant contributor dose from the sample is less than the insignificant contributor dose assigned for DCGL adjustment (see LTP Chapter 6, Section 6.13.1), then the current adjustment to the soil or buried pipe DCGLs will be retained. If the insignificant contributor dose from the continuing characterization soil or buried pipe sample is greater than the insignificant contributor dose assigned for DCGL adjustment, then the soil or buried pipe DCGLs for the affected survey unit will be re-adjusted to account for the increased dose. It is possible, but not likely, that the data could indicate different ROC for the area where the additional characterization data was taken. If so, the specific ROC will be applied to the survey unit.

Similarly, Section 6.18.1 of the LTP states:

> As discussed in LTP Chapter 5, if continuing characterization is performed for buried pipe and the results indicate that the buried piping dose could exceed 50 percent of the 25 mrem/yr dose criterion, then samples will be analyzed for HTD radionuclides and additional assessments performed.

It is unclear why the licensee has committed to taking a minimum of one sample for HTDs per inaccessible area without any dependency on the SOF, but also states that one sample will be analyzed for HTDs from the location of highest measurement only if the SOF > 0.5 for soil and buried pipe. In addition, three out of the five inaccessible areas listed in the LACBWR LTP are for soil or buried pipe so it is unclear which rule will apply to each inaccessible area.

Furthermore, while the LTP describes a trigger for re-evaluating the insignificant contribution dose should the one sample show HTDs exceeding MDCs, it does not describe any triggers for further investigation and sampling for HTDs. In the case that HTDs are positively identified in the one sample, the NRC staff would expect this event to trigger additional sampling and analysis of HTDs to get a better sense of the insignificant contribution and surrogate ratios. Accordingly, the LTP should describe any situations that would trigger additional sampling beyond the commitment of 10 percent or a minimum of one sample per inaccessible area.

Section 5.1 of the LTP also states that "based on process knowledge, the radionuclide mixture found in the Reactor Building, WTB and Remaining Structures was applied to the WGTV as it is expected to be the most representative mixture." Additional details on the process knowledge applied should be provided, especially in light of the fact that the WTB and Piping Tunnel will no longer remain on site.

Section 5.5.2.1.1 of the LTP states that "the entire source term in the Reactor Building basement will be removed." In addition, Page 6-22 of the LTP states that "cores were not collected in the Reactor Plant / Ventilation Plant area or the Turbine Building sump and pit due to the low expectation of significant contamination being present and their very small areas." Additional information is necessary to confirm both statements in order to complete the NRC staff's review.

Resolution:

a. Provide additional details regarding the plans for continuing characterization at the La Crosse site, including the survey units comprising the five areas listed as inaccessible areas in Chapter 2 of the LACBWR LTP.

b. Explain the technical basis for taking a minimum of one sample to be analyzed for the initial suite of radionuclides from each inaccessible area identified in Chapter 2 of the LTP. Clarify whether the commitment is to take one sample per survey unit, or one sample in each of the five areas that are listed.

c. Explain why there is a commitment to take a minimum of one sample in the five inaccessible areas listed in Chapter 2 without a dependency on SOF, but to take one sample from the highest measurement area only if the SOF > 0.5 for soil and buried pipe. Furthermore, since items 3 to 5 listed above are either soil or buried pipe areas, clarify whether there will be a minimum of one sample taken in these areas or whether one sample will only be taken when the SOF > 0.5.

d. Describe whether any continuing characterization results would trigger additional analysis of HTDs beyond 10 percent of the samples (or a minimum of one sample) from each survey area. The licensee should specify when the additional sampling of HTDs would take place (i.e., during further continuing characterization activities or during the FSS).

e. Describe the "process knowledge" basis for using measurement results from other buildings as "the most representative radionuclide mixture" for the WGTV building and/or other structures. Discuss this conclusion especially given that the WTB and Piping Tunnel will no longer remain on site. Provide the characterization plan for the WGTV interior and structural surfaces, including the basis for the number and location of samples, as well as which samples will be analyzed for the full suite of radionuclides.

f. Provide the characterization plan for the underlying concrete in the Reactor Building Basement after liner removal to confirm the statement that "the entire source term" in the Reactor Building basement will be removed. Describe the measurements, including the basis for the number and location of samples that will be conducted to confirm that there is no contamination remaining below or behind the steel liner after removal.

g. Clarify why there is a low expectation of significant contamination in the Reactor Plant / Ventilation Plant area and/or the Turbine Building sump and pit. Discuss this considering the history of radiological spill incidents in the Turbine Building. Clarify whether any additional continuing characterization will be done for these areas. Describe the number and location of samples to be taken in these areas.

LACBWR Response (PAB 5a) – LACBWR will commit to providing continuing characterization sample plans to the NRC for information as they are developed and results to the NRC for evaluation, including the five areas listed above in PAB 5. LTP Section 5.3.4.4 will be revised to state, "*Continuing Characterization plans will be provided to the NRC for information and the results will provided to the NRC for evaluation*."

Areas where characterization surveys were deferred will be surveyed in accordance with LC-FS-PN-002, "Characterization Survey Plan," as they become accessible or in some instances the areas will be incorporated into the FSS plan (such as soil beneath or adjacent to the WTB). In areas other than the five listed above, continuing characterization may be performed in accordance with LC-FS-PR-003, "Radiological Assessments and Remedial Action Support Surveys" (e.g., soil beneath slab-on-grade structures after the slab is removed). The scope, methods and adequacy of the surveys are summarized as follows:

<u>WGTV interior structural surfaces:</u>

Continuing characterization of the Waste Gas Tank Vault was performed in September of 2017 in accordance with LC-FS-PN-002 and sample plan no. B1-010-04A. The scope of the survey was the interior concrete surfaces as well as the soil adjacent to and beneath the structure.

The continuing characterization of the structure interior concrete surfaces consisted of a beta scan of 100% of all accessible surfaces augmented with a minimum of 30 loose surface contamination samples. Five (5) concrete core samples were obtained on the floor and wall surfaces and an additional three (3) concrete cores were biased towards areas of elevated activity identified during the scan survey (including two cores in the sump). The cores were 3" diameter to a depth of 6" and all cores were sliced into ½" pucks to ascertain the depth of contamination. All core samples underwent gamma spectroscopy using the on-site laboratory and all were sent to the off-site laboratory for HTD analysis of the full suite of radionuclides. An assessment of the results confirmed the calculated IC dose is unchanged (less than 10% of the dose limit) prior to FSS.

The soil adjacent to and beneath the WGTV was also characterized as part of the sample plan. A gamma scan was performed over 100% of the safely accessible topside soil adjacent to the structure and four (4) surface soil samples were obtained. Additionally, four (4) soil samples were obtained beneath the WGTV floor at the locations of highest activity identified during the scan survey, at low points (e.g., sump) or areas that could act as conduits for contamination migration such as cracks. This was accomplished by coring through the concrete until soil was encountered. Like the concrete core samples, all eight of the soil samples underwent gamma spectroscopy using the on-site laboratory and all were sent to the off-site laboratory for HTD analysis of the full suite of radionuclides. An assessment of the results confirmed the calculated IC dose is unchanged prior to FSS and there is no change to the surrogate ratio.

LACBWR believes the DQOs to perform characterization inspections and surveys of sufficient quantity and quality to determine the nature, extent, and range of radioactive contamination in the survey unit have been met.

Sample plan no. B1-010-04A will be submitted to the NRC for information and the results will be submitted to the NRC for evaluation.

<u>Underlying concrete in the Reactor Building basement after liner removal:</u>

Continuing characterization of the underlying concrete in the Reactor Building basement will be performed after the liner is removed (currently estimated to complete in June, 2018). The characterization survey will consist of a Radiological Assessment (considered a form of continuing characterization) performed in accordance with LC-FS-PR-003, "Radiological Assessments and Remedial Action Support Surveys," to ensure that any individual ISOCS measurements will not exceed the Operational $DCGL_B$ during FSS. The RA will consist of a beta-gamma scan over 100% of all accessible surfaces. A minimum of 30 loose surface contamination samples will be obtained. Six (6) concrete core samples (6" in depth) will be obtained at evenly distributed locations and an additional four (4) cores will be obtained at any areas of elevated activity identified during the scan survey. If no areas of elevated activity are identified during the scan, then the four core samples will be obtained at biased locations such as low points, cracks, or areas of discoloration. All core samples will first be analyzed by the on-site gamma spectroscopy system. Because an RA is a form of continuing characterization, 10% of all media samples collected in this survey unit, with a minimum of one sample, will be analyzed for HTD radionuclides. In addition, a minimum of one sample beyond the 10% minimum will be selected at random, also for HTD radionuclide analysis. Additionally, if levels of residual radioactivity in an individual sample exceed the Sum-of-Fractions (SOF) of 0.1 then the sample(s) will be analyzed for HTD radionuclides. All samples selected for HTD analysis during the RA will be analyzed for the full initial suite of radionuclides from Table 5-1 in the LTP.

The sample plan for the underlying concrete in the Reactor Building basement after liner removal will be submitted to the NRC for information. The accompanying data will be submitted to the NRC for evaluation.

<u>Soil under the Turbine Building (suspect broken drain line):</u>

On June 25, 2015, as part of a broader site characterization, five (5) locations were selected for angled coring to obtain soil from beneath the Turbine Building at the location of the broken drain lines. GeoProbe® technology was used to obtain the samples. At each of the 5 locations, samples were collected from the 10', 15' and 20' depths, for a total of fifteen (15) soil samples. The results are provided in 2015 Characterization Survey Report (LC-RS-PN-164017-001).

In February of 2018, the Turbine Building foundation was removed in its entirety, including all broken drain lines and adjacent soil. The soil from beneath the drain lines was sampled as part of the FSS Plan for survey unit L1-010-102 (L1-SUB-TDS). A total of eight (8) soil samples were collected from the region beneath the broken drain lines, turbine sump, turbine pit, and condenser pit. Although four (4) of the samples were required to be sent off-site for Sr-90 analysis, as a conservative measure, all were sent off-site for Sr-90 analysis. Additionally, 7 of the 8 samples were sent off-site for HTD analyses for the full initial suite of ROC. An assessment of the results confirmed the calculated IC dose is unchanged prior to FSS and there is no change to the surrogate ratio.

The 2015 Characterization Survey Report (LC-RS-PN-164017-001) was previously submitted to the NRC on July 26, 2016. The FSS Plan (L1-SUB-TDS) for survey unit L1-010-102 will be submitted to the NRC for information. The accompanying data will be submitted to the NRC for evaluation.

<u>Soils adjacent to and beneath basement structures</u>:

As previously discussed, the soil adjacent to and beneath the WGTV was characterized as part of Sample Plan no. B1-010-04A.

Continuing characterization of the soil beneath and adjacent to the Reactor Building is estimated to start in June of 2018 and will consist of soil borings at the nearest locations along the foundation walls that can be feasibly accessed and the acquisition of core bores deep into or through the building floors to assess migration potential from building interiors to soils under basement concrete. The number and location of the additional subsurface soil samples will be determined by the DQO process during survey design. The interior core locations will be biased to cracks, sumps, wall/floor interfaces, or any other areas where contamination may have migrated to the soil beneath. Angled soil bores will be performed via GeoProbe® to access the soils under the concrete (if coring through the foundation after liner removal is not feasible).

For the Waste Treatment Building (WTB), Stack (Chimney Slab), Piping and Ventilation Tunnels and Reactor/Generator Plant (Turbine Building), which have been removed in their entirety, after concrete removal, the resultant excavations after concrete removal will undergo FSS in accordance with LC-FS-PR-002, "Final Status Survey Package Development." The excavations traverse two Class 1 survey units: L1-010-101 and L1-010-102 and FSS will be performed in these areas using four sample plans as follows:

Sub-Grade Location	FSS Package	Survey Unit
Waste Treatment Building	L1-010-101C	L1-010-101
Pipe Tunnel, Stack Slab, RP/GPA	L1-SUB-CDR	L1-010-101
Fuel Pad, Low Pressure Service Water	L1-SUB-FPL	L1-010-101
TB Slab, Pit and Sump, RP/GPA and Sump	L1-SUB-TDS	L1-010-102

After total removal of the WTB, continuing characterization samples were collected during the FSS of the resultant excavation. Sample Plan L1-010-101C specified a gamma scan over 100% of the survey unit including sloped walls. In addition to the systematic samples collected during FSS, two (2) additional samples were collected for continuing characterization. These 2 samples were sent off-site for HTD analysis of the full suite. Sample Plan L1-010-101C will be submitted for information and the results will be submitted for evaluation.

After total removal of the Stack Slab, Piping and Ventilation Tunnels (and a small portion of the Reactor/Generator Plant), continuing characterization samples were collected during the FSS of the resultant excavation. Sample Plan L1-SUB-CDR specified a gamma scan over 100% of the survey unit including sloped walls. In addition to the systematic samples collected during FSS (minimum of 14), five (5) additional samples were collected for continuing characterization. These 5 samples were sent off-site for HTD analysis of the full suite. Sample Plan L1-SUB-CDR will be submitted to the NRC for information and the results will be submitted for evaluation.

After total removal of the Turbine Building (including the suspect broken drain lines) and the remaining portion of the Reactor/Generator Plant), continuing characterization samples were collected during the FSS of the resultant excavation. As previously discussed, Sample Plan L1-SUB-TDS specified that four soil samples be taken for continuing characterization; however, eight soil samples were collected and sent off-site for HTD analysis (one for Sr-90 and seven for the full initial suite of ROC).

<u>Soils under concrete or asphalt coverings</u>:

Continuing characterization of the soil beneath concrete slabs or asphalt will consist of a RA in accordance with LC-FS-PR-003 when the soil beneath is exposed. An RA was performed in February of 2018 on the sub-slab soil beneath Warehouses 1, 2 and 3 after removal of the structures using Sample Plan L2-SUB-WRS-A. Because the structures were designated as Class 2, a minimum of 25% of the soil area underwent a gamma scan. A total of fourteen (14) surface soil samples were systematically obtained along with one (1) judgmental sample. Two (2) soil samples were sent off-site for HTD analysis for the full initial suite of ROC. An assessment of the results confirmed the calculated IC dose is unchanged prior to FSS and there is no change to the surrogate ratio.

The need to remove any other concrete or asphalt coverings is not anticipated.

Sample Plan L2-SUB-WRS-A will be sent to the NRC for information and results will be sent for evaluation.

Interiors of buried pipe:

When the interior surfaces become accessible, several potentially contaminated buried pipe systems to be abandoned in place will be characterized. The objective of the continuing characterization survey is to assess the potential radiological classification in the pipe in cases which the HSA or process knowledge has been determined to be insufficient. Continuing characterization will consist of direct measurements on pipe openings and the acquisition of sediment and/or debris samples (if available) for analysis. If necessary (as part of an investigation) the radiological survey may be expanded further into the pipe. Any sediment or debris samples will be analyzed by the on-site gamma spectroscopy system and 10%, with a minimum of one, will be sent off-site for HTD analysis for the full initial suite of ROC.

LACBWR Response (PAB 5b, 5c and 5d) –Note, the requirement to analyze a continuing characterization or FSS sample for HTD ROC if the ‘SOF >0.5’ has been changed to ‘SOF >0.1’ consistent with the commitments made to the NRC. The appropriate portions of LTP Section 5.1 will be revised with the following.

The previously inaccessible areas identified in LTP Chapter 2 will be characterized during the continuing characterization process. In order to verify that the insignificant contributor (IC) dose does not change prior to implementing the FSS, and to verify the HTD to surrogate radionuclide ratios used for the surrogate calculation are still valid, LACBWR will obtain and analyze concrete core and soil samples during continuing characterization (including radiological assessments) and FSS within each individual survey unit or area as described below.

For continuing characterization, 10% of all media samples collected in a survey unit during continuing characterization will be analyzed for HTD radionuclides, with a minimum of one sample analyzed for HTD radionuclides, whichever is greater. In addition, a minimum of one sample beyond the 10% minimum will be selected at random, also for HTD radionuclide analysis. All samples will first be analyzed by the on-site gamma spectroscopy system. In the absence of detectable gamma activity, locations will be selected based on the potential for the presence of activity using HSA information or other process knowledge data. All samples selected for HTD analysis during continuing characterization will be analyzed for the full suite of radionuclides from Table 5-1.

The actual IC dose will be calculated for each individual sample result using the DCGLs from Revision 3 of TSD RS-TD-313196-004, Table 4 for soils and Table 35 for basement structures. If the IC dose calculated is less than the IC dose assigned for DCGL adjustment, then no further *action will be taken. If the actual IC dose calculated from the sample result is greater than the IC dose assigned for DCGL adjustment, then a minimum of five (5) additional investigation samples will be taken around the original sample location. Each investigation sample will be analyzed by the on-site gamma spectroscopy system and sent for HTD analysis (full suite of radionuclides from Table 5-1). As with the original sample, the actual IC dose will be calculated for each investigation sample. In this case, the actual calculated maximum IC dose from an individual sample observed in the survey unit will be used to readjust the DCGLs in that survey unit. If the maximum IC dose exceeds 10%, then the additional radionuclides that were the cause of the IC dose exceeding 10% will be added as additional ROC for that survey unit. The survey unit-specific DCGLs used for compliance, the ROC for that survey unit and the survey data serving as the basis for the IC dose adjustment will be documented in the release record for the survey unit.*

The final ROC for the decommissioning of LACBWR are Co-60, Cs-137, Eu-152 and Eu-154, which are gamma emitters and Sr-90 which is a HTD radionuclide. For sample(s) analyzed for HTD radionuclides during continuing characterization, if the analysis of the sample indicates positive results (greater than MDC) for both a HTD ROC (Sr-90) and the corresponding surrogate radionuclide (Cs-137), then the HTD to surrogate ratio will be derived. If the derived HTD to surrogate ratio is less than the applicable HTD to surrogate ratio from TSD RS-TD-313196-001, Table 40, then no further action is required. If the HTD to surrogate ratio exceeds the applicable ratio from TSD RS-TD-313196-001, Table 40, then a minimum of five (5) additional investigation samples will be taken around the original sample location. Each investigation sample will be analyzed by the on-site gamma spectroscopy system and then sent for HTD analysis. As with the original sample, the HTD to surrogate ratio will be calculated for each investigation sample. The actual maximum HTD to surrogate ratio observed in any individual sample will be used to infer HTD radionuclide concentrations in the survey units shown to be impacted by the investigation. The survey unit-specific HTD to surrogate ratio and the survey data serving as the basis for the ratio will be documented in the release record for the survey unit(s).

Survey unit-specific surrogate ratios, in lieu of the ratios from TSD RS-TD-313196-001, Table 40, may be used for compliance if sufficient radiological data exists to demonstrate that a different ratio is representative for the given survey unit. In these cases, the survey unit-specific radiological data and the derived surrogate ratios will be submitted to the NRC for approval. If approved, then the survey unit-specific ratios used and the survey data serving as the basis for the surrogate ratios will be documented in the release record for the survey unit.

Radiological Assessment (RA) surveys will be performed in currently inaccessible soil areas that are exposed after removal of asphalt or concrete roadways and parking lots, rail lines, or building foundation pads (slab-on-grade). A limited number of soil samples are typically collected as a part of the RA. Ten percent (10%) of any soil samples collected during an RA in a survey area, with a minimum of one sample, will be analyzed for the full initial suite of radionuclides. Additionally, if levels of residual radioactivity in an individual soil sample exceed the Sum-of-Fractions (SOF) of 0.1 then the sample(s) will be analyzed for full suite of radionuclides from Table 5-1.

Soil samples and concrete cores will be collected during FSS to confirm the HTD to surrogate radionuclide ratios used for the surrogate calculation. Only Sr-90 will be analyzed in the FSS confirmatory samples. Concrete cores will be collected from the Waste Gas Tank Vault *basement and the Reactor Building basement where concrete will remain. The number of cores collected and analyzed for ROC HTD will be ten percent (10%) of the number of FSS ISOCS measurements. The concrete core locations will be selected from the floor and lower walls in the survey unit to alleviate safety concerns from working at heights and to focus on the areas expected to contain the majority of residual radioactivity. For soil, ten percent (10%) of the FSS samples collected from open land survey units (including excavations where major sub-grade structures previously resided) will also be analyzed for ROC HTD radionuclides. Additionally, if levels of residual radioactivity in an individual soil sample exceed a SOF of 0.1, then the sample(s) will be analyzed for ROC HTD radionuclides. For soil samples or concrete cores with positive results for both a Sr-90 and the corresponding surrogate radionuclide (Cs-137), the HTD to surrogate ratio will be derived. The applicable ratio from TSD RS-TD-313196-001, Table 40 will be used unless specific survey information from continuing characterization supports the use of a surrogate ratio that is specific to the area. In these cases, the area-specific ratios as determined by actual survey data will be used in lieu of the TSD RS-TD-313196-001, Table 40 ratios. The area-specific ratios used and the survey data serving as the basis for the ratios will be documented in the release record for the survey unit.*

LACBWR Response (PAB 5e) – The radionuclide mixture presented in Revision 0 of the LTP was based on concrete core samples obtained in 2015 from the Reactor Building, Waste Treatment Building and Piping Tunnel. The results of the cores and methodologies for determining the mixture were provided in Revision 4 of TSD RS-TD-313196-001, "Radionuclides of Concern During LACBWR Decommissioning." In mid-2017, ten (10) additional concrete cores were obtained from the Reactor Building and eight (8) cores were obtained from the Waste Gas Tank Vault. RS-TD-313196-001 was revised to include the data from the eighteen (18) concrete core samples, recalculate the radionuclide fractions using three methods, add the dose contribution from Np-237, and recalculate the insignificant contributor dose for soil, Reactor Building, WGTV, and buried pipe."

As shown in PAB 5a, the second paragraph of LTP Section 5.1 will be revised to reflect the additional data. The last two sentences in the second paragraph of LTP Section 5.1 (as shown below) will be deleted.

