# ZION*SOLUTIONS*, LLC

# REPORT ON PHASE 1 OF THE REGULATORY AUDIT OF RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION RELATED TO PARTIAL SITE RELEASE AND RECENT SITE SURVEY ACTIVITIES AT ZION NUCLEAR POWER STATION UNITS 1 AND 2

July-August 2022

## 1.0 BACKGROUND AND PURPOSE

The Zion License Termination Plan (LTP) was approved by the U.S. Nuclear Regulatory Commission (NRC) on September 28, 2018, (Agencywide Documents Access and Management System Accession No. ML18163A313). After the licensee performed decommissioning activities and surveys, the licensee submitted the final status survey reports (FSSRs) along with a partial site release (PSR) request dated June 5, 2020 (ML20164A096), that requested the removal of approximately 112 acres of land from the licenses for Zion Nuclear Power Station Units 1 and 2.

Based on its review of the FSSRs and the results of a narrow scope discrete radioactive particle (DRP) survey performed by the NRC and its contractors in April 2021 (ML21267A523), the NRC staff determined that additional information was needed to complete its review of FSSRs and approve the partial site release request (i.e., to reach a reasonable assurance determination that the licensee has demonstrated that they meet the criteria in 10 CFR Part 20 for unrestricted release). The NRC issued 11 Requests for Additional Information (RAIs) dated August 19, 2021 (ML21231A187), and October 14, 2021 (ML21238A067). By letter dated March 8, 2022 (ML22069A329), the licensee submitted its responses to the 11 RAIs. By letter dated March 23, 2022, the licensee also submitted a License Amendment Request (LAR) to the LTP.

On February 8, 2022, the review of the Zion FSSRs was placed on hold pending receipt of all survey result reports from areas re-surveyed since April 2021, confirmation that all site work is finished, and receipt of complete and adequate responses to all 11 RAIs (ML22040A116). All survey results were needed for the staff to risk-inform its review of the RAI responses; therefore, a review of these responses would not be conducted until all items were received. Based on a preliminary review of the March 2022 RAI responses, the NRC staff considered it would be beneficial to discuss the RAI responses and supporting material at a high level to facilitate a common understanding while the project remains on hold, which led to the audit.

The audit report does not make any licensing conclusions or findings, but it is an administrative record of the NRC staff's preliminary review of the RAI responses dated March 8, 2022, and may provide information supporting the NRC's staff's upcoming review of the License Amendment Request for the LTP. The NRC's audit plan was issued on July 19, 2022 (ML22200A007).

## 2.0 REGULATORY AUDIT BASIS

The basis for the audit is the regulations in Subpart E, "Radiological Criteria for License Termination", and Subpart F, "Surveys and Monitoring", of 10 CFR Part 20.

## 3.0 AUDIT SCOPE AND ACTIVITIES

During this audit, staff reviewed the licensee's responses to RAIs 1 and 10 and discussed information provided by the licensee on the docket. RAIs 1 and 10 were the focus as RAI 1 requested information concerning the origin and characteristics of the particles and chunks of residual material, and RAI 10 requested information about the licensee's surveys and the potential dose of the particles. Audit meetings were held virtually through Microsoft Teams on July 19-20, 2022, and August 24-25, 2022. The discussions focused on the on extent, purpose, and technique of surveys. Discussions were based on the staff's preliminary review of the March 2022 RAI responses, and supplemental documents were not reviewed as part of the audit.

Members of the audit team are listed below:

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|---|---|
| Kim Conway | Project Manager |
| Greg Chapman | Senior Health Physicist |
| Leah Parks | Risk Analyst |
| Karen Pinkston | Risk Analyst |
| Louis Caponi | Risk Analyst |

## 4.0 DISCUSSION AND SUMMARY OF OBSERVATIONS

To approve the partial site release request, the NRC needs to make a determination that the current site conditions are consistent with 10 CFR 20.1402 and that the site has been adequately characterized per 10 CFR 20, Subpart F. The information needed to justify this determination includes an adequate characterization of each survey unit that reflects the final site conditions and the extent to which any residual radioactivity remains below grade (i.e., physical configuration and radiological activity). This information is needed to reasonably estimate potential exposures and risks to future site occupants and to support the determination that the radiological conditions at the site are consistent with the NRC regulations. The NRC identified gaps in the information provided by Zion to date and issued 11 RAIs dated August 19, 2021 (ML21231A187), and October 14, 2021 (ML21238A067). Without adequate answers to the RAIs, the NRC staff will not be able to make the determination that there is reasonable assurance that the criteria have been met to grant the partial site release.

