



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

October 14, 2021

Mr. John Sauger  
General Manager  
Zion Restoration Project  
ZionSolutions, LLC  
101 Shiloh Boulevard  
Zion, IL 60099-2797

SUBJECT: ZION NUCLEAR POWER STATION, UNITS 1 AND 2 - REQUEST FOR  
ADDITIONAL INFORMATION RELATED TO PARTIAL SITE RELEASE AND  
RECENT SITE SURVEY ACTIVITIES (EPID L-2020-DSR-0000)

Dear Mr. Sauger:

Beginning in November 2018, ZionSolutions, LLC (ZS, the licensee), requested U.S. Nuclear Regulatory Commission (NRC) review of the Final Status Survey Report (FSSR) for the Zion Nuclear Power Station, Units 1 and 2 (ZNPS, also referred to as Zion) by letters dated:

- November 1, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18331A016);
- June 21, 2019 (ADAMS Accession No. ML19178A109);
- March 11, 2019 (ADAMS Accession No. ML19077A095);
- September 30, 2019 (ADAMS Accession No. ML19295G627);
- November 25, 2019 (ADAMS Accession No. ML19338B809);
- December 30, 2019 (ADAMS Accession No. ML20009E643);
- April 30, 2020 (ADAMS Accession No. ML20147A092); and
- May 1, 2020 (ADAMS Accession No. ML20133J976).

These requests were supplemented by letters dated:

- May 15, 2020 (ADAMS Accession No. ML20147A128);
- June 4, 2020 (ADAMS Accession No. ML20167A280);
- November 11, 2020 (ADAMS Accession No. ML20351A154);
- February 10, 2021 (ADAMS Accession No. ML21067A225);
- April 2, 2021 (ADAMS Accession No. ML21103A229);
- April 15, 2021 (ADAMS Accession No. ML21112A166); and
- May 11, 2021 (ADAMS Accession No. ML21131A072).

These submittals also support the ZNPS partial site release request received on June 5, 2020 (ADAMS Accession No. ML20164A096), which would remove a 112-acre portion of the site from ZNPS License Nos. DPR-39 and DPR-48. These licenses were issued pursuant to Part 50, "Domestic Licensing of Production and Utilization Facilities," of Title 10 of the *Code of*

*Federal Regulations* (10 CFR). The proposed action would effectively terminate the ZNPS 10 CFR Part 50 licenses outside the footprint for the remaining onsite Independent Spent Fuel Storage Installation (ISFSI), which encompasses approximately 5 acres.

Specifically, ZS intends to remove an area from its license consisting of 7 basement survey units and 116 land survey units (including 3 below grade excavation survey units), and 5 buried piping survey units. This action will represent the completion of decommissioning activities at the ZNPS site until such time as the ISFSI is no longer needed for the storage of spent fuel and is subsequently decommissioned. The FSSR is the documentation that demonstrates completion of the activities described in the License Termination Plan (LTP), which was submitted by letter dated December 19, 2014 (ADAMS Accession No. ML15005A336), as supplemented by letters dated:

- February 26, 2015 (ADAMS Accession No. ML15061A281);
- November 12, 2015 (ADAMS Accession No. ML15344A344);
- March 8, 2016 (ADAMS Accession No. ML17129A311);
- July 20, 2016 (ADAMS Accession No. ML16211A200);
- February 27, 2017 (ADAMS Accession No. ML17208A121);
- July 20, 2017 (ADAMS Accession No. ML17215A095);
- February 7, 2018 (ADAMS Accession Nos. ML18052A529 and ML18052A851);
- April 10, 2018 (ADAMS Accession No. ML18103A016); and
- August 28, 2018 (ADAMS Accession No. ML18242A082).

The Zion LTP was approved by the NRC on September 28, 2018 (ADAMS Accession No. ML18163A223). The LTP provided the details of the plan for characterizing, identifying, and remediating the remaining residual radioactivity at the ZNPS site to a level that will allow the site to be released for unrestricted use. The LTP also described how the licensee will confirm the extent and success of remediation through radiological surveys, as captured in the FSSR, provide financial assurance to complete decommissioning, and ensure that the environmental impacts of the decommissioning activities are within the scope originally envisioned in the associated environmental documents. The NRC staff is reviewing the FSSR and the associated partial site release request to ensure that the removal of these 128 survey units from the 10 CFR Part 50 license demonstrates satisfaction of the criteria for unrestricted release contained in Subpart E, "Radiological Criteria for License Termination," of 10 CFR Part 20, "Standards for Protection Against Radiation."