No core samples were taken in the WGTV structure during initial characterization. Based on process knowledge, the radionuclide mixture found in the Reactor Building, WTB and Remaining Structures was applied to the WGTV as it is expected to be the most representative mixture.

Application of the existing core data to soil is reasonable because soil contamination could come from any of the buildings. As stated in response to PAB 5b, 5c and 5d, a percentage of samples from the soil areas collected for continuing characterization will be analyzed for the full initial suite of radionuclides and a percentage of soil samples taken during FSS will be analyzed Sr-90.

As discussed in PAB 5a, continuing characterization of the WGTV was performed in accordance with sample plan no. B1-010-04A. The continuing characterization of the structure interior concrete surfaces consisted of a beta scan of 100% of all accessible surfaces augmented with a minimum of 30 loose surface contamination samples. Five (5) concrete core samples were obtained on the floor and wall surfaces (biased toward areas with low points, cracks and/or staining) and an additional three (3) concrete cores were biased towards areas of elevated activity identified during the scan survey (including two cores in the sump). All core samples underwent gamma spectroscopy using the on-site laboratory and all were sent to the off-site laboratory for HTD analysis of the full suite of radionuclides.

LACBWR Response (PAB 5f) – Because the Reactor Building will undergo FSS as a Class 1 survey unit, it is no longer necessary to confirm the statement that "the entire source term" in the Reactor Building basement will be removed; the statement, "*As a consequence, the entire source term in the Reactor Building basement will be removed as well*" will be deleted from LTP Section 5.5.2.1.1.

As described in PAB 5a, continuing characterization of the underlying concrete in the Reactor Building basement after the liner is removed will consist of a Radiological Assessment performed in accordance with LC-FS-PR-003, "Radiological Assessments and Remedial Action Support Surveys" to ensure that any individual ISOCS measurements will not exceed the Operational $DCGL_B$ during FSS. The RA will consist of a beta-gamma scan over 100% of all accessible surfaces. A minimum of 30 loose surface contamination samples will be obtained. Six (6) concrete core samples will be obtained at evenly distributed locations and an additional four (4) cores will be obtained at any areas of elevated activity identified during the scan survey. If no areas of elevated activity are identified during the scan, then the four core samples will be obtained at biased locations such as low points, cracks, or areas of discoloration. All core samples will first be analyzed by the on-site gamma spectroscopy system. For an RA (considered a form of continuing characterization), 10% of all media samples collected in this survey unit, with a minimum of one sample, will be analyzed for HTD radionuclides. In addition, a minimum of one sample beyond the 10% minimum will be selected at random, also for HTD radionuclide analysis. Additionally, if levels of residual radioactivity in an individual sample exceed the Sum-of-Fractions (SOF) of 0.1 then the sample(s) will be analyzed for HTD radionuclides. All samples selected for HTD analysis during the RA will be analyzed for the full initial suite of radionuclides from Table 5-1 in the LTP.

LACBWR Response (PAB 5g) – The only structure basements that will remain at the time of license termination will be the Reactor Building and the Waste Gas Tank Vault and therefore, LTP Section 6.10.1, Source Term, will be revised. Specifically, discussion of source term within the Waste Treatment Building and Remaining Structures will be deleted, including the language, "*Cores were not collected in the Reactor Plant/Ventilation Plant area or the Turbine Building sump and pit due to the low expectation of significant contamination being present and their very small areas*."

As discussed in the response to PAB 5e, additional concrete core samples were obtained from the Reactor Building and the WGTV. Because the WTB and Remaining Structures were being removed in their entirety, it was deemed not prudent to obtain additional cores in the WTB, or any cores in the Remaining Structures. Although additional characterization was not performed within these structures prior to demolition, the soil adjacent to and beneath the structures was characterized (to verify the radionuclide mixture and surrogate ratios) as described in the response to PAB 5b.

After total removal of the WTB, continuing characterization samples were collected during the FSS of the resultant excavation. Sample Plan L1-010-101C specified a gamma scan over 100% of the survey unit including sloped walls. In addition to the systematic samples collected during FSS (minimum of 14), two (2) additional samples were collected for continuing characterization. These 2 samples were sent off-site for HTD analysis of the full suite. Sample Plan L1-010-101C will be submitted for information as part of these RAI responses and the results will be submitted for evaluation.

After total removal of the Stack Slab, Piping and Ventilation Tunnels (and a small portion of the Reactor/Generator Plant), continuing characterization samples were collected during the FSS of the resultant excavation. Sample Plan L1-SUB-CDR specified a gamma scan over 100% of the survey unit including sloped walls. In addition to the systematic samples collected during FSS (minimum of 14), five (5) additional samples were collected for continuing characterization. These 5 samples were sent off-site for HTD analysis of the full suite. Sample Plan L1-SUB-CDR will be submitted for information as part of these RAI responses and the results will be submitted for evaluation.

After total removal of the Turbine Building (including the suspect broken drain lines) and the remaining portion of the Reactor/Generator Plant), continuing characterization samples were collected during the FSS of the resultant excavation. As previously discussed, Sample Plan L1-SUB-TDS specified that four soil samples be taken for continuing characterization; however, eight soil samples were collected and sent off-site for HTD analysis (one for Sr-90 and seven for the full initial suite of ROC).

NRC Comment (PAB 6): Additional justification is needed regarding the conceptual model for the Reactor Building.

Basis: Section 6.11.1 of the LACBWR LTP states, with regard to the Reactor Building Conceptual Model:

> The mixing distance into the fill after leaching from floor and wall surfaces above 619 foot is more uncertain than leaching into the Reactor Building fill volume below 619 foot. Above 619 foot, contact with water is the result of periodic flushing from seasonal water level rise, or rainwater infiltration, as opposed to continual contact with water in the saturated zone.
>
> A different approach to defining the vertical flow rate was required for LACBWR due to the site groundwater being hydraulically connected to the Mississippi River and the resulting seasonal water level fluctuation into and out of the unsaturated zone…. The vertical water flow rate is conservatively modeled in RESRAD by assuming that the annual rate is defined by the distance that water recedes from the seasonal high elevation of 629 foot to the 619 foot average water table elevation (10 feet (ft) or 3.05 meter (m)). This seasonal 3.05 m water elevation change is used to conservatively bound the net flow of water to the saturated zone in RESRAD by forcing the infiltration rate to be 3.05 m/yr."

Given the uncertainty associated with the water table level (see HYDRO-1 on determining the groundwater level), and therefore the extent to which the Reactor Building walls may be in contact with the saturated zone, the use of an infiltration / precipitation rate to mimic water elevation changes is not appropriate.

The NRC staff notes that the sensitivity report associated with the LACBWR LTP showed that precipitation is not a sensitive parameter for the Reactor Building conceptual models above or below the 619 foot level. However, groundwater elevation changes, and the fraction of the contaminated zone in the saturated zone, would be expected to significantly impact dose.

Accordingly, if the precipitation / infiltration rate was influencing dose in a meaningful way, it would have been identified as a sensitive parameter. The fact that precipitation rate is not a sensitive parameter is a clear indication that the licensee's manipulation of precipitation rate in their attempt to model the groundwater elevation changes is not adequate.

The justification for this approach is explained by the licensee as follows:

> The use of 3.05 m/yr is conservative because the seasonal water level fluctuation includes periods of increase and decrease, as well as a horizontal component, that are not accounted for. Full resolution of the actual water flow pattern during the seasonal fluctuations into the unsaturated zone would require detailed groundwater transport and dispersion modeling which is not justified given the bounding / screening approach used to develop the BFM conceptual model.

The NRC staff agrees with the licensee that full resolution of the actual water pattern is not justified. However, the value for groundwater elevation should reflect a conservative value given the changes in water table level. Therefore, an alternative conceptual modeling of the Reactor Building as a single structure, which assumes that a fraction of the contamination is in contact with the water table, is warranted.

Path Forward:

a. Instead of modeling the Reactor Building as two separate conceptual models (above the 619 foot elevation, and below the 619 foot elevation), analyze the impact on the DCGLs should the Reactor Building be modeled as one conceptual model with an appropriate groundwater elevation (see HYDRO-1 on Groundwater Level and Unsaturated Zone Thickness). The parameter value for the contaminated fraction below the water table should reflect the appropriate value for groundwater elevation based on this new conceptual model.

b. Analyze the impact on the insignificant radionuclide dose when using the alternative conceptual model for the Reactor Building.

LACBWR Response (PAB 6a) – The conceptual model for the Reactor Building was revised to combine the entire basement structure, both above and below the water table, into one model. The assumed groundwater elevation was increased to 629 foot to account for the maximum elevation measured during site groundwater monitoring as opposed to the average elevation of 619 foot applied in LACBWR LTP Rev 0 (see response to HYDRO-1). The RESRAD "contaminated fraction below water table" was derived assuming a groundwater elevation of 629 foot.

Assuming a groundwater elevation of 629 foot also results in a fraction of the WGTV being below the water table which was not the case when the average elevation of 619 foot was applied. The conceptual model for the WGTV was therefore also revised to include contaminated fractions above and below the water table.

The revised Reactor Building and WGTV conceptual models and dose assessments are described in Section 3.1 of TSD RS-TD-313196-004 Rev 3. A full sensitivity analysis was performed using the revised conceptual models for the Reactor Building and WGTV. See Section 3.1.2 of TSD RS-TD-313196-004 Rev 3 for details.

The information in Section 3.1 of RS-TD-313196-004, Rev. 2 will be included in LACBWR LTP Rev. 1.

LACBWR Response (PAB 6b) – The insignificant radionuclide doses for the Reactor Building and WGTV were recalculated using the DCGLs derived from the revised conceptual model. The IC dose calculation is provided in Section 6.2 of RS-TD-313196-001, "Radionuclides of Concern During LACBWR Decommissioning", Rev 4. The process for adjusting the $DCGL_B$ to account for IC dose is described in Section 4.1 of TSD RS-TD-313196-004, Rev 3.

NRC Comment (PAB 7): Additional information is necessary to determine the potential dose from excavated concrete or fill material.

Basis: Section 6.12 of the LACBWR LTP describes the conceptual model for the Excavation Scenario, stating that "the calculation is driven by the baseline limitation in the conceptual model that the average radionuclide concentrations in the concrete after inadvertent mixing during excavation will not exceed the surface soil DCGLs." To derive the Excavation DCGLs, the licensee starts with the Surface Soil DCGL concentrations in pCi/g and finds the total Curies associated with the total volume of concrete in the basement. This activity is homogeneously distributed over the entire surface area of the basement. So, in essence, the intruder is assumed to excavate all the surfaces and total volume of concrete in a basement, and homogeneously mix it to obtain a concentration in pCi/g. The concrete is assumed to act like soil, which is a conservative assumption. However, this analysis dilutes, to an unrealistic extent, the source term which is allowed on the building surfaces.

Section 6.5.1.2 of the LACBWR LTP states that "the residual radioactivity remaining in the backfilled basements is assumed to inadvertently mix with the mass of structural concrete removed during excavation which is consistent with the guidance in NUREG-1757, Appendix J, for addressing subsurface contamination." The NRC staff would argue that the degree of mixing assumed by the licensee in this scenario is not consistent with the guidance in NUREG-1757. Specifically, while some degree of mixing is expected, assuming that the intruder excavates the entire volume of structural concrete for any given basement is unrealistic and non-conservative. This is especially true for a larger basement like the Reactor Building.

NUREG-1757, Volume 2, Appendix J, "Assessment Strategy for Buried Material," describes three acceptable approaches for determining source concentration (see Sections J.3.1, J.3.2, and J.3.3). In the first approach in Section J.3.1 (Mass Balance) the total buried source term (in pCi) is assumed to be brought to the surface and spread evenly across 360 cubic meters (m^3), and then spread out to an area of 2400 m^2 at a thickness of 0.15 m. For example, the $DCGL_b$ for Cs-137 in the Reactor Building is 1.05×10^8 pCi/m^2 and the surface area of the Reactor Building is 511.54 m^2. Therefore, the total source term would be 5.37×10^{10} pCi. If you divide this source term by the mass in 360 m^3, at an assumed fill density of 1.76 g/cm^3, the resulting concentration is 85 pCi/g. This value is four times greater than the maximum fill concentration calculated by the licensee of 21 pCi/g, and about 1.5 times greater than the Adjusted Soil DCGL of 55.2 pCi/g.

NUREG-1757, Volume 2, Page J-6 states that "this approach should be used if the thickness of the residual radioactivity is unknown and it can be safely assumed that the volume of residual radioactivity is greater than or equal to 360 m^3." The total volume of fill in the Reactor Building Basement is 1485.16 m^3. However, note that since the WTB, WGTV, and Reactor Building have fill volumes of 60 m^3, 305 m^3, and 357 m^3, the approach described in Section J.3.1 may not be appropriate.

The approach in Section J.3.2 describes a simulation assuming that the contaminants are distributed uniformly within the volume of contaminated soil while interspersing clean soil, and assuming that the soil is distributed over a surface to a depth of 0.15 m. This second approach requires that the depth of residual radioactivity be known. The approach in Section J.3.3 describes a dual simulation with two contaminated zones (one which has been excavated, and one which remains buried), each with a separate concentration. In order to find the concentration of the excavated material, the initial concentration of the buried residual radioactivity must be known. The depth (and volume) of fill is known, but the extent of mixing between the surface contamination and the fill volume is not known. In addition, the depth of the contamination on the wall and floor surfaces is not known. Therefore, these two methods, as they are specifically described in Appendix J of NUREG-1757, Volume 2, Revision 1, will not adequately guide the licensee in calculating a source term. Accordingly, the licensee may need to evaluate different values for depth of contamination and mixing in order to determine an appropriate value for the thickness of contamination and/or initial concentration.

Section 6.14 of the LTP describes a check calculation on the final $DCGL_b$ values:

> A check calculation was performed in Reference 8 to determine the maximum hypothetical concentrations of ROC in fill material after excavation. The calculation assumed that 100 percent of the residual radioactivity in the concrete was instantly released to the fill and uniformly mixed in the fill during basement concrete excavation. Therefore, the source term would be in the fill and not in the concrete. The calculation assumed that the residual radioactivity is uniformly distributed over basement surfaces at the BFM $DCGL_B$ concentrations. For all ROC and all basements, the hypothetical maximum fill concentrations were less than the surface soil DCGLs.

The check calculation in the LACBWR LTP was not appropriate, in part, because the maximum fill concentrations are determined for Cs-137, Sr-90, and Co-60 assuming they are at the adjusted $DCGL_b$ values. Since the adjusted $DCGL_b$ values are based on a 5 percent Insignificant Radionuclide contribution, this calculation may not adequately take into account uncertainty in the radionuclide mixture should the insignificant contribution be higher (see PAB-1 on the dose contribution from Insignificant Radionuclides). This evaluation also does not discuss potential hotspots that could be excavated. Finally, assuming complete mixing with the total volume of fill is optimistic and not appropriate for an excavation scenario in this case.

Path Forward:

a. Evaluate the impact on the excavation dose due to uncertainty in the radionuclide mixture percentages, and therefore the percent insignificant contribution.

b. Evaluate the excavation of the $DCGL_b$ concentrations with more defensible assumptions regarding the depth of contamination on the building surfaces and dilution with fill or concrete material.

c. Evaluate the impact on potential dose based on excavation of the maximum hotspot which could be allowed based on the area factor equations proposed.

LACBWR Response (PAB 7a) – The impact of mixture uncertainty on the calculation of maximum fill concentrations is conservatively addressed by applying the 75th percentile values from the "Cs Ratio" mixture to calculate the percent insignificant contribution. The uncertainty in radionuclide mixture fractions is discussed in the responses to PAB-1b and 1c. The IC dose calculation is provided in Section 6.2 of RS-TD-313196-001, Rev 4.

LACBWR Response (PAB 7b) –

Concrete

The assumptions for the inadvertent mixing volumes for concrete excavation were revised to be more conservative (i.e., to reduce mixing volumes). Section 3.2 of TSD RS-TD-313196-004, Rev. 3 describes the BFM Excavation Scenario as follows:

> *The BFM Excavation scenario assumes that some or all of the backfilled structure concrete is excavated and spread on the surface at some time after license termination. A typical excavation process for a backfilled structure would entail using a medium sized excavator with a 1.0 to 1.5 cubic yard bucket to excavate and stockpile fill. After removing the fill to the planned excavation depth, a hoe-ram would be used to pound out the concrete walls and floor (if the excavation reaches the floor). The concrete would be segregated, the rebar removed, and remaining concrete size reduced. The excavation scenario assumes that the size reduced concrete is used as onsite fill. Large-scale industrial excavation of the entire basement may require different methods but the result would be the same, i.e., a volume of sized concrete to be used as onsite fill.*

Section 3.2 of TSD RS-TD-313196-004 Rev 3 also states:

> *The radionuclide concentrations (pCi/g) in the inadvertently mixed, excavated concrete that is assumed to be spread on the site surface is a linear function of the ratio of concrete surface area (SA) to concrete volume (V). The SA/V ratio was calculated in two ways; 1) assuming full excavation of the entire basement, and 2) assuming partial excavation that includes only the walls with the minimum thickness (0.75 feet for both the Reactor Building and WGTV). The walls with minimum thickness will have the maximum SA/V ratio and will result in the maximum concentration in the excavated concrete.*
>
> *As seen in Table 1, the SA/V ratios for the partial excavation of the minimum thickness wall are greater than the SA/V ratio assuming full excavation. To ensure conservatism, the maximum SA/V ratio was used in the DCGL calculation.*

Table 1 from TSD RS-TD-313196-004 Rev 3 - BFM Concrete Excavation SA/V Ratios for Full and Partial Excavation

Structure	*Full Excavation SA/V (m^2/m^3)*	*Partial Excavation SA/V (Minimum Wall Thickness) (m^2/m^3)*	*Partial SA/V ÷ Full SA/V*
Waste Gas Tank Vault	*2.55*	*4.37*	*1.72*
Reactor Building	*0.95*	*4.37*	*4.61*

As seen in Table 14, the SA/V ratios for the excavation of walls with minimum thickness are 1.72 and 4.61 times higher than the full excavation SA/V ratios for the WGTV and Reactor Building, respectively. The revised Excavation Scenario $DCGL_{BS}$ values calculated in RS-TD-313196-004, Rev 3 were based on the more conservative partial excavation of minimum wall thickness which reduced the Excavation Scenario $DCGL_{BS}$ concentrations by factors of 1.72 and 4.61for the WGTV and Reactor Building, respectively.

The information in Section 3.2 of RS-TD-313196-004, Rev. 3 will be included in LACBWR LTP Rev. 1

<u>Fill</u>

The calculation of the maximum hypothetical concentrations in fill is revised in RS-TD-313196-004, Rev. 3, Section 8 and Attachment 11. The revised calculation reduces the fill volume over which mixing occurs which increases the maximum concentrations. RS-TD-313196-004, Rev 1 and LACBWR LTP Rev 0 assume that 100% of the concrete source term is released and mixed with the entire volume of fill during excavation. The revised calculation minimizes the fill mixing volume under the assumption that a typical excavation process for a backfilled structure would entail using a medium sized excavator with a 1.0 to 1.5 cubic yard bucket to excavate and stockpile fill (as described in RS-TD-313196-004, Rev 3, Section 3.2). A single bucket load of ~1 m^3 is therefore the minimum physical volume of fill that would be excavated and mixed. The calculation assumes that 100% of the activity in the concrete, at all depths, under a 1 m^2 area is released to the fill. The 1 m^3 volume of fill adjacent to the 1m^2 surface area (i.e., at a distance 1 m from the concrete surface) is then excavated in a single bucket load. The activity is mixed within the 1 m^3 volume during the subsequent stockpiling and spreading on the ground surface.

The calculated fill concentrations for the Full and Partial excavation assumptions are provided in the last two tables of RS-TD-313196-004, Rev. 3, Attachment 11 which are reproduced below. The revised partial excavation fill concentrations for the Reactor Building are 2.9 times higher than the Full excavation concentrations. The partial and full excavation concentrations are nearly the same for the WGTV. This is due to the relatively small size of the WGTV and the presence of several interior walls that add to the surface area (and corresponding source term) in the full excavation. The highest fill concentration for each basement from the tables below were applied in the comparison to soil DCGLs and in the calculation of Alternate Scenario Resident Gardener dose from excavated fill.
Calculating the maximum concentration based on a single 1 m^3 bucket load of fill is conservative. All activity is assumed to be contained in the fill excavated from a distance of 1 m from the concrete surface with no activity contained in fill excavated from distances greater than 1 m. The calculation does not include any mixing with fill excavated at distances greater than 1 m during the stockpiling and spreading process.

The ROC fill concentrations (assuming all activity is released to the fill), calculated using either the full or partial excavation assumptions, are below the adjusted soil DCGLs. The worst-case dose from excavation of fill would therefore be lower than the dose from the excavation of concrete assuming all activity remains in the concrete.

Fill Concentration: Full Excavation and Activity Mixing with all Fill
Concentration Levels for each Radionuclide (Assuming Each ROC at BFM $DCGL_B$ Concentration)

	Fill Concentration Rx Bldg (pCi/g)	Fill Concentration WGTV (pCi/g)
Co-60	1.15E+00	3.31E+00
Sr-90	3.23E+00	5.18E+00
Cs-137	4.83E+00	1.42E+01
Eu-152	2.65E+00	7.83E+00
Eu-154	2.45E+00	7.25E+00

Unit Area	1 m^2
1 m fill distance from wall	1 m

Fill Concentration: Partial Fill Excavation and Activity Mixing Limited to 1 m^3 of Fill Imediately Adjacent
Concentration Levels for each Radionuclide (Assuming Each ROC at BFM $DCGL_B$ Concentration)

	Fill Concentration Rx Bldg (pCi/g)	Fill Concentration WGTV (pCi/g)
Co-60	3.33E+00	3.25E+00
Sr-90	9.37E+00	5.08E+00
Cs-137	1.40E+01	1.39E+01
Eu-152	7.69E+00	7.69E+00
Eu-154	7.11E+00	7.12E+00

Finally, the RAI requests clarification regarding the "depth of contamination on the building surfaces". The depth of contamination is not a factor in the calculation of concentrations after inadvertent mixing during excavation of concrete or fill. All activity at all depths is included as the source term in the calculations. For compliance, FSS is performed using ISOCS which applies an efficiency calibration that accounts for contamination at all depths in the concrete. The FSS measurement results are reported in units of pCi/m^2 which includes all activity, at all depths within the 1 m^2 area of concrete.

