UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 19, 2020

Mr. John Sauger
Executive Vice President
Chief Nuclear Officer Reactor D & D
EnergySolutions
2701 Deborah Avenue
Zion, IL 60099

SUBJECT: LA CROSSE BOILING WATER REACTOR – REQUEST FOR ADDITIONAL INFORMATION REGARDING THE LACROSSE SOLUTIONS FINAL STATUS SURVEY REPORT AND SUPPORTING INFORMATION (CAC 000083; EPID L-2019-DF1-0003 AND EPID L-2019-LIT-0000)

Dear Mr. Sauger:

By letters dated September 11, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19261A344), December 13, 2019 (ADAMS Accession No. ML20006D756), and January 28, 2020 (ADAMS Accession No. ML20031C839), LaCrosse*Solutions*, LLC (LS, the licensee) requested U.S. Nuclear Regulatory Commission (NRC) review of the Final Status Survey Report (FSSR) for the La Crosse Boiling Water Reactor (LACBWR). These submittals support the LACBWR partial site release request received on February 14, 2020 (ADAMS Accession No. ML20052D015), which, if approved, will remove a 36.5 acre portion of the site from the LACBWR 10 CFR Part 50 license, License No. DPR-45, effectively terminating the license outside of the footprint for the remaining onsite Independent Spent Fuel Storage Installation (ISFSI), which encompasses approximately 39 acres.

Specifically, LS intends to remove an area consisting of two basement survey units, eight above-grade building survey units, and 21 land survey units (including seven below grade excavation survey units), and ten buried piping survey units. This action will represent the completion of decommissioning activities at the LACBWR reactor site, until such time as the ISFSI is no longer needed for the storage of spent fuel and subsequently decommissioned. The FSSR is the documentation that demonstrates completion of the activities described in the LACBWR License Termination Plan (LTP), which was submitted by letter dated June 27, 2016 (ADAMS Accession No. ML16200A095), as supplemented by letter dated December 1, 2016 (ADAMS Accession No. ML16347A026). The LACBWR LTP was approved by the NRC on May 21, 2019 (ADAMS Accession No. ML19008A079).

The LACBWR LTP provided the details of the plan for characterizing, identifying, and remediating the remaining residual radioactivity at the LACBWR site to a level that will allow the site to be released for unrestricted use in the future. The LACBWR LTP also described how the licensee will confirm the extent and success of remediation through radiological surveys, as captured in the FSSR, provide financial assurance to complete decommissioning, and ensure the environmental impacts of the decommissioning activities are within the scope originally envisioned in the associated environmental documents.

In order to complete its ongoing review of the LACBWR FSSR, the NRC staff requests additional information as specified in the Enclosure. The requested information was discussed, in part, with your staff during conference calls with the NRC staff on July 16, 2020, July 30, 2020, August 3, 2020, and August 6, 2020. In order to assist the NRC staff in continuing its review of the subject request, please respond to this request for additional information within 30 days or as soon as possible based on the LS schedule for this action as well as the similar efforts related to the review of the FSSR for the Zion Nuclear Power Station (ZNPS).

As of the date of this letter, at your request, the NRC intends to shift the staff resources that were focused on the LACBWR FSSR review to support the ZNPS FSSR review, in accordance with the Energy*Solutions* stated schedule priorities. This will effectively suspend the review of the LACBWR FSSR until the ZNPS FSSR review is completed or has progressed substantially. If you would like to discuss the LACBWR FSSR review schedule in more detail, or revise the preference to focus on the ZNPS FSSR at this time, please contact me or Marlayna Doell, the LACBWR Project Manager, at (301) 415-3178 or via e-mail at marlayna.doell@nrc.gov.

Sincerely,

Bruce A. Watson, CHP, Chief
Reactor Decommissioning Branch
Division of Decommissioning, Uranium Recovery,
and Waste Programs
Office of Nuclear Material Safety
and Safeguards

Docket Nos.: 50-409 and 72-046
License No.: DPR-45

cc w/enclosure: Distribution via Listserv

SUBJECT: LA CROSSE BOILING WATER REACTOR – REQUEST FOR ADDITIONAL INFORMATION REGARDING THE LACROSSE SOLUTIONS FINAL STATUS SURVEY REPORT AND SUPPORTING INFORMATION (CAC 000083; EPID L-2019-DF1-0003 AND EPID L-2019-LIT-0000)

DATE: August 19, 2020

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REQUEST FOR ADDITIONAL INFORMATION

FINAL STATUS SURVEY REPORT REVIEW

LA CROSSE BOILING WATER REACTOR

LACROSSE*SOLUTIONS*, LLC

DAIRYLAND POWER COOPERATIVE

DOCKET NO. 50-409

By letters dated September 11, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19261A344), December 13, 2019 (ADAMS Accession No. ML20006D756), and January 28, 2020 (ADAMS Accession No. ML20031C839), LaCrosse*Solutions*, LLC (LS, the licensee) requested U.S. Nuclear Regulatory Commission (NRC) review of the Final Status Survey Report (FSSR) for the La Crosse Boiling Water Reactor (LACBWR). These submittals support the LACBWR partial site release request received on February 14, 2020 (ADAMS Accession No. ML20052D015), which, if approved, will remove a 36.5-acre portion of the site from the LACBWR 10 CFR Part 50 license, License No. DPR-45, effectively terminating the license outside of the footprint for the remaining onsite Independent Spent Fuel Storage Installation (ISFSI), which encompasses approximately 39 acres.

Specifically, LS intends to remove an area consisting of two basement survey units, eight above-grade building survey units, and 21 land survey units (including seven below grade excavation survey units), and ten buried piping survey units. This action will represent the completion of decommissioning activities at the LACBWR reactor site, until such time as the ISFSI is no longer needed for the storage of spent fuel and subsequently decommissioned. The FSSR is the documentation that demonstrates completion of the activities described in the LACBWR License Termination Plan (LTP), which was submitted by letter dated June 27, 2016 (ADAMS Accession No. ML16200A095), as supplemented by letter dated December 1, 2016 (ADAMS Accession No. ML16347A026). The LACBWR LTP was approved by the NRC on May 21, 2019 (ADAMS Accession No. ML19008A079).

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1. LACBWR LTP Investigation and Reclassification Process Not Consistently Followed

Comment: It appears that the licensee did not consistently follow (1) commitments made in Section 5.6.4.6, "Investigation Process," of the LACBWR LTP regarding the investigation process, or (2) commitments outlined in Table 5-17, "Remediation, Reclassification, and Resurvey Actions," of the LACBWR LTP on remediation, reclassification, and resurvey actions.

Basis: Section 5.6.4.6 of the LACBWR LTP states that areas exceeding given investigation levels will be "addressed by further biased surveys and sampling as necessary" according to the investigation levels in Table 5-16, "Final Status Survey (FSS) Investigation Levels." For Class 1 and Class 2 areas, the direct investigation level is a survey result greater than the Operational Derived Concentration Guideline Limit (DCGL). For Class 3 areas, the direct investigation level is a survey result greater than 50 percent of the Operational DCGL (OpDCGL). There are several instances in the FSSR where the licensee did not follow the process outlined in Section 5.6.4.6 of the LACBWR LTP without sufficient justification. In some survey units, the process in the LACBWR LTP was not followed because LS conducted the FSS and backfilled the area before the LACBWR LTP was approved, which prevented the licensee from taking additional investigation samples after the LACBWR LTP approval.

Section 5.6.4.6.1, "Remediation, Reclassification and Resurvey," of the LACBWR LTP covers the scenarios that would require remediation, reclassification, or resurvey of a survey unit based on sample results. According to Table 5-17 of the LACBWR LTP, if one or several survey measurements (scan, sample, or direct measurement) exceed 50 percent of the OpDCGL in a Class 3 area, the licensee committed to reclassify the area of elevated activity to a Class 1 area and create a Class 2 buffer zone of appropriate size around the elevated area.

Table 5-17 of the LACBWR LTP further states that for Class 3 areas, if one or several survey measurements (scan, sample, or direct measurement) exceed 1 percent of the OpDCGL, the area of elevated activity is to be reclassified to Class 2. Contrary to this commitment, it does not appear that this 1 percent criterion for reclassification was followed in the FSS designs or during the performance of the surveys. The licensee should explain why this commitment was not followed for the surveys or provide justification for the alternate approach used.

The following are examples of the licensee not consistently following the commitments in the LACBWR LTP regarding the investigation and/or reclassification process:

- The release record for the Turbine Building, Sump, and Pit Diesel Excavation (Survey Unit L1-SUB-TDS), which was a Class 1 area, states that "retroactively fitting the scan data to Action Levels based on the OpDCGL and the actual background data collected during the FSS, resulted in fourteen scan measurements that would have alarmed, and in turn would have triggered the collection of investigational soil samples,…[but] no investigational samples were collected. Because 100 percent of the soil in the survey unit was scanned and the maximum Sum-of-Fractions (SOF) of all applicable Radionuclides of Concern (ROC), either by direct measurement or by inference, is equal to 0.0552 when applying the respective OpDCGLs for soil, the probability of discovering an elevated soil sample is very low, even had investigational samples been collected."

  The Action Level used in the scan was 33,706 counts per minute (cpm), and the release record further states that "at the time of the FSS, the Action Level was based upon a fraction of the Base Case Cesium-137 (Cs-137) DCGL and a pre-established background count rate. The Action Level was calculated using a background of 31,800 cpm and a Minimum Detectable Count Rate (MDCR) of 1,906 cpm for a total of 33,706 cpm. The MDCR value equates to Cs-137 concentration of 9.2 picocuries per gram (pCi/g), which is equivalent to approximately 20 percent of the Cs-137 Base Case DCGL for soil. A pre-established gross background and Alarm Set Point (ASP) was used during FSS because of an anticipated elevated background due to the survey unit's proximity to the Reactor Building." In comparison, the measured background for this survey unit was about 8,000 cpm and the OpDCGL was equivalent to about 3,500 cpm.

The licensee collected 14 systematic soil samples, and 10 judgmental soil samples. The release record states that a map of the scan locations is provided in Attachment 1, "Figures and Maps," but the scan locations are not marked on Figure 16-1, "L1-SUB-TDS Systematic Sample Locations Map," or Figure 16-2, "L1-SUB-TDS Judgmental Sample Locations," of the release record; only the systematic and judgmental locations are noted. Because the scan data locations are not indicated on the figures, it is difficult to tell where the 10 judgmental samples were taken in relation to the higher scan readings. Additional information should be provided to ensure that the radioactive material in areas which would have triggered investigation have been accounted for properly in the release record.