The NRC staff reviewed the subject submittals and determined that additional information is needed to complete its review. Requests for information (RAIs) 1-9 and RAI-11 were provided to the licensee on August 19, 2021 (ADAMS Accession No. ML21231A187). As noted in the August 19, 2021 letter, RAI-10 is provided separately as an enclosure to this letter. RAI-10 was discussed with ZS during a teleconference with the NRC staff on September 22, 2021. In order to continue the review of the ZNPS FSSR and partial site release, please respond to these RAIs in a timely fashion.

In accordance with 10 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 ADAMS. ADAMS is accessible from the NRC Web site at <https://www.nrc.gov/reading-rm/adams.html>.

J. Sauger

- 3 -

If you have any questions regarding this request or the ongoing partial site release review, please contact me at (301) 415-1335 or via e-mail at [Kimberly.Conway@nrc.gov](mailto:Kimberly.Conway@nrc.gov).

Sincerely,



Signed by Conway, Kimberly  
on 10/14/21

Kim A. Conway, 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-48

Enclosure: Request for Additional Information 10

cc w/enclosure: Zion Listserv



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

REQUEST FOR ADDITIONAL INFORMATION

RELATED TO THE ZIONSOLUTIONS, LLC

PARTIAL SITE RELEASE REQUEST AND RECENT SITE SURVEY ACTIVITIES

ZION NUCLEAR POWER STATION, UNITS 1 AND 2

DOCKET NOS. 50-295 AND 50-304

The NRC staff is reviewing the Zion FSSR and the associated partial site release request to ensure that the proposed removal of 128 survey units from the ZNPS 10 CFR Part 50 licenses satisfies the criteria for unrestricted release contained in Subpart E of 10 CFR Part 20. The NRC staff has reviewed the FSSR submittals and supplements provided to date, as well as the results from the April 2021 inspection survey (ADAMS Accession No. ML21267A523) and determined that additional information related to current radiological conditions at the site and potential remediation is needed to complete its review. RAIs 1-9 and RAI-11 were provided to the licensee on August 19, 2021 (ADAMS Accession No. ML21231A187). As noted in the August 19, 2021 letter, RAI-10 is provided separately below. The information gathered in response to these RAIs will be used, in part, by the NRC staff to perform additional risk assessments and/or dose calculations to determine whether there is reasonable assurance to grant ZNPS' partial site release request without undue risk to public health and safety, or impact on the environment.

**10. Dispositioning the Remaining Discrete Radioactive Particles at the Zion Facility**

**Comment:** As noted in RAI-1 in the NRC letter dated August 19, 2021 (ADAMS Accession No. ML21231A187), the NRC staff and its independent contractor, Oak Ridge Institute for Science and Education, found several discrete radioactive particles during a limited-scope confirmatory survey in April 2021. Since the survey was completed, the licensee has subsequently found several pieces of radioactive material, including discrete radioactive particles and solid materials with radioactive contamination at the site. The presence of discrete radioactive particles and other solid material with radioactive contamination after the Zion Final Status Surveys (FSS) were completed calls into question the previous surveys' adequacy for detecting such radioactive materials, as well as the possibility of redistribution of radioactive materials after FSS were completed.

The NRC staff requires additional information to determine compliance with 10 CFR 20.1402, "Radiological criteria for unrestricted use," because of the discovery of discrete radioactive particles and other solid objects with radioactive contamination during the April 2021 survey and afterward.

One approach available to the licensee is to consider developing a new survey plan specifically designed to detect discrete radioactive particles that may remain at the site, concurrent with the remediation of any detected discrete radioactive material. As part of this survey plan, the licensee could send discrete radioactive particles detected during the survey to a laboratory for analyses to inform dosimetry with respect to demonstrating compliance with 10 CFR 20.1402. In this approach, the licensee would estimate the dose from remaining particles that were not detected and collected during the survey (i.e., discrete radioactive particles with activity levels less than the Minimum Detectable Activity (MDA) of the survey method). This information, along with an FSS Record for the survey, would be provided to the NRC staff for the purpose of demonstrating compliance with 10 CFR 20.1402.

An alternative approach to providing a new survey plan is for the licensee to submit a detailed dose assessment, along with the results of a characterization survey, to inform dose assessment assumptions and justify that the discrete radioactive particles remaining at the site meet the requirements of 10 CFR 20.1402, which requires the total effective dose equivalent to an average member of the critical group does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable. The alternative approach should be consistent with current the NRC regulatory bases in 10 CFR Part 20 (International Commission on Radiological Protection [ICRP] Publication 30 (ICRP-30), "Limits for Intakes of Radionuclides by Workers," and Federal Guidance Report No. 11 (FGR-11), "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion").