LACBWR Response (PAB 7c) – As described in the response to PAB 10, the Operational DCGL approach applied to demonstrate compliance does not allow activity to remain in concrete at concentrations greater than the $DCGL_B$ (SOF>1) and therefore, the use of AFs is no longer applicable for concrete. See LC-FS-TSD-002, "Operational Derived Concentration Guideline Levels for Final Status Survey", Rev 0.

The AF equations and values that were proposed in Section 6.16 of LACBWR LTP Rev 0 will be deleted in LACBWR LTP Rev 1. The maximum elevated area measured by ISOCS during

FSS cannot exceed the $DCGL_B$ given the above constraint and the removal of the AF equations and values.

NRC Comment (PAB 8): Additional information is necessary to determine the potential dose from the Drilling Spoils Scenario.

Basis: Section 6.11.2 of the LACBWR LTP describes the Drilling Spoils Scenario. In this scenario, concrete is assumed to be brought to the surface during the installation of a well that randomly hits backfilled structural concrete. Section 6.11.2 states that "the source term for the BFM $Insitu_{ds}$ scenario is the residual radioactivity remaining in concrete at the time of license termination assuming no decay or release to fill."

In order to derive the Drilling Spoils DCGL for all basements, the licensee ran the Soil Conceptual Model, which was used to derive the Industrial Use soil DCGLs, in RESRAD with a Contaminated Zone area of 0.457 m^2 and a thickness of 15 cm. The Drilling Spoils concentrations in pCi/g corresponding to 25 mrem/yr from RESRAD were multiplied by a conversion factor of pCi/m^2 per pCi/g. The conversion factor finds the amount of contamination (in pCi) that is contained in the total grams of drilling spoils assuming a concentration of 1pCi/g in the drilling spoils, and divides by the surface area of the borehole. The drill is assumed to be a 12-inch borehole, and the contamination is assumed to be in the first 2.54 cm of concrete. A minimum of 3 feet of backfill is assumed to minimize mixing dilution with fill material.

In other words, the contamination source is assumed to be the activity found in the concrete diluted by the mass of the drilling spoils. However, this derivation does not consider a scenario where a driller might drill into a hotspot existing on the basement concrete, buried piping, or equipment drains.

Path Forward:

- Analyze the potential dose from drilling through hotspots that may be left in the basement concrete, buried piping, or equipment drains (see PAB-10 on Area Factors). Include the inventory or concentration assumed, the amount of material assumed to be excavated, and the amount of dilution from mixing with overburden material that was assumed. In addition, provide details on how the assumed inventory compares to the maximum activity that will remain (i.e., the area factors proposed). Provide a basis for how it is known that the assumed inventory bounds the potential dose from the drilling spoils scenario.

LACBWR Response (PAB 8a): As described in the response to PAB 10, the Operational DCGL approach applied to demonstrate compliance does not allow activity to remain in concrete or buried pipe at concentrations greater than the $DCGL_B$ (SOF>1). See LC-FS-TSD-002, "Operational Derived Concentration Guideline Levels for Final Status Survey", Rev 0. The dose from any FSS measurement, systematic or judgmental, exceeding the OpDCGL but less than the $DCGL_B$ will be evaluated as discussed in response to PAB 10d.

NRC Comment (PAB 9): More information is needed on the Sensitivity Analysis of the Kd Factors for some radionuclides.

Basis: Table 6-13, "BFM $Insitu_{gw}$ WGTV Uncertainty Analysis Results for Distribution Coefficients (Kd)," of the LACBWR LTP lists the WGTV uncertainty analysis results for the associated distribution coefficients (Kd). Page 6-27 of the LTP states:

> The predominance of negative correlation with Kd was expected since the primary dose pathway in the BFM $Insitu_{gw}$ scenario is through the ingestion of well water and lower Kd values result in a greater percentage of radioactivity in the water phase at equilibrium. Therefore, the deterministic Kd values selected for the non-sensitive radionuclides that were included in the uncertainty analysis were also conservatively assigned the 25th percentile values from Reference 14. The 75th percentiles were assigned as indicated by the [partial rank correlation coefficient] (PRCC) results in order to follow the parameter selection process in Figure 6-7 [RESRAD Parameter Selection Flow Chart] but this will have a very minor, if any, effect on dose since the parameters were shown to be only slightly sensitive.

The implemented deterministic model for the WGTV needs clarification because the distribution coefficients for Iron-55 (Fe-55), Nickel-39 (Ni-59), Nickel-63 (Ni-63), and H-3 are set to the non-sensitive values (or 25th percentile) for the contaminated zone, but the values for the unsaturated zone (or saturated zone for Ni-63) are set to the 75th percentile values because the PRCC values were greater than 0.25 in one of the repetitions. Erosion of the cover and contaminated zone may be one explanation for positive correlations of distribution coefficients with dose, but that explanation is inconsistent with the use of higher Kd values in the deeper layers than the shallow layers. The cause of the conflicting PRCC values in the sensitivity analysis (strong negative correlation in some repetitions versus strong positive correlations in other repetitions) is not adequately explained in the LACBWR LTP.

As implemented for the WGTV, lower distribution coefficients in the contaminated zone lead to higher leach rates from the source area, thereby pushing more radionuclides to the unsaturated and saturated zones where the larger distribution coefficients cause radionuclides to sorb to the solids rather than stay in the water phase. Therefore, the selected set of distribution coefficients leads to non-conservative assumptions for both the soil inhalation / ingestion and groundwater pathways. In addition, the LTP does not specify the treatment of parameters whose |PRCC| = 0.25 exactly

Path Forward:

a. Provide justification that the uncertainty analysis was accurate given that it did not produce consistent results. Specifically, rerun the sensitivity analysis with more realizations to reassess the consistency of the correlations.

b. Provide the rationale for the values used in the three zones as distribution coefficients for Fe-55, Ni-59, Ni-63, and H-3 for the WGTV BFM In situ Groundwater Model (Table 6-13) using the updated uncertainty analysis.

c. Analyze the impact on the DCGLs should the Kd values for Fe-55, Ni-59, Ni-63, and H-3 be set to the 25th percentile consistently across the contaminated zone, unsaturated zone, and saturated zone.

d. Clarify the treatment of a parameter whose |PRCC| = 0.25.

LACBWR Response (PAB 9a, 9b and 9c) - The sensitivity analysis was rerun for the two basements as well as soil due to changing the groundwater elevation from 619 foot to 629 foot in response HYDRO-1. Therefore, specific analysis of the results for Fe-55, Ni-59, No-63, and H-3 from the previous uncertainty analysis are no longer applicable. For the revised analysis, the number of realizations was increased and all Kd values were correlated with a Rank Correlation Coefficient of 0.99. There were no inconsistent Kd sensitivity results with the revised sensitivity analysis. See RS-TD-313196-004, Rev 3, Table 2, Table 8, and the RESRAD Uncertainty Analysis Reports listed in Attachment 2.

LACBWR Response (PAB 9d) - A |PRCC| = 0.25 is treated as non-sensitive as described in LACBWR LTP Rev 0, section 6.8.1 which is reproduced below:

> *A PRCC value less than -0.25 was considered sensitive and negatively correlated to dose. The 25th percentile of the parameter distribution was assigned to negatively correlated parameters. A PRCC value greater than +0.25 was considered sensitive and positively correlated to dose.*

To clarify the treatment of |PRCC| = 0.25, a statement will be added to LTP Section 6.8.1 stating that "A |PRCC| = 0.25 is treated as non-sensitive". In addition, LTP Figure 6.7 will be revised to change the decision box statement "Non-Sensitive, |PRCC| < 0.25" to "Non-Sensitive, |PRCC| ≤ 0.25".

NRC Comment (PAB 10): **More information is needed regarding Area Factors and the Elevated Measurement Comparison.**

Basis: Section 6.16 of the LACBWR LTP presents the Area Factors and Elevated Measurement Comparison (EMC) test to be applied in basement structures during FSS. Given that the WTB was the only Class 1 basement proposed, the discussion in Section 6.16 focuses on the WTB. The NRC staff acknowledge that the WTB is now going to be removed. However, if other basement structures are to be classified as Class 1, much of this request for information remains relevant to the elevated measurement comparison for those basement structures. Section 6.16 states that "the EMC test will be performed for the WTB basement concrete survey unit (or any other Class 1 basement survey unit if there is a classification change) using Equation A-1 from NUREG-1757 which is shown in Equation 6-5 with the required site-specific modifications." Equation 6-5 from the LTP for the EMC test and corresponding Equations 6-3 and 6-4 for the Area Factors are reproduced below.

The Area Factors for the Insitu_{gw} DCGL_{bs} are calculated using Equation 6-3 from the LACBWR LTP and captured in Table 6-27, "Area Factors for WTB Insitu_{gw} Scenario Assuming FSS [In Situ Object Counting System] (ISOCS) [Field of View] (FOV) of 28m^2." The title and column headings of this table indicate an area of 28 m^2 for the FOV, but the text indicates an area of 7.3 m^2. Section 6.16.1 of the LTP states that "the DSRs and Area Factors for the assumed 7.3 m^2 ISOCS FOV in the WTB are provided in Table 6-28." The reference to Table 6-28 is a typo as the reference should be to Table 6-27; in addition, the appropriate FOV area should be clarified.

Equation 6-3

$$\text{AF Insitu}_{gw}\ (\text{WTB}) = \frac{\text{DSR } Insitu_{gw}\ (\text{WTB})}{\text{DSR } Insitu_{gw}\ \text{FSS FOV(WTB)}}$$

Table 6-27 Area Factors for WTB Insitu$_{gw}$ Scenario Assuming FSS ISOCS FOV of 28 m^2

Radionuclide	WTB DSR (28 m^2 Area) mrem/yr per pCi/g	AF
Cs-137	1.519E-04	1.2
Co-60	1.598E-04	1.8
Sr-90	6.008E-03	2.2

The Area Factors for Excavation DCGL$_{bs}$ are calculated using Equation 6-4. The Excavation DCGL$_{bs}$ Area Factor is determined by taking the ratio of the Survey Unit Area for the WTB over the area of the ISOCS FOV.

Equation 6-4

$$\text{AF Excavation (WTB)} = \frac{\text{Survey Unit Area (WTB)}}{\text{ISOCS FSS FOV(WTB)}}$$

The differences in approach between the Area Factor for the excavation scenario and the drilling spoils scenario need additional explanation given the similarities in how the DCGL$_{bs}$'s are derived for each scenario.

With regard to the Excavation Scenario, Section 6.16.2 of the LACBWR LTP states:

> The Excavation scenario is a mixing model with dose pathways that are dependent only on the total source term in the concrete and are independent of the activity distribution. The total source term for each ROC that represents 25 mrem/yr for the Excavation scenario can be calculated by multiplying the DCGL$_{bs}$ for the excavation scenario in Table 6-27 (pCi/m^2) by the survey unit area (m^2).

The reference to Table 6-27 should be corrected since this table does not reference DCGL$_{bs}$. In addition, since the Excavation DCGL$_{bs}$ are derived by assuming the Soil DCGL concentration is in the total volume of concrete, and then dividing that activity amount by the surface area of the basement (including floor and walls), one would expect this sentence to read: "The total source term for each ROC that represents 25 mrem/yr for the Excavation scenario can be calculated by multiplying the DCGL$_{bs}$ for the excavation scenario (pCi/m^2) by the surface area of the WTB (m^2)."

With regard to the Drilling Spoils Area Factor, Section 6.16.3 of the LTP states:

> Unlike the In situ$_{gw}$ and Excavation scenarios, the dose from the In situ$_{ds}$ scenario does not systematically decrease with decreasing size of elevated areas. Theoretically, an area on a basement floor as small as the assumed eight-inch diameter of the well borehole could be the source term in the In situ$_{ds}$ scenario. Therefore, an EMC test will be applied to each contiguous elevated area on the WTB floor that contains activity exceeding the DCGL$_b$ (or a SOF of one considering all ROC) to account for the Insitu$_{ds}$ scenario dose from the elevated

> areas. The Insitu$_{ds}$ scenario does not apply to contamination on walls and therefore the drilling spoils EMC test does not apply to walls.… A typical [Area Factor] (AF) calculation is not applicable to the drilling spoils scenario because the dose from drilling spoils does not decrease as a function of decreasing elevated area size. Therefore, the AF for the EMC test for the Insitu$_{ds}$ scenario will have an AF of one, which is the most conservative value that can be applied.

Similar to the Drilling Spoils Scenario, the Excavation Scenario DCGL$_{bs}$ are derived based on the total activity brought to the surface since the assumed clean mixing volume is kept constant within a particular basement. Specifically, the activity is assumed to be in the volume / mass of concrete, which is constant for a particular basement in the derivation of the DCGL$_{bs}$. Similarly, the volume / mass of fill material is kept constant per basement in the check calculation performed in Section 6.14 of the LACBWR LTP. This is similar to the concept used for the Drilling Spoils Scenario, whereby the concentration of the drilling spoils once brought to the surface is limited to be the Soil DCGL, and the pCi/m^2 is derived from that concentration and the mass of the drilling spoils.

The dose from the Excavation Scenario may not systematically decrease with decreasing size of the elevated area. This will depend on assumptions regarding the size of the hotspot(s), the volume of material excavated, and dilution with clean fill. It is the NRC staff's position that the Area Factor for the Excavation Scenario should be one instead of having it be based on Equation 6-4 from the LACBWR LTP.

In addition, the NRC staff does not agree that a driller cannot conceivably drill into the remaining basement walls at the La Crosse site. Drilling technology would conceivably allow an intruder to drill into these walls at an angle. Therefore, the drilling spoils EMC test should also apply to the remaining basement walls (see PAB-13 on classification and survey coverage for basement structures).

The EMC test will be analyzed using Equation 6-5 from the LTP, which is:

Equation 6-5

$$\frac{\delta}{\mathrm{DCGL}_B} + \frac{\text{Max Elevated Floor Core} - \delta}{\mathrm{DCGL_{BS}}(\mathit{Drilling\ Spoils})} + \frac{\text{Elevated FSS ISOCS} - \delta}{AF_{Excav} * \mathrm{DCGL_{BS}}\ (\mathit{Excavation})} + \frac{\text{Elevated FSS ISOCS} - \delta}{AF_{GW} * \mathrm{DCGL_{BS}}\ (\mathit{Groundwater})} < 1$$

With regard to the Maximum Elevated Floor Core term in Equation 6-5, Section 6.16.3 of the LACBWR LTP states that "a concrete core sample will be collected at the location within the bounded area that exhibits the maximum reading and the activity quantified. If the total activity in the core, including all core slices with depth, exceeds the DCGL$_b$, the EMC test will be performed using the DCGL$_{bs}$ from Table 6-27 applicable to the WTB BFM Insitu$_{ds}$ scenario." The reference to Table 6-27 should be corrected since this table does not reference DCGL$_{bs}$.

In addition, the way in which the total activity in the concrete core will be calculated from survey data needs further explanation. Does the licensee intend to compare concentration values or total activity values? If the licensee intends to average over the entire depth of the core, that is not appropriate for the drilling spoils scenario since only a portion of concrete, 2.54 cm thick with an area of 730 cm^2 at a certain concentration, needs to be brought to the surface. Furthermore, it is unclear from the LACBWR LTP what, if any, Area Factors are to be used for Buried Piping. The LTP should stipulate how hotspots will be handled during FSS of buried piping.

Page 5-23 of the LACBWR LTP states that "if more than one elevated area is identified during FSS, then the same calculation will be performed for each…The fractions associated with each elevated area are summed and the result must be less than unity for the survey unit to pass." It unclear whether the licensee intends to apply the unity rule to the sum of all hotspots within each survey unit.

Section 8.5.2 of NUREG-1575, Revision 1, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," states that "if there is more than one elevated area, a separate term should be included for each." It is unclear from the LACBWR LTP whether the licensee considers all elevated areas together and assumes that the receptor is affected by them all. If the licensee intends to comply with MARSSIM Section 8.5.2, the sum of all the hotspots (i.e., elevated areas) needs to comply with the unity rule. Deviations from this method would need to be justified.

For comparison, the discussion in Equation 5-15 (see Page 5-62) of the LACBWR LTP (which is intended for areas other than the basements) and also Equation 5-13 from the Zion Nuclear Power Station LTP, clearly includes an "n" factor and indicates that "if the individual elevated areas pass, then they are combined and evaluated under the unity rule." As such, Equation 6-5 from the LACBWR LTP needs clarification as it is not readily evident that the MARSSIM guidance is being followed.

Path Forward:

a. Choose one of the following (i or ii):

   i. Provide a more detailed technical basis for using Equation 6-3 through Equation 6-5, addressing the issues raised in the Basis of this RAI.

   ii. As an alternative to using Equation 6-3 through Equation 6-5, provide a table of Area Factors to be used with the $DCGL_b$ (similar to what was supplied in Table 5-7, "Area Factors for Soils," for Soil) for each of the basement categories to remain (i.e., Reactor Basement, WGTV, and Remaining Structures). The table should indicate either the Area Factor or the hotspot concentration that will be considered acceptable for various area sizes of contamination. Revise Equation 5-5 and Equation 6-5 accordingly to incorporate the Area Factors in the requested table and the $DCGL_b$, similar to what is presented in Equation 5-4 for Soil

b. Provide a more detailed description of how the "Maximum Elevated Floor Core" term in Equation 6-5 is determined from survey and sampling data, assuming it would still be used after responding to this RAI.

c. Provide a table of Area Factors to be used with Piping DCGLs.

d. Provide a detailed example of how survey units with more than one hotspot will be evaluated for the Elevated Measurement Comparison.

LACBWR Response (PAB 10a) – LACBWR LTP Rev 1 will incorporate the Operational DCGL approach as detailed in LACBWR TSD LC-FS-TSD-002, "Operational Derived Concentration Guideline Levels for Final Status Survey", Rev 0. The Operational DCGL approach requires that compliance be demonstrated during FSS using a reduced Operational DCGL ($OpDCGL_B$) as opposed to the full $DCGL_B$ (which is referred to as the Base Case DCGL ($BcDCGL_B$) in LC-FS-TSD-002, Rev 0). This approach does not allow systematic or judgmental FSS measurements in concrete to exceed the $BcDCGL_B$. Therefore, no AF will be applied to concrete and Section 6.16 of LACBWR LTP Rev 0 will be deleted from LACBWR LTP Rev 1.

LACBWR Response (PAB 10b) – The Operational DCGL approach being adopted in LACBWR LTP Rev 1 does not allow systematic or judgmental FSS measurements in concrete to exceed the $BcDCGL_B$. Therefore, no AFs will be applied and Section 6.16 of LACBWR LTP Rev 0, including Equation 6-5, will be deleted from LACBWR LTP Rev 1. The term "Maximum Elevated Floor Core" is no longer applicable.

LACBWR Response (PAB 10c) – The adoption of the Operational DCGL approach does not allow systematic or judgmental FSS measurements in buried pipe to exceed the $BcDCGL_{BP}$. Therefore, no AF will be applied to buried pipe.

LACBWR Response (PAB 10d) – The adoption of the Operational DCGL approach does not allow systematic or judgmental FSS measurements in basement concrete or buried pipe (or above grade buildings) to exceed the BcDCGL (SOF>1). Therefore, no hot spots will be present and no "Elevated Measurement Comparison" performed for basement concrete, buried pipe, or above grade buildings. Note that the Elevated Measurement Test will be performed for systematic or judgmental soil FSS results that exceed the BcDCGL using standard AFs and MARSSIM methods as described in LACBWR LTP Rev 0, Section 5.10.4.

The Operational DCGL approach conservatively accounts for Systematic and Judgmental FSS results for concrete and buried pipe that exceed the OpDCGL, but are less than the BcDCGL, which are defined as "elevated areas" in LC-FS-TSD-002, Rev 0, using an equation that is equivalent to Equation 8-2 from section 8.5.2 of MARSSIM. Before addressing elevated areas, the FSS results must pass the Sign Test using the OpDCGLs. This method of addressing elevated areas is identical to the method approved by NRC in the Zion LTP Rev. 2.

As an example, Equation 4 from LC-FS-TSD-002, Rev 0, which applies to Buried Pipe, is reproduced below. The form of this equation is specifically used to be equivalent to Equation 8-2 in MARSSIM.

Equation 5 from LC-FS-TSD-002, Rev 0

$$BcSOF_{BURIED\ PIPE} = \sum_{i=1}^{n} \frac{Mean\ Conc\ BP_{ROC_i}}{Base\ Case\ BP\ DCGL_{ROC_i}} + \frac{\left(Elev\ Conc\ BP_{ROC_i} - Mean\ Conc\ BP_{ROC_i}\right)}{\left[Base\ Case\ BP\ DCGL_{ROC_i} \times \left(\frac{SA_{SU}}{SA_{Elev}}\right)\right]}$$

where:

$BcSOF_{BURIED\ PIPE}$	=	SOF for buried pipe survey unit using Base Case DCGLs
$Mean\ Conc\ BP_{ROCi}$	=	Mean concentration for the systematic measurements taken during the FSS of buried pipe in survey unit for each ROC_i
$Base\ Case\ BP\ DCGL_{ROCi}$	=	Base Case DCGL for buried pipe ($DCGL_{BP}$) for each ROC_i
$Elev\ Conc\ BP_{ROCi}$	=	Concentration for ROC_i in elevated area
SA_{Elev}	=	surface area of the elevated area
SA_{SU}	=	surface area of FSS unit

Although no hotspots will be present (i.e., exceeding the BcDCGL), to ensure a complete and comprehensive response to PAB 10d, LACBWR assumes that the question regarding the evaluation of areas with more than one hotspot would also apply to areas with more than one elevated area under the Operational DCGL approach. MARSSIM addresses the possibility of multiple elevated areas being present in section 8.5.2 which states "if there is more than one elevated area, a separate term should be included in each". The same statement is included in LC-FS-TSD-002, Rev 0. An example of how Equation 4 would be applied is provide below.

