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

November 4, 2020

Mr. John Sauger
General Manager
Zion Restoration Project
Zion*Solutions* LLC
101 Shiloh Blvd.
Zion, IL 60099-2797

SUBJECT: ZION NUCLEAR POWER STATION, UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION RELATED TO FINAL STATUS SURVEY REPORTS

Dear Mr. Sauger:

By letters dated Sept. 30, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19295G627), Nov. 25, 2019 (ML19338B863), Dec. 30, 2019 (ML20009E643), and May 1, 2020 (ML20133J975), Zion Solutions, LLC submitted Final Status Survey Reports (FSSRs) Phase 2a, 2b, 3, and 4, for Zion Nuclear Power Station, Units 1 and 2 to the U.S. Nuclear Regulatory Commission (NRC).

The NRC staff has reviewed the subject submittals and determined that additional information is needed to complete its review, as described in the enclosed Request for Additional Information. These questions were discussed with your staff in an October 21, 2020, conference call. During the call you stated that you anticipate responding to this request by November 11, 2020. Please note some changes were made to RAI 4 since the draft RAIs were provided to you. The areas of changes are marked by change bars. Additional phrasing changes are not marked.

In accordance with 10 *Code of Federal Regulations* (CFR) 2.390 of the NRC's "Agency Rules of Practice and Procedure," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's ADAMS. ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Should you have any questions regarding this action please contact me at 301-415-3017 or John.Hickman@nrc.gov.

Sincerely,

John B. Hickman, Project Manager
Reactor Decommissioning Branch
Division of Decommissioning, Uranium Recovery
and Waste Programs
Office of Nuclear Material Safety
and Safeguards

Docket Nos. 50-295 and 50-304
License Nos. DPR-39 and DPR-49

Enclosure: Request for Additional Information

cc: w/enclosure Zion Service List

SUBJECT: ZION NUCLEAR POWER STATION, UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION RELATED TO FINAL STATUS SURVEY REPORTS

DATE: NOVEMBER 4, 2020

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REQUEST FOR ADDITIONAL INFORMATION

RELATED TO THE ZION*SOLUTIONS*, LLC

FINAL STATUS SURVEY REPORTS PHASES 2, 3 AND 4

ZION NUCLEAR POWER STATION, UNITS 1 AND 2

DOCKET NOS. 50-295 AND 50-304

1. Final Status Survey Reports and Release Record Revisions

Comment: Final Status Survey Reports and release records (or addendums to these documents) reflecting the final radiological conditions of the site are needed.

Basis: The NRC staff has identified a number of release records that provide information that is inconsistent with the final radiological conditions of the site due to recontamination of the survey unit with concrete debris after the Final Status Survey (FSS) as well as investigations and remediations of elevated areas after the FSS was completed (see e.g., RAIs 9 and 10). The Final Status Survey Reports that contain the summary information from these release records were similarly inconsistent with information on the final conditions of the site. Section 5.12 of the License Termination Plan (LTP) states that "If a routine surveillance identifies physical observations and/or radiological scan measurements that require further investigation, then FSS will be repeated in the affected survey unit". It appears that for many of the survey units, recontamination with concrete debris, investigations, and remediations occurred after the time of the FSS described in the release records. This appears to be inconsistent with the commitments made in the LTP.

The NRC staff needs information on the final conditions of the site to evaluate if the site meets the unrestricted release criteria of 10 CFR 20.1402.

Path Forward:

Provide revised Final Status Survey Reports (or addendums to these reports) that reflect the final radiological conditions of the site and that incorporate any revisions to the release records referenced in the report. Provide a statement confirming that the Final Status Survey Reports reflect the final conditions of the site, and remediation or potential recontamination of the survey units (including with concrete debris from the demolition of structures on site) after the time of the FSS is documented in the report or its associated release records. Also, confirm that all investigations and remediations that occurred after the FSS are documented in the report or its associated release records and addenda.

Provide revised release records (or addendums to these records) for any survey unit in which an investigation and/or resurvey was performed after the FSS was completed (see e.g., RAI 10).

Provide revised release records (or addendums to these records) for any survey unit which concrete demolition debris was placed on or transported through after the FSS was completed (see e.g., RAI 9).

Provide a list of the revision numbers for the release records and any associated addenda that are to be relied on for demonstrating compliance with 10 CFR 20.1402. If any of the revisions used for demonstrating compliance have not already been provided to the NRC, provide these documents.

2. 100% Coverage of *Accessible* Area versus Actual Surface Area and Static Measurements for Embedded Piping and Penetration Survey Units

Comment: In some Class 1 areas for piping and penetrations, 100% of the accessible area was scanned during the FSS as opposed to 100% of the survey unit.

Basis: MARSSIM recommends 100% coverage for the survey design for Class 1 survey units.

Section 5.5.5 of the LTP states that, "The interior of embedded pipe or penetration sections that cannot be accessed directly will be inspected prior to survey using a miniature video camera designed to assess the physical condition of the pipe/sleeve interior surfaces. The miniature camera with supporting lighting components as well as the subsequent detectors that will be used to survey the pipe/sleeve interior surfaces will be maneuvered through the pipe/sleeve by the manipulation of fiber-composite rods which will be manually pushed or pulled to provide locomotion. The detectors will be deployed into the actual pipe/sleeve and a timed measurement acquired at a specified distance traversed into the pipe. This distance will be determined as a DQO based on the contamination potential in the pipe/sleeve. As an example, based upon a conservative "area of detection" for the detectors used, a measurement interval of one measurement for each foot of pipe will conservatively provide 100% areal coverage of all accessible pipe/sleeve interior surfaces."

MARSSIM Section 4.8.4.1 states the following about access to piping, "Piping, drains, sewers, sumps, tanks, and other components of liquid handling systems present special difficulties because of the inaccessibility of interior surfaces. Process information, operating history, and preliminary monitoring at available access points will assist in evaluating the extent of sampling and measurements included in the survey."

The release record for the Unit 1 Containment Incore-Sump Drain (Survey Unit 01111) states that coverage of the actual surface area of 1.05 m^2 is necessary to provide 100% coverage requirement for a Class 1 survey unit. It states, "Due to an obstruction (90-degree elbow), 22 measurements were taken to achieve 100% areal coverage of the accessible internal surface which equated to a surface area of 0.86 m^2."

The combined revised release record for the Unit 1 and Unit 2 Containment Building Penetrations, as well as the Auxiliary Building Penetrations (Survey Units 01112, 02112, and 05120) states “sufficient measurements were taken in all penetrations to ensure 100% areal coverage of all *accessible* internal surfaces within the penetrations.”

For smaller diameter penetrations, 100% coverage was established by taking a static measurement every foot. For the survey of larger diameter pipes, the survey design required 100% scan of the accessible interior surfaces of the penetration. In addition, a minimum of one 1-minute static measurement was acquired in each penetration at systematic locations based on a triangular grid, and at least one 1-minute static measurement was acquired in each penetration at the location of the highest scan result. The 16 systematic static measurement locations were developed using Visual Sample Plan (VSP) using a pre-determined number of measurements (16) with a random start point on a triangular grid superimposed on the laid out interior surface area of the relevant penetrations. The NRC staff note that there is no demonstration of how the number 16 was calculated in the final release record (i.e., relatives shift, standard deviation, etc. per MARSSIM).

For pipes greater than 12 inches in diameter, the report states, “The entire surface area (100%) of the interior surface area of the designated penetrations were scanned using either the Ludlum 2350-1 paired with a pipe detector or a Ludlum 2360 paired with a Ludlum 43-93 detector operated in the rate-meter mode and using audio response.” The report describes an exception to the 100% scan for larger pipes stating, “As an exception, the five 24-inch diameter penetrations for the Cavity Flood Sump and the Recirculating Sump suctions (P035-P037, P123, and P124 for Unit 1 Containment and P235-P237, P323 and P324 for Unit 2 Containment) were surveyed using the gamma detector approach as the length of the pipes (~50 feet) prevented access solely by hand-held detectors. Instrument efficiencies were recalculated for a 23-inch diameter pipe, permitting one-foot interval static measurements along the approximate 50-foot length of each pipe.” Tables 16 and 18 list 50 or more measurements for these 50-ft pipes with the exception so it appears the licensee achieved 100% coverage for the excepted pipes. However, the report is not clear about areas that may have been *inaccessible* for the smaller pipes, and the percentage coverage missed (if this was the case). The licensee should describe the percentage coverage missed in the penetrations (if this was the case) or verify that the penetrations did have 100% coverage achieved by static measurements.

Path Forward:

Provide more discussion on the inability to survey the complete pipe in the Unit 1 Containment Incore-Sump Drain, including details such as the location of each sample on a diagram (if available), the location of the 90 degree bend on a diagram (if available), and some text about why the licensee believes their analysis is reasonable and the remaining pipe is not contaminated beyond the levels surveyed. The licensee may consider process information, operating history, and preliminary monitoring at available access points in their response.

For the revised combined release records on Class 1 Penetrations (Survey Units 01112, 02112, and 05120), clarify whether certain areas of the smaller penetrations were inaccessible for measurements. If so, provide the reasons why they were inaccessible, and the percentage of the penetration that was accessible. If less than 100% coverage was achieved, the licensee should provide justification as to why their analysis is reasonable and the remaining penetration is not contaminated beyond the levels surveyed. The licensee may consider process information, operating history, and preliminary monitoring at available access points in their response.

For the penetrations that had measurements taken at systematic locations, clarify how the required number of samples was calculated (i.e., relatives shift, standard deviation, etc.). Also, if debris samples from within the pipe system were available for analysis, please provide the results of those samples.

3. 100% Coverage of *Accessible* Area versus Actual Surface Area during FSS for Phase 3 and Phase 4 Land Survey Units

Comment: In some Phase 3 and Phase 4 Class 1 areas, 100% of the *accessible* area was scanned during the FSS as opposed to 100% of the actual survey unit.