- The release record for the Waste Treatment Building (WTB) Excavation (Survey Unit L1-010-101C) states that "evaluating the logged scan data to the correct and current Action Levels based on the OpDCGL shows that nearly all the scan measurements from the E, EX, and N grids would have produced alarms, and in turn would have triggered the collection of investigational soil samples. It was discovered that background values for the scan grids (E, EX, and N) for this survey unit were erroneously collected in the environmental lab and were not representative of actual background levels…. If the average background for the sample locations (6,824 cpm) was applied to the scan grids, and the scan data was evaluated against the current Action Levels based on the OpDCGL, only two locations would have produced alarms. Because 100 percent of the soil in the survey unit was scanned and no soil samples collected for FSS resulted in ROC concentrations above the OpDCGLs, the probability of discovering an elevated soil sample is very low, even had investigational samples been collected."

  The survey design called for 15 systematic samples, which were originally taken, but subsequent remediation was required that invalidated the original samples. The survey unit was then backfilled because the subsequent scan (which was done with the incorrect alarm setting) did not produce any alarms. As a result, the licensee took the necessary systematic samples via Geoprobe after the survey unit was backfilled. Additional information should be provided to ensure that the Geoprobe sampling was adequate to meet the systematic sampling requirements of the survey design.

- The release record for the Waste Gas Tank Vault (WGTV) Basement (Survey Unit B1-010-004) states that "prior to implementation of In-Situ Object Counting System (ISOCS) measurements for FSS, 100 percent of the floor surface was scanned using a Ludlum Model 43-37 detector attached to a Ludlum Model 3250-1 instrument. This survey was performed to ensure that no small areas of elevated activity were present before ISOCS measurements were collected. The ASP for this survey was set at the Basement OpDCGL for Cobalt-60 (Co-60), converted to cpm, plus the average background from the survey unit. The maximum scan reading captured was 10,276 cpm. No alarms were produced during the performance of this survey."

  The release record further states that "the pre-FSS survey was replicated (except with the use of the Ludlum Model 44-10 detector rather than the Ludlum Model 43-37) during a surveillance that took place after implementation of the ISOCS measurements was concluded. The survey was performed as a response to a change in the condition of the survey unit after a rain event caused the release of a concrete core hole plug. Water and sediment were also observed to enter the isolated and controlled basement, as it was still exposed post-FSS before being backfilled. The maximum scan reading captured during this surveillance survey was 14,383 cpm. No alarms were produced

during the performance of this survey. The water and sediment intrusion from clean areas did not change the as-left radiological conditions of the survey unit and therefore, the FSS was deemed still valid."

However, the NRC staff notes that the maximum reading for the scan post-rain event (14,383 cpm) is higher than the maximum survey reading pre-rain event (10,275 cpm). The full scan data for the pre-rain or post-rain scan is not provided, only the maximum readings. Additional information should be provided to ensure that the post-rain event scan data is adequate to support the survey conclusions in the release record.

- The release record for the LACBWR Crib House (Survey Unit B2-010-101) states that "three alarms were produced during the scanning of survey unit B2-010-101. Static measurements collected at the locations of scan alarms were below the action level." The NRC staff assumes that the static measurements collected at the locations of the scan alarms are part of the systematic measurements reported in Table 7-3, "Summary of Systematic, Judgmental, and Quality Control Static Measurements," of the associated release record. However, the staff notes that if three of those measurements were *also* considered investigation measurements for the scan, they should have been discussed as such in the release record.

  It is not clear whether the static measurements were considered investigation measurements, since Table 7-1, "Synopsis of Scan Results," of the release record lists zero under the Investigation Measurement column, and Section 9, "Investigation and Results," states that "no investigations were performed during the performance or analyses of the survey." Additional information should be provided to ensure that the systematic measurements are adequate to support the survey conclusions in the release record, and that the investigation process was followed in accordance with the commitments in the approved LACBWR LTP.

- The release record for the Stack, Pipe Tunnel, and Reactor Plant Generator Plant Area (RPGPA) Excavation (Survey Unit L1-SUB-CDR) states that "six investigational samples were collected at locations of scanning alarms in scan lanes CDR14 through CDR18 and W11, W16, and W17…. Inadvertently, the investigational samples were not labeled correctly, the coordinates were not collected, and the locations were not marked on the survey maps. The six investigational samples were labeled NRC #4 through NRC #9." As part of the FSSR quality assurance / quality control (QA/QC) process, the licensee should review why the six investigational samples were not labeled correctly, the coordinates not collected, and the locations not marked on the survey map.

  In addition, it appears that samples labeled "Sump #1" and "Sump #2" were collected during the FSS of this survey unit. Sump #1 and Sump #2 were analyzed using LACBWR's onsite gamma spectroscopy system, and sample Sump #1 was also sent to the GEL Laboratories for analysis of the full suite of radionuclides. However, these samples and the analysis results are not discussed in the associated release record. Additional information should be provided to ensure that the results of these analyses continue to support the survey conclusions in the release record.

- In the release record for the RPGPA Excavation (Survey Unit L1-SUB-TDS B), one of the samples taken via Geoprobe, L1-SUB-TDS-FSGS-B04-SB, had an SOF of 1.4655 compared to the OpDCGL, and a Cs-137 concentration of 24.4 pCi/g. The release record indicates that "as an investigation, additional judgmental boring locations were

added, and the other three samples collected nearest the sample location were evaluated. None of the other three samples had a SOF greater than one."

There were eight judgmental samples taken in total and three were required by the survey design, but it is not clear how many of the judgmental Geoprobe borings are associated solely with investigation activities. One judgmental Geoprobe bore location (B36) looks to overlap a systematic sample location (L1-SUB-TDS-FSGS-B04-SB), but that sample contained a much lower concentration of Cs-137 (1.2 pCi/g compared to 24.4 pCi/g in the systematic sample). The map of sample locations shows that four of the other judgmental Geoprobe bore sample locations are relatively close to L1-SUB-TDS-FSGS-B04-SB (B32, B33, B34, and B35). The maximum Cs-137 concentration reported in these samples was 11 pCi/g at B33.

The release record also refers to "evaluating" the three samples that were closest to the systematic location in question (L1-SUB-TDS-FSGS-B04-SB), but it is unclear what that evaluation entailed (e.g., if the three samples were recounted or otherwise reanalyzed). The release record indicates that "during the first few sampling attempts with the GeoProbe®, it became evident that the interface could not be discerned." Therefore, the licensee collected samples from four different stratums at each location, at three-foot intervals, and each soil sample consisted of a minimum of one liter of soil. The highest Cs-137 concentration measured in the four stratums was used in the Sign Test. It is not clear if the investigational judgmental sample results are from the same stratum as the systematic location of L1-SUB-TDS-FSGS-B04-SB.

Additional information should be provided related to the evaluation conducted for the three additional investigational judgmental samples near L1-SUB-TDS-FSGS-B04-SB to confirm that the measurements are adequate to support the survey conclusions in the release record, and that the investigation process for this survey unit was followed in accordance with the commitments in the approved LACBWR LTP.

- The release record for the Eastern Portion of the Turbine Building, Sump, Pit, and Diesel Excavation (Survey Unit L1-SUB-TDS A) states that "a total of four alarms were verified during scanning which triggered the collection of four investigational samples. Samples L1-SUB-TDS-FJGS-A16, L1-SUB-TDS-FJGS-A20, and L1-SUB-TDS-FJGS-A21 were discarded after a 200 square foot (ft^2) area of soil was excavated. The other eight alarms were voided after the removal of the 200 ft^2 area; the area was then rescanned. Table 7-1 [of the release record] provides an overview of the scan results for all scan lanes (identified as 01 through 84), the 1 square meter (m^2) scan areas around each sample location before and after sample collection (identified with "A"), the alarm area (identified with "AA"), and QC locations (identified with a "QC")."

  From this description, it appears that remediation of an area of approximately 200 ft^2 was conducted in the survey unit after FSS activities began. However, Section 9 of the release record states that "no radiological remedial action as described by [the Multi-Agency Radiation Survey and Site Investigation Manual] (MARSSIM), Section 5.4, ["Remedial Action Support Surveys,"] was performed in this survey unit prior to or as a result of the FSS." The NRC staff notes that the process outlined in MARSSIM Figure 2.7, "The Characterization and Remedial Action Support Survey Portion of the Radiation Survey and Site Investigation Process," and Figure 2.8, "The Final Status Survey Portion of the Radiation Survey and Site Investigation Process," indicates that when additional remediation is conducted during an FSS, the Data Quality Objectives

(DQOs) should be reassessed to ensure that they are satisfied. In addition, Section 5.6.4.6.1 of the LACBWR LTP states that "if an area is remediated, then a [Remedial Action Support (In-Process) Survey] (RASS) will be performed to ensure that the remediation was sufficient." However, it is not clear from the associated release record that the appropriate DQO verification and post-remediation surveys were performed in accordance with MARSSIM or the commitments made in the LACBWR LTP.

In addition, the scan data in Table 7-1 of the release record show that there were eight alarms in the rows for certain scan lanes (9, 22, 28, 29, 30, 31, 73, 79). Table 7-1 also indicates that investigational samples were taken at scan lanes 9, 22, 73, and 79. It is not clear why investigational samples were not also taken at scan lanes 28, 29, 30, and 31 where alarms were also produced. Without a map showing the scan locations it is difficult to discern if these alarm locations were part of the 200 ft^2 area that was excavated. Table 7-1 also indicates that alarms were produced during the scans around sample locations A12, A15, A17, and A19, but it is not clear why investigational samples were not taken from these areas. Sample location A12 appears to be part of the 200 ft^2 that was removed / remediated, but sample locations A15, A17 and A19 are not.

Furthermore, the release record states that samples A16, A20, and A21 were discarded after the 200 ft^2 area of soil was excavated. In Figure 16-1, "Survey Unit L1-SUB-TDS A Systematic and Judgmental Sample Locations Map," of the release record, samples A16 and A21 appear inside the excavated area. However, sample A20 is outside of the excavated area. The licensee should provide a map of the scan locations in conjunction with the sample locations, and a clearer explanation of the investigations, remediation, and resurvey of the survey unit. The details should include the scan and soil sample results that prompted the additional remediation of the survey unit.

RAI-1 Path Forward:

- Section 5.6.4.6 of the LACBWR LTP states that areas exceeding given investigation levels will be "addressed by further biased surveys and sampling as necessary" according to the investigation levels in Table 5-16, "FSS Investigation Levels." The licensee should provide additional details regarding the process that was followed for determining when further biased surveys and sampling were deemed necessary.

- For relevant survey units, provide a reasonably bounding evaluation of the potential dose impacts of areas that should have been investigated per Section 5.6.4.6 of the LACBWR LTP, but were not investigated. When assessing the dose impacts, take into consideration the potential misclassification of survey units or portions of survey units. The response should include a review of all impacted survey units and should not be limited to the survey units that are discussed as examples in this RAI.

- For the Turbine Building, Sump, and Pit Diesel Excavation (Survey Unit L1-SUB-TDS), provide a survey map that shows the scan locations in comparison with the judgmental sample locations for the survey unit.