Assume FSS was performed on the buried pipe survey unit "Circulating Water Discharge Pipe" with a surface area of 766 m^2. For the sake of simplicity, it is assumed that there is only one ROC, in this case, Cs-137, which has a Base Case DCGL of 3.30E+05 dpm/100 cm^2. For this example, assume 14 systematic measurements were collected and one judgmental sample. Using the Operational DCGL for Cs-137 (9.91E+04 dpm/100 cm^2), 13 of the 14 systematic measurements had a SOF of less than one (based on the OpDCGL), with the 14^{th} measurement exhibiting a Cs-137 concentration of 1.2 E+5 dpm/100 cm^2. A judgmental measurement was also performed at the pipe opening with a result of 2.5E+05 dpm/100 cm^2. Both elevated areas exceed the OpDCGL but are less than the BcDCGL. The average Cs-137 concentration for the14 systematic measurements was 3.7E+04 dpm/100 cm^2 and the survey unit passes the Sign Test. The areas of the systematic and judgmental elevated areas were determined to be 2 m^2 and 3.5 m^2, respectively. The calculation for the $BcSOF_{\text{Buried Pipe}}$ for the survey unit, considering the multiple (2) elevated areas then becomes:

$$BcSOF_{BURIED\ PIPE} = \sum_{i=1}^{n} \frac{3.7 \times 10^4}{3.30 \times 10^5} + \frac{(1.2 \times 10^5 - 3.7 \times 10^4)}{\left[3.30 \times 10^5 \times \left(\frac{766}{2}\right)\right]} + \frac{(2.5 \times 10^5 - 3.7 \times 10^4)}{\left[3.30 \times 10^5 \times \left(\frac{766}{3.5}\right)\right]}$$

$$BcSOF_{BURIED\ PIPE} = 0.115$$

Comment (PAB 11): **More information is needed for Equation 5-3 on Compliance.**

Basis: Page 5-10 and 5-11 of the LACBWR LTP states that "the mean values from FSS will include the results of judgmental samples based on an area weighted average approach. Detailed instructions for calculating the compliance dose using Equation 5-3 will be provided in a procedure which will be submitted to NRC for information." The level of detail provided in the LTP for Equation 5-3 is not sufficient. For example, the area weighted average approach is not described. In addition, the maximum basement term is described as a survey unit dose, but the scenario in which there is more than one survey unit per basement is not described.

Path Forward:

a. The details regarding Equation 5-3 should be provided to the NRC for approval, not just information. In addition, provide a detailed example showing how the factors for Equation 5-3 will be determined from survey measurements.

LACBWR Response (PAB 11a) – LACBWR TSD LC-FS-TSD-002 "Operational Derived Concentration Guideline Levels for Final Status Survey," Rev 0 provides details regarding compliance with Equation 5-3 which will be provided to NRC for approval. The format of Equation 5-3 is revised in LC-FS-TSD-002 as shown and Equation 5-3 will be revised in LACBWR LTP Rev 1 accordingly.

LC-FS-TSD-002 provides specific equations and descriptions as to each term in the revised Equation 5-3. A detailed example of how the dose from the terms of Equation 5-3 are calculated, including elevated systematic and judgmental results, was provided for buried pipe in response to PAB 10d.

$$\text{Compliance Dose} = (\text{Max BcSOF}_{\text{BASEMENT}} + \text{Max BcSOF}_{\text{SOIL}} + \text{Max BcSOF}_{\text{BURIED PIPE}} + \text{BcSOF}_{\text{AG BUILDING}} + \text{GW BcSOF}_{\text{BS OB}} + \text{GW BcSOF}_{\text{BPS OBP}} + \text{Max SOF}_{\text{EGW}}) \times 25 \text{ mrem/yr}$$

where:

Compliance Dose	=	must be less than or equal to 25 mrem/yr,
Max $\text{BcSOF}_{\text{BASEMENT}}$	=	Maximum BcSOF (mean of FSS systematic results plus the dose from any identified elevated areas) for backfilled Basements,
Max $\text{BcSOF}_{\text{SOIL}}$	=	Maximum BcSOF (mean of FSS systematic results plus the dose from any identified elevated areas) for open land survey units,
Max $\text{BcSOF}_{\text{BURIED PIPE}}$	=	Maximum BcSOF (mean of FSS systematic results plus the dose from any identified elevated areas) from buried piping survey units,
Max $\text{BcSOF}_{\text{AG BUILDING}}$	=	Maximum BcSOF (mean of FSS systematic results plus the dose from any identified elevated areas) from above grade standing building survey units,
GW $\text{BcSOF}_{\text{BS OB}}$	=	Groundwater scenario dose from the "Other Basement" (OB) which is defined as the basement not used to generate the Max $\text{BcSOF}_{\text{BASEMENT}}$ term in Equation 1
GW $\text{BcSOF}_{\text{BPS OBP}}$	=	Groundwater scenario dose from the "Other Buried Pipe" (OBP) which is defined as the buried pipe survey unit not used to generate the Max $\text{BcSOF}_{\text{BURIED PIPE}}$ term in Equation 1
Max SOF_{EGW}	=	Maximum SOF from existing groundwater (EGW)

NRC Comment (PAB 12): More information is needed on the conceptual model for the Waste Gas Tank Vault and Remaining Structures.

Basis: Table 6-8, "Deterministic Geometry RESRAD Parameters Used in the Uncertainty Analysis for the Five BFM Insitu_{gw} Configurations," of the LACBWR LTP shows that the thickness of the contaminated zone is set to 2.54 cm for the WGTV, WTB, and Remaining Structures. The area of the contaminated zone is set to be the total surface area of the basements including floors, walls, and ceiling (where applicable). The 2.54 cm thick contaminated zone is assumed to be entirely at an elevation equivalent to the floor elevation. While this conceptual model does artificially assume a lower elevation for some of the wall and/or ceiling contamination for the WGTV and WTB, it also artificially alters the geometry and extent of the contaminated zone for these structures in a way that makes it difficult to tell if it is an overall conservative assumption.

In reality, there will be some contamination mixing with fill near the floor, wall and/or ceiling surfaces at various elevations. The extent of mixing into the fill is uncertain. The licensee performed a sensitivity analysis on the extent of contamination mixing with the fill in which the mixing distance ranged from 2.54 cm to the full height or length of the fill for the both the Reactor Building Above 619 foot and the WGTV.

This sensitivity analysis assumed all the surface area was in a horizontal position for the WGTV, whereas for the Reactor Building Above 619 foot the wall contamination was modeled vertically. The sensitivity analysis showed that for the Reactor Building Above 619 foot, the full mixing distance out from the wall of 9 meters yielded higher doses, while for the WGTV, the smaller mixing distance of 2.54 cm yielded higher doses. The NRC staff notes that contamination on the walls of other structures may be more likely to yield sensitivity results similar to the Reactor Building above 619 foot. Therefore, the assumptions for the orientation of the contamination in the sensitivity analysis should be reviewed to ensure that the related assumptions regarding extent of contamination are appropriate.

For the Remaining Structures Conceptual Model, one conceptual model is applied to represent a variety of the Remaining Structures at the LACBWR site (i.e., Piping and Ventilation Tunnels, Reactor / Generator Plant, Chimney Slab, Turbine Sump 1C, and Turbine Pit at G5). The elevation of the floor of the WGTV is 621 foot and the WTB is 630 foot, while the Remaining Structures elevation varies from 639 foot to 618 foot. The licensee applies an Area Weighted Average Floor Elevation of the Remaining Structures for the Remaining Structures Conceptual Model. This approach conceptually moves some of the contamination further away from the Saturated Zone, especially any contamination remaining in the Turbine Sump and Turbine Pit, which are at the 618 foot elevation. The adequacy of these assumptions should be reviewed, especially given the uncertainty in the groundwater elevation (see HYDRO-1 on Groundwater Level and Unsaturated Zone Thickness.

Path Forward:

a. Provide additional justification regarding the geometry assumptions for the contaminated zone for the WGTV and Remaining Structures. Include additional discussion on the related assumptions for the contaminated zone thickness and contaminated zone area. Analyze the impact on dose and sensitivity of mixing depth when modeling the contamination on the walls vertically, as opposed to assuming all contamination is at the floor elevation.

b. Provide an additional basis for why the single BFM conceptual model (and an area weighted average floor elevation) appropriately represents the variety of Remaining Structures. Analyze the impact on the DCGLs should these structures be modeled separately with the contamination at separate elevations.

c. Analyze the impact on the DCGLs should a higher groundwater elevation be applied in the conceptual models for the WGTV and Remaining Structures.

LACBWR Response (PAB 12a) – After the issuance of LTP Rev 0, project plans changed to include full excavation of all "Remaining Structures." Only the WGTV (and Reactor Building) will remain.

In response to HYDRO-1, the basement conceptual model was revised to apply the maximum groundwater elevation of 629 foot as opposed to average elevation 619 foot. This resulted in the 618 foot elevation of the WGTV foundation, and portions of the walls, being below the groundwater table.

Due to the change in groundwater elevation, as well as the change in the Reactor Building conceptual model to combine both the above and below groundwater portions into a single model, a revised sensitivity analysis of the contaminated zone mixing distance (depth) and geometry was performed for the WGTV and Reactor Building in RS-TD-313196-004, Rev. 3, section 4.2.

The mixing distance sensitivity analyses for the BFM Groundwater scenario were performed assuming that released activity mixes over distances of 1 m, 2 m, and 3 m from the floor and wall surfaces, as opposed to full mixing. A mixing distance of 1 m was assumed to conservatively represent a minimum width from which a well drawdown zone would not include dilution with adjacent, uncontaminated, groundwater. Summaries of the sensitivity analysis input geometries and results from RS-TD-313196-004, Rev. 2, Section 4.2 are provided below.

The information in Section 4.2 of RS-TD-313196-004, Rev. 2 will be included in LACBWR LTP Rev. 1

Reproduced from RS-TD-313196-004, Rev. 3 Table 2 – WGTV Mixing Sensitivity RESRAD Source Term Geometries

Parameter	Mixing Distance	Perpendicular Walls	Parallel Wall	Floor
Area of Contaminated Zone (m^2)	1	18	9.6	86.4
	2	36	19.2	86.4
	3	54	28.8	86.4
Thickness of Contaminated zone (m)	1	4.57	4.57	1
	2	4.57	4.57	2
	3	4.57	4.57	3
Length Parallel to Aquifer Flow (m)	1	2	9.6	9.6
	2	4	9.6	9.6
	3	6	9.6	9.6

Reproduced from RS-TD-313196-004, Rev. 3 Table 3 – Reactor Building Mixing Sensitivity RESRAD Source Term Geometries

Parameter	Mixing Distance	Perpendicular Walls	Floor
Area of Contaminated Zone (m^2)	1	102.34	262.68
	2	179.55	262.68
	3	231.62	262.68
Thickness of Contaminated zone (m)	1	7.32	1
	2	7.32	2
	3	7.32	3
Length Parallel to Aquifer Flow (m)	1	2	18.29
	2	4	18.29
	3	6	18.29

Table 4 – Mixing Sensitivity Analysis Results Summary
Maximum Ratio of Dose Factor Partial Mix/Full Mix

ROC	Rx Building Wall + Floor	WGTV Wall + Floor
Co-60	1.25	1.19
Cs-137	1.91	1.42
Sr-90	1.08	1.18
Eu-152	2.03	1.41
Eu-154	2.03	1.40

As stated in RS-TD-313196-004, Rev. 3, section 4.2, "To ensure a conservative and bounding $DCGL_{gw}$ for ROCs in backfilled basement surfaces, The $DCGL_{gw}$ values calculated for each ROC under the full mixing assumption were reduced by the ratios in Table 4." Additional details regarding the mixing sensitivity analysis inputs and calculation results is provided in RS-TD-313196-004, Rev. 3, Attachment 4.

LACBWR Response (PAB 12b) –PAB 12b no longer applicable due to the change in project plans to fully excavate the Remaining Structures.

LACBWR Response (PAB 12c) – As discussed in response to PAB 6a (and HYDRO-1), the conceptual models for the WGTV (and Reactor Building) were revised to apply a groundwater elevation of 629 foot to account for the maximum elevation measured during site groundwater monitoring as opposed to the average elevation of 619 foot applied in LACBWR LTP Rev 0. The RESRAD "contaminated fraction below water table" was derived assuming a groundwater elevation of 629 foot. The revised Reactor Building and WGTV conceptual models and dose assessments are described in Section 3.1 of TSD RS-TD-313196-004, Rev. 3.

NRC Comment (PAB 13): Additional information is needed regarding classification and survey coverage of basement structures.

Basis: Table 2-2, "LACBWR Structural Survey Units," of the LACBWR LTP lists several survey areas which were initially classified as Class 1: Reactor Building, Waste Treatment Building, Ventilation Stack, WGTV, Turbine Building, Turbine Office Building, Piping Tunnel, etc. However, Table 5-8, "Number of ISOCS Measurements per FSS Unit Based on Areal Coverage," of the LACBWR LTP lists the WTB Basement as the only remaining Class 1 survey unit for FSS purposes.

MARSSIM Section 2.2 provides one example of a MARSSIM Class 1 area as "site areas previously subjected to remedial actions" and goes on to add a footnote that "remediated areas are identified as Class 1 areas because the remediation process often results in less than 100 percent removal of the contamination, even though the goal of remediation is to comply with regulatory standards and protect human health and the environment. The contamination that remains on the site after remediation is often associated with relatively small areas with elevated levels of residual radioactivity. This results in a non-uniform distribution of the radionuclide and a Class 1 classification. If an area is expected to have no potential to exceed the $DCGL_w$ and was remediated to demonstrate the residual radioactivity is as low as reasonably achievable (ALARA), the remediated area might be classified as Class 2 for the final status survey."

Page 2-5 of MARSSIM further states that "to justify changing the classification from Class 1 to 2, there should be measurement data that provides a high degree of confidence that no individual measurement would exceed the $DCGL_w$." To date, the licensee has not yet provided characterization data showing with a high degree of confidence that no individual measurement would exceed the $DCGL_b$.

Due to the initial classification of the Reactor Building, WTB, Ventilation Stack, WGTV, and Turbine Building as Class 1 impacted areas, and the fact that these areas are being subjected to remedial actions, according to MARSSIM Section 2.2, the survey units listed in Table 5-8 of the LACBWR LTP should remain as Class 1 until additional characterization results are provided for review and approval to sufficiently justify changing the classification of these areas from Class 1 to Class 2.

The NRC staff acknowledge the licensee's recent decision to remove the WTB in its entirety. However, given that other structures will now likely be Class 1 for the purposes of FSS, the following discussion is still relevant. Regarding the WTB surveys, Section 5.5.2 of the LACBWR LTP states that "the basement structure FSS units will be comprised of the combined wall and floor surfaces of each remaining building basement." The WTB is a single survey unit, and Table 5-8 of the LTP specifies that the survey unit will receive a 100 percent scan. The surface area of the floors of the WTB are about 37 m^2, while the surface area of the walls are about 65 m^2. Therefore, the entire surface area of the WTB in Table 5-8 is listed as 101.9 m^2, which includes both the floors and the walls.

However, it is unclear whether the WTB walls will receive a 100 percent scan due to other statements made in the LACBWR LTP. For example, Page 5-2 of the LTP states that "in the WTB, the only portion of the structure that will remain is the 630 and 635 foot floor, sump and concrete footers below the 636 foot elevation." It is unclear which parts of this description of the WTB correspond to walls and which parts correspond to floors. Furthermore, Page 5-22 of the LTP states that "for the FSS of basement structures, the EMC is only applicable to Class 1 survey units when an elevated area is identified by systematic or biased / judgmental ISOCS measurements. As stated in Section 5.5.2.1, this is expected to apply only to the 630 and 635 foot elevations of the WTB."

Page 5-23 states that elevated areas will only be investigated on the **floor surfaces**:

> As discussed in Section 5.4.3, small elevated areas (smaller area than the ISOCS FOV), if present, are identified and investigated during the post-demolition survey **of the floor only**. The areal extent of identified elevated areas on the floor will be bounded and a concrete core sample collected at the location within the bounded area that exhibits the highest activity. If the activity in the core (summing activity in all core slices) exceeds the $DCGL_b$ values in Table 5-3 [Basement DCGLs (pCi/m^2)], then an EMC test will be performed using the $DCGL_{bs}$ for the Drilling Spoils scenario from Table 5-4 [DCGLs for Individual BFM Scenarios ($DCGL_{bs}$)] with an Area Factor of one. The Drilling Spoils scenario, and corresponding EMC test, does not apply to walls.

The reference to Section 5.4.3 of the LTP in this paragraph seems to be a typo. Instead, this should refer to Section 5.4.4 of the LTP, which states:

> Following demolition, after all debris is removed and the floors cleaned, an additional scan survey will be performed on **100 percent of the Class 1 basement floors**, again using hand-held beta-gamma instrumentation as presented in Table 5-13 [Typical FSS Survey Instrumentation] in typical scanning and measurement modes. Any identified elevated areas that could potentially exceed the $DCGL_b$ will be identified and bounded. A concrete core sample will be collected at the location that exhibits the highest activity within any bounded area. If the activity in the core (summing activity in all core slices) exceeds the $DCGL_b$ values in Table 5-3, **an EMC test will be performed using the $DCGL_{bs}$ for the Drilling Spoils scenario** from Table 5-4 (see Section 5.5.3).

Given that Section 5.4.4 of the LACBWR LTP uses the phrase "100 percent of Class 1 basement floors," it is unclear whether the wall surface areas of Class 1 survey units will receive 100 percent scan coverage as well. In addition, the licensee has not adequately justified why the EMC test will only apply to the floors and not also the walls of Class 1 areas (see PAB-10 on Area Factors and the Elevated Measurement Comparison). It is also unclear whether the licensee intends to apply the EMC test as it is described in Equation 5-5 of the LTP, or only the Drilling Spoils term from Equation 5-5. The statement "**an EMC test will be performed using the $DCGL_{bs}$ for the Drilling Spoils scenario**" seems to disagree with the statement on Page 5-23 of the LTP that "for the FSS of Class 1 basement structures, the EMC test will be performed using Equation A-1 from NUREG-1757, as shown in Equation 5-5.

Path Forward: List the areas identified in Table 5-8 of the LACBWR LTP as Class 1 survey areas until additional characterization results are provided to the NRC staff for review and approval to sufficiently justify changing the classification of these areas to Class 2 survey areas. Adjust the minimum areal coverage and number of ISOCS measurements for these survey units accordingly. If additional characterization results are available showing a high degree of confidence that no individual measurement would exceed the $DCGL_b$, provide these to the NRC.

a. Clarify LACBWR's current FSS plan for Class 1 basement structures, which areas are walls versus floors, and their various elevations. In addition, clarify whether or not there are multiple survey units within each basement structure. If possible, provide a diagram for each basement structure or identify where this information may be available in the materials which have already been submitted to the NRC. Finally, clarify which surfaces will be receive 100 percent scan coverage and which surfaces will be subject to the EMC test.

b. Commit to 100 percent scan coverage and systematic sampling of all Class 1 surface areas, and to appropriately investigate and/or remediate hotspots according to the MARSSIM guidance for Class 1 surfaces (regardless of whether the surfaces are walls, floors, or ceilings).

c. With regard to the EMC test for Class 1 structures, clarify what is meant by "an EMC test will be performed using the $DCGL_{bs}$ for the Drilling Spoils scenario." Reconcile this with the later statement that "for the FSS of Class 1 basement structures, the EMC test will be performed using Equation A-1 from NUREG-1757, as shown in Equation 5-5."

d. Clarify whether operational DCGLs will be applied in the design of Final Status Surveys for basement structures.