Basis: MARSSIM and NRC guidance for Class 1 surveys units in outdoor areas recommends 100% coverage but acknowledges that some areas may be inaccessible. Section 5.6.4.4 of the LTP states, "For Class 1 survey units, 100 percent of the accessible soil surface will be scanned."

MARSSIM provides a risk-informed approach for clearing to provide access to these areas. MARSSIM Section 4.8.4.2. discusses considerations for clearing to provide access for land areas and states the following, "The extent of site clearing in specific areas depends primarily on the potential for radioactive contamination existing in those areas where: 1) the radiological history or results of previous surveys do not indicate potential contamination of an area (it may be sufficient to perform only minimum clearing to establish a reference coordinate system); 2) contamination is known to exist or a high potential for contamination necessitates completely clearing an area to provide access to all surfaces; and 3) new findings as the survey progresses may indicate that additional clearing be performed." In other words, if contamination is known to exist in certain inaccessible areas, MARSSIM necessitates completely clearing an area to provide access to all surfaces.

The scan coverage in three of the Class 1 survey units in Phase 3, Survey Units 10209B, 10221F, and 10211A, was less than 100%. For Survey Unit 10209B, the release record states that approximately one m^2 was not scanned due to standing water. In Survey Unit 10221F, six rows (each 22 m) (about 6% of the survey unit) were not scanned due to the presence of standing water and ice. In Survey Unit 10211A, approximately 12 m^2 in the northeast corner of the survey unit was not scanned due to safety concerns associated with an open hole and razor wire in the area. Because these Class 1 survey units have areas that do not appear to have

been surveyed, it is not clear if the survey units meet the unrestricted release criteria in 10 CFR 20.1402.

The scan coverage for several Phase 4 survey units was less than 100% as described in the following below.

The release record for Phase 4 Survey Unit 10213B, “NE Corner of Exclusion Area,” which is a Class 1 open land survey unit and is 1,994 m^2 in size, states, “Approximately 42 m^2 was inaccessible for scanning due to low lying trees. This area was not in the vicinity of the previously discussed elevated area. The inaccessibility of this area is documented on the applicable field log.” Approximately 2% was inaccessible.

The release record for Phase 4 Survey Unit 10213C states, “Approximately 123 m^2 was inaccessible for scanning due to low lying trees and approximately 86 m^2 was inaccessible due to standing water and ice (the inaccessibility of these areas is documented on the applicable field logs). Nine (9) surface soil samples were collected in the area with standing water/ice (L1-10213C-FJGS-001-SS through L1-10213C-FJGS-009- SS) and one (1) subsurface sample (L1-10213C-FJGS-001-SB) was taken at a low point within the area that was being used as a sump to support the removal of water from the survey unit. The sump was later backfilled with clean fill (a map of the judgmental sample locations is included in Attachment 1). This area contained no standing water when it was scanned during the FSS readiness survey (discussed in Section 3) performed in October of 2019. On November 13, 2019, the accessible areas of rows 25-40 and the middle Section of rows 9-16 were scanned with greater than 2 inches of snow/ice being present. These conditions did not ensure that the detector end-cap was within 2 inches from the ground surface as specified in the FSS Plan. These areas were scanned again on November 16, 2019, when there was only up to 1 inch of snow present. The alarms that occurred in rows 27 and 28 on the earlier scans (see Section 9 for further discussion) could not be reproduced on the subsequent scans and no elevated areas were identified during these scans.”

The release record for Phase 4 Survey Unit 10220H states, “In addition, surface scanning was performed on 100% of the total accessible surface area in the survey unit…. Judgmental samples taken in the wetland area, which were not accessible for scan surveys, showed low levels of Cs-137 activity.” A wetland area runs along the southeast boundary of the survey unit, but the release record does not indicate how much of the area was inaccessible. NRC staff note that some upstream areas in other survey units were elevated. This could mean that the elevated areas from upstream were transported down to this sampling area. The release record states that “An area of elevated activity above an OpSOF of 1.0 was found in survey unit 10221D. This activity was found at the discharge point of a drainpipe that runs under the rail line. This water drains to the wetland area in Survey Units 10220I and 10220H. An additional area was found in the wetland in 10220I that was also above an OpSOF of 1.0. To determine if the activity had spread to the wetlands in 10220H, four (4) judgmental samples were taken in the wetland starting at the boundary with 10220I. Positive Cs-137 was identified in all of the samples, with Co-60 present above the Minimum Detectable Concentration (MDC) in one (1) of

the samples. These samples were all below an OpSOF of 1.0, with the highest at 0.371. No further action was taken."

The Phase 4 Survey Unit 10220I encountered some of the same issues as 10220H with wetland not being accessible to be scanned. This survey unit is closer to the upstream source than 10220H. An elevated area with Sum of Fractions (SOF)>1 was identified. The release record states, "A discrete area in the wetland was not accessible for surface soil scanning due to the presence of standing water. This area is documented on the field log."

The release record for Phase 4 Survey Unit 10221D states, "A 0.2-meter x 8-meter area (1.6 m^2) between rows 22 and 30 was not accessible for survey due to standing water. This inaccessibility of this area is documented on the applicable field log." NRC staff note that this survey unit had an elevated area that was remediated and that was the potential source of contamination for 10220H and 10220I.

Phase 4 Survey unit 12205C, "Area Under the Turbine Building," is a Class 1 open land survey unit and is 1,818 m^2 in size. The release record for 12205C states, "Two (2) scan rows were inaccessible for gamma scans because the sand was too wet to safely access the area". Each row is 1 m wide by 32.41 m long, so the inaccessible area is roughly 3%.

The release record for Phase 4 Survey Unit 12111 describes how surface scanning was performed on 100% of the *accessible* surface area in the survey unit. It states, "an approximately 20-meter Section of rows 1 to 3 were covered by water and were not accessible for scan survey. Two (2) judgmental samples were taken in this area in lieu of the scan surveys. An additional judgmental sample was also taken in the northern 20-meter Section of rows 1 and 2 to investigate an elevated background count rate. The analytical results for all soil samples (systematic and judgmental) taken in Survey Unit 12111 indicated that the SOF for each sample, when compared to the Operational Derived Concentration Guideline Levels (OpDCGL), was less than 1.0." The release record does not provide an approximate percentage of the survey unit that was inaccessible, but in looking at Attachment 1, this would equate to about 60 m^2, which is about 3% of the survey unit.

Additional information is needed on areas within Class 1 survey units that were not accessible to be scanned in order for the NRC staff to have reasonable assurance that these survey units do not have areas of residual radioactivity that could result in doses for the survey unit above the 25 mrem/yr. unrestricted release criteria remaining on site following license termination. Below is a table summarizing the inaccessible areas which were not scanned in Phase 3 and Phase 4 that have been identified during this review (this may not be an exhaustive list).

Phase	Survey Unit	Date of FSS	% Inaccessible	Reason
Phase 3	10209B	07/30/19-08/07/19	1 m^2/ 1,977 m^2 (0.05%)	Water
Phase 3	10221F	10/24/18-12/18/18	132 m^2/1,968 m^2 (6 %)	Water/ice
Phase 3	10211A	11/17/18 – 12/03/18	12 m^2/ 1,536 m^2 (0.8%)	Safety concern
Phase 4	10213B	10/15/19 – 11/15/19	42 m^2/1,994 m^2 (2%)	Low trees
Phase 4	10213C	11/13/19 – 01/30/20	205 m^2/ 1,934 m^2 (10%)	Low trees and water/ice
Phase 4	10220H	05/22/19 – 08/01/19	Not Provided / 2,088 m^2	Wetland
Phase 4	10220I	02/22/19 – 07/30/19	Not Provided / 2,060 m^2	Wetland
Phase 4	10221D	05/14/19 – 07/30/19	1.6 m^2/ 1,697 m^2 (1%)	Standing Water
Phase 4	12205C	09/24/19 – 10/1/19	64 m^2/1,818 m^2 (3%)	Wet Sand
Phase 4	12111	09/16/19 – 09/23/19	60 m^2 / 1,964 m^2 (3%)	Water

Path Forward:

- Provide additional information, e.g., as a picture or map, on the area that could not safely be scanned for the survey units described above (see, for example the thorough description of the areas not scanned in Section 13 of the release record for 10212D, Revision 1).
- For the areas in the survey units described above that were not scanned due to the presence of ice, standing water, or unsafe conditions, provide additional information on why measures could not be taken to allow scans of these areas or why the areas could not be scanned at a later date when the areas were free of ice and standing water.
- Provide a justification that there is reasonable assurance that the survey units described above meet the 25 mrem/yr. unrestricted release criteria despite the fact that some areas within the survey unit were not scanned. This justification should include an evaluation of the results of other samples or scans in and around the areas that were not scanned. Include whether contamination is known to exist or a high potential for contamination exists in these areas.
- For the portion of Survey Unit 10213C that was scanned with ice greater than 2 inches of snow/ice being present, adjust the scan data to account for attenuation through the snow.

4. Post-Remediation Scans and Survey Data Not Provided for Power Block Phase 4 Land Survey Units

Comment: The licensee did not provide post-remediation scans and survey data that reflects the status of the surface of the land survey areas prior to clean backfill being placed. The NRC requires this information to determine if the survey units meet license termination criteria.

Basis: The LTP Section 5.7.1.6 states the following with regard to post-remediation scans: "During decommissioning of Zion, any subsurface soil contamination that is identified by continuing characterization or operational radiological surveys that is in excess of the site-specific Base Case Derived Concentration Guideline Levels (DCGLs) for each of the potential Radionuclides of Concern (ROC) as presented in Table 5-2 will be remediated. The remediation process will include performing Remedial Action Support Survey (RASS) of the open excavations in accordance with Section 5.4.2 of this FSS Plan. The RASS will include scan surveys and the collection of soil samples during excavation to gauge the effectiveness of remediation, and to identify locations requiring additional excavation. The scan surveys and the collection of and subsequent laboratory analysis of soil samples will be performed in a manner that is intended to meet the DQOs of FSS." Given that RASS scans are performed in a manner intended to meet the DQOs of FSS, the licensee should provide the RASS survey and scan data.