- For the WTB Excavation (Survey Unit L1-010-101C) and RPGPA Excavation (Survey Unit L1-SUB-TDS B) Geoprobe samples, the licensee should discuss why they are confident that the Geoprobe samples represent the end state of the bottom of the excavations and can be relied on as part of the release records.

This discussion should include the following information, as a minimum:

- Discuss how the depth of the Geoprobe sample was determined, including any visual cues used to verify that the top of the excavation was indeed sampled as opposed to the fill or beneath the excavation, etc.

- Provide additional details on the sampling approach for the 3-foot stratums obtained using the Geoprobe method in the WTB Excavation and RPGPA survey units. These additional details should describe whether the entire 3-foot stratum length comprised the 1-liter sample, or a portion of soil from each stratum was selected and analyzed. The details should also state whether the 3-foot stratum was mixed before being analyzed.

- Provide additional basis for why the 1-liter sample is representative of the 6-inch layer that would have been directly below the interface of natural soil and backfill, and that the sample for this targeted zone is not diluted by additional material (natural sediment or backfill) from the 3-foot lengths of core. In addition, provide a discussion of any considerations that were used to ensure that the 6-inch layer was not inadvertently split between the bottom two core lengths, if the sample results were not mixed before analysis.

- For the WGTV Basement (Survey Unit B1-010-004), the licensee should provide additional information about the rain event to demonstrate that the rain event did not affect the radiological status of the survey unit, since the systematic FSS samples were taken prior to the rain event and were not repeated after the rain event. The licensee should provide the scan data for the survey unit both pre-rain event and post-rain event.

- For the LACBWR Crib House (Survey Unit B2-010-101), the licensee should indicate whether the three static measurements discussed were investigation measurements.

- For the Stack, Pipe Tunnel, and RPGPA Excavation (Survey Unit L1-SUB-CDR), the licensee should review why the six investigational samples were not labeled correctly and the coordinates not collected. The licensee should also include a discussion of the nature of the Sump #1 and Sump #2 samples and the results of the analysis.

- For the RPGPA Excavation (Survey Unit L1-SUB-TDS B), clarify how the three samples that were closest to systematic sample location L1-SUB-TDS-FSGS-B04-SB were evaluated during the investigation phase of the survey. Please explain whether the result of the judgmental boring sample (B36) taken directly adjacent to this elevated systematic sample location was expected, given the different Cs-137 concentrations (1.2 pCi/g for B36 compared to 24.4 pCi/g for L1-SUB-TDS-FSGS-B04-SB). Include any relevant details regarding the depths from which the two samples were collected, and the size(s) of the Geoprobe used in the survey.

- For the Eastern Portion of the Turbine Building, Sump, Pit, and Diesel Excavation (Survey Unit L1-SUB-TDS A), the licensee should provide a map of the scan locations and a more detailed explanation of the investigations, remediation, and resurvey of the area. The information should distinguish between the scans and sampling that were conducted prior to remediation, versus those conducted post-remediation.

The details should include all the scan and soil sample results that were taken after FSS activities commenced (June 26, 2019), even those that were discarded due to the subsequent remediation. The response should also explain why the result for judgmental sample A20 was discarded, as it appears to be outside the blue dotted line indicating the excavated / remediated area in Figure 16-1 of the release record. If the result for sample A20 was intentionally discarded, indicate why and whether it was used as a judgmental sample result in an adjacent survey unit and indicate which survey unit. The licensee should also revise the figure in Attachment 1 of the release record to show that sample A20 was outside of the survey unit boundary.

Finally, the licensee should perform an analysis that demonstrates the survey design and DQOs for survey unit L1-SUB-TDS A are still valid, and that the proper resurvey FSS was conducted given that remediation was necessary in this area.

2. RPGPA Remedial Action Survey Information

Comment: Additional information is needed regarding the RPGPA survey unit FSS activities, given that this survey unit was backfilled prior to the FSS being conducted.

Basis: Section 5.6.4.4, "Scan Coverage," of the LACBWR LTP commits to performing a 100 percent surface scan of Class 1 survey units, along with collecting the appropriate number of systematic samples based on the survey design. The RPGPA Excavation (Survey Unit L1-SUB-TDS B) is a Class 1 survey unit, which includes a historically identified leak from the Turbine Building drains to the groundwater system (see Section 2.3.7.3, "Previous Investigations," and Section 6.5.4, "Existing Groundwater," of the LACBWR LTP) that was not adequately characterized spatially or in duration prior to submittal of the LACBWR LTP (see Section 3.7.8.1, "1983 Leak – Turbine Building," of the NRC Safety Evaluation Report (SER) associated with approval of the LACBWR LTP).

Considering radionuclide decay rates, significant Cs-137 from the historical leak could still be present, sorbed to the sediments below the Turbine Building. The NRC SER assumed that the presence or absence of both Co-60 and Cs-137 during the FSS of the RPGPA Excavation would confirm the assumptions made in the LACBWR LTP regarding groundwater contamination as a result of this event. However, a 100 percent scan of the RPGPA surface during FSS activities was not possible because a portion of the survey unit was backfilled prior to FSS to facilitate demolition of the LACBWR reactor building. As a result of this backfilling, the systematic samples needed for the RPGPA FSS were collected using a Geoprobe.

The associated release record describes how four samples were taken (from different elevations in a vertical column) for each of 28 Geoprobe locations in the RPGPA survey unit, for a total of 112 samples from the 615-foot to the 627-foot elevation. Four samples were taken from each vertical column because the interface between the native soil and backfill could not be discerned. The interface should have been roughly at the 618-foot elevation. Since a surface scan was not possible during FSS, the licensee performed "qualitative" scans on the sample tubes as the Geoprobe samples containing the backfill and underlying natural sediments were collected. The release record states that "no alarm set points were calculated, but all measurements were consistent with background." The highest scan reading from the Geoprobe sample tubes indicated in Attachment 2, "Scan Data," of the release record for the RPGPA Excavation is 5,600 cpm in location 23B SP.

Although surface scans were not possible during the FSS, the licensee did conduct remedial action scans of the survey unit prior to backfill, which were provided to the NRC via email on May 9, 2019. Remedial action gamma scan surveys of soil in the RPGPA trench box that were completed on December 5, 2017, prior to the survey unit being backfilled, indicated readings ranging from 34,000 cpm to 60,000 cpm. The detector model number is indicated as "Mod 2221," but the model of the probe is not indicated. A soil sample was collected as part of the RASS on December 6, 2017, from a 55,000 cpm area, with corresponding soil sample results of 5 pCi/g of Cs-137 and 0.147 pCi/g of Co-60. The NRC staff notes that this sample was taken from the RPGPA excavation area, which is reported to be 15 feet deep, but the depth of the sample is not clearly indicated in the RASS documentation.

The licensee should indicate whether the scans of the Geoprobe sample tubes and systematic sample results collected during the FSS reflected what was expected, given the RPGPA RASS scans and corresponding soil sample results. The licensee should include a discussion of the timing of the demolition and subsequent backfill of the LACBWR Reactor Building, and indicate when the source related to shine from the Reactor Building was eliminated in comparison to the timing for the RASS and FSS activities. The licensee should also consider the geometry of the 15-foot trench when comparing the RASS scan data to the corresponding sample results, as well as in the discussion of shine from the LACBWR Reactor Building.

RAI-2 Path Forward:

- Provide additional details supporting the licensee's confidence that the FSS sampled the appropriate interface between the bottom of the RPGPA excavation and the backfill.

- Include a discussion of the timing of the demolition and subsequent backfill of the Reactor Building, and indicate when the source related to shine from the Reactor Building was eliminated in comparison to the timing for the RASS and FSS activities.

- Indicate the model of the probe that was used for the RPGPA RASS, in addition to the Ludlum Model 2221 Scaler-Ratemeter. Discuss the soil concentrations the licensee would expect to see from a result of 55,000-60,000 cpm for this type of detector, and whether the activity concentrations of 5 pCi/g of Cs-137 and 0.147 pCi/g of Co-60 in the soil samples were expected results. In addition, the licensee should take into account the geometry of the 15-foot trench when comparing the RASS scan data to the sample results, as well as in the discussion of shine from the LACBWR Reactor Building.

- The licensee should indicate whether the FSS scans reflected what they expected given the RASS scan data. Indicate whether additional remediation of the RPGPA survey unit was conducted after the RASS that was completed on December 6, 2017.

3. <u>Commitment for Hard to Detect (HTD) and Full Initial Suite Radionuclide Analyses to Verify Surrogate Ratio and Insignificant Radionuclide Contribution (IC) Dose During Continuing Characterization</u>

Comment: Additional information is needed to demonstrate that the licensee followed the commitments in Section 5.1, "Radionuclides of Concern and Mixture Fractions," of the LACBWR LTP to analyze 10 percent of all media samples collected during continuing characterization for the full initial suite of radionuclides, in order to verify the IC dose and HTD ratio. Based on the information in the release records, it is not clear this commitment was consistently followed.

Basis: Section 5.1 of the LACBWR LTP states that "for continuing characterization, 10 percent 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 percent minimum will be selected at random, also for HTD radionuclide analysis. All samples will first be analyzed by the onsite gamma spectroscopy system. In the absence of detectable gamma activity, locations will be selected based on the potential for the presence of activity using Historical Site Assessment information or other process knowledge data. All samples selected for HTD analysis during continuing characterization will be analyzed for the full suite of radionuclides…."

Section 5.1 further states that "the actual IC dose will be calculated for each individual sample result using the DCGLs from [Technical Support Document] (TSD) RS-TD-313196-004, "LACBWR Soil DCGL, Basement Concrete DCGL, and Buried Pipe DCGL," 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 additional investigation samples will be taken around the original sample location. Each investigation sample will be analyzed by the onsite gamma spectroscopy system and sent for HTD analysis (full suite of radionuclides). As with the original sample, the actual IC dose will be calculated for each investigation sample."

In addition, Section 5.1 states that "for sample(s) analyzed for HTD radionuclides during continuing characterization, if the analysis of the sample indicates positive results (greater than the minimum detectable concentration) for both a HTD ROC (Strontium-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, "Radionuclides of Concern During LACBWR Decommissioning," 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 additional investigation samples will be taken around the original sample location."

Section 5.3.3.4, "Inaccessible or Not Readily Accessible Areas," of the LACBWR LTP describes the areas where continuing characterization was expected to be conducted during ongoing FSS activities. However, in some cases it is unclear which of the FSSR release records discuss the continuing characterization for these areas. In other cases, the release record of interest is clear, but it is unclear that the LTP commitments discussed above were followed.