LACBWR Response (PAB 13a) –LACBWR has decided to remove the WTB basement and the Remaining Structures (Piping and Ventilation Tunnels, Chimney slab and Reactor/Generator Plant) in their entirety. These structures will be removed from Table 5-8 and Table 5-9. The remaining Reactor Building basement and Waste Gas Tank Vault will be subject to a FSS using a Class 1 designation for both sub-grade structures. Tables 5-8 and 5-9 will be revised as follows:

Table 5-8 Number of ISOCS Measurements per FSS Unit based on Areal Coverage

FSS Unit	Classification	Area (m^2)	Minimum Areal Coverage (% of Area)	# of ISOCS Measurements (based on 28 m^2 FOV)
Reactor Building basement	Class 1	683	100%	24
WGTV	Class 1	300	100%	11

Table 5-9 Adjusted Minimum Number of ISOCS Measurements per FSS Unit

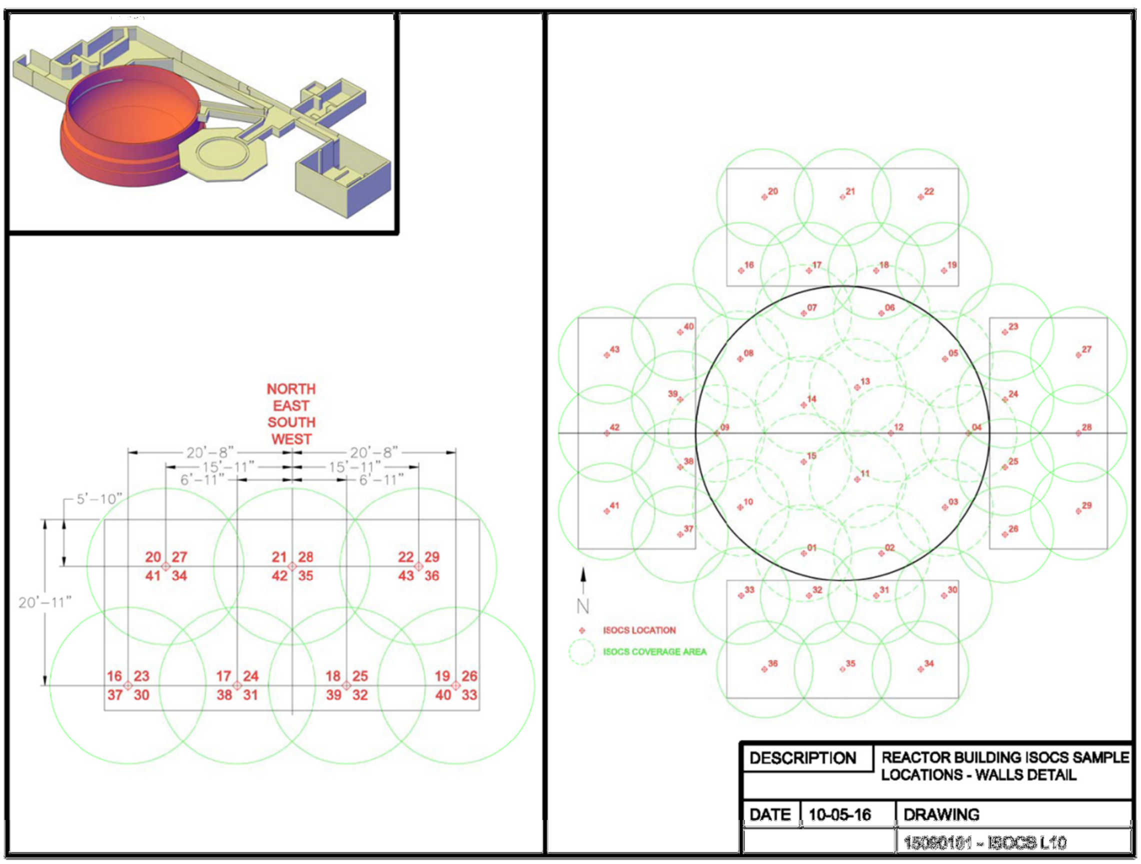
FSS Unit	Classification	Required Areal Coverage (m^2)	Adjusted # of ISOCS Measurements (FOV-28 m^2)	Adjusted Areal Coverage (m^2)	Adjusted Areal Coverage (% of Area)
Reactor Building basement	Class 1	683	43	683	100%
WGTV	Class 1	300	22[1]	300	100%

[1] Includes 18 floor/wall measurements plus 4 measurements to account for interior concrete column.

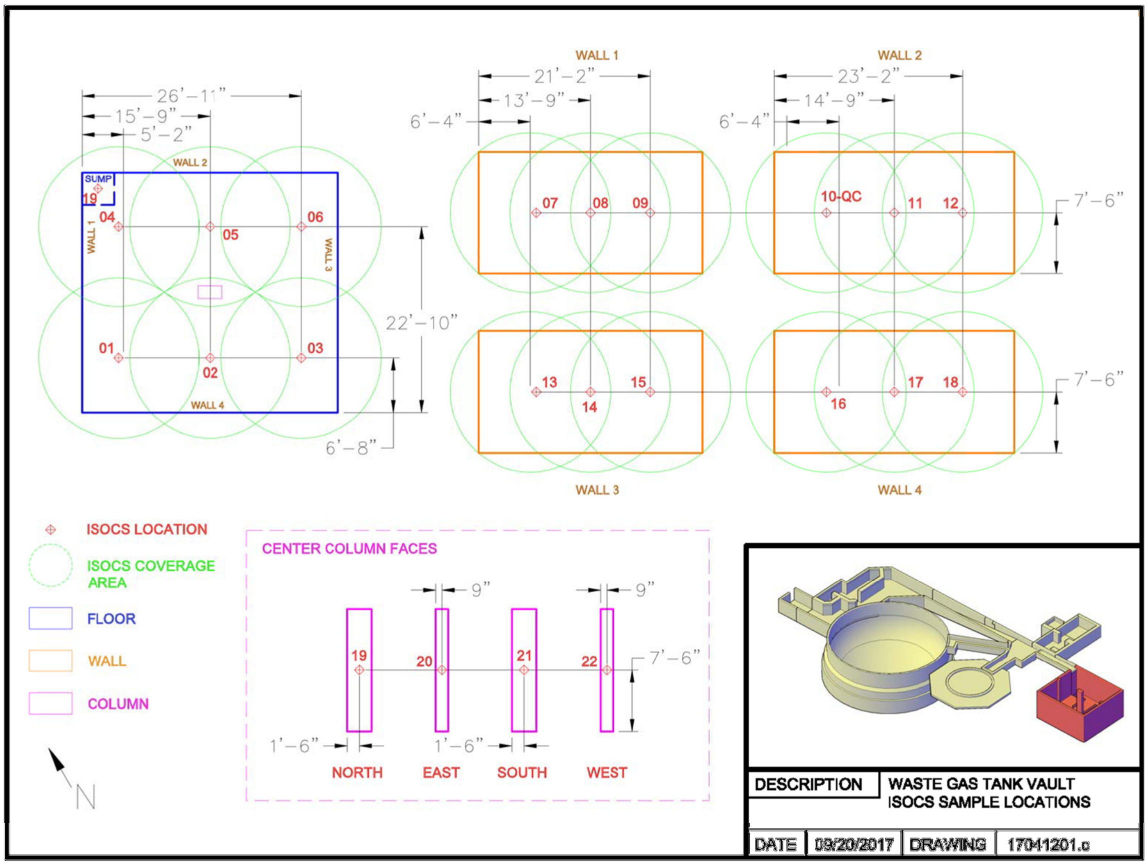
LACBWR Response (PAB 13b) – Because LACBWR will not use Elevated Measurement Comparisons for structure surfaces or buried pipe, LTP Section 5.4.6 will be revised to state, "*Following demolition, after all debris is removed and the floor cleaned, an additional scan survey will be performed to ensure that any individual ISOCS measurement will not exceed the Operational $DCGL_B$ during FSS. The survey will be performed using hand-held beta-gamma instrumentation as presented in Table 5-13 in typical scanning and measurement modes. The scan survey will be performed on 100% of Class 1 basement floors and on any wall surfaces that are suspect of having residual contamination in excess of the Operational $DCGL_B$ (e.g., cracks, penetrations, or areas that have undergone remediation).*"

The two remaining sub-grade structures that will be subject to FSS using a Class 1 designation are the Reactor Building basement and the Waste Gas Tank Vault. Each one of these basement structures will undergo FSS as a single survey unit. A general description and diagram of the final configuration of each structure is as follows.

Reactor Building Basement: The Reactor Building will be demolished to 3' below grade (636' elevation). All remaining interior concrete and the metal liner will be removed leaving just the external concrete behind the liner (the spherical floor from the 612' elevation to the 621' elevation, and the walls from the 621' elevation to the 636' elevation). All floor and wall surfaces (totaling approximately 512 m^2) will be subjected to 100% coverage using the ISOCS.



Waste Gas Tank Vault: The WGTV has been demolished to 3' below grade (636' elevation). All interior components were removed leaving the floor at the 621' elevation and four walls and a center column from the floor to the 636' elevation. All floor and wall surfaces (totaling approximately 311 m^2) were subjected to 100% coverage using the ISOCS (see drawing below). After evaluation by the NRC the WGTV basement was backfilled.



LACBWR Response (PAB 13c) –Table 5-8 in LTP Rev 0 and the revised Table 5-8 provided in response to PAB 13a which will be provided in LTP Rev 1, commits to 100% coverage of walls and floors using ISOCS during FSS. The 100% coverage provided by ISOCS satisfies the MARSSIM guidance for scan coverage of Class 1 surfaces. As stated in response to PAB 13b, in addition to the 100% ISOCS coverage during FSS a scan survey will be performed prior to FSS to ensure that any individual ISOCS measurement will not exceed the Operational $DCGL_B$ during FSS. The scan survey will be performed on 100% of Class 1 basement floors and on any wall surfaces that are suspect of having residual contamination in excess of the Operational $DCGL_B$. LACBWR will not use the EMC test for structure surfaces or buried pipe. The EMC test will only be used in Class 1 open land (soil) areas. Therefore, any areas in a structure or buried pipe survey unit with an FSS measurement in excess of the Base Case DCGLs will be remediated.

LACBWR Response (PAB 13d) – LACBWR will not utilize EMCs for structure surfaces or buried pipe. All ISOCS measurements must be less than the Base Case DCGL; area factors are not applicable to ISOCS FSS measurements. Any ISOCS FSS result that exceeds the Base Case DCGL will be remediated. LTP Section 5.5.3 will be deleted as will Table 5-10 (Area Factors for WTB Groundwater Scenario) and Equation 5-5 and therefore, PAB 13d is no longer considered applicable.

LACBWR Response (PAB 13e) – Operational DCGLs will be used for the FSS design of all survey units (calculation of surrogate DCGLs, investigation levels, etc.).

NRC Comment (PAB 14): Clarification is needed on whether the underground tanks should be categorized as Buried Pipes.

Basis: Page 5-44 of the LACBWR LTP states that "designated sections of buried piping will be remediated in place and undergo FSS. The tanks associated with the Administration Building Sanitation system and leach field will also be addressed during FSS as buried pipe. Compliance with the DCGL values, as presented in Table 5-6, "DCGLs for Buried Piping (dpm/100cm^2)," will be primarily demonstrated by measurements of total surface contamination and by the collection of sediment samples when available." Page 6-5 of the LTP states that "the Administrative Building Sanitary System includes three small tanks that are also designated as buried pipe for the purpose of dose assessment and FSS." Table 6-2, "Buried Piping to Remain in LACBWR End State," of the LTP lists the three tanks as a 2500-gallon septic tank, a 750-gallon dosing tank, and a 94-gallon distribution tank. Additional information is needed to determine the acceptability of treating the underground tanks as buried piping for the purposes of performing FSS.

Path Forward:

a. Provide additional justification that the conceptual model for developing the buried piping DCGLs is appropriate for these tanks. Include a description of the location (survey unit), geometry (diameter and height), and elevation of each tank, the potential for contamination given historical use, and the end state (e.g., whether they will be backfilled or grouted.

b. Provide a technical basis for why the mixture fractions assumed in deriving the buried piping DCGLs apply to these underground tanks.

c. Provide additional information on the surveys that will be conducted on the tanks; clarify the classification of the tanks; and include a description of what is meant by "compliance…will be primarily demonstrated by measurements of the total surface." In addition, include a specific description of how it is determined whether sediment samples are available. For example, is availability determined by accessibility, the mass of sediment existing, or some combination of both?

LACBWR Response (PAB 14a, b and c) – PAB 14a, b, and c are no longer applicable due to a change in project plans after the submittal of LACBWR LTP Rev 0 which now include full excavation of the underground tanks associated with the Administration Building Sanitation system and leach field. The final end-state will not include any underground tanks.

LACROSSE SOLUTIONS

Health Physics Topics (Identified by HP)

NRC Comment (HP 1): ISOCS FOV Uncertainties for Remedial Action Support Surveys (RASS) and FSS Measurements.

Basis: Section 5.4 and Section 5.5 of the LACBWR LTP address the use of ISOCS measurements in a discussion of RASS and FSS. NUREG-1700, Section 5, "Final Radiation Survey Plan," calls for a demonstration that the in situ sample measurements with field instruments, and the associated survey methods, have adequate sensitivity as part of the FSS design. Accordingly, the LACBWR LTP should address the effects of ISOCS FOVs that are smaller than the source area. The additional information should specifically address the measurement of inaccessible areas and the licensee's method for demonstrating that they are capable of 100 percent scan coverage for the Class 1 survey units.

Path Forward:

a. Provide additional information on how ISOCS measurements compare to conventional measurements. Identify how ISOCS FOVs provide for 100 percent scan coverage of Class 1 survey units and how inaccessible areas are addressed. Discuss the possibility of utilizing combinations of in situ and conventional measurements as part of the overall FSS design.

b. Consider reevaluating characterization data and survey unit classifications before conducting FSS measurements. MARSSIM Section 8.5.2, "Interpretation of Statistical Test Results," states that a separate term should be included for each elevated area when determining whether the total dose is within the release criterion of a survey unit. Accordingly, clarify whether all elevated areas are considered together or independently in a Class 1 survey unit.

LACBWR Response (HP 1a): Table 2 of LC-FS-TSD-001, *Use of ISOCS for FSS of End State Sub Structures at LACBWR*, provides a comparison of the Circular Plane Model Cs-137 MDC to the sub structure DCGLs. Table 2 below (modified to include the Operational DCGLs) clearly shows the ISOCS MDC to be <1% of the Cs-137 DCGL for the two basements that are slated to remain at license termination and be subject to FSS.

Sub-grade Structure	Cs-137 OP $DCGL_B$ (pCi/m²)	Cs-137 ISOCS MDC (pCi/m²)	Fraction of OP $DCGL_B$
Reactor Building	6.52E+06	2.76E+04	0.004%
WGTV	6.10E+06	2.76E+04	0.004%

LC-FS-TSD-001 will be submitted for regulatory review along with the submittal of these RAI responses.

A sufficient number of ISOCS measurements will be obtained in the two Class 1 sub-grade basement survey units to meet the 100% scan requirement. The ISOCS FOV will be overlapped to ensure that there are no un-surveyed corners and gaps. The response to PAB 13b provides drawings the depict the ISOCS measurement locations and the overlapping FOV for each.

Because equipment and components and interior walls will be removed from the two subsurface basement survey units, it is not anticipated that there will be any areas during FSS that will not be accessible with the ISOCS; therefore, it will not be necessary to incorporate combinations of in situ and conventional measurements during FSS.

LACBWR Response (HP 1b): During FSS, hot spots (surface scans or sample analyses which exceed the Base Case DCGL) must be evaluated both individually and in total to ensure compliance with the release criteria. At LACBWR, the EMC is only applicable to Class 1 open land (soil) survey units when a hot spot is identified by surface scans and/or biased and systematic samples or measurements. As such, the application of the $DCGL_{EMC}$ does not apply to basement surfaces or buried pipes. As described in PAB 10d, measurements in basements or buried pipes that are between the Operational DCGL and Base Case DCGL will undergo an assessment analogous to the $DCGL_{EMC}$ process described below for soil hot spots.

The investigation level for the EMC is the $DCGL_{EMC}$, which is the Base Case DCGL modified by an AF. Soil locations identified by surface scans or sample analyses which exceed the Base Case DCGL are subject to additional surveys to determine compliance with the elevated measurement criteria. Based upon the size of the hot spot area, the corresponding AF will be determined from Table 5-7.

Any identified hot spots are each compared to the specific $DCGL_{EMC}$ value calculated for the size of the affected area. If the individual hot spots pass, then they are combined and evaluated under the unity rule. This will be performed by determining the fraction of dose contributed by the average radioactivity across the survey unit and by adding the additional dose contribution from each individual hot spot following the guidance as provided in section 8.5.1 and section 8.5.2 of MARSSIM.

The average activity of each identified elevated areas is determined as well as the average activity value for the survey unit. The survey unit average activity value is divided by the Base Case DCGL, the survey unit average value is then subtracted from the average activity value for the elevated area and the result is divided by the appropriate $DCGL_{EMC}$. The net average activity for each identified elevated area is evaluated against its applicable $DCGL_{EMC}$. The fractions are summed and the result must be less than unity for the survey unit to pass. This is summarized in the equation as follows;

Equation Error! No text of specified style in document.-6

$$\frac{\delta}{DCGL_W}+\frac{\tau_1-\delta}{DCGL_{EMC_1}}+\frac{\tau_2-\delta}{DCGL_{EMC_2}}+\cdots\frac{\tau_n-\delta}{DCGL_{EMC_n}}<1$$

where:

δ	=	the survey unit average activity;
$DCGL_W$	=	the survey unit Base Case DCGL concentration,
τ_n	=	the average activity value of hot spot *n*, and
$DCGL_{EMCn}$	=	the $DCGL_{EMC}$ concentration of hot spot *n*.

NRC Comment (HP 2): Judgmental Sampling, Laboratory Analyses, and Surveyor / Instrument Efficiencies.

Basis: Section 5.5 of the LACBWR LTP includes a statement on judgmental sampling and basing judgmental measurements on a "higher potential" for elevated concentrations of residual concentration based on characterization, contamination verification survey (CVS) results, or professional judgment.

Section 5.3 of the LTP discusses laboratory instrument methods and sensitivities, including the use of offsite vendor laboratories. Instrument calibrations are also dependent on source geometry, specifically 2π or 4π geometry. In addition, surveyor efficiency is an important component of calculating scan MDCs as noted in NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," and NUREG/CR-6364, "Human Performance in Radiological Survey Scanning." Scan MDC values based on a surveyor efficiency of between 0.5 and 0.75 are generally acceptable; use of a surveyor efficiency above 0.7 should have a documented basis.

Path Forward:

a. Provide more detail on specific triggers for judgmental sampling. Identify the minimum criteria, if any, that surveyors use to select judgmental sample locations. Provide details on how judgmental samples are based on an area weighted average and do not dilute dose by taking judgmental samples from clean areas rather than areas of "higher potential."

b. Clarify whether the onsite and offsite laboratories used by LACBWR participate in an independent inter-laboratory comparison program.

c. Identify the basis for false positive analytical results and any follow-up measures used to investigate those results. Provide a basis for eliminating any data points identified as a false positive result. Identify whether there are minimum trigger levels based on analytical results that warrant sample recount.

d. Provide additional information on survey instrument calibration calculations and specify whether 2π or 4π source geometry is utilized.

e. Describe the technical basis for surveyor efficiencies which exceed 0.7.

LACBWR Response (HP 2a): – Section 5.4.5 of LTP Rev 1 will be revised to state, "*Any areas identified that have the potential to exceed the Operational $DCGL_B$ by ISOCS measurement during the performance of CVS in these areas will be remediated. Any areas of elevated activity that could potentially approach the Operational $DCGL_B$ will be identified as a location for a judgmental ISOCS measurement during FSS*". Section 5.5.2.1.1 of LTP Rev 1, will be deleted in its entirety.

The definition of a judgmental measurement in MARSSIM states that a judgmental measurement and/or sample will not be included in the statistical evaluation of the survey unit data. As described in PAB 10d, LACBWR will incorporate the dose from "elevated areas" into the calculation of the mean SOF using Equation 5-5. Areas of elevated activity will be defined as any area identified and/or bounded by measurements/samples (systematic or judgmental) that exceeds the Operational DCGL but is less than the Base Case DCGL. Once the survey data set passes the Sign Test (using the Operational DCGL), the mean radionuclide activity for each ROC from systematic measurements along with any identified elevated areas (identified and/or bounded by systematic and/or judgmental measurements/samples) will be used with the Base Case DCGLs to derive a SOF for the survey unit. The dose from residual radioactivity assigned to the FSS unit is the SOF multiplied by 25 mrem/yr.

The following equation reproduces Equation 5-5 from LTP Chapter 5 and is applicable to basement surfaces.

$$SOF_B = \sum_{i=1}^{n} \frac{Mean\ Conc_{B\,ROC_i}}{Base\ Case\ DCGL_{B\,ROC_i}} + \frac{\left(Elev\ Conc_{B\,ROC_i} - Mean\ Conc_{B\,ROC_i}\right)}{\left[Base\ Case\ DCGL_{B\,ROC_i} \times \left(\frac{SA_{SU}}{SA_{Elev}}\right)\right]}$$

where:

SOF_B	=	SOF for structural surface survey unit within a Basement using Base Case DCGLs
$Mean\ Conc_{B\,ROCi}$	=	Mean concentration for the systematic measurements taken during the FSS of structural surface in survey unit for each ROC_i
$Base\ Case\ DCGL_{B\,ROCi}$	=	Base Case DCGL for structural surfaces ($DCGL_B$) for each ROC_i
$Elev\ Conc_{B\,ROCi}$	=	Concentration for ROC_i in any identified elevated area (systematic or judgmental)
SA_{Elev}	=	surface area of the elevated area
SA_{SU}	=	adjusted surface area of FSS unit for DCGL calculation

If the result of a judgmental FSS measurement(s) and/or sample(s) in a Class 1 or Class 2 survey unit exceeds the Operational DCGL, or 50% of the Operational DCGL in a Class 3 survey unit, then the investigation process as specified in LTP Chapter 5, section 5.6.4.6 will be implemented. For all media except soils, if the SOF for a sample/measurement(s) exceeds one when using Base Case DCGLs, then remediation will be required.

LACBWR Response (HP 2b): LACBWR participates in an independent inter-laboratory comparison program with NIST traceable standard testing program with Eckert Ziegler for gross beta, gross alpha, gamma spectroscopy and tritium. As part of its purchase order with LACBWR, our off-site laboratory (GEL) maintains NELAC accreditation.

LACBWR Response (HP 2c):

As part of the Data Quality Assessment (DQA) process, analytical results are reviewed to identify anomalies that would require follow-up measures such as recounting the sample(s). Examples of these anomalies could be:

- duplicate analysis failure
- low chemical yield
- positive blank sample analysis
- abnormally high sample result
- identification of an unexpected radionuclide
- disagreement between onsite and off-site gamma spectroscopy results

LACBWR Response (HP 2d): The LACBWR uses a 2π geometry for beta-sensitive instruments and all calibration procedures meet ANSI N323A-1997 requirements.