Prior to the survey units in the Power Block being covered with clean soil, NRC's contractor, Oak Ridge Institute for Science and Education (ORISE), was not able to scan 100% of the 588-foot elevation surface of the survey units during confirmatory surveys (see *Figure A.4, Gamma Walkover Survey Performed During the July 2019 Site Visit* in the ORISE confirmatory report (5271-SR-07)). The release records for these survey units do not discuss inaccessible areas and do not provide the details of the RASS scans completed prior to the July 2019 confirmatory surveys. After the July 2019 confirmatory surveys, the licensee placed clean soil on top to bring the survey units up to the 591-foot elevation. The ORISE confirmatory report states that "certain site conditions, such as excavations and/or standing water, rendered some areas inaccessible". These conditions existed before the areas were backfilled and may have also existed during the licensee's post-remediation scans. For these survey units, the RASS scans will be used to support demonstration of compliance since they provide support that the survey units were adequately remediated. Therefore, the licensee should provide the surveys and describe whether they were able to meet the DQOs of the FSS during post-remediation scans, as described in LTP Section 5.7.1.6.

Path Forward:

- For the Power Block survey units, the licensee should revise the release records to include the post-remediation survey data (or point to the data in the RAI response). The licensee should provide additional information demonstrating how the post-remediation scans meet the DQOs of an FSS.

5. Inaccessible Area in Survey Unit 10212D, "NE Corner of Exclusion Area – Lakeshore"

Comment: The licensee should provide additional information on why the area that was inaccessible in Survey Unit 10212D (about 25% of the survey unit) does not contain concentrations that may have needed additional remediation.

Basis: Phase 4 – Survey Unit 10212D, "NE Corner of Exclusion Area - Lakeshore," is a Class 1 open land survey unit and is 1,490 m^2 in size. The release record for Survey Unit 10212D states, "The inlet pipe on the west end of the drainage ditch and the outlet pipe on the east end were both dammed, and two (2) pumps were removing water during the FSS. However, due to the influx of ground water, it was not possible to remove all of the water from the drainage ditch. That being the case, approximately 377 m^2 was inaccessible for scanning due to standing water in the drainage ditch. See Figure 3 below. A map of the inaccessible areas is included in Attachment 1. The standing water in the drainage ditch also precluded scanning a 1-meter radius around the following sample locations as prescribed in ZS-LT-300-001-001: systematic soil sample points #101 through #110, judgmental soil sample point #1 and judgmental sediment sample point #1. This did not adversely affect the quality of the data collected during the FSS of this survey unit, which was deemed acceptable." While the release record describes the inaccessible area in detail in terms of size and location, the licensee should provide additional information on why the inaccessible area does not contain concentrations that may have needed additional remediation.

Survey Unit 10212D has a history residual radioactivity levels in excess of release criteria that required remediation. In May 2016, the original FSS that was performed on Class 3 open land Survey Unit 10212A was withdrawn due to the need to remove additional sub-grade piping systems. In December 2018, Survey Unit 10212A was split into 10212C and 10212D and 10212D reclassified to Class 1 as a result of an attempted FSS. The FSS readiness survey in April 2019 showed it was not ready for the FSS and additional remediation was necessary. In the post-remediation survey in April 2019, four out of five of the samples with an SOF >1 were in the drainage ditch. In August 2019 the licensee remediated the drainage ditch, but post-remediation scans determined that more remediation was necessary. The release record states, "In August of 2019, Survey Unit 10212D was remediated. Approximately one (1) to two (2) feet of soil was removed from the drainage ditch and approximately six (6) inches of soil was removed from the area north of the drainage ditch." The description of the post-remediation scan in August 2019, after that remediation, states, "A post-remediation survey was then performed on the remediated areas. Nineteen (19) surface soil samples were collected in the larger area in the west half of the survey unit. Samples were taken every ten (10) feet in the center of the drainage ditch and every ten (10) feet at the water line on the north and south banks." The release record states that the August 2019 post-remediation surveys indicated that the survey unit was ready for the FSS. The FSS took place from September 5-18, 2019. The release record does not say when the groundwater intrusion occurred, but it does say the drainage ditch is designated a wetland. The licensee should confirm when the water intrusion

occurred and if the water was present during the August 2019 post-remediations survey when samples were collected from the center of the drainage ditch.

Section 11 of the release record states “due to miscommunication between FSS supervision and the technicians assigned to collect the systematic soil samples, the samples were collected prior to the survey unit being fully remediated and ready for FSS. These samples were not used for statistical testing. Because of this, there was an addendum to the FSS Plan to collect another set of systematic soil samples for statistical testing.” The licensee should provide the date of when the first set of FSS samples were collected, and whether any additional remediation occurred after the August 2019 post-remediation surveys. The licensee should provide a description of the first set of sample results (locations and results) and any remediation that occurred due to those sample results so that they can be reviewed to see if they provide additional support that the inaccessible areas meet the release criteria.

The FSS states that the water intrusion “did not adversely affect the quality of the data collected during FSS,” but given that the area under water in the ditch was not scanned or sampled during the FSS, and considering that the ditch had required prior remediation, additional information is needed.

Path Forward

- For Survey Unit 10212D, revise the release record to provide any additional information (including prior samples and/or survey data) on why the area that was inaccessible does not contain concentrations that may have needed additional remediation.
- Describe approximately when the water intrusion occurred and if the water was present during the August 2019 post-remediations survey when samples were collected from the center of the drainage ditch. Clarify if those samples were collected from beneath the water or not.
- Provide the date of when the first set of FSS samples were collected and whether any additional remediation occurred after the August 2019 post-remediation surveys. The licensee should provide the first set of sample results (locations and results) and any remediation that occurred due to those sample results.

6. Additional Information is Needed Regarding Unit 1 Containment Incore-Sump Drain (Survey Unit 01111)

Comment: The release record for Unit 1 Containment Incore-Sump Drain (Survey Unit 01111) needs additional information on the MDC calculations, the elevated reading, and the results in Attachment 2 (Sample Data).

Basis: The release record for Unit 1 Containment Incore-Sump Drain (Survey Unit 01111), Table 4 provides a gamma mixture MDC but does not show the details on the derivation of the gamma mixture MDC. Specifically, Table 4 provides a “typical” efficiency of 0.024 for the

Ludlum 44-159 (0.7 x 0.7 inch) CsI detector. This table notes that the efficiency is based on calibration of the Ludlum 44-159 detector with cesium-137. However, the radionuclide mixture assumed within this 1.61-inch ID pipe system consists of approximately 68% cesium-137 and 32% of other radionuclides, including 27% from Ni-63, a hard-to-detect radionuclide. It is not clear from the FSS record how the procedure in technical support document ZS-LT-300-001-006 was followed to arrive at the MDC, or the efficiency value of 0.024 for the CsI detector in this specific pipe geometry and radionuclide mixture.

Also, this release record describes how an elevated measurement (OpSOF of 5.793) was noted at the 1-foot measurement location, which is interpreted to the reviewer as being at the pipe entrance. However, Attachment 2 (Sample Data) lists this measurement at 0-feet into the pipe. This would imply the highest radiation was at the opening, but the release record does not contain a diagram with sample locations to provide confirmation of this assumption. Also, it is not clear if the ambient dose rate at the opening of the pipe influenced the measurement. Figure 1 in the release record shows the survey unit but does not appear to have sample locations on it. From an ALARA perspective, this raises a question about whether decontamination was attempted at the opening section of the pipe to remove residual radioactivity.

In addition, Attachment 2 lists the sample results. Row 2 shows a value of 0.464 for the Base Case SOF. This appears to be a typo (possibly a copy paste error from the top row, which has the same value). It appears that the SOF for the second row should be 0.072. The results presented in this table should be checked for quality purposes and the raw data provided if available.

Path Forward:

- Provide additional information on the derivation of the MDC for the Ludlum 44-159 CsI detector that was used to perform the survey in this pipe system, taking into account the radionuclide mixture in the pipe and the detector calibration.
- Provide additional information on the location of the elevated measurement near the opening of the pipe, and any ALARA measures that may have been taken to evaluate or reduce activity of the elevated area within the pipe system.
- Check the values presented in Attachment 2 and provide the raw measurement data if available. Provide a revised release record for this survey unit with corrected information if errors are confirmed in Attachment 2.

7. <u>Remediation and Surveying of Subsurface Soil Excavations: Remedial Action Support Surveys Versus Final Status Surveys</u>

Comment: Remedial action or post-remediation surveys were used in lieu of final status surveys for some excavated/remediated soil surfaces before backfilling with clean soil, without providing enough detail on how the post-remediation surveys meet the intent of the FSS DQOs.

The result is that release record reflects only measurements of clean backfill that was placed on top of the remediated soils, and limited subsurface sampling via GeoProbe. In other areas where the licensee performed remediation of excavated areas, the licensee did perform an FSS of the excavation, but the dose from those excavated areas does not appear to be considered when determining the total compliance dose.

Basis: LTP Section 5.7.1.6, Subsurface Soils, states that "Any soil excavation created to expose or remove a potentially contaminated sub-grade basement structure will be subjected to FSS prior to backfill. The FSS will be designed as an open land survey using the classification of the removed structure in accordance with Section 5.6.4 of the LTP using the Operational DCGLs for subsurface soils as the release criteria."

Also, LTP Section 5.7.1.6 states, "During decommissioning of Zion, any subsurface soil contamination that is identified by continuing characterization or operational radiological surveys that is in excess of the site-specific Base Case DCGLs for each of the potential ROC as presented in Table 5-2 will be remediated. The remediation process will include performing RASS of the open excavations in accordance with Section 5.4.2 of this FSS Plan. The RASS will include scan surveys and the collection of soil samples during excavation to gauge the effectiveness of remediation, and to identify locations requiring additional excavation. The scan surveys and the collection of and subsequent laboratory analysis of soil samples will be performed in a manner that is intended to meet the DQOs of FSS."