The NRC appreciates the licensee's support of this regulatory audit. During the audit, the licensee made key personnel available for extended discussions related to RAIs 1 and 10, clarified information submitted in the RAI response, and provided additional information for NRC staff to consider. Based on these discussions, staff have a better understanding of the licensee's logic for the surveys performed and the timing of key activities on the site. For example, the licensee provided additional clarifications and information on:

- the site history, including the timing of key site activities, such as the movement of soil and the timing of surveys done for the affected areas;
- their approach for surveying for DRPs, including the process for determining which areas it selected for DRP surveys, the use of the towed array surveys as a method for identifying areas for follow-up investigative surveys involving hand scanning, and the applicability of surveys that were not explicitly DRP surveys but were performed with DRP Data Quality Objectives (DQOs);
- revisions to consider uncertainty in the estimate of particles remaining onsite and the probability of interacting with a particle; and,

- the justification for key assumptions in the biokinetic models utilized for their dose evaluation.

During the audit, the licensee indicated that they intend to provide additional information on the docket and to revise some of the RAI responses. The licensee indicated that some of the information previously provided on the docket has been superseded by more recent information and is not accurate. The NRC staff noted that in cases where the licensee intends to provide information that supersedes previous RAI responses, clear documentation is needed for what information is no longer valid.

**Topics of Audit Discussion**

*Site History Narrative*

The licensee stated that they intended to provide a more detailed narrative regarding the site history and surveys performed on the docket after the audit. The NRC staff agrees that this type of information will be useful in identifying the areas of highest concern to risk-inform its review and support conclusions on final site conditions.

To the extent that additional information is available, areas where additional narrative would be helpful include:

- movement of soil across the site in relation to when the final status surveys (FSSs) were conducted;
- in areas where there have been changes to the configuration of the site (e.g., movement of soil into or out of the survey unit), the basis for why the previous characterization remains applicable and data to support this basis (e.g., surveillance survey data); and
- the timing and locations of waste handling activities or other site work that influenced the source, release, and potential transport mechanisms of particles.

*Isolation and Control*

To reach a determination that the site meets the characterization criteria in 10 CFR Part 20 Subpart F and 20.1402, the NRC evaluates information on the process used for isolation and control and any supplemental surveys performed (and their results) when isolation and controls might have been broken such as haul paths through survey units that have previously received FSS, or grading operations that affect the final site conditions. Breakdowns in isolation and control after FSS would affect the NRC's ability to evaluate the current conditions of the site for both typical diffuse residual radioactivity as well as DRPs. Based on the discussion, the staff sought to better understand whether there was a breakdown in isolation and controls after FSS that might affect whether the FSSs are reflective of the final site conditions. Staff discussed possible efficiencies could be gained if a list of applicable FSSRs is provided in cases where multiple FSSRs have been submitted for survey units. If the licensee is unable to provide adequate justification that survey information corresponds to the final site conditions (e.g., the current state of site grading), the licensee may need to redo, as appropriate, FSS and/or surveillance survey(s).

*Adequacy of DRP Survey Coverage*

During the audit, much of the discussion focused on areas excluded from the DRP survey plan. Specifically, the NRC staff noted that the response provided by the licensee for excluding areas from the DRP survey plan and addressing potential particles left below the top layer of soil (below 15 cm) relies on multiple previous surveys supporting operations, some of which were not explicitly designed to detect DRPs. Therefore, the licensee must demonstrate that their surveys appropriately account for DRPs or have a reasonable justification for why DRPs would not reasonably be present in survey units that are excluded from the DRP survey.

During the audit, the licensee stated that some of their surveys met the DQOs for DRPs even if they were not specifically designed for DRPs. The NRC staff will consider the licensee's position and noted that surveys that were not specifically designated "DRP surveys" could be considered for characterization of particles in those areas if: the DQOs were appropriate for finding the particles of interest, the results are well documented as supplements to the FSS, and there was no breakdown in isolation and control after the survey was completed.