LACBWR Response (HP 2e): The LACBWR does not use surveyor efficiencies other than 0.5.

NRC Comment (HP 3): Background Reference Areas and Materials

Basis: Section 2.3.1 of the LACBWR LTP discusses a background study which concludes that no suitable offsite background radiation reference area was identified for the La Crosse site, resulting in the selection of an onsite area to assess background radioactivity. This section also references the use of Zion Nuclear Power Station data for the global fallout of Cs-137 in soils at LACBWR. Section 5.2 of the LTP identifies the DCGLs as the level of radioactivity above background levels that could result in a dose of 25 mrem/yr to the average member of the critical group. Therefore, an accurate assessment of background radioactivity is important for determining compliance with the DCGLs. MARSSIM Section 4.5 discusses background reference areas, and states that reference areas and materials should not be part of the survey unit being evaluated. In addition, background radiation levels can vary by a factor of five or more within a few acres.

Path Forward:

a. Provide a basis for not selecting an offsite background radiation reference area at the La Crosse site and not using LACBWR specific historical Cs-137 global fallout data. Assess whether existing historical data from the annual radiological environmental monitoring reports or semiannual effluent release reports can be used to more appropriately document background and Cs-137 fallout.

b. With the exception of basement structures, which will not subtract background radiation from measurements, provide additional information regarding the basis for the background levels used with the applicable DCGLs to demonstrate compliance with the release criteria of each survey unit.

LACBWR Response (HP 3a and 3b): La Crosse Station Restoration Project (LACBWR) incorporated the Wilcoxon Rank Sum (WRS) Test into the LTP as an option in order to optimize flexibility. However, based upon the radiological characterization and assessments performed to date, background is known to be a small fraction of the unrestricted use criteria for soil, basements and piping. LACBWR will therefore exclusively use the Sign Test for FSS data assessment. All references to WRS test will be deleted from the LTP.

The Sign Test will be applied without subtracting background. Therefore HP 3, which requests more information regarding background reference areas, is no longer considered applicable.

NRC Comment (HP 4): Sub-Foundation and Inaccessible Area Sampling

Basis: Section 5.3.4.4 of the LACBWR LTP defines areas where surveys are deferred for soils under structures, soils under concrete or asphalt coverings, inaccessible concrete basements surfaces, and interiors of buried pipe (i.e., inaccessible areas). This section also states that continuing characterization plans and reports for these areas will be provided to the NRC for information.

NUREG-1757, Volume 2, Appendix A, "Implementing the MARSSIM Approach for Conducting Final Radiological Surveys," provides guidance on characterization of subsurface soil. Section 5.7.1.8 of the LACBWR LTP addresses buried piping, but does not discuss grouting of pipes, how underground tanks will be assessed, or continuing assessment of the areas around and under structures.

Path Forward:

a. Additional information is needed to address the scope and adequacy of deferred surveys for currently inaccessible areas. Specifically, provide additional information on the GeoProbe technology that will be used for soil surveys and sampling in these areas. In addition, identify the methods and criteria that will be used to survey the interior surfaces of buried piping that will remain onsite.

b. Provide additional information on grouting of pipes and subsequent dose assessment of any grouted piping.

c. Provide a technical support document for the use of ISOCS measurements for buried piping and underground tanks at LACBWR.

d. Submittal for NRC review and approval of continuing characterization plans and reports is expected in lieu of being "provided to the NRC for information."

LACBWR Response (HP 4a): Detailed discussion on the scope and adequacy of deferred surveys for currently inaccessible areas is provided in PAB 5a, including the methods and criteria that will be used to survey the interior surfaces of buried piping that will remain on site.

Soil borings and angled soil borings will be performed using GeoProbe® technology, split spoon sampling or other methods. GeoProbe® is a direct push technology that basically consists of mechanical hammering of a 2.5" (typically) pipe into the ground. The soil is captured in plastic sleeves for retrieval. Subsurface soil samples will be segmented and homogenized over each 1 meter of depth. Extraneous material will be removed from each segment and the sample will be adequately dried. The material will then be placed into a clean sample container and properly labeled. All samples will be tracked from time of collection through the final analysis in accordance with procedure and survey package instructions.

LACBWR Response (HP 4b): There are six buried pipe systems that are slated to remain at the time of license termination. Of these, the only pipe earmarked for grouting (for structural integrity purposes) is the Circulating Water Discharge Pipe that has been designated as Class 2. All portions of the pipe that are buried within the LSE will be removed; the only portion of the pipe that is to remain is from just west of the LSE fence to where it ties in with the G-3 discharge at the diffuser along the river embankment. This remaining section will be grouted in its entirety. The purpose of grouting is for structural integrity and not for contamination control purposes.

No credit was taken for the grout during dose modeling and DCGL development. The survey design of the buried piping and investigation levels are based on Operational DCGLs and compliance is based on the Base Case DCGLs. Any portions of the pipe that exceed the Base Case DCGL will be remediated and the pipe resurveyed.

LACBWR Response (HP 4c): ISOCS will not be used for obtaining measurements inside buried piping and therefore, HP 4c is no longer considered applicable.

LACBWR Response (HP 4d): All continuing characterization sample plans will be provided to NRC for information and continuing characterization results will be provided to the NRC for evaluation.

NRC Comment (HP 5): Confirmatory Surveys, Split Sampling, and Side by Side Measurements.

Basis: Section 5.9.6 of the LACBWR LTP briefly discusses "confirmatory measurements," but does not address split sampling and/or analysis of side by side instrument comparisons with the NRC. NUREG-1757, Volume 2, Chapter 4, "Facility Radiation Surveys," describes the performance of confirmatory surveys, split sampling, and side by side measurements as part of FSS design. NUREG-1575, Chapter 7, "Sampling and Preparation for Laboratory Measurements," discusses collocated samples, field duplicate samples, and laboratory duplicate samples.

Path Forward:

a. Provide additional information that addresses split sampling and analysis, as well as the performance of side by side instrument comparisons with the NRC, both during and after FSS. Split sampling and side by side measurement locations need to be identified prior to the performance of decommissioning activities that may compromise the ability to replicate the samples or measurements. The number of samples and measurements will be directed by the NRC.

b. In accordance with NUREG-1575, Chapter 7, provide additional information on the criteria used to identify the location and number of collocated samples, field duplicate samples, and laboratory duplicate samples.

LACBWR Response (HP 5a): LACBWR believes that in-process inspections by the regulator are more efficient than one-time confirmatory surveys at the end of a project as it allows the licensee and NRC to take side-by-side measurements, compare instrument readings and sensitivity and helps the decommissioning project in maintaining the release schedule.

LACBWR has individual confirmatory surveys built into the project schedule as a predecessor to the FSS of each specific survey unit. A 30-day notice is provided to the NRC prior to the start of a FSS in a specific survey unit. A window is provided for the NRC (or its contractor) to perform confirmatory measurements. Typically, the window starts when the FSS starts and ends one-week after the FSS completes. This window allows time for the regulator to perform side-by-side measurements if warranted or take additional measurements/samples once the FSS data is analyzed.

Prior to the NRC or its contractor arriving on site for confirmatory surveys, a copy of the sample plan and maps showing measurement and/or sample locations is provided. This allows the regulator, or its contractor, ample time to design the confirmatory survey.

As stated in Section 5.9.6 of the LACBWR LTP, timely and frequent communications with the NRC will ensure it is afforded sufficient opportunity for these confirmatory measurements prior to implementing any irreversible decommissioning actions.

LACBWR Response (HP 5b): Section 5.9.3 of the LACBWR LTP, "Measurement/Data Acquisition" (as it relates to Quality Assurance), provides details on the criteria used to identify the location and number of replicate measurements and surveys, duplicate and split samples, field blanks and spiked samples as well as the acceptance criteria for each.

Hydrogeology Topics (Identified by HYDRO)

NRC Comment (HYDRO-1): **Groundwater Level and Unsaturated Zone Thickness**

Provide a basis for selecting a water table at 619 foot mean sea level (MSL) for calculations in RESRAD for the LACBWR site. The water table elevation is used to determine the unsaturated zone thickness, which in turn is used to set the distance between contaminated structures and the saturated zone.

River stage levels, which are highly correlated with water table levels across the La Crosse site, exhibit a high season from April through September and a low season from October through March. Measurements from onsite wells during the low season appear to be in the 620 to 624 foot MSL range, whereas those in the high season are in the 624 to 630 foot MSL range.

Alternatively, demonstrate that the use of a water table at 619 foot MSL for RESRAD calculations is conservative compared to use of a water table that more closely reflects onsite measurements of water table elevation. RESRAD inputs for unsaturated zone thickness, mixing distances used for setting concentration distributions in the building infill, and contaminated fraction below the water table would be expected to change depending on the water table elevation. Accordingly, analyze the sensitivity of the BFM and soil conceptual models to a higher groundwater elevation assumption

LACBWR Response (HYDRO-1): The basement conceptual model has been revised to address the seasonal groundwater fluctuations by the use of the maximum measured groundwater elevation of 629 foot. The revised Reactor Building and WGTV conceptual models and dose assessments are described in Section 3.1 of TSD RS-TD-313196-004, Rev. 3.

NRC Comment (HYDRO-2): **Embankment Design and Design Criteria**

Provide information on the design and design criteria for the embankment and rip-rap that protects the hydraulic fill used to elevate the site to 639 foot MSL.

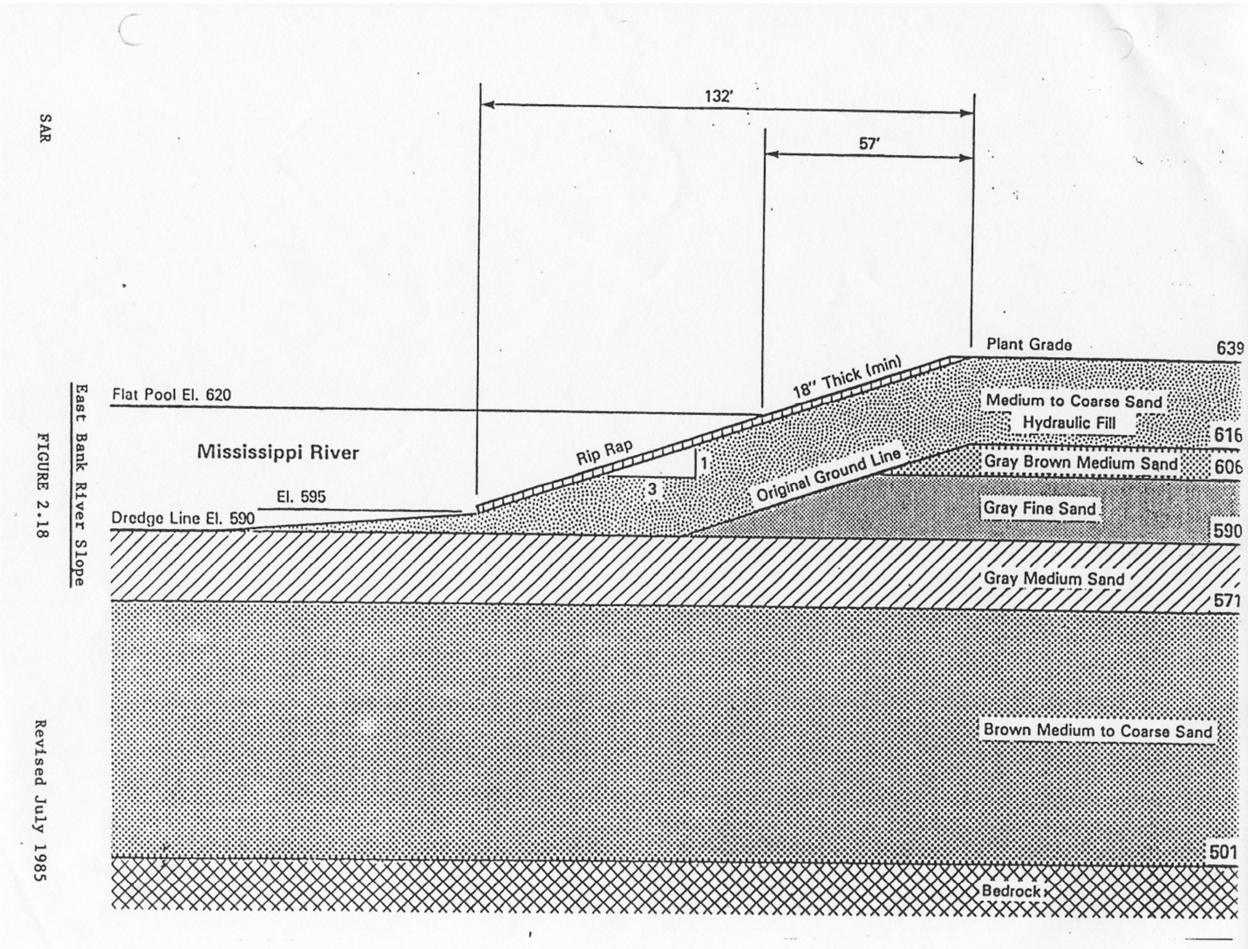
The site elevation is above the recorded river stage levels; however, the 1965 recorded flood stage and the estimated 100-year flood stage are within 1.8 feet of the site elevation. In addition, the upstream and adjacent configuration of the Mississippi River indicates that the possibility of cut-bank erosion along the site cannot be discounted, especially during flood events near the site. Finally, there is no information provided on the capability of the embankment and rip-rap to withstand cut-bank erosion during high river flow periods over the 1000-year performance period of the embankment, or the 200-year design period.

LACBWR Response (HYDRO-2): The 639 foot MSL elevation was selected on the basis of the calculated 100-year flood, which would reach an elevation of 635.2 feet MSL with a flow of 220,000 cfs. The highest floods on record did not reach 639 feet MSL, although flows in excess of 220,000 cfs have been recorded.

According to Section 5.1.3 of the Final Environmental Statement (April 1980), "*Because the site is near (about 3,300' downstream) U.S. Lock and Dam No. 8, and no large stream enters the river between the site and dam, the area potentially impacted is small. There are no significant structures along the river in this area. Thus, the incremental impacts of floods caused by the presence of the site would be expected to be small. The only structures now in the river are the intake and discharge structures (the latter being common to LACBWR and Genoa 3). All of the units (LACBWR and Genoa 3) had been running for a number of years prior to issuance of Executive Order (EO) 11988 (EO 11988 provides for avoidance of direct or indirect support of floodplain development wherever practicable alternatives exist and for continuing interest in minimizing, restoring, and preserving floodplain values). The site is devoted solely to the continued operation of Genoa 3 and no evidence has been claimed of adverse flood impacts because of the presence of the site (further, no additional fill is planned).*" The FES was written in accordance with NUREG-0191 and concludes that there are no practicable or reasonable measures available to enhance floodplain values in this case.

According to Section 2.5.4.3, Slope Stability, of the LACBWR FSAR (1985), "*Review of available on and off site topographic data indicates there are no onsite slopes whose failure could cause radiological consequences adversely affecting the public health and safety. One offsite slope, the east bank of the Mississippi River adjacent to the plant crib house site was identified from topographic data and evaluated for safety in conjunction with this topic. A stability analysis was performed using conservative soil strength parameters developed from the results of the site subsurface investigation. In the analysis an angle of internal friction of 27 degrees was assigned each soil layer and the slope stabilizing influence of the slope protection riprap material was conservatively ignored. Results of the analysis indicates the factor of safety against failure under static loading conditions is greater than 1.5 The U.S. Nuclear Regulatory Commission has concluded that an adequate margin of safety exists under static loading conditions. Due to the fact that the crib house and the associated water intake and discharge piping are the only plant structures in the vicinity which will potentially be affected by a postulated failure of the east river bank slope, and these structures are not designated as seismic Category I structures, a dynamic (pseudostatic) slope stability analysis is not appropriate and* *was not performed."* In Section 2.5.4.4 of the FSAR, Conclusions of the U.S. Nuclear Regulatory Commission, it is stated, "*Based on the review of available site data and on information obtained during an NRC staff visit to the site, it was concluded that the stability of slopes associated with the LACBWR site does not pose a safety concern for this plant.*" It was also concluded that failure of the Lock and Dam No. 8 would not adversely affect the safety of the LACBWR plant.

A generalized typical section for this slope (obtained from the LACBWR FSAR, 1985) is presented below:



NRC Comment (HYDRO-3): Contamination of Groundwater from a 1983 Spill

Provide additional information on the potential spill incident in 1983 that is briefly described on Page 2-36 of the LACBWR LTP. Any additional information will enable the staff to assess the LTP with regard to the acceptance criteria in Section B.2 of NUREG-1700 [10 CFR 50.82(a)(9)(ii)(A)], which recommends sampling strategies for collecting hydrogeologic information in accordance with the guidance in Section F.4 and Section F.5 of NUREG-1757. Specifically, the licensee should address:

6. Are there indications that other radionuclides, besides those listed in Table 2-17, "1983 Groundwater Analysis from Temporary Well-Point South of Turbine Building," of the LACBWR LTP, may have been involved in the spill and subsequently entered the groundwater?
7. What indications are there that the spatial extent and magnitude of contamination of the groundwater related to the spill is small, and thus not important for site characterization?
8. Is there any information to suggest that the well-point was located in the zone of peak concentration of the plume?

A temporary well-point was sampled once and then later abandoned. Table 2-17 lists analytical results for Manganese-54 (Mn-54), Cobalt-57 (Co-57), Co-60, Niobium-95 (Nb-95), Cs-137, and Cerium-141 (Ce-141). When considered individually, only the Co-60 result was above (by a factor of five) the derived concentration corresponding to the primary drinking water standard for beta emitters.

After approximately fifteen years, the Co-60 levels would have dropped below the standard. In terms of monitoring, there were no other wells down-gradient of this location, including the new well pairs that were later installed. The MW-203A/B monitoring well pair were later installed up-gradient of the temporary well-point location. Please provide additional information to describe how the current wells are adequate to monitor the potential contamination from the 1983 spill.

LACBWR Response (HYDRO-3):

The potential spill relates to radioactive liquids that were discharged to the floor drains within the Turbine Building, which were suspected of leaking. As noted in the LTP, at the time the leaks were identified, one piezometer was installed in the assumed down-gradient location. The groundwater sample collected from this location contained cobalt above the derived concentration corresponding to the primary drinking water standard for beta emitters. There is little information on the depth of the screen or if a sufficient study was conducted to evaluate groundwater gradients.

As described in the LTP, in 2012 five additional groundwater well pairs were installed to evaluate groundwater quality and to characterize flow and velocity. The monitoring well pair locations were selected both down-gradient of potential releases as well as for spatial distribution. As part of this network, monitoring well pairs MW-201A/B, MW-202A/B, and 203A/B were installed down-gradient of the Turbine Building. These wells were specifically installed to evaluate groundwater down-gradient of the Turbine Building floor drains. The locations of these wells, as well as the potentiometric surface of the shallow aquifer, are shown on Figure 1. It should also be noted that the LTP states that the MW-203 pair was installed up-gradient of the piezometer location, but it did not note that the well pair was installed down-gradient of the Turbine Building and the potential floor drain leaks.

Since 2014, the following seven sampling rounds were performed from each of the six (6) groundwater monitoring well pairs.

- June 2014
- September 2014
- March 2015
- November 2015
- December 2016
- May 2017
- December 2017

In each of these sampling rounds, the samples were analyzed by General Engineering Laboratories in Charleston, South Carolina, for Co-60, Cs-137, Ni-63, H-3, and Sr-90. The analysis for all sampling rounds through May 2017 showed that all analyte results were non-detectable.

In December 2017, the analysis identified the presence of H-3 at a concentration of approximately 13,000 pCi/L for MW-203A. This detection prompted the initiation of an investigation, which is currently in progress and includes the following:

- Resampling all monitoring wells on a higher frequency,
- Development of a groundwater flow and transport model using ModFlow and simplified box model for particle tracking to assess groundwater flow paths and possible capture zones in three dimensions,
- Introduction of a fluorescent dye into the reactor building sump to assist in the model calibration.
- Investigation sampling of potential site sources.

The objectives of this investigation were to determine: the source of tritium, the three-dimensional extent of the plume, the maximum plume concentration, and the transport rate and direction of the plume. Sampling conducted in February identified tritium in excess of the MDC in MW-202A and MW-203A with the highest concentrations in MW-202A of 13,200 pCi/L and MW-203A of 24,200 pCi/L.

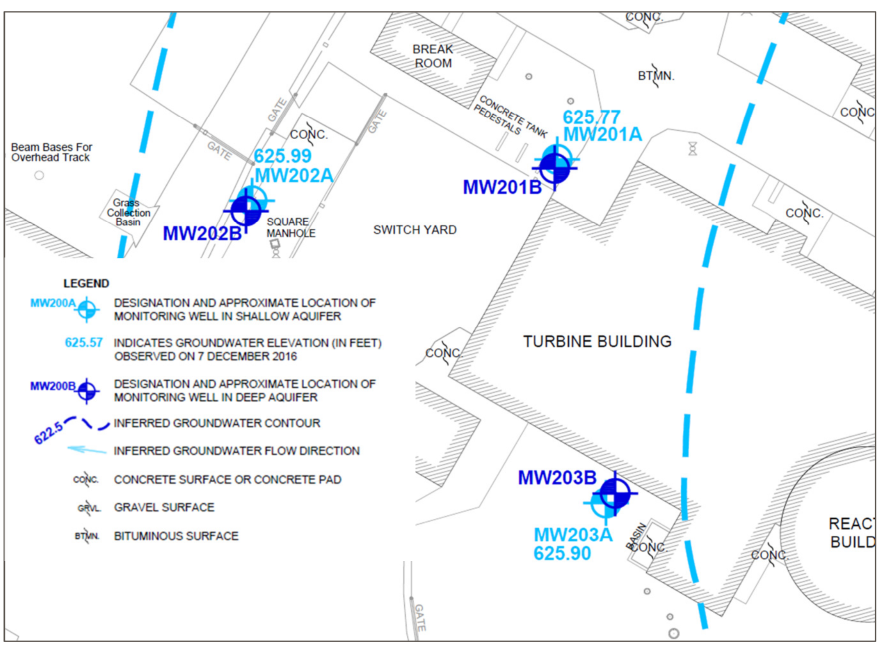
At this point in the investigation, it is believed that the source is likely a historical source (spill or leak) that has mobilized in the environment as a result of the removal of impervious surfaces (buildings and asphalt) during current decommissioning activities.