LTP Section 5.7.1.6.1, Scanning of Subsurface Soils during FSS, states, "Per NUREG-1757, scanning is not applicable to subsurface soils during the performance of FSS. Scanning will be performed during the RASS of excavations resulting from any remediation of subsurface soil contamination. The scanning of exposed subsurface soils during the RASS, where accessible as an excavated surface, will be used with the analysis of soil samples to demonstrate compliance with site release criteria."

To put in context the licensee's reference to NUREG-1757 in the LTP, the licensee appears to be quoting Appendix G, which states, "When the appropriate DCGLs and mixing volumes based on an acceptable site-specific dose assessment are established, the FSS is performed by taking core samples to the measured depth of the residual radioactivity. The number of cores to be taken is initially the number (N) required for the Wilcoxon Rank Sum (WRS) or Sign test, as appropriate. The adjustment to the grid spacing for an elevated measurement comparison (EMC) is more complicated than for surface soils, because scanning is not applicable." This section of Appendix G is referring to subsurface soils, and not soils which are at the surface and able to be scanned with relative ease.

LTP Section 5.7.1.6.2, Sampling of Subsurface Soils during FSS, states that in Class 1 open land survey units, a subsurface soil sample will be taken at 10% of the systematic surface soil sample locations in the survey unit with the location(s) selected at random. In addition, if during the performance of FSS, the analysis of a surface soil sample, or the results of a surface gamma scan indicates the potential presence of residual radioactivity at a concentration of 75%

of the subsurface Operational DCGL, then additional biased subsurface soil sample(s) will be taken within the area of concern as part of the investigation."

RAI response letter no. ZS-2020-028, dated May 15, 2020, states (in response to RAI 3a), "Keyway Soils - LTP Chapter 5, Section 5.3.4.4 states that the subsurface soils in the "keyways" between the Containment Buildings and the Turbine Building will be assessed for radiological contamination once subsurface utilities and subsurface access-interfering structures (e.g., Waste Annex Building) have been removed. This applied to the Survey Unit 12109 as well as the north boundary of Survey Unit 12110. The disposition of these areas was addressed in Section 3.3 of the Phase 4 Final Status Survey Final Report (FSSR). During the course of the decommissioning and the remediation of the indigenous soils following the removal of the sacrificial layer, the soils that were earmarked for continuing characterization were completely removed and disposed of as contaminated waste. The tops of the underlying structures were exposed, and post-remediation scans and samples taken from the excavation prior to backfill did not indicate the presence of any ROC at concentrations exceeding the OpDCGLs for subsurface soils."

According to the LTP Section 5.7.1.6, if the subsurface access-interfering structures (e.g., Waste Annex Building) that were removed to expose this soil classify as 'potentially contaminated sub-grade basement structures', then this excavation to remove the subsurface keyway soils should have undergone FSS instead of post-remediation scans and sampling. Alternatively, if the subsurface access-interfering structures are not classified as 'potentially contaminated sub-grade basement structures', then according to Section 5.7.1.6.1, the RASS scans of the exposed excavations "will be used with the analysis of soil samples to demonstrate compliance with site release criteria". Therefore, if post-remediation or RASS scans are being used to demonstrate compliance with these or other survey units, the full results (not just a high-level summary) of the RASS scans should be provided with the release records.

The release records for Survey Units 12109 and 12110 provide a high-level summary of the post-remediation surveys stating, "during the course of the decommissioning and the remediation of the indigenous soils following the removal of the sacrificial layer, the soils in question were completely removed and disposed of as contaminated waste. The tops of the underlying structures were exposed, and post-remediation scans and samples taken from the excavation prior to backfill did not indicate the presence of the ROC at concentrations exceeding the OpDCGLs. No further action was taken. However, all excavations remained open to allow the ORISE to perform confirmatory surveys of the exposed remediated soil. ORISE performed confirmatory surveys of the exposed subsurface soils surrounding the Containments in August of 2019. Shortly thereafter, clean fill was acquired from an off-site source and used to increase the grade of all survey units surrounding any end-state basement to the 591-foot elevation." In addition to this high-level summary, the licensee should provide the detailed post-remediation survey results. The NRC staff note that the licensee acknowledged a typo in the release records and the release records should have stated that the confirmatory survey of these survey units was completed in July 2019 instead of August 2019.

The licensee completed the FSS in September 2019 after the areas had been backfilled with clean fill.

In contrast to the approach taken for Survey Units 12109 and 12110, the licensee took a different approach for Survey Units 12105, 12106, and 12107 in that the licensee performed an FSS of the excavated and remediated soil areas prior to placing clean backfill. It is not clear under what circumstances the licensee decided to perform the FSS of excavated and remediated soil prior to backfill versus only performing post-remediation or RASS surveys.

Survey Unit 12106 has an addendum to the release record to document the results of an FSS performed on the subsurface soil in an open excavation prior to backfill (Survey Unit 12106K) in 2018. Similarly, the release records for Survey Units 12105 and 12107 each have an addendum to describe the FSS of the open excavation, 12105K and 12107K respectively. The Survey Unit 12016K release record states, "In the spring of 2018, an area was excavated to expose the remaining foundation of the FHB and Car Shed. This excavation included the west half of survey units 12105, 12106, and 12107." During FSS in July 2018 of 12106K the release record states, "Investigations were performed in two (2) areas identified by gamma scans. An elevated area in Row 24, which was approximately 1 m^2 in size, revealed activity with an OpSOF of 1.832. An elevated area in Row 27, which was approximately 3 m^2 in size, revealed activity with an OpSOF of 2.833… The conclusion of the investigation was that the survey unit would have passed the EMC, with a final dose for the survey unit of 3.46 mrem/year TEDE…it was decided to remediate the activity identified in the elevated areas described in the previous Section. For the 1 m^2 area in Row 24, 6 inches of soil was removed. The post-remediation sample indicated an OpSOF of 0.60. For the 3 m^2 area in Row 27, approximately 2 feet of soil was removed. During the scan during the second FSS, several additional small areas of elevated activity were detected. Spot remediation occurred at each location directed by scanning until all identified elevated activity was removed. The final post-remediation sample result showed a maximum OpSOF of 0.922."

Once the licensee completed the FSS in Survey Unit 12106 of the excavated area to demonstrate compliance with the unrestricted release criteria, the open excavation was backfilled with clean fill. The licensee should explain why the dose calculated for Survey Unit 12106K was not somehow incorporated into the release record and total dose for Survey Unit 12106, or somehow separately considered for the total compliance dose assessment. The Partial Site Release does not list Survey Unit 12106K as a separate survey unit. The NRC staff note that the backfill placed over Survey Unit 12106K changes the conceptual site model that was assumed to derive the subsurface DCGLs. However, the licensee has not provided an alternative approach to more realistically account for the dose from the underlying land survey units, such as Survey Unit 12106K.

In Survey Unit 12106, contaminated soils around the Containment were remediated additionally after the sacrificial layer was removed. "From February 26, 2019, through June 18, 2019, scanning and remediation commenced south of Unit 1 and progressed to the north and west of the Containment footprints. Large areas of elevated activity were identified by scan and verified

by soil sample analysis. The areas were marked. All soil identified as exceeding the OpDCGLs for subsurface soil was excavated and removed from the site as radioactive waste. Following excavation, post-remediation surveys were performed by scan and media sampling." The soils were surveyed under a Radiological Assessment (RA) which required "100% scan of the soils exposed by the removal of the sacrificial layer". Clean fill was then brought in to bring the elevation to 591-foot elevation and the licensee performed an FSS on the clean fill. Note that Section 11 of Survey Unit 12106 states that "There were no addendums to the FSS Plan." Note that this does not reflect that there is an Addendum 1 attached to the Survey Unit 12106 release record for Survey Unit 12106K. Furthermore, the RASS data for Survey Unit 12016 are not included in the release record.

Path Forward:

- Clarify under what circumstances the licensee decided to perform the FSS of excavated and remediated soil prior to placing clean backfill versus only performing post-remediation or RASS surveys.
- The licensee should clarify if the subsurface access-interfering structures (e.g., Waste Annex Building) that were removed to expose soil in Survey Units 12109 and 12110 classify as 'potentially contaminated sub-grade basement structures' according to the LTP Section 5.7.1.6. If they do, the licensee should provide a reason for why the FSS was not performed on the excavation prior to backfilling with clean soil.
- For the land survey units that had an FSS performed on a sub-grade soil excavation, the dose from the sub-grade excavation should be accounted for when determining the total compliance dose.
- The licensee should revise the release records for Survey Units 12109 and 12110 to include the post-remediation survey data for that was performed in accordance with Section 5.4.2 of the LTP. The revised release record should show how the RASS scans meet the DQOs of the FSS and how the data collected as part of the RASS is sufficient for NRC to have reasonable assurance that the performance objectives are met. The data should include any analysis for hard-to-detect (HTD) or insignificant radionuclides in samples that were acquired during the post-remediation surveys.
- For any other survey units in Phase 3 or Phase 4 where soil remediation occurred, but the FSS took place after clean backfill had been placed, the licensee should clarify if there were removed sub-grade basement structures removed to access those areas. The licensee should provide the post-remediation or RASS surveys performed just prior to backfill, describe how those surveys meet the DQOs of the FSS, and provide a dose based on the post-remediation surveys.

8. <u>Additional Information on Subsurface Remediation in Land Survey Units Where Piping Was Removed Is Required</u>

Comment: More information is needed on remediation of survey units that occurred between the LTP approval and the FSS.

Basis: The LTP Section 5.11.1, FSS Unit Release Records, states "The FSS Unit Release Record will contain the following information: Any remediation activities, both historic and resulting from the performance of the FSS". In some cases, the release records do not give an adequate history of remediation activities surrounding FSS activities that could have contaminated the subsurface.