The inaccessible or not readily accessible areas in Section 5.3.3.4 of the LACBWR LTP are:

- WGTV interior structural surfaces
- Underlying concrete in the Reactor Building basement after liner removal
- Soil under the Turbine Building (suspect broken drain line)
- Soil adjacent to and beneath basement structures
- Soils under concrete or asphalt coverings
- Interior of buried piping that may remain

The following are examples where additional information is necessary to confirm the licensee followed commitments in the LACBWR LTP for analyzing HTDs and the full suite of radionuclides to verify surrogate ratios and IC dose during continuing characterization activities.

- The release record for the WGTV Basement (Survey Unit B1-010-004) states that "an assessment of the results of continuing characterization confirmed that the IC dose is unchanged (dose fraction less than 10 percent)." Core and soil samples were collected during continuing characterization. The NRC staff notes that the continuing characterization cores taken from the WGTV Basement had some higher concentrations for Cs-137. Eight concrete cores were collected from the WGTV in September 2017 during continuing characterization. Cs-137 was positively detected in seven of the eight cores with concentrations ranging from 4.4 pCi/g to 240 pCi/g. Very low concentrations of Co-60, Nickel-63 (Ni-63), Plutonium-238 (Pu-238), Pu-239/240, Pu-241, and Americium-241 (Am-241) were sporadically identified in three cores, with a range of 0.021 pCi/g to 10.5 pCi/g. The details of the IC dose calculations performed are not provided, nor are the GEL Laboratories analytical reports containing the results. In addition, the associated release record does not indicate whether additional remediation took place after the continuing characterization cores were taken. The licensee should describe whether the ISOCS results during FSS reflect their expectations, considering the Cs-137 values obtained from the continuing characterization cores.

- The release record for the underlying concrete in the Reactor Building Basement (Survey Unit B1-010-001) after liner removal states that "the top half-inch pucks from concrete core samples B1-010-001-CJFC-C04-CV, B1-010- 001-CJFC-C09-CV, and B1-010-001-CJFC-C11-CV were sent off-site to GEL Laboratories for gamma spectroscopy and HTD analysis of the full suite of ROC. Cs-137 was positively identified in two of the three core samples. No other ROC was identified in the core samples sent off-site." Given that only Cs-137 was identified, it is not necessary to include detailed calculations for the IC dose, but the GEL Laboratories analytical reports should be provided in the release record to verify the HTD analysis results.

- The release record for the Eastern Portion of the Turbine Building, Sump, Pit, and Diesel Excavation (Survey Unit L1-SUB-TDS A), which was a Class 1 area, describes how seven samples collected during continuing characterization were analyzed for the full suite of radionuclides. The release record further states that "an assessment of the results of continuing characterization confirmed that the IC dose is unchanged (dose fraction less than 10 percent). A summary of the off-site analytical results for the judgmental soil samples collected for Continuing Characterization is provided in Table 7-4[, "Off-Site Analysis Results]." However, the detailed calculations estimating the insignificant contributor radionuclides dose contribution are not provided.

- The release records that address soil adjacent to and beneath basement structures:

    - Section 5.3.3.4 of the LACBWR LTP states that "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 (approximately six) at the nearest locations along the foundation walls that can be feasibly accessed and the acquisition of angled soil borings (four) to assess migration potential from building interiors to soils under basement concrete. The number of angled soil borings is limited to four due to the presence of deep concrete pilings. Angled soil bores will be performed via GeoProbe®." It is unclear which release record contains information on the continuing characterization of this soil beneath and adjacent to the LACBWR Reactor Building.

- Section 5.3.3.4 of the LACBWR LTP states that "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. The sample plan specified a gamma scan over 100 percent of the survey unit including sloped walls. In addition to the systematic samples collected during FSS (minimum of 14), five additional samples were collected for continuing characterization. These five samples were sent off-site for HTD analysis of the full suite."

  These five samples are discussed in the release record for the Stack, Pipe Tunnel, and RPGPA Excavation (Survey Unit L1-SUB-CDR). The release record states that "Strontium-90 (Sr-90) was not detected in the off-site analysis of samples L1-SUB-CDR-FSGS-008-SS, L1-SUB-CDR-FSGS-009-SS, L1-SUB-CDR-FSGS-011-SS, L1-SUB-CDR-FSGS-012-SS, and L1-SUB-CDR-FSGS-014-SS." In addition to the five samples taken for continuing characterization, the release record also states that six investigational samples were taken (sample numbers NRC #4 through NRC #9).

  Of those samples, it appears that sample NRC #4 was analyzed for the full suite of radionuclides. The GEL Laboratories analytical reports are provided as an attachment to the release record. The GEL Laboratories analytical report for sample NRC #4 shows a Sr-90 concentration of 3.55 pCi/g, and a Cs-137 concentration of 171 pCi/g. The GEL Laboratories report for sample NRC #4 also positively identified Am-241, Am-243, Curium-234/244 (Cm-234/244), Pu-238, Pu-239/240, Pu-241, Co-60, Technetium-99 (Tc-99), and Ni-63.

  The GEL Laboratories analytical report also provides results for a soil sample labeled Sump Area #1, which showed positive results for several radionuclides. However, the GEL Laboratories analytical report data for sample NRC #4 or sample Sump Area #1 does not seem to be discussed in the associated release record. In addition, these two samples should be evaluated and discussed in terms of validating the IC dose contribution.

- Section 5.3.3.4 of the LACBWR LTP states that "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, the sample plan 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 suite of ROC). An additional seven judgmental samples will be obtained during the FSS of the western portion of the excavation."

  The release record for the RPGPA Excavation (Survey Unit L1-SUB-TDS B) describes eight soil samples that were collected during continuing characterization and sent for off-site analysis. The release record presents the results in Table 3-2, "Continuing Characterization Off-Site Analysis Results." However, Table 3-2 shows that three of the eight samples were analyzed for the full suite of radionuclides and the other five samples were analyzed only for tritium (H-3) and Sr-90. While 10 percent of the 28 overall samples collected in the RPGPA Excavation would be 3 samples, this seems contrary to the

commitment in the LACBWR LTP, which states that "all samples selected for HTD analysis during continuing characterization will be analyzed for the full suite of radionuclides from Table 5-1, 'Initial Suite of Radionuclides.'"

In comparing Table 3-2 of the release record to the GEL Laboratories analytical reports, it appears that some of the radionuclides that were above the minimum detectable concentration (MDC) are not indicated correctly in the table. For example, sample L1-SUB-TDS-CJGS-B03A-SB indicates a Co-60 concentration of 0.04 pCi/g when it should be 0.122 pCi/g, and the Cs-137 concentration is listed as 0.04 pCi/g when it should be 4.28 pCi/g. The licensee should explain why only three of the eight continuing characterization samples were analyzed for the full suite of radionuclides. In addition, the licensee should correct these and any additional mistakes in Table 3-2 of the release record.

- The release records that address soils under concrete or asphalt coverings:

    - Section 5.3.3.4 of the LACBWR LTP states the following, referring to sub-slab soil beneath LACBWR Warehouses 1, 2, and 3: "A total of fourteen surface soil samples were systematically obtained along with one judgmental sample. Two soil samples were sent off-site for HTD analysis for the full 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." It is unclear which release record(s) contains information on this continuing characterization activity related to the soil beneath LACBWR Warehouses 1, 2, and 3.

- The release records that address interior of buried piping that may remain:

    - Section 5.3.3.4 of the LACBWR LTP states that "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 Historical Site Assessment 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 onsite gamma spectroscopy system and 10 percent, with a minimum of one, will be sent off-site for HTD analysis for the full initial suite of ROC."

      From the information provided, it is unclear to which buried pipes the commitment in Section 5.3.3.4 of the LACBWR LTP applies. The buried piping release records do not mention sediment or debris, except for the release record for Storm Drain 2 (Survey Unit S3-012-109 B). This release record states that "the off-site laboratory, GEL Laboratories, processed the three sediment samples (S3-012-109B-FJGS-062-SM, S3-012-109B-FJGS-063-SM, and S3-012-109B-FJGS-064-SM) selected for HTD analysis. All samples were analyzed for Sr-90. The analyses met the required MDC. Laboratory results revealed that Sr-90 was not detectable in any of the samples. The results are provided in Table 7-3[, "Off-Site Analysis Results," of the release record]." According to the commitment in Section 5.3.3.4 of the LACBWR LTP, it appears

these three sediment samples, or one at a minimum, should have been analyzed for the full suite of radionuclides, not just Sr-90. In addition, the GEL Laboratories analytical reports should be provided in the release records associated with these three samples.

RAI-3 Path Forward:

- For areas that underwent continuing characterization, including the areas listed in Section 5.3.3.4 of the LACBWR LTP where the licensee committed to performing continuing characterization, describe which release records include the description of the continuing characterization activities. Provide data (including GEL Laboratories analytical reports) for the continuing characterization where not already provided. This description should clearly indicate which release records contain information on the continuing characterization of the soil beneath and adjacent to the LACBWR Reactor Building. The description should also indicate which release record(s) contains information on the continuing characterization activities related to the soil beneath LACBWR Warehouses 1, 2, and 3.

- For areas that underwent continuing characterization, provide detailed calculations to estimate the actual IC dose for each individual sample result. The results of the analysis should demonstrate that the IC dose contribution did not exceed what was assumed in the LACBWR LTP (i.e., 2.5 millirem per year (mrem/yr) for all media).

- For the Stack, Pipe Tunnel, and RPGPA Excavation (Survey Unit L1-SUB-CDR), when estimating the IC dose contribution incorporate the results from sample NRC #4 and sample Sump Area #1 into the calculation, or provide justification for why they should not be included in the IC dose calculation.

- For the RPGPA Excavation (Survey Unit L1-SUB-TDS B), the licensee should address inaccuracies in Table 3-2 of the release record before subsequently estimating the IC dose, and should also describe why only three of the eight samples collected during continuing characterization were analyzed for the full suite of radionuclides.

- If the dose contribution from the insignificant radionuclides exceeds what was assumed for any survey unit, assign an appropriate additional dose from the insignificant radionuclides when calculating the total dose for that survey unit.

- For the buried piping survey units, the rationale for not collecting sediment and/or debris samples should be provided for the following survey units:

    - Circulating Water Discharge Pipe (S1-011-102)
    - De-Icing Line (S2-011-103 A)
    - Low Pressure Service Water Piping (S2-011-103 B)
    - Circulating Water Intake Pipe (S2-011-103)
    - Storm Drain 1 (S3-012-109 A)
    - Storm Drain 3 (S2-011-101 A)
    - Storm Drain 6 (S2-011-101 B)
    - Storm Drain 4 (S3-012-102 A
    - Storm Drain 5 (S3-012-102 B)

The licensee should also provide additional information on why a minimum of one of the three sediment samples collected from survey unit Storm Drain 2 (Survey Unit S3-012-109 B) were not analyzed for HTD radionuclides or the full suite of radionuclides in Table 5-1 of the LACBWR LTP.