Either approach may require a license amendment, in accordance with the Zion LTP change criteria (ADAMS Accession No. ML21231A187) and 10 CFR 50.90. The licensee should compare the contents of its submittal to NRC regulations and the LTP change criteria to determine if a license amendment is required under the chosen approach and provide the results of this analysis to the NRC with its submittal.

**Basis:** 10 CFR 20.1402 establishes the requirements for the release of a site for unrestricted use. The Zion LTP included Derived Concentration Guideline Levels (DCGLs) to meet this requirement. However, as noted in RAI-1 in the letter dated August 19, 2021, the DCGLs approved in the LTP do not apply to discrete radioactive particles (ADAMS Accession No. ML21231A187). Specifically, the assumption inherent in the approved dose model in the LTP is that there are no discrete radioactive particles and the residual radioactivity concentrations are averaged over a larger defined area than the size of the discrete radioactive particles found during the April 2021 survey and afterwards by the licensee.

Alternative methods for demonstrating compliance with 10 CFR 20.1402 are provided in NUREG-1757, "Consolidated Decommissioning Guidance," Volume 1, "Decommissioning Process for Materials Licensees," Revision 2, Section 15.4.3, "Final Status Survey." Although this guidance was not prepared with consideration of discrete radioactive particles, it provides general information on alternative methods considered acceptable to the NRC staff for evaluating licensee proposals using survey methodologies other than those that are part of the current, NRC-approved Zion LTP.

Survey methods should be appropriate to detect discrete radioactive particles that may remain at the Zion site, which is not the case for the survey methods described in the Zion LTP. Therefore, the licensee should consider developing a new survey plan specifically designed to detect discrete radioactive particles that may remain at the site for the purpose of demonstrating compliance with 10 CFR 20.1402 or otherwise demonstrate such compliance.

Current guidance for conducting radiological surveys and dose modeling, such as NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," Revision 1, and NUREG-1757, Volumes 1 and 2, do not contain detailed information on acceptable methods for demonstrating compliance with 10 CFR 20.1402 when residual radioactivity includes discrete radioactive particles. Due to the lack of this guidance information, this RAI provides information for the licensee to consider in preparing a new survey plan for conducting a survey for discrete radioactive particles at the Zion site.

**Request for Additional Information:**

The licensee should demonstrate how its FSS meets 10 CFR 20.1402, or propose a revised survey plan specifically designed for detecting and removing discrete radioactive particles. Goals of this survey would be to: (1) detect discrete radioactive particles; (2) remediate detected discrete radioactive particles ; (3) determine the radionuclide composition and activity of the collected particles; (4) estimate the number of discrete radioactive particles that may remain at the site after the survey is completed (i.e., discrete radioactive particles either missed or below the MDA); and (5) facilitate collection of information necessary (physical and chemical properties) to estimate the radiation dose from discrete radioactive particles that may remain at the Zion site after the survey is completed. In developing its survey plan, the licensee should consider the information provided below, in addition to other applicable resources, as it applies to the Zion facility. In this approach, it is expected that the licensee would collect discrete radioactive particles that were detected during the survey, and then analyze them to better understand their characteristics and impact on the final site assumptions.

Due to the lack of specific NRC guidance on planning and conducting surveys for discrete radioactive particles at this time, the staff is providing the following information that the licensee may consider when developing its survey plan, if it chooses to develop a survey plan. Overall, the licensee should consider using the Data Quality Objectives Process, as recommended in the existing NRC guidance for planning decommissioning surveys. In addition, the survey plan should take into account the results from the limited-scope NRC confirmatory conducted in April 2021 and describe which portions of the site are to be surveyed, along with the rationale for any portions of the site not included in the survey. This rationale should consider information on the source and transport of the discrete radioactive particles provided in response to RAI-1 in the NRC letter dated August 19, 2021 (ADAMS Accession No. ML21231A187). Also, when designing the survey plan and determining the MDA for discrete radioactive particles, the licensee should consider the investigation levels that may require a change to the Zion LTP (i.e., ZNPS License Condition 2.C.(17) Criterion F).