The release record of Survey Unit 12112 mentions the removal of a pipe and subsequent remediation. The record states, "In April of 2017, a contaminated underground pipe was removed from this survey unit. A water spill from the pipe occurred during the pipe removal. A soil sample from this location indicated activity of 9.3 pCi/g of Co-60 and 1.7 pCi/g of Cs-137. This area was again remediated. The highest concentration of residual radioactivity detected following commodity removal and remediation of the soils in the trench at the completion of the job was 0.18 pCi/g of Cs-137. In April of 2017 an additional eight characterization samples were obtained in the survey unit. These were taken in the area where the Primary Water Storage Tank (PWST) and Secondary Storage Tank (SST) were located. These were surface samples, with only sample #4 having activity above MDC at 0.37 pCi/g of Co-60 and 0.10 pCi/g of Cs-137."

The release record of Survey Unit 10220G states "In June of 2018, during the performance of a RA survey to remove buried pipe, a small radioactive particle measuring 50,000 counts per minute (cpm) was found in the area. Due to the discovery of the particle and as a conservative measure, Class 2 Survey Unit 10220B was reclassified as Class 1, and divided into five (5) survey units: 10220B, 10220D, 10220E, 10220F, and 10220G to comply with the survey unit size recommendations from MARSSIM Section 4.6."

Path forward:

- Provide additional information on any land survey unit where buried piping or sub-grade piping systems were removed that required subsurface remediation before the FSS (e.g., Wastewater Treatment Plant (WWTP) subsurface piping), including the results of the post-remediation surveys.
- For Survey Unit 10220G, provide the source of the radioactive particle and describe why it was located subsurface.

9. <u>Recontamination of Survey Units with Concrete Debris after FSS Completed</u>

Comment: Information is needed on the stockpiling of potentially contaminated concrete demolition debris from the Containment Building and subsequent remediation and surveys that occurred after the FSS was completed.

Basis: During the winter of 2019, potentially contaminated concrete demolition debris (referred to by the site as "Clean Concrete Demolition Debris") from the Containment Buildings was stockpiled on survey units that had previously had an FSS completed on them. The release

records for Survey Units 12205A, 12205B, 12205C, 12205D, and 12205E each state “After completion of the FSS in January of 2019, Clean Concrete Demolition Debris (CCDD) from the demolition of the Containment Buildings was stored in the area. After the CCDD was removed in the summer of 2019, the area needed to be backfilled again to an elevation of 591-foot elevation over the basements due to a significant amount of soil being removed along with the CCDD. Since this action significantly changed the end state of the survey unit, it was decided to perform the FSS again”. The stockpiling of the debris does not appear to have been limited to Survey Units 12205A, 12205B, 12205C, 12205D, and 12205E and it appears that the debris was also stockpiled in other areas that had already been final status surveyed. For example, NRC Inspectors documented that the concrete debris was placed in Survey Units 12113 and 12203 after these survey units had been final status surveyed. The inspectors identified a severity level IV violation of License Condition 2.C.(17) for failing to implement and maintain in effect all provisions of the approved LTP (ML20080J249), which did not allow for the concrete debris to remain on-site other than as backfill in the basements. The storage of the potentially contaminated concrete debris on Survey Units 12113 and 12203 after the FSS does not appear to be mentioned in the release records for Survey Units 12113 and 12203A, 12203B, 12203C, and 12203D. Information on the removal of the debris, remediation, and resurvey of those survey units also does not appear to be addressed in those release records, and the FSS information provided does not appear to reflect the final status of the survey units. It is also not clear if the concrete material was stored on any other survey units other than the ones previously mentioned in this paragraph (12203A, B, C, and D, 12205 A, B, C, D, and E, and 12113).

Additionally, the storage of this debris on-site does not appear to be mentioned in the release records for neighboring survey units (most of which had an FSS completed prior to the summer of 2019 when the debris was removed) and it is not clear what measures, if any, were taken to ensure that the stockpiled debris did not re-contaminate other nearby survey units which already had an FSS completed.

The information requested in this RAI is needed for the NRC staff to have reasonable assurance that the site meets the unrestricted release criteria in 10 CFR 20.1402 (i.e., less than 25 mrem/yr. plus ALARA) and that potentially contaminated debris from the site has been properly surveyed and/or removed from the site.

Path forward:

- Provide a list of all survey units in which concrete debris was stored or transported through after the FSS had been completed for the survey unit.
- For any survey unit in which concrete was stored on or transported through after completion of the FSS, provide details on: the amount and type of debris stored on the survey unit, remediation performed to remove the debris after completion of the FSS, surveys performed post-removal of the debris, and data collected during surveys performed post-removal of the debris.

- Provide revised release records which reflect the final status of the survey units for any survey unit in which concrete debris was stored on or transported through after completion of the FSS.
- Provide information on measures used to prevent the concrete debris from contaminating neighboring survey units that were already final status surveyed. Provide information on surveys performed to confirm that neighboring survey units were not contaminated from the concrete debris after the FSS had been completed.

10. <u>FSSR and Release Record Documentation Should Discuss Corrective Actions that Were Done in Response to ORISE Confirmatory Surveys</u>

Comment: Issues identified during confirmatory surveys do not appear to be adequately addressed.

Basis: Confirmatory surveys were performed by NRC's contractor ORISE in portions of the Zion site. During these confirmatory surveys, some issues were identified that do not appear to have been addressed in the FSSR or release records. Additionally, it is not clear what corrective actions or procedural changes were taken to avoid similar issues from occurring in other parts of the site.

ORISE report 5271-SR-08-0 provides the results of confirmatory surveys performed in land areas in December 2019 and January 2020. During these confirmatory surveys, ORISE identified some areas of elevated radioactivity on the site, but the investigation of these elevated areas by the licensee does and any subsequent remediation and additional surveys do not appear to be discussed in the release records. For example, in Survey Unit 12112 and in the area of Survey Units 10220I/10220J (GPS location 641146 North/343614 East meters), ORISE identified elevated areas that were referred to the site for investigation. However, neither the release record for Survey Unit 12112 (signed in December 2019) nor the release record for Survey Unit 10220I (signed in April 2020) have a discussion on this investigation. Similarly, during the confirmatory surveys, a discrete particle was identified in Survey Unit 12204A, but information on this discrete particle (such as its composition and its activity) are not included in this release record (signed in December 2019). ORISE also identified an elevated area in Survey Unit 10209C, which consisted of soil with elevated Cs-137 activity as well as a piece of concrete-like debris. According to the ORISE report, the concrete sample was provided to site personnel for analysis. Neither the results of this analysis nor an evaluation of the elevated area of Cs-137 contamination in the soil appears to be addressed in the release record (signed in April 2020). The FSS data provided for these survey units (10209C, 10220I, 12112 and 12204A) appears to predate the ORISE confirmatory survey and in some cases also predates the submission of the release records to the NRC. However, it is the expectation of the NRC staff that the licensee would provide the NRC with the final status of the survey units and that the FSSRs and release records would be updated to reflect changes to site conditions and detections and investigations of elevated areas of residual radioactivity.

ORISE report 5271-SR-07-0 provides the results of confirmatory surveys performed in land areas in April 2019 and July 2019. These confirmatory surveys were completed in an atypical fashion because instead of doing them after the licensee had completed the FSS, they were done prior to the licensee placing clean soil and doing the FSS. In April 2019 there was a miscommunication and ORISE surveyed areas that were not ready for confirmatory surveys. Therefore, the confirmatory surveys were ceased, and the licensee completed their post-remediation scans prior to the July 2019 confirmatory surveys.

In April 2019, ORISE identified two discrete particles in Survey Unit 12106 and concrete-like debris and surrounding contaminated soil in 12202A with Cs-137 which exceeded the SOF based on the Base Case DCGLs. In July 2019, ORISE identified two additional discrete particles (one in Survey Unit 12202D and one in Survey Unit 12202F). The decision rule in the report was stated as follows: "If ROC concentrations in confirmatory samples are reported less than analytical detection limits, then the subject area is presumed to be free of residual contamination. Otherwise, the subject area may be impacted by site operations and additional action may be required. Present results to NRC for their evaluation." Based on the results of the July 2019 confirmatory survey, ORISE concluded that the study area did contain residual radioactivity. The FSS was completed for these survey units in September and October 2019 after the licensee placed clean fill and soil from off-site. The release records for Survey Units 12016, 12202A, 12202D, 12202F, which are dated April 2020, do not discuss the discovery of the discrete particles or concrete-like debris by ORISE. Furthermore, if remediation or investigations were performed because of the confirmatory surveys done by ORISE, a description of the investigations and/or remediation are not included in the release records. For the NRC staff to have reasonable assurance that the elevated areas identified by ORISE in confirmatory report 5271-SR-07-0 were investigated and remediated properly, and for completeness of the release records, more information should be included in the release records where remediation occurred as a result of the confirmatory surveys.

Path forward:

- For Survey Units 10209C, 10220I, 12112 and 12204A, provide information on investigations and remediation performed after the FSS was completed (including any investigations and remediations based on issues identified by ORISE) and provide the results of scans and sample analyses performed after the FSS.
- In the survey units where the source of the elevated areas identified by ORISE was found to be a discrete particle (e.g., 12204A), provide information on composition of the particle. Provide information on the expected origin of these particles given their composition and location.
- Provide information on corrective actions taken to ensure that elevated areas like those identified by ORISE are not missed in other survey units.
- For any survey unit in which there were investigations and/or remediations performed after the FSS was completed, provide revised release records that incorporate the post-FSS investigations and remediations and that accurately describe the final status of the survey unit.

- For the NRC staff to have reasonable assurance that the elevated areas identified by ORISE in confirmatory report 5271-SR-07-0 were investigated and remediated properly prior to the licensee emplacing clean fill, and for completeness of the release records, more information should be included in the release records where investigations and remediation occurred as a result of the confirmatory surveys.