- For the WGTV Basement (Survey Unit B1-010-004), indicate whether additional remediation took place after the continuing characterization cores were taken. The licensee should describe whether the ISOCS results during FSS reflect their expectations, considering the Cs-137 values obtained from the continuing characterization cores.

4. Assumed Radionuclide Mixture for Above-Grade Building and Buried Piping Survey Units Needs Additional Verification

Comment: Additional information is needed to demonstrate that the assumed radionuclide mixture for the eight above-grade building and ten buried piping survey units is appropriate. Based on information contained in the associated release records, it is not clear that the assumed radionuclide mixture was verified during the FSS activities.

Basis: Section 5.1 of the LACBWR LTP states that "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 where concrete will remain. The number of cores collected and analyzed for ROC HTD will be ten percent 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 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 (using the Operational DCGL), then the sample(s) will be analyzed for ROC HTD radionuclides. For soil samples or concrete cores with positive results for both Sr-90 and the corresponding surrogate radionuclide (Cs-137), the HTD to surrogate ratio will be derived."

Section 5.1 of the LACBWR LTP then states that "for Quality Assurance, 10 percent of the soil samples taken during FSS will also be analyzed for Sr-90 in addition to the gamma emitting radionuclides. For concrete structures, this requirement will be accomplished by taking concrete core samples. The number of concrete cores taken will be 10 percent of the number of direct measurements taken during FSS. The concrete core locations will be selected on the floor and lower walls in the survey unit to alleviate safety concerns from working at heights. In addition, the majority of the source term is expected in the lower walls and floors. For the analysis of FSS samples, if the sample has positive results (greater than MDC) for both Sr-90 and Cs-137, then the Sr-90/Cs-137 ratio will be compared to the Sr-90/Cs-137 ratio assigned for use in the surrogate calculation for Sr-90 (see section 5.2.4[, "Operational Derived Concentration Guideline Levels for Soil," of the LACBWR LTP]). If the Sr-90/Cs-137 ratio from the sample or core data exceeds the assigned ratio, then the ratio from the continuing characterization core will be applied to the FSS surrogate calculations for the survey unit."

The NRC staff interprets the above commitments to mean that the assumed concentration of Sr-90 relative to other potential radionuclides would be verified in 10 percent of the samples taken during FSS for each of the survey units, including above-grade buildings. However, in the

above-grade building release records, the licensee does not seem to have followed this commitment for verifying the HTD ratio. In addition, it appears that the Sr-90 to Cs-137 ratio that was assumed for the above-grade buildings was different from the commitments in the LACBWR LTP. Specifically, in Section 5.2.9, "Surrogate Radionuclides," of the LACBWR LTP, the discussion of surrogate ratios includes a footnote on the bottom of Table 5-11, "Final Sr-90 to Cs-137 Ratios," which states that "the soil designation [Sr-90/Cs-137 Surrogate Activity Ratio of 5.02E-01] represents all concrete core bores and could also be used for other miscellaneous structures (e.g., above-grade structures) to remain if needed."

In Section 5.2.9 of the LACBWR LTP, the licensee appears to commit to using the ratio of 0.502 for Sr-90 to Cs-137 for above-grade structures. Contrary to this commitment, the ratio of 0.502 for Sr-90 to Cs-137 does not seem to have been used based on the associated release records for above-grade structures. The licensee should explain why this ratio was not applied and what alternative method was used to calculate the HTD ratio for above-grade structures.

In addition, Section 5.3.3.4 of the LACBWR LTP describes similar commitments made by the licensee to measure HTD radionuclides in buried piping systems (see RAI-3 for more detailed information concerning buried piping HTD ROCs). The licensee should explain what method was used to calculate the HTD ratio for buried piping survey units.

The following are examples of FSS release records not containing sufficient information to demonstrate that the commitments in Section 5.1 of the LACBWR LTP for HTD analysis and re-evaluation of surrogate ratios were followed consistently, or the assumed radionuclide mixture was not verified in the data or discussion provided in the FSSR.

- In the release records associated with the survey units for above-grade buildings (B2-010-101, B2-010-102, B2-010-103, B3-012-101, B3-012-102, B3-012-103, B3-012-104, and B3-012-109), the licensee did not describe any samples that were analyzed for the HTD radionuclide Sr-90 to verify the applied surrogate ratio.

  For example, in the LACBWR Crib House (Survey Unit B2-010-101), compliance with the unrestricted release criteria was demonstrated through a combination of surface scanning and surface static measurements using a Ludlum 2350-1 data logger paired with a Ludlum Model 44-116 detector (125 square centimeter (cm^2) detector area). The licensee collected static measurements in cpm, subtracted background, and converted the net cpm to disintegrations per minute per 100 square centimeters (dpm/100 cm^2) by dividing by the detector efficiency. The measurement value in dpm/100 cm^2 was compared to a Gross OpDCGL and Gross BaseCaseDCGL. The detector efficiency used in this comparison should account for an assumed radionuclide mixture.

  Similarly, the Gross DCGL value was calculated assuming mixture fractions for the ROCs from Table 4-1, "Dose Significant Radionuclides and Mixture for Above Grade Buildings," of the release records (replicated below). This table appears contrary to the commitment in Section 5.2.9 of the LACBWR LTP to use the ratio of 0.502 for Sr-90 to Cs-137 for above-grade structures. Instead, as noted in the table below, Sr-90 is about 10 percent of the radionuclide mixture fraction assumed in above-grade buildings. This radionuclide mixture ratio is derived from approximately 40 concrete cores taken from the WGTV, Reactor Building, Tunnel, and WTB during site characterization, which may not be representative of the radionuclide mixture ratio in above-grade buildings. (See Table 6-3, "Initial Suite of Potential Radionuclides and Mixture Fractions," of the LACBWR LTP, and TSD RS-TD-313196-001, Table 22.)

Radionuclide	Fraction of Total Activity (normalized)
Co-60	0.0644
Sr-90	0.0981
Cs-137	0.829
Europium-152 (Eu-152)	0.00549
Eu-154	0.00281

Because the ROC mixture ratios can affect both the instrument efficiency of the Ludlum 44-116 detector (which is used to convert the cpm to dpm/100 cm^2) and the Gross DCGL (which is compared to the dpm/100 cm^2 to calculate the SOF for each measurement), the radionuclide mixture ratios should be verified, or shown to be conservative, given the potential variation in relative radionuclide concentration throughout the survey units for above-grade buildings.

For example, if the radionuclide mixture comprised 20 percent Co-60 and 80 percent Cs-137, without any Sr-90, Eu-152, or Eu-154 present, the Gross OpDCGL would be 2,820 dpm/100 cm^2 instead of 3,160 dpm/100 cm^2. Similarly, one would expect the instrument efficiency of the Ludlum 44-116 detector to change with a different assumed radionuclide mixture.

- In the release records associated with the survey units for buried piping (S1-011-102, S2-011-103 A, S2-011-103 B, S2-011-103, S3-012-109 A, S2-011-101 A, S2-011-101 B, S3-012-102 A, S3-012-102 B, and S3-012-109 B), the licensee did not describe any samples that were analyzed for the HTD radionuclide Sr-90 to verify the applied surrogate ratio. (See RAI-3 for more detailed information concerning buried piping.)

RAI-4 Path Forward:

- For the above-grade building survey units, provide the detailed calculations used to derive the detector efficiency values, as well as the procedures used to determine these detector efficiencies. In addition, explain the difference in the detector efficiencies reported in Table 5-19, “Typical FSS Instrument Detection Sensitivities,” of the LACBWR LTP and the detector efficiencies applied to the above-grade building surveys (e.g., Table 7-2, “Detector Efficiencies,” of the release record for the Genoa 3 Crib House (Survey Unit B2-010-102)). This information should include how the detection area of the Ludlum Model 44-116 probe was accounted for in the detector efficiency used in the above-grade building surveys.

- For the above-grade building survey units, provide additional justification for why the applied radionuclide mixture is representative for the above-grade buildings. Show that the efficiency of the detector and the Gross OpDCGL are both appropriate, given the potential variation in relative radionuclide concentrations within above-grade buildings. Specifically, provide information on the representativeness of the detector efficiency calculations for the range of radionuclide mixtures within the buildings. This information should address changes in instrument response that would, in turn, alter the count rate (cpm) and calculated surface activity (dpm/100 cm^2), such as a higher instrument efficiency decreasing the calculated surface activity. Similarly, provide information on potential changes to the calculated Gross DCGL for corresponding changes in the relative radionuclide concentrations for the above-grade buildings.

- Provide a discussion of how the survey approach used for the above-grade buildings accounted for the 10 percent IC radionuclide dose that was committed to in Section 6.14.1, “Insignificant Contributor Dose and Radionuclides of Concern,” of the LACBWR LTP. This section of the LTP states that “the IC dose percentage assigned to adjust the DCGLs for the ROC in all media (soil, basements, buried pipe, and above-grade buildings) is increased to 10 percent.” If 10 percent was not assigned to the IC radionuclides dose, state so, and provide a technical basis for why those radionuclides would not be expected to be present in the above-grade buildings.

- For the buried piping survey units, for any samples that were analyzed for individual radionuclide activities, the licensee should compare the results to the assumed radionuclide mixture fraction used to calculate the Gross OpDCGL. In addition, the licensee should provide a copy of the LACBWR procedures used for calculating the MDCs for piping, including documents that describe detector efficiency calculations for different size piping (see RAI-6 for additional information).

5. <u>Quality Control Investigations of FSS Data</u>

Comment: Additional information is needed to demonstrate that the licensee followed commitments in Section 5.9, “Quality Assurance,” of the LACBWR LTP related to quality assurance of survey data, as described in the release records. Based on information contained in the release records, it is not clear that this commitment was consistently followed.

Basis: Section 5.9.2.3, “Measurement and Data Acquisitions,” of the LACBWR LTP states that “FSS records will be designated as quality documents and will be governed by site quality programs and procedures.” Section 5.9.3, “Measurement / Data Acquisition,” of the LACBWR LTP states that QC surveys and samples will be performed to verify that FSS results are valid, and that QC surveys may include replicate surveys, field blanks and spiked samples, split samples, third party analysis, and sample recounts.

In addition, Section 5.9.3.4, “QC Investigations,” of the LACBWR LTP states that “if QC replicate measurements or sample analyses fall outside of their acceptance criteria, a documented investigation will be performed in accordance with approved procedures; and if necessary, shall warrant a condition report in accordance with approved corrective action procedures. The investigation will include verification that the proper data sets were compared, the relevant instruments were operating properly, and the survey / sample points were properly identified and located. Relevant personnel will be interviewed, as appropriate, to determine if proper instructions and procedures were followed and proper measurement and handling techniques were used including chain of custody, where applicable. If the investigation reveals that the data is suspect and may not represent the actual conditions, additional measurements will be taken. Following the investigation, a documented determination is made regarding the usability of the survey data and if the impact of the discrepancy adversely affects the decision on the radiological status of the survey unit.”