*Dose/Risk Assessment for Particles*

The licensee has addressed some, but not all, of the potential exposure concerns for public exposure to DRPs after license termination and staff have a better understanding of the licensee's dose assessment after completion of this audit phase. The NRC staff has communicated the need to understand what residual materials may reasonably be left on the site and the associated potential dose/risk in order to make a regulatory decision as to the site's acceptability for license termination. The licensee's response to the RAIs provides a significant amount of information about the potential dose from DRPs, and their revised response is anticipated to include further technical details as discussed in the audit. The NRC staff will consider any supplemental information provided in the revised RAI responses, along with the previous submitted information that is not superseded, to evaluate the risk from residual DRPs during the full technical evaluation.

One area of focus during the full technical review will be the potential for DRPs remaining at depth below the ground surface because they are difficult to detect. During the audit, the NRC noted that the licensee had not yet provided complete information on the activity/size of DRPs that may be left below the ground surface.

Another point of discussion during the audit was the minimum detectable activity (MDA) of the towed array as compared to that of traditional hand scanning. The licensee clarified during the audit that the towed array scanning is used to identify areas for DRP investigations, which are investigated using hand scanning methods. Staff noted this approach for identifying areas to investigate relies on an understanding of the sensitivity and variability imposed by the survey technique and discussed several factors that need to be considered (i.e., response rate, surface roughness, depth of the potential DRPs, etc.) to assess whether the paired approach is a reasonable survey. The staff further noted, based on the licensee's field performance test of the towed array methodology (ML22111A184), that the towed array scanning generally appears less sensitive than hand scanning for identifying DRPs, but that no direct comparison of the two methods has been performed. The licensee should consider providing hand scanning MDAs to facilitate staff evaluation of the DRP investigations.

Regarding the risk assessment, the NRC staff commented that the probability of ingesting or interacting with a particle in the RAI response did not account for uncertainty in the number of particles remaining. The licensee indicated that a revised estimate would be provided that would supersede the estimate of 31 particles remaining onsite and that the licensee believes this

revised number is reasonably bounding. The NRC staff also noted that for skin dose estimate, the licensee should consider estimating the skin dose equivalent (SDE), and not translate the SDE to the equivalent cancer risk associated with 25 mrem/yr.

In order to adequately assess the potential dose of future site occupants, the staff discussed the technical details that could help to provide sufficient risk information and inform staff's evaluation. Examples include: varying the size of DRPs to include 10 micron effective aerodynamic diameter when assessing potential respiratory intakes; varying the selection of F1 transfer factors to show a more consistent basis for appropriate biokinetic models when assessing ingestion intakes; varying the size/radioactivity of DRPs based on scanning sensitivity for DRPs at depth; varying the size of "area averaging" for determining skin dose to include a 1 $cm^2$ area; assessing an exposure scenario based on collecting chunks or artifacts larger than DRPs; etc. Staff requested that the licensee consider these issues and provide reasonable variations to their assessments to best evaluate the potential range of public risk from exposure to DRPs.

## 5.0 EXIT BRIEFING

A closeout meeting for this audit was conducted on September 8, 2022, to note observations above related to RAIs 1 and 10. The NRC appreciates the licensee's support of this regulatory audit.

The staff noted that additional clarity and efficiencies could be gained by:

- identifying the survey(s) and results that the licensee is relying on for demonstrating compliance with NRC regulations for residual radioactivity (radionuclides of concern and DRPs);
- identifying whether there have been any breaks in isolation and control for the survey unit after the survey(s) were performed; and
- identifying the minimum detectable concentration (MDC)/MDA associated with the survey(s) (including subsurface DRPs) and updating the technical details in the dose assessment as discussed above.

The NRC staff communicated that the licensee should review its responses to all 11 RAIs considering the audit discussions and revise or provide supplemental information on the docket as appropriate.

## 6.0 REQUESTS FOR ADDITIONAL INFORMATION RESULTING FROM AUDIT

No additional RAIs were identified as a part of this audit phase.

## 7.0 PROPOSED CLOSURE PATHS

At the exit briefing on September 8, 2022, the licensee noted that they intended to submit supplemental information on the docket and a revision to its March 2022 RAI response to provide additional clarity based on audit discussions.

Report on Phase 1 of the Regulatory Audit for Zion Nuclear Power Station Units 1 and 2 DATE November 17, 2022

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