11. <u>Scanning Adequacy for Finding Discrete Particles of Residual Radioactivity</u>

Comment: Additional information is needed to have reasonable assurance that the FSS methodology was adequate to detect discrete particles of residual radioactivity.

Basis: Discrete particles were detected in samples from a number of survey units by the licensee, by the licensee's off-site lab (Eberline Analytical), and by NRC's contractor ORISE during confirmatory surveys. In some cases these discrete particles were detected by the licensee during the FSS scans, but in other cases the discrete particles were detected in systematic samples in areas where no scan alarm had been seen (e.g., Sample L1-10220A-FSGS-016-SS in Survey Unit 10220A) or were detected during confirmatory surveys in areas that did not appear to have had a scan alarm during the FSS (e.g., Survey Unit 12204A). In many cases, the release records do not provide details on the composition of the discrete particles found. However, the sample analysis results in the release records for Survey Unit 10202B (Sample L1-10202B-FIGS-001-SS) and Survey Unit 12112 (Sample L1-12112A-FQGS-014-SS-A) indicate that residual radioactivity in discrete particles found in those survey units was primarily Co-60.

The release record for the Unit 1 Primary Water Storage Tank and Secondary Storage Tank area, Survey Unit 12112, states in Section 8 that "no elevated measurement locations were identified by surface scan." Scan data contained in Table 11 indicates that two scan alarms occurred in rows 41 and 42, and that two investigation samples were taken (L1-12112A-FIGS-001-SS and L1-12112A-FIGS-002-SS) at scan alarm locations. The analytical results of the investigation soil samples indicate that residual radioactivity levels were low. However, a Quality Control (QC) sample collected from a systematic sampling location identified a discrete particle of cobalt-60 (L1-12112A-FQGS-014-SS), which was not identified during the scan surveys of the area.

In December 2019, ORISE performed a confirmatory survey, which included Survey Unit 12112, after the FSS was completed in early 2019. The results of a confirmatory survey identified a small elevated area (less than 0.5 m^2). This elevated area appears to be in the same general area where the scan alarms occurred during the FSS, but it is not clear if the elevated area is in the exact same location as the scan alarms.

FSS records of open land areas reference TSD-11-004, "Ludlum Model 44-10 Detector Sensitivity," as the technical basis document for deriving scan MDCs for land area surveys. This document not address the use of collimators on the Ludlum 44-10 detector, as it was configured for conducting the FSSs of open land areas. Use of collimators can change the field

of view of the detector, in addition to lowering background radiation levels in the detector. Additionally, the modeling assumptions in TSD-11-004 did not address the scan sensitivity for discrete (small) particles of Co-60, which were identified during FSSs and confirmatory surveys of open land areas.

The licensee should address the identification of a discrete particle in Survey Unit 12112 by laboratory measurement rather than scan survey, the lack of information in TSD-11-004 on discrete particle detection capability and the impacts of collimators on the field of view, and resulting scan MDC calculations for the Ludlum Model 44-10 detector.

This information is needed for the NRC to have reasonable assurance that the site has been adequately characterized and that the final site conditions are consistent with the criteria in 10 CFR 20.1402.

Path forward:

- Demonstrate that the scan sensitivity was adequate to meet the data needs for the survey and was adequate to detect small discrete particles like the one observed in the QC sample in Survey Unit 12112. This demonstration should include an evaluation of the assumed relative ratio of radionuclides observed in the particles (i.e., the particles primarily consisting of Co-60 versus primarily consisting of Cs-137). The demonstration should also evaluate the impact of the collimators used on the field of view. The licensee should also revise the scan MDC calculations for the Ludlum 44-10 detector to address the small discrete particles of Co-60 with the collimator.
- Provide information on the composition of particles found on-site. Provide information on the source of the particles observed on-site given their composition and location. Provide details on what areas of the site in which these particles would be expected to be found.
- For Survey Unit 12112, provide information on the location of sample L1-12112A-FQGS-014-SS in relation to the location of the scan alarms in rows 41 and 42. Also provide information on the location of both sample L1-12112A-FQGS-014-SS and the scan alarms in rows 41 and 42 in relation to the scan alarms. If the scan alarms did not identify the particle observed in sample L1-12112A-FQGS-014-SS and/or the elevated area observed by ORISE, provide information on the reason that the scan might have missed the particles.
- Describe any corrective actions taken to ensure that all risk-significant particles were identified in all survey units.

12. <u>Commitment for Continuing Characterization in LTP Section 5.3.4.4 (RAI 3a Response)</u>

Comment: Additional information is needed to ensure the licensee fulfilled the commitments for continuing characterization in LTP Section 5.3.4.4.

Basis: Section 5.3.4.4 of the LTP defines several areas where the licensee committed to doing continuing characterization. The Path Forward for RAI 3a, dated April 20, 2020, asked the licensee "For areas that underwent continuing characterization, including areas listed in Section 5.3.4.4. of the LTP where the licensee committed to performing continuing characterization, describe which release records include the description and data (including Eberline Analytical reports) for the continuing characterization."

For some of the areas listed in Section 5.3.4.4 their response to RA1 3a is not adequate. Also, the response did not address all areas listed in Section 5.3.4.4.

Keyways Soils

Section 5.3.4.4 of the LTP states, "The subsurface soils in the "keyways" between the Containment Buildings and the Turbine Building. This will occur once subsurface utilities and subsurface access-interfering structures (e.g., Waste Annex Building) have been removed. The objective of the continuing characterization survey will be to assess the radiological contamination of subsurface soils in these two areas. Continuing characterization will consist of the scanning of soils exposed by the demolition and building removal, the collection of soil samples of the exposed surface soil and collection of additional subsurface soil samples using GeoProbe sampling. The location of the GeoProbe samples will correspond to at least ten (10) locations that exhibit the highest surface-scan measurements of the exposed soils. If elevated activity is not identified by the scans, then the sample locations will be biased to locations where elevated activity could accumulate, such as below travel paths, below building access points and former waste loading areas. A surface soil and subsurface soil sample will be taken at each location. The subsurface soil sample will be taken to a depth of 3 meters below grade. All samples will be analyzed by the on-site gamma spectroscopy system."

In response to RAI 3a dated May 2020, the licensee states, "Keyway Soils - LTP Chapter 5, Section 5.3.4.4 states that the subsurface soils in the "keyways" between the Containment Buildings and the Turbine Building will be assessed for radiological contamination once subsurface utilities and subsurface access-interfering structures (e.g., Waste Annex Building) have been removed. This applied to the Survey Unit 12109 as well as the north boundary of Survey Unit 12110. The disposition of these areas was addressed in Section 3.3 of the Phase 4 FSSR. During the course of the decommissioning and the remediation of the indigenous soils following the removal of the sacrificial layer, the soils that were earmarked for continuing characterization were completely removed and disposed of as contaminated waste. The tops of the underlying structures were exposed, and post-remediation scans and samples taken from the excavation prior to backfill did not indicate the presence of any ROC at concentrations exceeding the OpDCGLs for subsurface soils." Additional information is needed regarding the remediation and post-remediation scans of the keyway soils (See RAI 7).

Soils under Basement Concrete

Section 5.3.4.4 of the LTP states, "the soils under the basement concrete of the Containment Buildings, the Auxiliary Building and the Spent Fuel Pool (SFP)/Transfer Canal. This will occur

once commodity removal and building demolition have progressed to a point where access can be achieved. The objective of the continuing characterization survey will be to assess the radiological contamination of subsurface soils adjacent to and below these basement slabs. Continuing characterization will consist of GeoProbe soil borings at the nearest locations along the foundation walls that can be feasibly accessed and angled GeoProbe soil bores to access the soils under the concrete. A minimum of four subsurface soil samples will be taken around each foundation from grade to the depth of approximately 55 feet or refusal, whichever is less. Attempts shall be made to acquire a minimum of two subsurface soil samples from beneath each Containment basement foundation and the Auxiliary Building basement floor slab. **Samples from under the SFP foundation slab will be acquired from within the excavation prior to backfill**. Additional investigations and sampling will be performed in accordance with a sample plan if activity is positively identified. All samples will be analyzed by the on-site gamma spectroscopy system."

The licensee attempted to acquire samples from beneath basement floor slabs and around each foundation from grade to the floor slab depth or refusal, but many of these attempts failed. The RAI response from May 2020 states, "Many attempts were made to acquire these samples following the demolition of all above grade structures. As part of this effort, one (1) subsurface soil sample was taken in survey unit 12109 along the west side of the Auxiliary Building to a depth of 52 feet below grade, where refusal was met. Several attempts were made to acquire samples at a deeper depth and below the basement slab in survey unit 12109. However, with the exception of sample acquired under the Auxiliary Building, the "mud-mat" placed around the Containment basement exterior during construction obstructed the GeoProbe from acquiring samples at a deeper depth. For the sample acquired in survey unit 12109, the probe was able to punch through the mud-mat and acquire a sample at a sub-basement slab depth. Twelve (12) additional samples were taken adjacent to the foundations of both Unit 1 and Unit 2 Containment buildings and the Auxiliary Building to a depth of 32 feet to 48 feet. All of the deep subsurface soil samples were analyzed by the on-site gamma spectroscopy system. No ROC was positively detected in any of these samples except for one sample taken along the foundation of Unit 2 Containment where Cs-137 was positively detected at a concentration of 0.095 pCi/g. Two samples (L1-12109L-CJGS-001-SB-A and L1-12106L-CJGS-001-SB-A) were analyzed for the full suite of radionuclides from LTP Chapter 5, Table 5-1. The results are provided in Attachment 1 and the Eberline Analytical reports are provided in Attachment 2. Residual concentrations of Cs-137 were detected in both samples. In addition, residual concentrations of H-3 and Eu-155 were positively detected in sample L1-12109L-CJGS-001-SB-A, but at levels that do not require reassessment of IC dose or mixture as per LTP Chapter 5, Section 5.1."