In order to address the presence of tritium identified in groundwater, the dose contribution from groundwater sources has been increased to 3.26 mrem based on a tritium concentration of approximately 140,000 pCi/L and nominal MDCs for the remaining ROCs to provide margin well above the maximum concentration of 24,000 pCi/L identified to date. This corresponds to a total groundwater dose fraction of 0.13 in order to establish the applicable operational DCGLs and IC dose fractions as provided in LC-FS-TSD-002 Rev 01. However, if the investigation indicates that the maximum tritium concentration would be greater than 140,000 pCi/L following license termination, the NRC will be notified and the operational DCGLs readjusted accordingly. The results of the continued groundwater investigation will be provided to NRC for review.

Additionally, as discussed in the response to PAB 5, two rounds of sampling were performed on the soil under the Turbine Building near the location of the suspect broken drain line. In 2015, as part of a broader site characterization, five locations were selected for angled coring (using GeoProbe® technology) to obtain soil from beneath the Turbine Building at the location of the broken drain lines. The results are provided in 2015 Characterization Survey Report (LC-RS-PN-164017-001). In February of 2018, the Turbine Building foundation was removed in its entirety, including all broken drain lines and adjacent soil. The soil from beneath the drain lines was sampled as part of the FSS Plan for survey unit L1-010-102 (L1-SUB-TDS). A total of eight (8) soil samples were collected from the region beneath the broken drain lines, turbine sump, turbine pit, and condenser pit.

The 2015 Characterization Survey Report (LC-RS-PN-164017-001) was previously submitted to the NRC on July 26, 2016. The FSS Plan (L1-SUB-TDS) for survey unit L1-010-102 will be submitted to the NRC for information. The accompanying data will be submitted to the NRC for evaluation.

Figure 1 – Well Locations and Groundwater Gradients within the Shallow Aquifer (December 2016)



NRC Comment (HYDRO-4): **Basement Backfill Description and Surveys**

Clarify the description of basement backfill to be used at the LACBWR site. Properties are used in the RESRAD modeling that infer the basement backfill will be identical to the onsite sediments. For the description of backfill, constraints are needed in terms of textural and hydrologic properties and geochemistry. Is there a supporting document that provided a description of the basement backfill?

Section 5.1.7.6 of the LACBWR LTP discusses excavating buried structures and using that soil to backfill the excavated feature. But the backfill for basements is only described in the LTP as "a radiological assessment is performed prior to introducing offsite material to ZSRP for use as backfill in a basement, or for any other use from a barrow pit, landfill, or other location. The radiological assessment consists of gamma scans and material sampling. Gamma scans are performed in situ, or by package (using a hand-held instrument or through the use of a truck monitor). Material samples are analyzed by gamma spectroscopy." Please clarify whether offsite backfill materials, including soil and sand, that will be used to fill the basements are subject to a survey plan, and describe that plan.

LACBWR Response (HYDRO-4):

The onsite based Dairyland Power Cooperative soils/sands are being used as backfill material in basement structures. Sand was the assumed backfill material in the RESRAD modeling. The borrow site location is from onsite in an area that is not under the NRC license. Radiological assessments of the borrow soils/sand were performed, and will continue to be performed, in accordance with an approved survey plan. The survey plan calls for a gamma scan of 50% of the surface area of the borrow location as the soils/sand become exposed, as well as the collection of soil samples where the highest gamma scan readings were located. Gamma scans are performed using a 2350-1 data logger coupled to a 44-10 NaI detectors. To date, 25 soil samples have been collected and analyzed by gamma spectroscopy. No plant-related radionuclides have been identified above background. Additional gamma scanning and soil sampling will be conducted as additional soils/sand are removed from the onsite borrow location.

LACBWR will also use backfill material from an off-site source in areas of the site other than basement structures (see ENV-25 for a description and location of the off-site barrow pit). Because this material is typically comprised of 3"-minus stone/gravel it may not have the same properties as the onsite soils/sand. For this reason, the fill material that originates from an off-site source will not be used to backfill basement structures. The survey plan for material from the offsite source calls for the same scan and sampling frequency as described for the onsite borrow pit. No plant-related radionuclides have been identified above background.

NRC Comment (HYDRO-5): River Sediment Contamination in Outfall Area

Provide a description of the contamination in the river sediments in the outfall area of the Circulating Water Discharge Pipe, clarify the area's categorization as impacted or non-impacted, and provide the basis for that treatment. If categorized as an impacted area, provide a discussion of how the outfall area will be treated in the process used to meet the requirements for terminating the LACBWR license.

The outfall area is outside the site boundary and is not considered an impacted area in the LACBWR LTP. The available information from the Initial Site Characterization Survey (see Reference LAC-TR-138, dated 1995, updated 2009; Page 19) and the annual Radiological Environmental Monitoring Reports indicate the possibility of contamination remaining in the river sediments in the outfall area. Results from the 1994 scuba diver sampling and the 2014 biannual sampling are on par with the biannual sampling results from the operating period, all of which are in the 2 to 4 pCi/g range for Cs-137 (except for the 21 pCi/g result from 1985); the annual reports reviewed only covered the 1985-1989, and 1999-2016 periods.

Based on the description of the sampling track by scuba divers in 1994 and the sampling location at the outfall in the annual reports, it is not clear that the peak sediment contamination was found. The NRC staff notes that the plume pathway,-sediment deposition and erosion, and possible past dredging in the area may have imparted a level of uncertainty in the pattern and presence of contamination. Specifically, decay alone is not consistent with the temporal pattern of radionuclide contamination in the sediments in the outfall area, thus possibly supporting the influence of other processes affecting the levels of contamination found. For example, the uptick in Cs-137 results in 2014 and 2015 may have followed a period of erosion uncovering previously buried contamination.

Depending on how the outfall area is treated in the FSS, additional information may be needed. Provide clarification of the biannual sediment sampling location in relation to the sample track of the 1994 scuba divers. Does the biannual sample location at the outfall correspond to the 1994 sample track that is described as starting 60 feet from the edge of the Mississippi River? The ambiguity may be related to the diffuser ramp that extends into the river, and the likelihood that sediments are not deposited on the ramp. Further clarification is also needed for the 1994 sample track location extending into the river, especially as compared to the general pattern of a plume discharging from the pipe

LACBWR Response (HYDRO-5):

Since the river is offsite and any accumulation of radionuclides would have been the result of permitted liquid radioactive waste discharges in compliance with 10CFR Part 20 and the NPDES permit, there is no requirement to perform additional sampling offsite in the Mississippi River. The HSA did not identify any historical releases that violated Part 20 limits."

Environmental Topics (Identified by ENV)

The purpose of these RAIs is to obtain information and data for the NRC to fulfill its responsibilities under the National Environmental Policy Act of 1969 (NEPA), as implemented by 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." The requirements for the contents of an Environmental Assessment are found in 10 CFR 51.53, "Post-construction Environmental Reports."

NRC Comment (ENV-1): **Status of Decommissioning Activities**

Update Chapter 3 of the LACBWR LTP, including Table 3-1, "Status of Major LACBWR Systems and Components," to provide the plans for and status of decommissioning efforts as of August 2017.

LACBWR Response (ENV-1): An updated Chapter 3 is provided in LTP Rev. 1.

NRC Comment (ENV-2): **Summary of Environmental Impacts**

In Chapter 8 of the LACBWR LTP, Table 8-1, "Summary of the Environmental Impacts from Decommissioning Nuclear Power Facilities," includes references to subsections on independent spent fuel storage installation (ISFSI) construction (Section 8.6.3.18), Vertical Concrete Cask (VCC) construction (Section 8.6.3.19), and rail line upgrades (Section 8.6.3.20). Those sections do not appear in Chapter 8 of the LTP, "Supplement to the Environmental Report." Accordingly, update Table 8-1 or provide the missing sections for Chapter 8 of the LTP. In addition, please update Table 8-1 to reflect any changes to the overall decommissioning plans and activities as of August 2017.

LACBWR Response (ENV-2): LACBWR LTP Table 8-1 will be modified to remove references to Section 8.6.3.18, ISFSI Construction: Land Use Impacts (Onsite), and Section 8.6.3.19, VCC Construction for the ISFSI Impacts (Onsite), and Section 8.6.3.20, Rail Line Upgrade and Extension (Onsite and Offsite). Construction of the ISFSI and spent fuel transfer to the ISFSI was completed in September 2012.The environmental impacts of that activity was previously addressed in NRC approval to use the NAC MPC Cask System for LACBWR spent fuel and GTCC radioactive waste. The existing rail line/spur is not being modified or refurbished.

LTP Section 8.6.3.1, Onsite Lane Use, will be revised remove the reference to rail refurbishment.

"The LACBWR decommissioning project is located and executed within the boundary of the existing LACBWR licensed property previously used for power generation; all work is expected to be conducted within the LSE footprint. Some onsite roads have been refurbished. No barge slips are being constructed. The existing rail line supported the operation of the facility. Containers will be unloaded and loaded onsite. Onsite activities such as vehicle parking and equipment/container laydown, storage, staging and waste loading are and continue to occur in a manner similar to when the facility was operational."

No additional changes are required to Table 8-1 to reflect overall decommissioning plans or activities.

NRC Comment (ENV-3): Land Use

Section 8.6.3.2 of the LACBWR LTP states that "appropriate isolation and control measures will be instituted to prevent the spread of contamination from the LSE [LACBWR Site Enclosure] area to the adjacent LACBWR property as well as offsite areas." Explain what isolation and control measures will be used to prevent the spread of contamination. Provide enough information to understand how the measures will accomplish the required function.

LACBWR Response (ENV-3): Prior to demolition, a Contamination Verification Survey is performed on all structures within the LSE to verify the as-left contaminations levels are below those levels established for open air demolition. During demolition, LACBWR will utilize to following measures to prevent the spread of contamination:

- Dust suppression (water truck, fire hoses), waddles at fence line, plywood at stack demo.
- Active water management through portable onsite water processing system.
- Evaluation of any soil or water movements past the LSE boundary area post Storm Water Pollution Prevention Program (SWPPP) events (event >1.2" of rain).

Soil samples and gamma walkover surveys are performed as necessary to verify the isolation and control measures are sufficient. If any contamination is inadvertently spread from the LSE, then procedures are in place to remediate the contamination, extend the LSE, and/or re-classify the impacted survey unit.

NRC Comment (ENV-4): Surface Water

Section 8.6.3.4 of the LACBWR LTP states that storm water runoff from active impacted areas undergoing remediation or demolition will be monitored and controlled, if necessary. Explain how this runoff will be "monitored and controlled" and how the licensee will determine if it is necessary.

In addition, provide the surface water monitoring requirements established by the Wisconsin Department of Natural Resources (WDNR) permit. Explain what parameters need to be monitored as required by the permit.

Finally, describe the best management practices (BMPs) that will be implemented to reduce impacts to the Mississippi River and the Thief Slough tributary.

LACBWR Response (ENV-4) – Storm water runoff from active impacted areas undergoing remediation or demolition will be monitored and controlled, if necessary, as follows:

- Radiological evaluation of any water movements past the LSE boundary area levels post SWPPP events.
- Operation of an active water management processing system onsite.
- The onsite SWPPP program and compliance with the DPC NPDES permit for waste water and the site SPCC Plan.
- Use of waddle berms to contain demolition area runoff around the LSE and on an as needed basis in other remediation areas.

- Per the WDNR Permit for LACBWR the surface water monitoring requirements include:
  - No discharge of floating solids or visible foam
  - No floating or submerged debris, oil scum or other material shall be present in such amounts as to interfere with public rights in waters
  - No materials producing color, odor, taste or unsightliness shall be present in amounts to interfere with public rights in use of the waters
  - No substances in concentrations or combinations which are toxic or harmful to humans will be found to be of public health significance
  - No use of water treatment additives without written approval from the WDNR.

The following Best Management Practices (BMPs) will be implemented to reduce impacts to the Mississippi River and the Thief Slough Tributary:

- Before any site grading activities begin:
  - Install downgradient silt logs
  - Install perimeter silt fence/hay bales at perimeter
  - Install storm drain inlet protection along west side of work zone
  - Construct stabilized construction exits

- Decontamination, Waste Management and Packaging:
  - Construct staging and materials storage area with perimeter silt fence/hay bale
  - Install temporary sanitary facilities and dumpsters
  - Disturbed areas where construction will cease for more than 14 days will be stabilized with erosion controls
- Earthwork:
  - Earth disturbance activities
  - Loadout and transport to staging area
  - Dewatering activities as necessary
  - Use of water truck on unpaved roadways including entrance and exit
- Final stabilization and landscaping:
  - Finalize site restoration activities
  - Remove all temporary control BMPs and stabilize any areas disturbed by their removal with erosion controls
  - Prepare final seeding and landscaping
  - Monitor stabilized areas until final stabilization is reached

NRC Comment (ENV-5): Air Quality

Please provide the Clean Air Act, Section 107, National Ambient Air Quality Standards attainment status of Vernon County per 40 CFR Part 81, "Designation of Areas for Air Quality Planning Purposes."

LACBWR Response (ENV-5):

Vernon County, WI, is in attainment with all applicable National Ambient Air Quality Standards (NAAQS). Currently NAAQS are displayed in the table immediately below.

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		Primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		Primary and Secondary	Rolling 3 month average	0.15 $\mu g/m^3$	Not to be exceeded
Nitrogen Dioxide (NO_2)		Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary and Secondary	1 year	53 ppb	Annual Mean
Ozone (O_3)		Primary and Secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	Primary	1 year	12.0 $\mu g/m^3$	Annual mean, averaged over 3 years
		Secondary	1 year	15.0 $\mu g/m^3$	Annual mean, averaged over 3 years
		Primary and Secondary	24 hours	35 $\mu g/m^3$	98^{th} percentile, averaged over 3 years
	PM_{10}	Primary and Secondary	24 hours	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		Primary	1 hour	75 ppb	99^{th} percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

NRC Comment (ENV-6): **In-Water Activities**

Section 8.6.3.2 of the LACBWR LTP states that "public access to the boat launch at the southern end of the site will be minimally impacted during decommissioning by rail and truck traffic entering or leaving the site." However, Section 8.6.3.2 does not specify what minimal impacts would occur.

Accordingly, describe any activities that would occur at or near the boat launch, the Thief Slough tributary, or the Mississippi River that would directly or indirectly support decommissioning or license termination of the LACBWR site. Explain whether the associated rail and truck traffic would impact the boat launch on the days it is most often used (e.g., if the boat launch is most often used on weekends, would rail and truck traffic impact it or would rail and truck traffic be less on weekends?).

LACBWR Response (ENV-6):

The public boat launch at the south end of the site is not directly impacted by truck traffic (there is no rail traffic entering or leaving the site). The only indirect impact would be to vehicular traffic flow because the boat launch and LACBWR (and G3) personnel use the same common entry/exit to Route 35.

Typically, no work activities are performed on weekends at LACBWR when the boat launches are more active.

NRC Comment (ENV-7): **Runoff and Erosion Containment**

In addition to the isolation and control measures mentioned in Section 8.6.3.2 of the LACBWR LTP, Section 8.6.3.6 of the LTP states that "protection of the nearby Refuge wetlands and habitats is, and will continue to be a priority when planning for site dismantling or waste management operations." Clarify what isolation, control, and other protective measures will be used to minimize erosion and degradation of the nearby ecological habitats, such as the Mississippi River and the Upper Mississippi River National Wildlife and Fish Refuge.

LACBWR Response (ENV-7) – The following isolation, control and other protective measures will be used to minimize erosion and degradation of the nearby ecological habitats:

- Radiological evaluation of any water movements past the LSE boundary area levels post SWPPP events.
- Operation of an active water management processing system onsite.
- The onsite SWPPP program and compliance with the DPC NPDES permit for waste water and the site SPCC Plan.
- Use of waddle berms to contain demolition area runoff around the LSE and on an as needed basis in other remediation areas.

NRC Comment (ENV-8): **Impingement and Entrainment**

Section 8.6.3.3 of the LACBWR LTP states that the facility withdraws Mississippi River water to supply the intact portion of the Low Pressure and High Pressure service water systems. However, Section 8.6.3.3 of the LTP does not state the withdrawal rates, which can lead to impingement and entrainment of aquatic organisms. Describe the withdrawal rates to supply the Low Pressure and High Pressure service water systems, as well as any operational or engineering features that minimize impacts from impingement and entrainment.

LACBWR Response (ENV-8):

LACBWR's circulating water pumps have been rendered inoperable due to decommissioning activities. The Low Pressure service water system has also been dismantled during the decommissioning process. The High Pressure service water system remains intact, and, when in use, has a withdrawal rate of 470 gpm. Clean Water Act Section 316(b), which governs fish impingement and entrainment, is applicable to facilities that are designed to withdraw at least 2 mgd of cooling water (impingement) and/or at least 125 mgd (entrainment). Since the facility has been decommissioned, the maximum river water withdrawal that could occur if the High Pressure service water system was in continuous use would only be 0.8 mgd, thus making the facility not subject to the requirements of the CWA Section 316(b) Rule.

NRC Comment (ENV-9): **Impingement and Entrainment Reference**

Provide a copy of Reference 19 in Chapter 8 of the LTP titled, "Impingement and Entrainment of Fishes at Dairyland Power Cooperative's Genoa Site."

LACBWR Response (ENV-9):

A copy of the document titled "Impingement and Entrainment of Fishes at Dairyland Power Cooperative's Genoa Site" is attached.

NRC Comment (ENV-10): **Bird and Bat Collisions**

Section 8.6.3.8 of the LACBWR LTP describes potential impacts to State and Federally protected species, including birds, as a result of activities associated with the license termination plan and decommissioning. However, Section 8.6.3.8 of the LTP does not describe the likelihood of bird collisions with decommissioning equipment and intact structures and buildings. Bird collisions may result in injury or mortality. In addition, artificial night lighting can increase the likelihood of such collisions. For example, migratory songbirds are most likely to collide with artificially lighted structures or cranes because of their propensity to migrate at night, their low flight altitudes, and their tendency to be trapped and disoriented by artificial light.

Although not mentioned in Chapter 8 of the LACBWR LTP, U.S. Fish and Wildlife's Information for Planning and Conservation database indicates that bats are known to occur in the decommissioning project area. Therefore, in order for the NRC staff to evaluate potential impacts to birds and bats as a result of the proposed license termination plan, please provide the following:

a. Any data, recorded observations, or studies related to bird and bat collisions at the LACBWR site. If available, please provide the date, time, number of individuals, species, and impact to each individual (e.g., death or injury) for each recorded bird and bat collision.
b. Describe whether artificial lighting would be used at night during decommissioning activities at the LACBWR site.
c. Describe whether any best management practices, such as light source shielding and appropriate directional lighting, would be used to mitigate impacts associated with artificial nighttime illumination and potential bird and bat collisions

LACBWR Response (ENV-10):

There are no known studies of bird and/or bat collisions at LACBWR. Due to the industrial nature of the site, songbird migration and mortality through the site was and is expected to be non-existent to minimal.

The use of artificial lighting LACBWR associated with decommissioning activities is less than that associated with the adjacent, operating Genoa-3 fossil plant. To date, nighttime dismantlement activities have been minimal and nighttime illumination within the work zone has likely decreased, as previously illuminated structures have now been demolished. The Reactor Building interior is lit using light strings and shop lights. The Administrative Building has minimal lighting during the night shift, with hallways, exits, and a few interior offices illuminated. A portable light plant is located on the northern side of the Backup Control Center, with the lights directed to the west, illuminating portions of the parking lot and walking pathway to the Reactor Building. Portable lighting was utilized for the duration of the second shift work, for approximately six months; however, currently, minimal light sources are utilized during the second shift, and all other portable light plants are utilized on an "as needed" basis, which has been limited in both length of use and frequency.

NRC Comment (ENV-11): **Peregrine Falcon Restoration Program**

The Peregrine Falcon is listed as a State-Endangered Species in Wisconsin. According to the Dairyland Power Cooperative (DPC) website (http://www.dairylandpower.com/environment/falcon_program.php), DPC has a Peregrine Falcon Restoration Program at its facilities. Please provide details on that program as it relates to the LACBWR / Genoa No. 3 site. Describe efforts taken, if any, to ensure that decommissioning activities at LACBWR do not adversely affect onsite peregrine falcons, if applicable.

LACBWR Response (ENV-11):

Decommissioning activities have not had an adverse impact on peregrine falcon nesting activities at the Genoa Site. The peregrine falcon nest box, which was installed at the 450’ level of the G-3 stack in 1997, is located approximately 450’ away from the LACBWR facility. The nest box is also positioned such that it faces away from any decommissioning activities that would be occurring. During decommissioning work, the use of dust suppression on roadways and on surfaces being dismantled minimizes any impact of moving dust in the Peregrine Falcon area(s). The use of portable lighting to support site work is directed such as to minimize any impact to the Peregrine Falcon area(s).

Since 1998, peregrine falcon chicks have successfully fledged from the Genoa Site nest box on an annual basis with the exception of 2013, when the newly hatched chicks in the nest box were killed by an aggressive, non-resident female falcon. The total number of peregrine falcon chicks fledged from the Site, since 1998 is 62 birds, which includes four peregrine falcon chicks successfully fledged each year from 2014 through 2017.