### Specific Considerations

1. The NRC staff offers the following information relevant to scan sensitivity of survey instruments for surveying the Zion discrete radioactive particles:
  - a. The results of the limited-scope NRC confirmatory survey in April 2021 identified three types of discrete radioactive particles at the site: (1) cobalt-60 primarily, with other activation products, in the form of activated metal; (2) potentially activated bioshield concrete; and (3) potentially irradiated fuel fragments. One of the objectives of scoping for the revised survey should be a determination of an appropriate surrogate ratio that is based on adequate characterization information. For each particle type, consider the use of surrogates for hard-to-detect radionuclides and for the calculation of total activity. In addition, consider how differences in radionuclide composition of the bioshield concrete and irradiated fuel fragments would be taken into account for calculating the scan MDAs. Relevant information from the licensee's RAI responses to the NRC letter dated August 19, 2021 (ADAMS Accession No. ML21231A187) should be also be taken into account.
  - b. For estimating the revised scan sensitivity of the survey instruments, expressed as a scan MDA, the scan MDA equation should be adjusted for a decreased observation interval for a particle in comparison to a diffuse source of residual radioactivity.
  - c. The detector speed over the land surface during the survey (e.g., 0.25 meter per second or other value) and the transect width of the survey path should be factored into the scan MDA calculation and the survey design, accordingly.
  - d. If collimators are used on the detectors, an estimate of the change in detector response (e.g., axial response and reduced background), as well as how the collimated detectors are addressed in the survey plan and scan MDA equation, should be considered. Additional factors, such as a shorter observation interval as noted in item 1B above, should be considered for estimating the revised scan MDA if detectors with collimators are used for the survey.
  - e. The method for calculating the efficiency of the detector should be described in the survey plan. If collimators are used on the detectors, the calculation method should account for the detector response, as noted in item 1D above.
  - f. A range of scan sensitivities for discrete radioactive particles located between the land surface and six inches or deeper below the land surface should be considered in the survey design. The assumed depth of particles informing the survey design should take into account the likely actual depth of the particles given the site history and prior survey results. For example, a "worst-case" scan MDA may be calculated for discrete radioactive particles located at 6 inches *or deeper* below the land surface, and/or the depth below which a discrete radioactive particle of nominal activity cannot be detected. Then, an upper bound on the range of scan sensitivity and discrete radioactive particle detection may be calculated as a "best-case" scan MDA, where the discrete radioactive particle is located on the land surface.

- g. The survey protocol should consider how the surveyor will pause during the survey, using the output signal from the detector to identify suspect discrete radioactive particles. Also, the survey protocol should consider the investigation level as a second stage, in units of counts per minute above the background count rate.
  - h. In addition to surveyors monitoring survey instrument physical meter movements and pre-set alarms, the existing NRC guidance on survey techniques recommends the use of additional methods to improve the human performance factors, such as headphones, to aid the surveyor's efficiency and ability to identify areas of concern when performing surveys. The revised survey plan should consider the use of headphones or other means for improving the surveyor performance for detecting discrete particles or other areas of concern.
  - i. Personnel training should be considered to ensure that surveyors can achieve the performance bases of the survey protocol (e.g., the assigned surveyor efficiency, maintaining detector distance to the land surface at the assigned scan speed, etc.).
2. The NRC staff offers the following considerations for developing a revised sample collection and laboratory analysis procedure relevant to the Zion discrete radioactive particles to be collected during the surveys:
- a. A systematic soil sampling plan should take into account a chosen confidence level for the purpose of performing statistical tests to determine what proportions of the investigation areas are impacted/not impacted by the presence of discrete radioactive particles and below the scan sensitivity of the survey.
  - b. The revised sample collection procedures should consider how discrete radioactive particles will be isolated and collected during the survey. In addition, this procedure should consider the process used for collecting soil around any discrete radioactive particles identified, and separate laboratory analyses of those soils.
  - c. Revised sample collection procedures and planned laboratory analyses for discrete radioactive particles found during the survey should consider additional identification measures, such as labeling of sample containers with discrete radioactive particles, for the protection of laboratory personnel.
  - d. Revised laboratory analysis procedures should consider the radionuclide composition and radioactivity levels of the discrete radioactive particles, taking into account relevant information from the licensee's RAI responses to the NRC letter dated August 19, 2021 (ADAMS Accession No. ML21231A187). The licensee should direct laboratory analyses to include the range of radionuclides potentially present based on operational and decommissioning history, and not rely solely on the radionuclide compositions identified in the limited-scope April 2021 survey.