The RAI response discusses the sampling and attempted sampling along/under the foundation of the Auxiliary Building and around Containment Buildings, but it doesn't discuss the samples from under the SFP foundation slab which the licensee commits to taking in the LTP Section 5.3.4.4.

Path Forward:

- Additional information is needed regarding the remediation and post-remediation scans of the keyway soils. (See RAI 7 above)
- The licensee should describe the continuing characterization soil samples from under the SFP foundation slab, that were part of the commitments in LTP Section 5.3.4.4 or point to the release record in which they are discussed. If no samples were taken prior to backfill, provide additional information to support that these soils do not contain residual radioactivity that would be in excess of the release criteria.

13. <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 Zion LTP related to Quality Assurance (QA) 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 LTP states that "the 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 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 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 Zion*Solutions* procedure ZS-AD-08, "Corrective Action Program" (Reference 5-25). 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 to determine if proper instructions and procedures were followed and proper measurement and handling techniques were used including CoC, 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."

Section 4.1 of the Quality Assurance Project Plan (QAPP) defines a replicate measurement as "an independent direct measurement performed by a qualified technician, other than the one who obtained the original characterization or FRS measurement, using a separate but similar instrument." In contrast, a "duplicate" and "split" sample is applicable only to a volumetric or material sample collected during a FRS. The licensee should clarify if the ISOCS QC measurements are replicate measurements or duplicate measurements.

Section 4.1.2 of the QAPP defines the acceptance criteria for replicate measurements. It states that replicate static results will be compared to the original measurement results to determine if the acceptance criteria are met. It states that, based on the professional judgment of the Radiological Engineer, the "same conclusion is to be reached for each measurement location and no other locations, greater than the scan investigation level for the area classification, are found. If the same conclusion is not reached or any exceptions are reported that were not reported in the original survey, further evaluations will be performed." Section 4.2.2 of the QAPP defines acceptance criteria for duplicate samples. It states that NRC Inspection Procedure Number 84750 (IP-84750) is used to "determine acceptability of split and duplicate sample analyses." Also, Section 6.2.2.1 states that the Radiological Engineer (RE) validates the survey data using MDC and uncertainty (along with other information) are used to verify the data.

The licensee should clarify whether IP-84750 or uncertainty ranges apply to measurements acquired from ISOCS and most pipe detector systems used for FSSs. These radiation measurement systems provide data in the release records as surficial concentrations of radioactivity (pCi/m^2) rather than volumetric concentrations of radioactivity (pCi/m^2). The clarification should address whether ISOCS quality comparison measurements are considered replicate as opposed to duplicate measurements, and whether evaluation of ISOCS data should be evaluated using acceptance criteria of Section 4.1.2 (not Section 4.2.2) of the QAPP.

Also, for those instances when IP-84750 is applied to survey data Table 4-1 in Section 4.2.2 of the QAPP contains the acceptance criteria. Resolution and Acceptable Ratios are provided for resolution values of <4 to >200 in Table 4-1. In some release records (including those for soil samples and ISOCS measurements), the Attachment on QC comparisons states that there was inadequate resolution for <4 and gives no acceptance ratio range for that resolution, but in other release records there is an acceptance ratio range of 0.4 to 2.5 for a resolution value of <4. The resolution value range (<4 to >200) should apply to all measurements, not a different range of resolutions (e.g., >4 to >200) for a specific measurement.

The following are examples of where additional information is necessary to confirm the licensee followed the commitments in the Zion LTP related to QA of survey data. These examples do not represent a comprehensive list.

Phase 2a

- Unit 1 Containment (Survey Units 1100 and 1110) provides information on 12 QC measurements of ISOCS data, which are three from under the vessel and nine from the 565 ft elevation. The FSS record states there was not acceptable resolution for Cs-137 in 3 of the 12 QC measurements. In two of the measurements from the 565 ft area, the K-40 did not have adequate resolution. Section 8 of the release record states, "All replicate ISOCS measurements met the required acceptance criteria." This statement does not seem to agree with results in Attachment 4 of the release record. Also, a typo is noted in the QC Form on page 172 (of 1455 pages), which lists Co-60 instead of Cs-137 as the radionuclide.
- Unit 1 Containment Incore-Sump Discharge Pipe (Survey Unit 01111) describes the QC measurements and analysis in Attachment 4. Two replicate measurement are considered within the acceptance range of +/- 20% and one replicate measurement is outside the acceptance range at +/- 30%. This release record states that "in accordance with Section 4.1.2 of the QAPP, a replicate measurement is in agreement if, based on the professional judgment of the Radiological Engineer, that the same conclusion is reached for the replicate measurement location as with the standard," and concludes that no further investigation is necessary because "the acceptance criteria for replicate static measurements and scan surveys is that the same conclusion is reached for each measurement. This is defined as + 20% of the standard."
- Similar to Survey Unit 01111 above, the Penetrations Combined report (Survey Units 01112, 02112 and 05120) describes how 2 of 18 QC measurements for Unit 1 Containment Penetrations did not pass the +/- 20% "There was acceptable agreement between the standard measurement and the replicate measurement with the exception of pipes P017 and P056-4.5 ft. In these comparisons, the standard result was ~35% greater than the comparison. In accordance with Section 4.1.2 of the QAPP, based on the professional judgment of the Radiological Engineer, the same conclusion was reached for each measurement. No further action is necessary."
- Similar to the examples above, for the Unit 2 Containment Penetrations (Survey Unit 02112), it is stated that "there was acceptable agreement between the standard measurement and the replicate measurement with the exception of pipe P324-26 ft. While the replicate measurement did fall out of the +20% range, the detector successfully passed the post use response check. The discrepancy was attributed to differing geometry. In accordance with Section 4.1.2 of the QAPP, based on the professional judgment of the Radiological Engineer, the same conclusion was reached for each measurement. No further action is necessary."
- Unit 2 Containment (Survey Units 2100 and 2110) states there were 12 QC ISOCS measurements taken (3 from under-vessel and nine from the 565 ft elevation). Only 2 out of 12 had adequate resolution for Cs-137, both from the under-vessel area). In the other 10 samples, Cs-137 did not have adequate resolution. In three of these QC samples, the K-40 did not have adequate resolution also. In the Comments/Corrective Actions section, it is stated that "the resolution when using Cs-137 and K-40 while using

the acceptance criteria from NRC Inspection Procedure, No. 84750 was not comparable. IAW Section 4.2.2 of the QAPP, agreement is ultimately determined when the same conclusion is reached for each compared result in the professional opinion of the RE. No further action is necessary."

- The Turbine Building (Survey Unit 6100) release record indicates that three ISOCS measurements were taken and all used K-40 for comparison. From this information, it is assumed that the Cs-137 measurement did not have adequate resolution, but this is not apparent from information contained in the Attachment of this release record.

Phase 3

- Survey Unit 10221B had three QC samples. The licensee used K-40 for two of the samples. Two had no detects in both splits, one had Cs-137 and Co-60 in original sample, but Cs-137 only in the split sample.
- The release record for Survey Unit 10201C states, "The on-site laboratory processed one (1) split sample, L1-10201C-FQGS-012-SS, using gamma spectroscopy analysis. The data was evaluated using acceptance criteria specified in Zion*Solutions* procedure ZS-LT-01. There was not acceptable agreement between field split results for the initial sample. It was suspected that insufficient homogenization was performed for the sample, which was a mix of clay and soil; therefore, the acquisition of a QC sample at location L1-10201C-FQGS-012-SS was re-performed. For the second sample, the analysis indicated that there was acceptable agreement between the split sample and no further action was deemed necessary." The NRC staff note that the samples L1-10201C-FQGS-012-SS and L1-10201C-FSGS-012-SS-A were also analyzed by the off-site laboratory, but those results were not used to also inform the QC comparison.
- The release record for Survey Unit 12112 states, "An anomaly was identified in the gamma spectroscopy results reported by Eberline Analytical for split sample L1-12112A-FQGS-014-SS-A. The Co-60 result for this sample was reported as 1.01 pCi/g. The split sample was returned from Eberline Analytical, and both halves of the split sample were recounted by the on-site laboratory. The "A" sample showed 0.117 pCi/g for Co-60, while the "B" sample showed < MDC for Co-60. It is suspected that the activity was from a small Co-60 particle in the soil matrix that was transferred from the original sample to the "A" split sample."
- The release record for 10220H states, "For both samples there was not acceptable agreement between field split results when using Cs-137 due to the fact that it is present in the samples at relatively low concentrations. However, when using K-40 (which is present in the samples at higher concentrations), there was acceptable agreement. Refer to Attachment 5 for data and QC analysis results."

Phase 4

- Survey Unit 10203A - Comments/Corrective Actions: The standard sample and QC sample did not both have a positive result above MDC for a gamma emitting ROC. Therefore, K-40 was used in the QC comparison. There was acceptable agreement when using K-40. No further action is necessary.
- Survey Unit 10203B - Comments/Corrective Actions: For systematic sample number 5, there was not acceptable agreement between the standard sample and QC sample when using Cs-137. This is due to the fact that Cs- 137 is present at very low concentrations in both samples. However, when using K- 40, which is present in the samples at a higher concentration, there was acceptable agreement. No further action is necessary. For judgmental sample number 1, the standard sample and QC sample did not both have a positive result for a gamma emitting ROC, therefore K-40 was used in the QC comparison. There was acceptable agreement when using K-40. No further action is necessary.
- Survey Unit 10204A - Comments/Corrective Actions: For both sample pairs, the standard sample and QC sample did not both have a positive result for a gamma emitting ROC, therefore K-40 was used in the QC comparison. There was acceptable agreement when using K-40. No further action is necessary.
- Survey Unit 10206A - Comments/Corrective Actions: For systematic sample number 5, the standard sample and QC sample both had positive results for Cs-137. However, the resolution was <4 which is not comparable, therefore K-40 was used in the QC comparison. There was acceptable agreement when using K-40. No further action was necessary. For systematic sample number13, the standard sample and QC sample did not have any positive results for a gamma emitting ROC, therefore K-40 was used in the QC comparison. There was acceptable agreement when using K-40. No further action is necessary.
- Survey Unit 10221D – For L1-10221D-QIGS-0013-SS there was not acceptable agreement between field split results when using Cs-137 due to the fact that it is present in the samples at relatively low concentrations. However, when using K-40 (which is present in the samples at higher concentrations), there was acceptable agreement. No further action was deemed necessary.