The following are examples where additional information is necessary to confirm the licensee followed the commitments in the LACBWR LTP related to quality assurance of survey data.

- The release record for the Turbine Building, Sump, and Pit Diesel Excavation (Survey Unit L1-SUB-TDS) contains information in Attachment 4, “Quality Control Assessment,” on the QC assessment for this survey unit. The split assessment for samples L1-SUB-TDS-FJGS-009-SB and L1-SUB-TDS-FJGS-009-SB SPLIT resulted in a failure.

The release record states that "because the values are well below the Operational DCGL no further action is necessary." Comparison to the OpDCGL is not an adequate quality assurance criterion. The licensee should reevaluate the rationale for using the OpDCGL as a quality assurance criterion for assessing FSS data and should also provide an alternative quality assurance criterion or discussion of the QC investigation process as described Section 5.9.3.4 of the LACBWR LTP.

- Similar to the example above, several additional release records contained information in Attachment 4 that indicated the QC samples did not meet the acceptance criterion for compared sample results (original samples versus QC samples). The licensee stated that since the values were well below the OpDCGL, no further review or action was necessary, instead of conducting an investigation and, if necessary, issuing a condition report as outlined in Section 5.9.3.4 of the LACBWR LTP.

  These survey units include the following:

  - LACBWR Crib House (B2-010-101)
  - Genoa 3 Crib House (B2-010-102)
  - LACBWR Administration Building (B2-010-103)
  - Back-up Control Center (B3-012-101)
  - Transmission Sub-Station Switch House (B3-012-102)
  - G-1 Crib House (B3-012-103)
  - Barge Wash Break Room (B3-012-104)
  - Security Shack (B3-012-109)
  - Circulating Water Discharge Pipe (S1-011-102)
  - De-Icing Line (S2-011-103 A)
  - Storm Drain (S3-012-102 A)

- As noted above, the release record for the Turbine Building West Excavation (Survey Unit L1-SUB-TDS) contains information in Attachment 4 on the QC assessment for this survey unit. The assessment states that for samples L1-SUB-TDS-FSGS-004-SB and L1-SUB-TDS-QSGS-004-SB, Potassium-40 (K-40) was substituted as the radionuclide for split sample assessment because Cs-137 was only present in the comparison sample. However, Table 7-2, "Summary of Gamma Spectroscopy Results for Soil Samples Comprising the Statistical Sample Population," of the associated release record records the Cs-137 concentration in sample L1-SUB-TDS-FSGS-004-SB as 5.89E-02 pCi/g, and it is incorrectly not bolded as being a value above the MDC. The gamma spectroscopy analysis report for this sample (Page 75 of the release record) likewise shows that the Cs-137 concentration was just above the MDC of 5.00E-02 pCi/g. The licensee should explain the rationale for using K-40, a naturally-occurring radionuclide, in the QC data assessment for this survey unit when Cs-137 was present above the MDC in both the L1-SUB-TDS-FSGS-004-SB and the L1-SUB-TDS-QSGS-004-SB samples.

- Similar to the example above, several additional release records contained information in Attachment 4 concerning the use of K-40 as part of the licensee's QC assessment. In accordance with Section 5.9.3.4 of the LACBWR LTP, the licensee should investigate why Cs-137 was not present in either the original or comparison sample but was present in the other during the QC assessments. For example, the investigation could include a discussion about the methods for determining the MDCs, as well as the verifications that are mentioned in Section 5.9.3.4 of the LACBWR LTP. These survey units include:

- Table 7-2 of the release record for the Low Specific Activity Building, Septic Tank, Maintenance Eat Shack Foundation, Oily Water Tank, Circulating Water Intake and Discharge Piping, and Main Transformer Substation (Survey Unit L1-SUB-LES) lists sample L1-SUB-LES-FSGS-008-SB as having a Cs-137 concentration of 7.74E-02 pCi/g, which is incorrectly not bolded. The associated analytical reports list the MDC for this sample as 5.49E-02 pCi/g, so the recorded Cs-137 value was above the MDC. The Cs-137 concentration in comparison sample LES-QSGS-008-SB is zero because it has a negative value in the raw data. Similarly, the Cs-137 concentration in L1-SUB-LES-FSGS-013-SB SPLIT is listed as 6.4E-02 pCi/g, which is above the MDC, but the Cs-137 concentration in the original sample L1-SUB-LES-FSGS-013 was below the MDC.

- In the release record for the Reactor Building Basement (Survey Unit B1-010-001), sample B1-010-001-QSFC-D16-GM is listed in Attachment 6, "Measurement Analytical Reports," as having an MDC of 6.23E+002 pCi/m^2 for Cs-137, and an activity of 5.085E+002 pCi/m^2, which is below the MDC. However, Attachment 4 of the release record describes this quality control sample as being above the MDC.

- In the release record for the Switchyard and Transmission Sub-Station Switch House (Survey Unit L3-012-102), samples L3-012-102-**Q**SGS-008-SG and L3-012-102-**Q**SGS-008-SS are denoted as QC samples with Cs-137 concentrations of 3.63E-02 pCi/g and 3.42 E-02 pCi/g, respectively, according to the information contained in Table 7-6, "Summary of Gamma Spectroscopy Results for QC Soil Samples." However, the QC assessment in Attachment 4 of the release record evaluated the Cs-137 concentration in sample L3-012-102-**F**SGS-008-SS, but not in sample L3-012-102-**F**SGS-008-SG. As such, there appear to be errors in the QC sample numbers in the release record. In addition, the reason stated for not evaluating Cs-137 in sample L3-012-102-FSGS-008-SG, and instead using K-40 as a substitute, is "because Cs-137 was identified at a low level in only the comparison sample." For this release record, the licensee should check the QC data contained in Section 7, "Survey Results," and Section 8, "Quality Control," as well as Attachment 4, for sample number and QC investigation errors.

- The release record for the WGTV Basement (Survey Unit B1-010-004) contains information in Table 7-4, "Summary of Replicate ISOCS Measurements for QC," Section 8, and Attachment 4 on two replicate ISOCS measurements acquired during the FSS of the basement structure. According to Attachment 4 and Section 8 of the release record, both pairs of measurements did not identify any radionuclides in the samples. The licensee stated that their acceptance method could not be utilized for this situation, and since the detectable radioactivity levels were well below the OpDCGL for basements, no further action was deemed necessary.

  Based on a review of the survey data in Attachment 6 of the release record, the Cs-137 concentrations in the original and QC samples were above the reported MDCs. For sample B1-010-004-QSFC-03-GM, the values are 2.13E+05 pCi/m^2 with an MDC of 4.81E+04 pCi/m^2; and for sample WGTV-03, the values are 1.93E+05 pCi/m^2 with an MDC of 4.72E+04 pCi/m^2. For sample B1-010-004-QSWC-10-GM, the values are 2.83E+04 pCi/m^2 with an MDC of 2.20E+04 pCi/m^2; and for sample WGTV-10, the

values are 2.62E+04 pCi/m^2 with an MDC of 2.38E+04 pCi/m^2. Given that both the QC and original ISOCS measurements have Cs-137 concentrations above the associated MDCs, the licensee should provide the QC analysis or a discussion of why this approach is acceptable. The licensee should also explain why Attachment 4 does not agree with the raw data, which matches the data summarized in Table 7-4 of the release record.

- Similar to the example above, the release record for the Reactor Building Basement (Survey Unit B1-010-001) contains information in the main body of the FSS report and Attachment 4 concerning a lack of mutually identified radionuclides in the original and replicate survey measurements. The licensee should review the information contained in this release record as part of the response to the above example.

RAI-5 Path Forward:

- Each of the 14 Phase 3 LACBWR FSS Reports reference a comparison of K-40 concentrations in the original and QC samples as the rationale for accepting the failure of the QC check; 9 of the 17 Phase 2 reports reference Operational DCGLs as the rationale for accepting the failure of the QC check; and 9 of the 10 Phase 1 reports have a combination of these rationales for accepting QC failures. The licensee should review each of the FSS reports that contained QC check failures and provide a description of the investigation(s) and outcome(s) associated with these quality assurance activities, consistent with the commitments in Section 5.9.3.4 of the LACBWR LTP.

  At a minimum, the discussion of these QA/QC topics should address the following:

  - How quality assurance protocols were followed during collection and analysis of these samples (e.g., measurement instrument performance checks, MDCs for the original and QC sample measurements, chain of custody, etc.).

  - For original and split samples with results greater than the MDC, explain why the QC checks failed the acceptance criterion for compared sample results. If the subsequent investigation and/or discussion reveals the survey data is suspect and may not represent actual conditions in the survey unit, provide information on the collection of additional measurements, the usability of the survey data, and the potential for the discrepancy to adversely affect the decision on the radiological status of the overall survey unit.

  - Provide a discussion of the supplementary QC steps that were taken, in addition to the use of a K-40 concentration comparison, in the data assessments for the survey units. The NRC staff notes that K-40 should not, by itself, be considered a substitute for explaining the QC assessment results. The licensee should supplement the QC analyses with other data analysis considerations and/or discussion of the various QA/QC processes that lead to confidence in the data assessment results (e.g., different MDCs for the ROCs in the samples, heterogeneity of soil samples, use of spiked samples, sample reanalysis, etc.).

  - Please describe the QC steps used for the ISOCS measurements, including the use of duplicate measurements and comparisons to core sample analysis for the survey units where ISOCS was a primary measurement instrument. Clarify whether NRC Inspection Procedure 84750, “Radioactive Waste Treatment and Effluent and Environmental Monitoring,” was used for ISOCS QC measurements.

If another document or method was used, please provide information on the method and how it was implemented for the analysis of ISOCS survey data.

6. Survey Measurements and Determination and Use of Background Measurements in Above-Grade Building and Buried Piping Survey Units

Comment: Additional information is needed on the licensee's procedure for determining background in above-grade building and buried piping survey units. Additional information is also needed on the licensee's adherence to commitments in Section 5.6.4.2, "Statistical Tests," of the LACBWR LTP regarding subtraction of background radioactivity when evaluating survey data using the Sign Test statistical test, as described in the LACBWR FSSR release records.

Basis: Section 5.6.4.2 of the LACBWR LTP states that "the Sign Test will be used for the statistical evaluation of the survey data. The Sign Test will be implemented using the unity rule, surrogate methodologies, or combinations thereof as described in MARSSIM and Chapter 11[, "Multiple Radionuclides,"] and Chapter 12[, "Multiple Surfaces,] of NUREG-1505[, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys."] ... Consequently, the Sign Test will be applied when demonstrating compliance with the unrestricted release criteria without subtracting background."