NRC Comment (ENV-12): **General Characterization of Species and Habitats on Site**

In Sections 8.6.3.6 – 8.6.3.8 of the LACBWR LTP, descriptions of the aquatic, terrestrial, and threatened and endangered species that may occur at the LACBWR site are given. In addition, Section 8.6.3.7 and Section 8.6.3.8 of the LTP state that no protected species occur at the LACBWR site. Chapter 8 of the LTP, however, does not describe the studies that provide a basis for determining whether State or Federally protected species occur or do not occur on site.

Provide the basis for the licensee’s determination that no protected species occur at the LACBWR site. In addition, please provide a copy of any field studies that have been conducted to characterize State and Federally protected species and habitats at or within the vicinity of LACBWR.

LACBWR Response (ENV-12):

With respect to aquatic ecology, in addition to the 1978 mussel survey, described in the FEIS and included in the LTP, Helms and Associates performed a survey in 1999 that is documented in “A Mussel Survey for a Proposed Fleeting Site Mississippi River - Pool 9 (River Mile 677.5) Near Genoa, Wisconsin.” While this survey identified nine species of mussels, no specimens of the endangered Higginsi pearly mussel (*Lampsilis higginsi*) were found, and the substrate did not appear suitable for that species. In addition, no Wisconsin listed threatened, endangered or species of special concern were observed in this survey.

Also, as indicated in the LTP, a 1980 study was performed to determine the impact from impingement and entrainment in Navigation Pool No. 9 of the Mississippi River in the vicinity of the LaCrosse and Genoa-3 sites. Impingement samples were taken once each week for a 24-hour period from August 8, 1978, through June 30, 1980, and entrainment sampling was conducted once each week for a 24-hour period from February 26, 1979, through September 10, 1979, and February 6, 1980, through June 20, 1980. The two power stations collectively impinged representatives of 53 species and 19 families of fish. No species of fish at the Genoa site were on the Federal Endangered Species List; however, one, the blue sucker (*Cycleptus elongates*) is considered threatened in Wisconsin.

With respect to terrestrial ecology, the only known occurrence of a special status species residing within the site, but adjacent to the LACBWR facility is the peregrine falcon, which was addressed in ENV-11. Turkey vultures, which are protected by the Migratory Bird Treaty Act, have, in the past, frequented the site. Turkey vultures displaced by the removal of perching structures at LACBWR have likely relocated to the adjacent G-3 facility and its ancillary structures.

Dairyland Power Corporation requested the Wisconsin Department of Natural Resources (DNR) to review the impacts of the activities associated with the proposed decommissioning project at LaCrosse. The Bureau of Natural Heritage Conservation, DNR, performed an Endangered Resources Review for the project, which is documented in an October 6, 2016, letter. The Bureau identified twenty-three terrestrial and aquatic species considered to be endangered, threated, or of special concern, which *could* reside in the area surrounding the decommissioning project. The Bureau determined that there was no impact to these species and no actions were required or recommended, based on the conclusions that either there was a lack of suitable habitat present at the site or that the habitat (e.g., the Mississippi River) would not be impacted by the proposed project activities. In the case of the Peregrine Falcon, the only known specially-statused specie, the Bureau concluded that no impacts are expected as the nesting box is adjacent to the project area, as the box is mounted on the stack for Genoa-3 and faces away from the demolition activities.

Copies of the referenced studies are being provided, as requested.

NRC Comment (ENV-13): **Impacts to Terrestrial and Aquatic Ecology Beyond the Site Boundary**

In Section 8.6.3.6 and Section 8.6.3.7 of the LACBWR LTP, the licensee states that the potential impacts to aquatic and terrestrial ecology beyond the site boundary have been evaluated and are considered to be “Small.” Please describe the activities that could cause direct or indirect offsite impacts to ecological resources.

LACBWR Response (ENV-13):

Terrestrial and aquatic impacts outside of the decommissioning work zone have been and are expected to be minimal at most. An increase in noise and fugitive dust generated within the work zone has occurred during the time when decommissioning activities were actively taking place. The likelihood of these disturbances expanding past the facility boundary and negatively impacting terrestrial and aquatic ecology is highly unlikely. The only activities occurring beyond the site boundary are the transporting of Intermodals waste containers from site to Seven Rivers Intermodal Facility in Winona, Minnesota where they are loaded on rail cars and shipped, via railroad for disposal at the Energy*Solutions* Clive, Utah waste disposal facility. The likelihood of these activities negatively impacting terrestrial and aquatic ecology is highly unlikely.

NRC Comment (ENV-14): **Radiological Health – Worker Dose**

Section 3.4.2 of the LACBWR LTP provides projections for occupational radiation exposure from activities associated with decommissioning. The projections are based on RS-TD-313196-007, "Radiation Exposure Projections for LACBWR Decommissioning," which was submitted to the NRC in November 2015. Provide any updates to these radiation exposure projections; if available, provide data from 2016 for the decommissioning activities and spent fuel management activities.

LACBWR Response (ENV14): Section 3.4.2 of the LTP will be revised to reflect the updated radiation exposure projections. The following is a summary of the 2016 and 2017 dose totals and projected dose for 2018:

Radiation Exposure Projections (in person REM)

Activity	2016 (actual)	2017 (actual)	2018 (estimate)	Total
Asbestos/Hazardous Material Abatement	0.17	2.50	-	2.67
Reactor Building	3.30	3.52	2.00	8.82
Waste Treatment Building	0.19	0.10	-	0.29
Turbine Building	0.04	0.03	-	0.07
Waste Processing	0.09	0.10	0.30	0.49
Remaining Structures	0.13	0.17	-	0.30
Totals	**3.92**	**6.42**	**2.30**	**12.64**

NRC Comment (ENV-15): **Socioeconomics**

Approximately how many permanent workers were at the LACBWR facility during operation of the nuclear power reactor (until approximately 1987)?

Approximately how many workers were at the LACBWR facility during the time it was being transitioned from permanent shutdown to SAFSTOR? How many workers were at the LACBWR facility while it was in SAFSTOR?

Provide the number of workers that will be required to complete dismantlement and decommissioning activities at LACBWR. Section 8.6.3.11 of the LACBWR LTP states that this increase in workers will occur in the 2016-2017 timeframe.

Section 8.6.3.11 of the LTP also states that some of these decommissioning workers will be from the local and regional area. Approximately how many of the workers will be from the local and regional areas?

After decommissioning of the LACBWR facility is complete in approximately 2018, approximately how many workers will remain on the former nuclear plant site?

LACBWR Response (ENV-15):

- Approximately 100 permanent workers during operation (Security, Ops, HP, QC, Management, and Maintenance.)
- Transition Period to SAFSTOR including Reactor Removal Project and the Spent Fuel Movement Project to ISFSI approximately 60 personnel (Security, Ops, HP, QC, Management, Safety, and Maintenance.)
- SAFSTOR 30 to 40 personnel (Security, Ops, HP, QC, Management, Safety, and Maintenance.)
- Decommissioning phase 75-100 day to day site personnel-including approximately 30 personnel from local and regional areas (Craft Workers, HP, QC, Management, Waste Management, Safety).
- Following Decommissioning work at LACBWR approximately 25 personnel to remain @ ISFSI location (Safety, Management, Security, HP).

NRC Comment (ENV-16): **Historic and Cultural Resources**

Section 8.6.3.13 of the LACBWR LTP states that "land disturbance for the removal of large components will be minimized as the waste will be primarily shipped via rail." Explain how shipping by rail will minimize land disturbances.

LACBWR Response (ENV-16):

The route employed by LACBWR for disposal of large components utilizes existing roadways and the existing Seven Rivers/UP rail spur/lines (none requiring modification) for transport. As no modifications to this route are required, no offsite land disturbances or associated impacts result. Use of this transportation route avoids using other routes that may require modifications or new roadways, barge slips, or rail spurs/lines, resulting in offsite land disturbances and potential associated impacts. Section 8.6.3.13 will be revised accordingly.

NRC Comment (ENV-17): **Noise**

Section 8.6.3.15 of the LACBWR LTP states that the licensee agrees to comply with any noise limitations imposed by the Village of Genoa. What noise limitations, if any, has the Village of Genoa imposed?

LACBWR Response (ENV-17): LACBWR contacted the Village of Genoa, and they currently do not have noise limitations. LACBWR agrees to comply with any future noise limitations that the Village of Genoa may impose.

NRC Comment (ENV-18): **Transportation – Barge**

Section 8.6.3.17 of the LACBWR LTP states that there will be no shipments of radioactive waste via barge, and that existing barge traffic is associated with the fossil station. Please confirm that no material, equipment, or supplies associated with decommissioning will be brought onsite or removed from the site by barge.

LACBWR Response (ENV-18): There will be no shipments of radioactive waste, material, equipment or supplies brought onsite or removed from site via barge in support of the LACBWR decommissioning project.

NRC Comment (ENV-19): **Transportation – Rail**

Provide an update on the plans for shipment of radioactive waste from the LACBWR facility by rail. Specifically, provide details on the transportation of waste material by rail, such as the name and location of the rail line, number of shipments / cars anticipated / completed to date, and the general frequency of rail shipments. In addition, provide information on the number of truck shipments, frequency of shipments, and route used to transport the waste material by truck to the rail line.

LACBWR Response (ENV-19): No rail shipments originate at the LACBWR site. LACBWR will utilize trucks to transport the Intermodals containers from site to Seven Rivers Intermodal Facility in Winona, Minnesota where they are loaded on rail cars and shipped, via Union Pacific (UP) railroad for disposal at the Energy*Solutions* Clive, Utah waste disposal facility. These trucks travel from the site north using State Highway 35, west to Minnesota on U.S. Highway 14, where they travel north to Winona on U.S. Highway 14/61.

LACBWR will utilize a minimum of four trucks with trailers to transport the waste from the site to Seven Rivers. LACBWR plans to ship approximately seven truck shipments a day, five days a week, until the waste is removed from site. LACBWR anticipates approximately a total of 900 intermodals of waste for the project.

LACBWR plans to ship via UP rail approximately four to five flat cars a week to the Clive, Utah disposal facility. The schedule of planned shipments in and out of the Seven Rivers facility is approximately 4 to 5 shipments out with loaded waste and 4 to 5 shipments in with empty containers a week. Due to the UP schedule this will either happen every Monday or Friday of each week. LACBWR will utilize approximately 26 flat cars and 260 intermodals in rotation for the project.

NRC Comment (ENV-20): **Transportation – Truck**

Section 8.6.3.17 of the LACBWR LTP states that the shipments of radioactive waste from the LACBWR facility via truck would be greater during decommissioning than during operation. Please provide the frequency of truck shipments (e.g., how many trucks per day, week, or month would be shipping waste material) and describe how this compares to similar shipments during the operation of LACBWR.

LACBWR Response (ENV-20): During operations, shipments were minimal to support operations. During decommissioning, LACBWR will utilize trucks with trailers to transport the Intermodals containers from onsite to Seven Rivers Intermodal Facility in Winona, Minnesota to be loaded on rail cars via Union Pacific (UP) railroad for shipment to the Energy*Solutions* Clive, Utah waste disposal facility. These truck transports will take place approximately seven times a day, five days a week, until the waste is completely removed from site.

NRC Comment (ENV-21): **Traffic**

Section 8.6.3.17 of the LACBWR LTP states that the "non-radiological impacts of transportation include increased traffic and wear and tear on roadways. It is anticipated that there will be no significant effect on traffic flow or road wear." Please explain why increased traffic and wear and tear on roadways is not expected.

LACBWR Response (ENV-21): As indicated in the response to ENV-20, LACBWR truck transport will add seven vehicles, five days a week, to the transport route, as a result of shipping intermodal containers from the LACBWR Site to the Seven Rivers Intermodal Facility in Winona, Minnesota. These trucks travel from the site north using State Highway 35, west to Minnesota on U.S. Highway 14, where they travel north to Winona on U.S. Highway 14/61.

Traffic counts were obtained using the interactive traffic count maps from the State of Wisconsin Department of Transportation (available at https://trust.dot.state.wi.us/roadrunner/) and the Minnesota Departments of Transportation (http://dotapp9.dot.state.mn.us/tfa/Map). The average annual daily traffic counts along the transportation route from the LACBWR Site to the Seven River Intermodal Facility were reviewed to identify the segment of the route with the lowest traffic count (and thus the most impacted by additional vehicle traffic). Note that traffic counts in the immediate vicinity of the Intermodal Facility are not available for all of the specific roadways employed; however, counts are available for adjacent roadways. The most limiting segment of the trip occurs in the vicinity of the facility with an average annual daily traffic count of 1100 vehicles, based upon counts available for adjacent roadways. The addition of fourteen vehicles making this trip daily (seven outbound and seven inbound) represents an increase in traffic of slightly more than 1% (14 vehicles/1100 vehicles). This small increase in traffic would result in no significant effect on traffic flow or road wear.

NRC Comment (ENV-22): **Projected Waste Quantities**

Section 3.3.4 of the LACBWR LTP, Table 3-3, "Projected Waste Quantities," provides the projected waste quantities that will be generated as a result of decommissioning activities at LACBWR. Please clarify if Table 3-3 includes the 75 cubic yards of legacy waste mentioned in Section 3.3.7 of the LTP. In addition, if the waste projections have changed since original submittal of the LACBWR LTP, please provide an updated projection of waste quantities.

LACBWR Response (ENV-22): The quantities identified in Table 3-3 do include the 75 cubic yards of legacy waste mentioned in LTP Section 3.3.7. The waste projections have not changed.

NRC Comment (ENV-23): **Characterization of Hazardous Waste**

NUREG-0586, Supplement 1, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," does not evaluate the impacts of nonradioactive waste (e.g., solid waste, hazardous waste). The LACBWR LTP does not account for nonradioactive waste management and the potential impacts of its disposal on the capacity of receiving waste management facilities.

Provide summary information about the nonradioactive wastes that were or will be generated by the LACBWR decommissioning activities, and the plans for its onsite and offsite management and disposal. If a document already exists that describes these activities, please provide this document to the NRC staff for reference. Information can be generally descriptive and does not need to be highly detailed.

LACBWR Response (ENV-23): With the proper planning for disposal of all nonradioactive waste associated with the project and obtaining prior approval for disposal, LACBWR does not anticipate any potential impacts to the receiving waste facilities. LACBWR utilizes site specific programs and procedures for management of all nonradioactive waste associated with the project.

- LC-WM-PR-003 Rev. 0 "Hazardous Waste Management"
- LC-WM-PR-007 Rev 0 "PCB Waste Management"
- LC-WM-PR-011 Rev 0 "Universal Waste Management"
- LC-WM-PR-015 Rev 0 "Used Oil Management"

To date, LACBWR has free released and disposed of universal and hazardous wastes to approved waste facilities in accordance with state and federal regulations. These wastes include:

- Lead-Acid, Lithium and other types of batteries
- Raw Lead (<150 lbs.)
- Fluorescent Bulbs
- Mixed Bulbs
- Electronic Wastes

LACBWR is currently in possession of universal and hazardous wastes that will be disposed of at approved non-radioactive waste facilities in accordance with state and federal regulations. These wastes include:

- Fluorescent Bulbs
- Mixed Bulbs
- Legacy chemicals
- PCB Wastes (ballasts and capacitors)
- Mercury containing devices
- Used oils from heavy equipment

Also, LaCrosse*Solutions* management is evaluating the feasibility of attempting to free release the Reactor Building exterior metal structure to a recycling contractor. All projected waste volumes are provided in LTP Table 3-3.

NRC Comment (ENV-24): **Disposal of Contaminated Soils**

Provide summary information regarding the quantities and types of contaminated soils that were or will be generated as a result of the decommissioning and license termination activities at the LACBWR site, and indicate where such soils will ultimately be disposed of (e.g., local landfill).

LACBWR Response (ENV-24): All potentially contaminated soils identified in Section 3.3.4 of the LTP Table 3-3 are to be disposed of in the Energy*Solutions* Clive Disposal Facility (example mixed waste, asbestos, lead and PCB). LACBWR does not plan to release any contaminated waste for disposal to a local landfill.

NRC Comment (ENV-25): **Backfill Material**

Provide additional information on (1) where the backfill material to be used at the LACBWR site will come from, (2) how many shipments are expected, and (3) will the backfill material be stored onsite until its use. This information will allow the NRC staff to determine if there are additional impacts on land use and transportation.

LACBWR Response (ENV-25):

The backfill material to be used for the LACBWR site originates from a non-impacted area just east of the G-3 coal pile. One dump truck, over the course of three months, will be utilized to transport the soil to the LACBWR site. Approximately 200 truckloads will be necessary and the dump truck will never leave DPC property.

An additional source for fill material will be utilized for any areas of the site, other than the two remaining basements (WGTV and Reactor Building). The Pedretti Barrow Pit is located at E11000 State Highway 56 in Genoa, WI approximately 6 miles from the LACBWR site. Approximately 200 truckloads of material from this off-site location have been delivered to site and approximately 50 more will be needed to complete the project.

The backfill material will typically be direct loaded; however, if it is necessary to temporarily stockpile the material it will be in accordance with the SWPPP and isolation/control procedures to prevent cross-contamination.

Miscellaneous Topics (Identified by MISC)

NRC Comment (MISC-1): Typos in the La Crosse LTP

a. Section 5.1.7.6: Appears to be cut-and-paste from the Zion LTP text; need to edit "ZSRP" and spell check the section in general.
b. Page 5-63: Correct the reference in the last sentence of the third paragraph of Section 5.10.5. The existing reference is to a spreadsheet on the Wilcoxon Rank Sum (WRS) test.
c. Page 6-18: "Reference 13" is cited twice; it should instead point to Reference 12.
d. Page 6-19: Table 6-5 footnote: NUREG-6607 should be NUREG/CR-6697.
e. Page 6-27: "Reference 14" is cited several places; however, there are only 13 references in the list on Page 6-56. Reference 14 likely refers to Sheppard and Thibault (1990), which is listed as Reference 12.
f. Table 6-6: The Entry for Runoff Coefficient has Uncertainty Result = 75th, but the Selected Deterministic Value = 0.45 is the median value of the distribution in NUREG/CR-6697, uniform [0.1, 0.8].

LACBWR Response (MISC-1a): The use of "ZSRP" in LACBWR LTP section 5.7.1.6 is a typo. It will be corrected to "LACBWR in LTP Rev 1.

LACBWR Response (MISC-1b): The reference to Section I.10 of MARSSIM, which describes the WRS spreadsheet, will be deleted from section 5.10.5 in LTP Rev 1.

LACBWR Response (MISC-1c): The two "Reference 13" citations in Section 6.8.3, second paragraph, will be revised to Reference 12 in LTP Rev 1.

LACBWR Response (MISC-1d): The Table 6-5 footnote will be changed from NUREG-6607 to NUREG/CR-6697 in LTP Rev. 1.

LACBWR Response (MISC-1e): The four "Reference 14" citations on page 6-27 will be revised to "Reference 12" in LTP Rev. 1.

LACBWR Response (MISC-1f): The correct value for the Runoff Coefficient was the 75th percentile which is 0.62, as opposed to the 0.45 (median) value used. The impact of using 0.45 instead of 0.62 was not checked because the uncertainty analysis was entirely rerun due to changing the groundwater elevation from 619 foot to 629 foot in response to HYDRO-1. See Section 2.1 of TSD RS-TD-313196-004, Rev. 3 for the methods and results of the revised uncertainty analysis. The Runoff Coefficient value selected through the revised uncertainty analysis was applied in the revised calculation of soil DCGLs. The information in Section 2.1 of TSD RS-TD-313196-004, Rev. 3 will be included in the LACBWR LTP, Rev. 1.

NRC Comment (MISC-2): **Clarifying Comments on the La Crosse LTP**

a. List the correct revisions to the references in the reference section of each Chapter of the LACBWR LTP.
b. Clarify whether "ZSRP" as used in the first sentence of the last paragraph of Section 5.7.1.6 of the LACBWR LTP is a typo or is intended as written.
c. Inhalation Rate for Industrial Workers: NUREG-5512, Volume 3, Table 5.7 lists inhalation rates for Construction Workers ranging from 1.26 m^3/hr to 1.68 m^3/hr. The value chosen in the soil conceptual model for the LACBWR LTP is 1917 m^3/hr. This value is based on the NUREG/CR-5512, Volume 3, Table 5.1.1 mean value of 8400 m^3/yr, which equates to 23 m^3/day, or 0.96 m^3/hr. Assuming 2000 hours per year at this rate gives you 1917 m^3/hr; however, the basis for multiplying by 2000 hours per year is not explained.

LACBWR Response (MISC-2a):

All references in LACBWR LTP Rev 1 will include the revision number.

LACBWR Response (MISC-2b):

The use of "ZSRP" in LACBWR LTP section 5.7.1.6 is a typo. It will be corrected to "LACBWR in LTP Rev 1.

LACBWR Response (MISC-2c):

The basis for 2000 hours per year was 40 hours per week times 50 weeks per year. However, to be consistent with the industrial use occupancy time of 2190 hours per year described in LTP section 6.8.2, the occupancy time assumed in the calculation of inhalation rate was increased to 2190 hours per year. Also, in response to NRC comment, the inhalation rate was increased from 0.96 m^3/yr to the value of 1.4 m^3/yr recommended in NUREG- 5512, Vol 3, section 5.3.4 which was based on data from section 5.3.3, including Table 5.7. The calculation of inhalation rate was revised to 2190 hr/yr * 1.4 m^3/hr = 3066 m^3/yr in the revised calculations of soil, basement and buried pipe DCGLs in Sections 2, 3, and 7 of TSD RS-TD-313196-004, Rev. 3. The information in Sections 2, 3, and 7 of TSD RS-TD-313196-004, Rev. 3 will be included in LACBWR LTP Rev 1.