Path Forward:
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 QA activities, consistent with the commitments in Section 5.9.3.4 of the Zion LTP.

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

- How QA 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 additional information on what is meant in QC investigations that state "the same conclusion was reached for each measurement" and therefore no further action is necessary.
- 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 replicate or duplicate measurements and comparisons to core sample analysis for the survey units where ISOCS was a primary measurement instrument. The licensee should clarify if the ISOCS QC measurements are replicate measurements or duplicate measurements. This clarification should address the use of NRC IP-84750, "Radioactive Waste Treatment and Effluent and Environmental Monitoring," for ISOCS QC measurements, rather than other evaluation methods described in the QAPP that are used to evaluate results from other measurement systems, such as pipe detectors, that provide radiological data in the same units (pCi/m^2).
- For the duplicate or split measurements that had inadequate resolution, ensure that the licensee is applying Table 4-1 of the QAPP for resolution values.
- For instances where there was high resolution in both the standard and comparison samples, but the comparison failure is attributed to "relatively low concentrations" please provide additional information as per the above bullets in the path forward.

14. <u>QC Failures Inadequately Explained by Low Concentrations of Co-60 in Soil Samples</u>

Comment: Cobalt-60 was positively identified by the licensee in certain QC samples. The quality comparisons for Co-60 failed and the licensee explained the failure was due to low concentrations. This explanation is inadequate given the high resolution of the samples. Additional information available to the licensee on the presence of cobal-60, as discrete particles in soils and sediments, is requested.

Basis: As noted in previous RAIs of this document, discrete particles of cobalt-60 were identified in soil and sediment samples by the licensee and the NRC contractor ORISE during confirmatory surveys. The following are examples of survey units where Co-60 was identified in soil samples, either as a discrete particle or in a soil sample. These examples do not represent a comprehensive list.

- During the course of conducting confirmatory surveys, ORISE collected soil and sediment samples that contained discrete particles in several survey units. Based on survey measurements in the field and laboratory, the survey units that ORISE identified with possible discrete considered are Survey Units 10207D, 12106, 12202D, and 12202F.

- Survey Unit 10202D. The licensee states that "the analytical results of all samples were less than a OpSOF of one when compared to the OpDCGLs. The results of the three investigation samples were also less than an OpSOF of one. It was discovered that there was a small radioactive particle in the soil matrix of sample L1-10202D-FIGS-001-SS. After the small radioactive particle was removed from the sample, the sample L1-10202D-FIGS-001-SS was counted, which resulted in an OpSOF of 0.034." From this description, there is little information on the activity of the discrete particle or its composition.
- Survey Unit 10220I. The release record states, “There was not acceptable agreement for L1-10220I-QJGS-005-SS when using Co-.60 because Co-60 was present in the samples at relatively low concentrations. However, when using Cs-137 (which is present in the samples at higher concentrations), there was acceptable agreement. No further action was deemed necessary.” This sample had a Co-60 value of 0.539 pCi/g, an uncertainty of 0.0351 pCi/g and a resolution of 15.4. The comparison sample had a value for Co-60 of 0.259 pCi/g, an and uncertainty of 0.0226.
- Survey Unit 10221A.The investigation of surface soil sample number L1-10221A-F in Attachment 5, the Standard Sample had a reported Co-60 concentration of 2.1 pCi/g with an uncertainty of 0.0788, and the Comparison Sample had a Co-60 concentration of 1.52 pCi/g with an uncertainty of 0.0636. The comment in the Duplicate Sample Assessment Form states, “For investigation sample #1, the standard sample and QC sample both had positive activity for Co-60 and Cs-137. There was not acceptable agreement on the Co-60 results. This is due to the fact that Co-60 is present in the samples at relatively low concentrations. There was acceptable agreement on the Cs-137 results. No further action is necessary.” However, the Cs-137 and Co-60 concentrations in this soil sample are fairly similar (between 2 and 7 pCi/g), and the sample Minimum Detectable Activities (MDAs) were acceptable. It is recommended the licensee provide further explanation of the Co-60 results, besides attributing results to relatively low concentration of Co-60 in the soil sample.

- In Survey Unit 10220H – For Judgmental Sample number 4, there was not acceptable agreement between the Standard Sample and the QC sample, using either Co-60 or Cs-137. This was attributed to the radionuclides being present at low concentrations. The value for Co-60 is 0.0916 pCi/g with a standard error of 8.94E-03, with a resolution of 10.25.

The Comparison Sample had a concentration of 0.0512 pCi/g with a standard error of 7.14E-03.

Path Forward:

- Review the aforementioned release records to determine the potential for discrete particles of Co-60 in the sample matrix. It is recommended the licensee provide further explanation of the Co-60 results, besides attributing the results to relatively low concentration of Co-60 in the samples matrix.

15. <u>Comparison of On-site Laboratory Data Versus Off-Site Eberline Analytical Data</u>

Comment: An evaluation of the differences observed in the sample results from the on-site gamma spectroscopy measurements and the off-site Eberline Analytical radiological measurements is needed.

Basis: Section 2.2.4, "Laboratory Instrument Methods and Sensitivities," of the Zion LTP states that "gamma spectroscopy was primarily performed by the on-site 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 on-site laboratory under the QAPP]." Additionally, Section 6.2.2 of the QAPP states that "data validation procedures shall be performed for both field and laboratory operations."

The release records do not provide enough information to determine if the sample results from Eberline Analytical were expected to be comparable to the results from the on-site measurement system, 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 on-site measurement system and Eberline Analytical are reported to be the same samples, it is not clear if the two different measurements (i.e., from the on-site measurement system and the Eberline Analytical t) 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 similarly at the onsite and offsite 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 on-site measurement system and Eberline Analytical, and how these differences were considered by the Zion QA program.

Path Forward:

- The licensee should perform a comparison of the on-site measurement system results to the Eberline Analytical results and investigate the potential differences between the two data sets.
- Describe how radionuclide concentration data from the on-site measurement system and Eberline Analytical for the same samples were evaluated and compared under the Zion QAPP.
- Provide additional information on the samples analyzed by the onsite measurement system and Eberline Analytical . For example, provide information on whether the samples analyzed 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 onsite measurement system and Eberline Analytical , and any other differences (e.g., analytical method) that could explain why the on-site measurement system generally reported lower concentrations than Eberline Analytical.

16. <u>Errors in Release Records</u>

Comment: The number and diversity of technical and editorial errors in the release records is excessive. These errors require the NRC staff to perform extensive follow-up as part of the licensing review.

Basis: In the response to RAI 9 in the "Response to Request for Additional Information Related to the Final Status Survey Final Reports for Phases 2a, 2b, and 3" submitted by Zion*Solutions* to the NRC on May 15, 2020, Zion*Solutions* described additional reviews performed on the Phase 4 release records and FSSR to address NRC's previous concerns on the document quality. The NRC has continued to identify some additional errors in the release records.

The following are examples of errors contained in the release records, in addition to the errors summarized in other RAIs.

- Phase 3 Survey Unit 10202D includes errors in which items are bold (i.e., which activity values were above the MDC). This same release record also includes an error in the name of the QC sample in Table 12.
- Phase 3 Survey Unit 12101, Revision 1, Table 16 is missing data for samples L1-12101A-FSGS-014-SS and L1-12101A-FSGS-015-SS. As a result, the maximum value for the OpSOF listed below the table is inconsistent with the information in the table.
- Phase 3 Survey Unit 10220B, Table 14 has an error in the name of the sample (it should be SS instead of SB).
- In Phase 2a Survey Unit 01111, Attachment 2 lists the sample results. Row 2 shows a value of 0.464 for the Base Case SOF. This appears to be a typo (possibly a copy paste

error from the top row, which has the same value). It appears that the SOF for the second row should be 0.072.

- In Phase 4, in Survey Unit 10221C in the scan data, one of the instruments was set to the wrong year (2001).

Additionally, for some samples, the “Identified Nuclide” table in the Apex-Gamma reports does not appear to include all radionuclides measured at levels above the MDA (as reported on subsequent pages of the report). The Zion*Solutions* staff appears to be catching these items when reporting which radionuclides in the main text of the release records, but this artifact of the analytical reports could lead to future reporting errors in sample results.

Path Forward:

- Review future submittals for overall quality and editorial errors.

Items still to be submitted by Zion based on previous discussions:

- Survey Unit 10221B – Release Record stated that remediation was “subsequent” to FSS. ZS said this was a typo and would provide a revised release record.
- Positive Tc-99 results
- Different doses provided for same penetration survey units
- Survey Unit 105A/B &C North Yard Storm Drain (Revised on 10-15-2020) - In the North Yard Storm Drain buried pipe system (Survey Unit 50 A/B/C), elevated areas were identified when a sediment sample was collected from the west access point (L2-10214C-RJGS-001-SM) during the performance of an FSS surveillance. The licensee notified NRC inspectors in June 2019 of the storm drain piping reclassification to a Class 2 survey unit, and the NRC inspectors made a site visit to discuss the issue. Also, the licensee generated CR number ES-ZION-CR-2019-0165 on the reclassification.

  Based on the review of this CR, the licensee should provide additional information on the on-site source of residual radioactivity that contaminated this drain system. Also, the licensee should state whether additional on-site storm drain systems were investigated for similar contamination or were removed from the site.