Contrary to the commitments in the LACBWR LTP, it appears that for the above-grade building and buried piping survey units, background radioactivity was subtracted prior to comparing the survey data to the unrestricted release criteria. For example, in the release record for the Genoa 3 Crib House (Survey Unit B2-010-102), which is a Class 2 survey unit, Section 7 states that "background was subtracted from all measurements, then the measurements were converted from cpm to dpm/100 cm^2 (net cpm divided by detector efficiency) for direct comparison to the Adjusted Gross DCGLs."

Survey data provided in Table 7-3, "Summary of Systematic, Judgmental, and QC Static Measurements," of the same release record lists several values of "gross activity" that are zero dpm/100 cm^2, which further supports that background radioactivity was subtracted from these measurements. In addition, survey data contained in supporting documents for the Genoa 3 Crib House shows that background radioactivity was subtracted from gross measurements to obtain net measurements. However, survey data provided in Column 2 of Table 7-3 of the release record lists survey data as "Gross Activity (dpm/100 cm^2)," which infers that background was *not* subtracted from the measurement.

Section 7 of the release record for the Genoa 3 Crib House further states that 60 scan areas (56 systematic and 4 judgmental, covering 780 m^2) were surveyed using a Ludlum Model 44-116 beta scintillator probe, which has a detection area of 125 cm^2. For this probe, Table 5-19 of the LACBWR LTP lists a typical total efficiency of 0.124, and Table 7-2, "Detector Efficiencies," of the release record provides an efficiency range of 0.16553 to 0.2169 counts per disintegration when performing surveys within this survey unit. However, the detailed calculations to derive the detector efficiencies are not included in the release record.

Finally, the Genoa 3 Crib House release record lacks sufficient detail on the licensee's procedure for determining background measurements. The release record states that "the background was established as the average of five 1-minute static measurements, while maintaining the detector waist high." From the associated data, it appears the five background measurements were taken in each survey unit, at one or more locations, with each detector. The five measurements per background location were averaged to determine a background

value for a specific detector for a specific area within the survey unit. However, the locations at which the background measurements were taken are not indicated on the survey map.

The NRC staff notes that it is not a standard survey practice to measure background radioactivity within a Class 2 survey unit. Specifically, Section 2.2, "Understanding Key MARSSIM Terminology," of MARSSIM defines a background reference area as follows:

> The background reference area is a geographical area from which representative reference measurements are performed for comparison with measurements performed in specific survey units. The background reference area is defined as an area that has similar physical, chemical, radiological, and biological characteristics as the survey unit(s) being investigated but has not been contaminated by site activities (i.e., non-impacted).

In addition, Section 4.5, "Select Background Reference Areas," of MARSSIM states the following about taking background measurements within a survey unit:

> A site background reference area should have similar physical, chemical, geological, radiological, and biological characteristics as the survey unit being evaluated. Background reference areas are normally selected from non-impacted areas, but are not limited to natural areas undisturbed by human activities. In some situations, a reference area may be associated with the survey unit being evaluated, but cannot be potentially contaminated by site activities. For example, background measurements may be taken from core samples of a building or structure surface, pavement, or asphalt. This option should be discussed with the responsible regulatory agency during survey planning. Generally, reference areas should not be part of the survey unit being evaluated.

Finally, Section A.4, "Methods to Evaluate Survey Results," of NUREG-1757, Volume 2, Revision 1, "Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria," states that when measurements of residual radioactivity are not radionuclide-specific, the survey unit should be compared to a reference area. In accordance with this information, additional information is needed on the licensee's procedure for determining background in above-grade building and buried piping survey units.

RAI-6 Path Forward:

- The licensee should explain whether the data listed in Table 7-3 of the Genoa 3 Crib House (Survey Unit B2-010-102) release record is for net radiological survey measurements (residual radioactivity minus background radioactivity) or gross radiological survey measurements (summation of residual radioactivity and background).

- The licensee should explain which FSS release records *excluded* background in the radiological survey data, and which FSS release records *included* background in the radiological survey data. This information could be provided in tabular format. As part of this explanation, the licensee should explain the rationale for not following the commitment in Section 5.6.4.2 of the LACBWR LTP to not subtract background when demonstrating compliance with the unrestricted radiological release criteria.

- The licensee should provide the detailed calculations used to derive detector efficiencies and explain the difference in the detector efficiencies reported in Table 5-19 of the

LACBWR LTP and the detector efficiencies applied for the above-grade building survey units (e.g., Table 7-2 of the release record for the Genoa 3 Crib House). This information should include how the detection area of the Ludlum Model 44-116 probe was accounted for when calculating the detector efficiency used for the above-grade building survey units and during the calibration procedure (see RAI-4 for additional information).

- The licensee should provide the procedure used for determining background radioactivity in the above-grade building survey units. The licensee should describe how the measurement locations were chosen, as well as how a representative "background" measurement was acquired with the Ludlum 44-116 probe. This description should state whether a beta shield was used with the probe, and in what position the detector was held when background measurements were taken (facing up or facing down).

- The licensee should provide a revised set of figures for sample locations in the above-grade building survey units (e.g., Figure 16-1 though Figure 16-4 of the Genoa 3 Crib House release record) that clearly illustrate where background measurements and static measurements were taken, as well as the areas where scanning was conducted in the survey unit. The revised figures should clearly shade or outline the areas where scans, background, and static measurements were taken. If static measurements were not taken at the locations shown on the grid in the revised figures, the licensee should provide an explanation for not taking measurements at those grid locations. For example, the presence of obstructions that interfered with taking static measurements at the grid locations should be described, or other considerations should be discussed.

- The licensee should explain why the background data is "blanked out" in, for example, Attachment 6, "Ludlum 2350-1 Download Reports," of the Genoa 3 Crib House release record, as well as other release reports. For example, state whether this is due to a spreadsheet formatting issue or as a result of output from the Ludlum 2350-1 ratemeter. In addition, state which data values in Attachment 6 were used to calculate the average background for each detector.

- The licensee should provide the procedure used for determining background radioactivity in the buried piping survey units. The locations where the background measurements were acquired for the buried piping should be described and a discussion of why this was a suitable reference area should be provided.

- Please explain the method that was used to determine the detector efficiencies for various sized buried piping. Include in the explanation the relevant supporting technical documents for determining the detector efficiencies used for each diameter size of piping and material type (e.g., TSD LC-FS-TSD-005, "General Monte Carlo N-Particle (MCNP) Modeling of Water Discharge Pipes for the La Crosse Boiling Water Reactor," and TSD LC-FS-TSD-003, "Assessment of the LACBWR Circulating Water Discharge Pipe Final Status Survey Data for Detection Efficiency and Detector Background").

  For the efficiency factor determination of buried piping, please explain how a background range is determined for the different sized piping and materials, considering that Section 4.1 of the associated procedure (TSD LC-FS-PR-018, "LACBWR Site Restoration Project Radiation Surveys of Pipe Interiors Using Sodium / Cesium Iodide Detectors," Revision 0) indicates that only one background measurement is to be taken to establish a background range for each buried piping survey unit.

- Section 4.1.10 of TSD LC-FS-PR-018 states that "a separate efficiency factor determination must be determined for each size of pipe that will be surveyed with the detector and data logger pairing. Efficiencies determined for larger piping diameters may be utilized for piping of a smaller diameter and construction material." This is also restated in Section 4.3 of the procedure. Please provide the technical justification for applying detector efficiencies determined for larger piping diameters to piping of a smaller diameter. The NRC staff recognizes that this point might be superseded by the licensee's response to the above bullet in the path forward for this RAI.

- Section 4.2 of TSD LC-FS-PR-018 does not include a pre-use operational check of the survey equipment with a check source to determine proper instrument response. Instead, the pre-use operational check includes a background measurement of the detectors. Please explain the reason for not determining proper instrument response with a check source prior to performing a pipe survey, as well as during the operational checks of the survey equipment that are performed twice per day during use.

- Procedure TSD LC-FS-PR-018 provides effective detection area estimates for two sizes of buried piping. An effective detection area of 3,050 cm^2 is applied to pipes greater than 13 inches in diameter; for pipes that are 10 inches in diameter, an effective detection area of 2,432 cm^2 is used. Please provide additional information on the derivation of these effective detection areas for buried piping.

- The licensee may choose to revise the above-grade building and buried piping survey unit FSS release records to include background prior to comparing the survey data to the unrestricted release criteria. However, the licensee should still provide a discussion regarding the above requested information on the measurement procedure for acquiring representative background in above-grade building and buried piping survey units.

7. <u>Comparison of Onsite Laboratory Data Versus Off-Site GEL Laboratories Data</u>

Comment: An evaluation of the differences observed in the sample results from the onsite LACBWR gamma spectroscopy measurements and the off-site GEL Laboratories radiological measurements is needed.

Basis: Certain concrete core samples in the Reactor Building Basement (Survey Unit B1-010-001) and the WGTV Basement (Survey Unit B1-010-004), as well as soil samples in the Turbine Building, Sump, and Pit Diesel Excavation (Survey Unit L1-SUB-TDS), the WTB Excavation (Survey Unit L1-010-101C), the Stack, Pipe Tunnel, and RPGPA Excavation (Survey Unit L1-SUB-CDR), and the RPGPA Excavation (Survey Unit L1-SUB-TDS B), were analyzed both in an onsite laboratory using gamma spectroscopy and in the off-site GEL Laboratories as part of continuing characterization activities and/or as part of the FSS. The data for both the onsite and GEL Laboratories analyses are included in the release records for these survey units, with the exception that the release record for L1-SUB-TDS-B does not include the data from the onsite measurements taken during continuing characterization. In some cases, the analytical results are presented in the release records, but not the raw data in the analytical reports from the various laboratory measurements (see RAI-3 for additional information).

Section 2.2.4, "Laboratory Instrument Methods and Sensitivities," of the LACBWR LTP states that "gamma spectroscopy was primarily performed by the onsite radiological laboratory. Gas proportional counting and liquid scintillation analysis was performed by an approved vendor

laboratory in accordance with approved laboratory procedures. Energy*Solutions* ensured that the quality programs of the contracted off-site vendor laboratories that were used for the receipt, preparation and analysis of characterization samples provided the same level of quality as the onsite laboratory under the QAPP [Quality Assurance Protection Program]." Additionally, Section 6.2.2 of the LACBWR QAPP states that "data validation procedures shall be performed for both field and laboratory operations."

The NRC staff notes is not clear what analysis, if any, was performed to compare the sample results from the onsite LACBWR gamma spectroscopy laboratory and GEL Laboratories as part of an evaluation of the quality programs at both laboratories. The primary purpose of sending samples to GEL Laboratories for analysis was to obtain measurements on the HTD ROC radionuclides (i.e., Sr-90) or to obtain measurements on the full suite of radionuclides, including the insignificant contributor radionuclides. However, the measurement of certain radionuclides in the samples by both the onsite and off-site laboratories provides useful information on how consistent the analytical results are between the two laboratories, which in turn provides useful information on the quality assurance programs at the two laboratories.