- e. In addition to the radioanalytical procedures described above, the licensee should consider obtaining information on the physical and chemical characterization of collected discrete radioactive particles that are relevant to internal dosimetry calculations (e.g., the size of each particle, as well as the chemical solubility in simulated lung and digestive-tract fluids). Note that in the absence of specific information on discrete radioactive particle size and solubility characteristics, default assumptions from ICRP-30 (i.e.,  $f_1$  values and inhalation class) are applied for internal dose calculations.
3. The revised survey plan should consider the following information for developing a dose estimate for discrete radioactive particles at the MDA:
    - a. Consider the range of potential discrete radioactive particles that were not detected during the survey (below MDA), taking into account the likely radionuclide composition, activity, physical size, depth beneath the surface, and chemical composition. See item 1F above for information concerning MDA ranges and detection capability. Also see RAI-1 in the NRC letter dated August 19, 2021, for additional information on origin of the particles and potential source terms (ADAMS Accession No. ML21231A187). The NRC staff notes that the Zion LTP dose modeling uses dose coefficients from FGR-11, which is based on ICRP-30.
    - b. Scenarios that should be considered include inhalation, ingestion, and skin exposures to remaining discrete radioactive particles. For inhalation and ingestion, the anticipated particle size ranges should account for particle size change over the 1,000-year compliance period. For ingestion, the technical basis for selection of the  $f_1$  value (fraction of ingested element absorbed directly into the body fluids) should be provided, based on the chemical compositions of activated metal, activated bioshield concrete, and irradiated fuel fragments. For skin exposures, the shallow dose equivalent and deep dose equivalent from discrete radioactive particle exposures to the skin for 24 hours should be considered. The calculations should consider the range of cobalt-60 (only) discrete radioactive particles, as well as the radionuclide mixes that comprise activated concrete from the bioshield and irradiated fuel fragments. VARSKIN Version 6.2.1 should be used for these calculations.
    - c. Consider updating the previous estimate of the number of discrete radioactive particles that may remain after the survey and collection activities are completed, which was based on the presence of one particle in every 50 centimeters (diameter) of the land surface (see the licensee's response to RAI-11 d in the letter dated February 10, 2021 (ADAMS Accession No. ML21067A225)). The estimate of the number of particles should consider the potential for discrete radioactive particles remaining below the surface and should consider the likely location of the particles given their origin and transport mechanisms (see RAI-1 in the NRC letter dated August 19, 2021 (ADAMS Accession No. ML21231A187)).

4. The revised survey plan, if developed, should consider the following information for addressing the survey area coverage during a future survey:
  - a. A description of the areas surveyed and the rationale for not performing additional surveys of specific site areas. The rationale should consider information for any areas not surveyed previously, as well as relevant information from the licensee's RAI responses to the NRC letter dated August 19, 2021 (ADAMS Accession No. ML21231A187).
  - b. The scan coverage for each of the survey units and whether survey unit coverage will increase if a discrete radioactive particle is detected in a survey unit.
5. The results of the survey and calculations should be submitted to the NRC. The licensee should provide a commitment to share the survey results with the NRC staff in the form of an FSS Record after the surveys and calculations have been completed. The result of the survey should include, as a minimum, the following information consistent with the considerations described in this RAI:
  - a. The number of discrete radioactive particles detected during the licensee's survey activities and their location.
  - b. The radionuclide composition and activity of the collected particles, along with a description of the laboratory analyses performed. Particles collected during the survey should be analyzed by an offsite laboratory for their radionuclide composition. This information is necessary given the discovery of unexpected particles of initially undetermined origin and radiological composition during the April 2021 survey.
  - c. An estimate of the number of discrete radioactive particles that may remain at the Zion site after the survey is completed (i.e., discrete radioactive particles either missed or below the MDA).
  - d. An estimate of the radiation dose from the particles that may remain at the Zion site after the survey is completed. In developing its survey plan, the licensee should consider, as a minimum, the information provided in this RAI, as it may apply to the Zion facility.

Zion RAI No. 10 Letter on April 2021 Survey Results DATE October 14, 2021

**DISTRIBUTION:**

- RidsNmssDuwpRdb, NMSS
- RidsRgn3MailCenterResource, RGN III
- DHills, R-III/DNMS/MCID
- REdwards, R-III/DNMS/MCID
- BLin, R-III/DNMS/MCID
- PHolahan, NMSS/DUWP
- AHuffert, NMSS/DUWP/RDB
- KPinkston, NMSS/DUWP/RTAB
- LParks, NMSS/DUWP/RTAB

**ADAMS Accession No.: Ltr ML21238A067**

**\* via email**

OFFICE	NMSS/DUWP/RDB	NMSS/DUWP/RDB	OGC/GCRPS/RMR /NLO*	NMSS/DUWP/RDB
NAME	KConway <i>KC</i>	BWatson <i>BW</i>	AGendelman <i>AG</i>	KConway <i>KC</i>
DATE	Oct 6, 2021	Oct 14, 2021	Oct 14, 2021	Oct 14, 2021

**OFFICIAL RECORD COPY**