The NRC staff also notes that the results reported from the onsite LACBWR gamma spectroscopy analyses are somewhat inconsistent with the radiological measurement results obtained by GEL Laboratories. In general, the onsite measurements are less than the GEL Laboratories measurements, often by a factor of two, for the samples that had values above the MDC for both measurements. For example, the measured Cs-137 concentrations in the concrete cores from the Reactor Building Basement and the WGTV Basement at the onsite laboratory were less than the GEL Laboratories measurements for 16 of 18 samples in which Cs-137 was detected. The onsite laboratory result was less than half of the GEL Laboratories result in 9 of 18 concrete core samples.

Similarly, for the soil samples in the Turbine Building, Sump, and Pit Diesel Excavation, the WTB Excavation, and the Stack, Pipe Tunnel, and RPGPA Excavation, the measured Cs-137 concentrations from the onsite laboratory were less than the GEL Laboratories measurements for 13 of 15 samples in which Cs-137 was detected. The onsite laboratory result was less than half of the GEL Laboratories result in 2 of 15 soil samples. The measured concentrations of Co-60 in the soil samples from these survey units from the onsite laboratory were less than the GEL Laboratories measurements for 7 of 8 samples in which Co-60 was detected. The onsite laboratory result was less than half of the GEL Laboratories result in 3 of 8 soil samples.

In addition, there is a significant difference between the Cs-137 concentration measured onsite in sample NRC-CDR #4 (1.52 pCi/g) and the Cs-137 concentration measured by GEL Laboratories (171 pCi/g), as well as between the Co-60 concentration measured onsite for this sample (0.0768 pCi/g) and the Co-60 concentration measured by GEL Laboratories (18.8 pCi/g). However, the licensee does not appear to have conducted an evaluation of these sample results to determine if the analyses are acceptable according to the QA/QC program.

The release records do not provide enough information to determine if the sample results from GEL Laboratories were expected to be comparable to the results from the onsite LACBWR gamma spectroscopy, or if there are differences in sample collection, preparation, and/or analysis that would be expected to lead to the two sets of data being dissimilar. For example, although the samples analyzed by the onsite laboratory and GEL Laboratories are reported to be the same samples, it is not clear if the two different measurements (i.e., the onsite laboratory measurement and the GEL Laboratories measurement) represent measurements performed on the same sample, measurements performed on split samples, or measurements on separate

samples from a similar location. Similarly, it is not clear if sample preparation was performed the same at both labs, or if there are differences in sample preparation that could result in expected differences in the measured concentration (e.g., the concentration being reported on a sample wet weight versus a dry weight). Finally, it is not clear if there are differences in the analytical method used that could result in expected differences in the measured concentration.

As a result, more information is needed on the differences between the radionuclide concentrations reported by the onsite laboratory and GEL Laboratories, and how these differences were considered by the LACBWR QA program. In addition, given the pattern of the onsite laboratory measurements being generally less than the measurements made by GEL Laboratories, justification is needed to provide assurance that the onsite gamma spectroscopy results were not consistently underreporting the concentration of residual radioactivity in the samples analyzed onsite. Finally, more information is specifically needed on the more than two orders of magnitude difference between the concentrations of Cs-137 and Co-60 measured onsite and by GEL Laboratories in sample NRC-CDR #4 in Survey Unit L1-SUB-CDR.

RAI-7 Path Forward:

- Describe how radionuclide concentration data from the onsite LACBWR gamma spectroscopy laboratory and the off-site GEL Laboratories measurements for the same samples were evaluated and compared under the LACBWR QAPP.

- Provide additional information on the samples analyzed by both laboratories. For example, provide information on whether the samples analyzed by each laboratory were the same sample, split samples, or separate samples taken from the same location. In addition, provide information on differences in sample preparation between the two laboratories, and any other differences (e.g., analytical method) that could explain why the onsite laboratory generally reported lower concentrations than GEL Laboratories.

- Given the pattern of the onsite measurements being generally less than the measurements made by GEL Laboratories, additional justification is needed to provide assurance that the onsite gamma spectroscopy results were not consistently underreporting the concentration of residual radioactivity in the samples analyzed onsite.

- Provide additional information or discussion of the reason for the significant difference in the reported concentration values for Cs-137 and Co-60 in sample NRC-CDR #4 from the Stack, Pipe Tunnel, and RPGPA Excavation (Survey Unit L1-SUB-CDR).

- Provide data for the onsite measurements from the continuing characterization activities in the RPGPA Excavation (Survey Unit L1-SUB-TDS B). In addition, provide the GEL Laboratories analytical reports for those survey units where they were not already provided (see RAI-3 for additional information).

8. <u>Errors in FSS Release Records</u>

Comment: The number and diversity of technical and editorial errors in the LACBWR FSSR release records is excessive. These errors require the NRC staff to perform extensive follow-up as part of the license termination review. The following are examples of errors contained in the release records, in addition to the errors summarized in other RAIs.

- Survey data is provided in Table 7-2, “Basic Statistical Properties of the Systematic Measurement Population,” of the release records. For the Circulating Water Discharge Pipe (S1-011-102) and Storm Drain 4 (S3-012-102A) survey units, Table 7-2 lists median and maximum values as 0.00 dpm/100 cm^2 for all radionuclides of concern.

- For the following survey units, the survey data in Table 7-2 of the release record shows that the minimum values *exceed* the maximum values for all radionuclides of concern:

    - Circulating Water Discharge Pipe (S1-011-102)
    - Storm Drain 3 (S2-011-101A)
    - Storm Drain 6 (S2-011-101B)
    - Circulating Water Intake Pipe (S2-011-103)
    - De-Icing Line (S2-011-103A)
    - Storm Drain 4 (S3-012-102A)
    - Storm Drain 5 (S3-012-102B)

- Table 5-5, “Synopsis of Survey Design,” of the release record for the Class 1 Stack, Pipe Tunnel, and RPGPA Excavation (L1-SUB-CDR) does not include information on the number of judgmental samples required or the number of judgmental samples taken.

- Table 7-3, “Summary of Systematic, Judgmental, and QC Static Measurements,” of the release record for the Class 2 Genoa 3 Crib House (B2-010-102) does not include data for two replicate QC static measurements (B2-010-102-FQCM-B05-BD and B2-010-102-FQWM-A01-BD) identified in Section 8, “Quality Control,” of the release record.

- Section 6, “Survey Implementation,” of the release record for the Class 2 LACBWR Administration Building (B2-010-103) states that “the implementation of survey specific QC measures included the collection of eight replicate static measurements for QC analysis.” However, in Section 8, “Quality Control,” of the release record it states that “the implementation of survey specific QC measures included the collection of thirteen replicate static measurements for QC analysis.”

- For the following survey units, Section 7, “Survey Results,” Tables 2, 3, and 4 of the release records should be identified as Tables 7-2, 7-3, and 7-4 respectively:

    - Backup Control Center (B3-012-101)
    - Transmission Sub-Station Switch House (B3-012-102)
    - Barge Wash Break Room (B3-012-104)
    - Security Shack (B3-012-109)

- For the following survey units, Table 1, “Synopsis of Scan Results,” states that the action level is based on average background plus $MDCR_{Surveyor}$, instead of average background plus 50 percent of the Operational DCGL:

    - Backup Control Center (B3-012-101)
    - Transmission Sub-Station Switch House (B3-012-102)
    - G-1 Crib House (B3-012-103)
    - Barge Wash Break Room (B3-012-104)
    - Security Shack (B3-012-109)

- For the following survey units, Attachment 2, “Measurement Data,” Footnote 1 for Activity (dpm/100 cm^2) is not defined:

    - De-Icing Line (S2-011-103A)
    - Low Pressure Service Water (S2-011-103B)
    - Circulating Water Intake Pipe (S2-011-103)
    - Storm Drain 2 (S3-012-109B)
    - Storm Drain 3 (S2-011-101A)
    - Storm Drain 6 (S2-011-101B)
    - Storm Drain 4 (S3-012-102A)
    - Storm Drain 5 (S3-012-102B)

- For the following FSSR Phase 3 survey units, Table 7-2, “Summary of Gamma Spectroscopy Results for Samples Comprising the Statistical Sample Population,” Table 7-5, “Summary of Gamma Spectroscopy Results for Judgmental and Investigational Samples,” and Table 7-6, “Summary of Gamma Spectroscopy Results for QC Samples,” include a column for sample MDC to verify samples exceeding the associated MDC.

  These tables use bolded values to indicate concentrations exceeding the MDC for a particular sample. However, some of the bolded values are lower in concentration than other unbolded values for the same radionuclide, which makes it difficult to verify which samples exceed the respective MDCs.

    - Reactor Building, WTB, WGTV, Ventilation Stack Grounds (L1-010-101)
    - Turbine Building, Turbine Office Building, 1B Diesel Generator Building Grounds (L1-010-102)
    - LSA Building, Maintenance Eat Shack (L1-010-103)
    - North LSE Grounds (L1-010-104)
    - North Interim Debris Storage Area (L1-010-105)
    - North Loading Area (L1-010-106)
    - Outside East LSE Area (L1-010-107)
    - Area North of LSE Fence (L2-011-101)
    - G-3 Crib House, Circulating Water Discharge Land (L2-011-104)
    - North End of Licensed Site (L3-012-101)
    - Plant Access, ISFSI Haul Road Grounds East (L3-012-109)
    - Turbine Building, Sump, Pit, and Diesel Excavation (L1-SUB-TDS A)
    - Stack, Pipe Tunnel, RPGPA Excavation (L1-SUB-CDR)
    - RPGPA (L1-SUB-TDS B) for Tables 7-1, 7-4, and 7-5

RAI-8 Path Forward:

- For the release records discussed in these RAIs, explain the reason for the error(s).

- Review future submittals for overall quality and editorial errors.

9. Survey Boundaries for the Turbine Building, Turbine Office Building, and 1B Diesel Generator Building Grounds and Surrounding Survey Units

Comment: Additional information on actual survey boundaries is needed for the Turbine Building, Turbine Office Building, 1B Diesel Generator Building Grounds (L1-010-102) and surrounding survey units to ensure 100 percent of the area was surveyed during FSS.

Basis: For Survey Unit L1-010-102 the Oak Ridge Associated Universities (ORAU) Confirmatory Report states that "based on a post-survey review of the gamma walkover maps, there is an apparent discrepancy between the planned survey unit boundary and the physical boundary observed in the field."

RAI-9 Path Forward:

- Confirm that the boundaries of the survey units surrounding the Turbine Building, Turbine Office Building, 1B Diesel Generator Building Grounds (Survey Unit L1-010-102) share physical boundaries such that 100 percent of the soil area was scanned during FSS. Please provide a map showing how the survey boundaries relate to one another.