

20.0 REQUIREMENTS RESULTING FROM FUKUSHIMA NEAR-TERM TASK FORCE RECOMMENDATIONS

20.3 Reliable Spent Fuel Pool Instrumentation (Based on Recommendation 7.1)

20.3.1 Introduction

During the events in Fukushima, responders were without reliable instrumentation to determine the water level in the spent fuel pool (SFP). This caused concerns that the pool may have boiled dry, resulting in fuel damage, and highlighted the need for reliable SFP instrumentation. The SFP level instrumentation at United States (U.S.) nuclear power plants is typically narrow range and, therefore, only capable of monitoring normal and slightly off-normal conditions. Although the likelihood of a catastrophic event affecting nuclear power plants and the associated SFPs in the U.S. remains very low, beyond-design-basis external events could challenge the ability of existing spent fuel pool instrumentation in providing emergency responders with reliable information on the condition of SFPs. Reliable and available indication is essential to ensure plant personnel can effectively prioritize emergency actions.

SECY-12-0025, Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami” states that the staff will request all combined license (COL) applicants to provide the information required by the orders and request for information letters described in SECY-12-0025, as applicable, through the review process. With regard to Recommendation 7.1 for reliable spent fuel pool instrumentation, SECY-12-0025 notes that the AP1000 standard design includes two permanently fixed safety related level instruments with the capability for a third instrument connection.

JLD-ISG-2012-03, Revision 0, “Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation,” (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12221A339), endorses with exceptions and clarifications the methodologies described in the industry guidance document, NEI 12-02, Revision 1, “Industry Guidance for Compliance with Nuclear Regulatory Commission (NRC) Order EA-12-051, To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,” (ADAMS Accession No. ML122400399) and provides an acceptable approach for satisfying the applicable requirements.

20.3.2 Summary of Application

The NRC issued request for additional information (RAI) Letter No. 108 dated March 15, 2012, concerning spent fuel pool instrumentation. The applicant responded to the staff’s RAI in letters dated April 25, June 19, August 1, September 27, October 15, and October 31, 2012, and January 18 (ADAMS Accession No. ML130230378), April 5, and May 13, 2013. As part of the RAI response, the applicant submitted a Westinghouse report, APP-SFS-M3R-004, “Response to NRC Orders EA-12-051 and EA-12-063 and Background Information for Future Licensees on AP1000 Spent Fuel Instrumentation.” The RAI responses also proposed adding supplemental information to the final safety analysis report (FSAR) and proposed a license condition.

Supplemental Information

- LNP SUP 9.1-1

The applicant provided supplemental information LNP SUP 9.1-1 addressing spent fuel pool instrumentation in FSAR Section 9.1.3.7.

License Condition

- Part 10, License Condition 12.B

The applicant proposed to add a license condition related to reliable personnel training for spent fuel pool instrumentation to Part 10 of the COL application:

20.3.3 Regulatory Basis and Guidance

The requirements and guidance for reliable spent fuel pool instrumentation are established or described in the following:

- SRM-SECY-12-0025, “Staff Requirements – SECY-12-0025 – Proposed Orders and Requests for Information in Response to Lessons Learned from Japan’s March 11, 2011, Great Tohoku Earthquake and Tsunami,” dated March 9, 2012, approves issuance of orders for reliable spent fuel pool instrumentation under an administrative exemption to the Backfit Rule and the issue finality requirements in 10 CFR 52.63 and 10 CFR Part 52, Appendix D, Paragraph VIII.
- Atomic Energy Act of 1954, as amended, (the Act), § 161, authorizes the Commission to regulate the utilization of special nuclear material in a manner that is protective of public health and in accord with the common defense and security.
- JLD-ISG-2012-03, Revision 0, “Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation,” issued August 29, 2012, endorses NEI 12-02, Revision 1, “Industry Guidance for Compliance with NRC Order EA-12-051, To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,” with exceptions and clarifications.

20.3.4 Technical Evaluation

In light of the SECY-12-0025, the staff issued RAI Letter No. 108 requesting additional information in relation to the lessons learned from Great Tohoku Earthquake and Tsunami. In RAI Letter No. 108, Question 1.5-1, third bullet, the staff requested the applicant to:

- Provide sufficient reliable instrumentation, able to withstand design-basis natural phenomena, to monitor key spent fuel pool parameters (i.e., water level, temperature, and area radiation levels) from the control room (detailed Recommendation 7.1 - Enclosure 6 of SECY-12-0025).

Out of these parameters, the most indicative of SFP conditions is the water level. The radiation monitors are used to confirm the integrity of the stored fuel, but cannot be used to determine how much time remains before the fuel integrity is compromised. The SFP water temperature

can be used to monitor SFP water temperature from normal range up to boiling temperature. After the SFP water reaches the boiling point it will remain constant while the pool boils dry, therefore, water temperature cannot be used to determine how much time remains before the fuel integrity is compromised. SFP water level is the most useful parameter to indicate SFP condition. The water stored in the pool provides spent fuel cooling and radiation shielding for the operators on the SFP deck. Therefore, the SFP water level can be used to determine how much time remains before the fuel integrity is compromised.

In Commission Order EA-12-051, the Commission describes the key parameters used to determine that a level instrument is to be considered reliable. NEI 12-02, Appendix A4, "AP1000 Spent Fuel Pool Instrumentation Guidance," provides an AP1000-specific acceptable approach for satisfying the applicable requirements. In order to address the staff's RAI, the applicant submitted a series of letters that discussed how the Levy SFP level instrument is designed to be reliable, following the guidance provided in NEI 12-02, Appendix A4, and the applicant added supplemental information LNP SUP 9.1-1 to Section 9.1.3.7 of the FSAR.

Arrangement:

Commission Order EA-12-051, Attachment 2, Section 1.1 states that the spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the safety-related instruments to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the spent fuel pool structure.

The applicant's response states that the AP1000 design has three safety-related SFP level instrument channels (AP1000 design control document (DCD) Revision 19, Table 7.5-1 (Sheet 7 of 12)). All three channels and associated instrument tubing lines are located below the fuel handling area operating deck and the cask washdown pit as stated in the supplemental information LNP SUP 9.1-1 added to LNP FSAR Section 9.1.3.7. This location provides level indication function protection from missiles that may result from damage to the structure over the spent fuel pool. In addition, the SFP level instruments associated with protection and safety monitoring system (PMS) Divisions A and C are physically separated from the SFP instrument associated with PMS Division B as stated in the supplemental information added to the LNP FSAR Section 9.1.3.7.

The staff evaluated the instrument description provided in the DCD and the proposed supplemental information added to LNP FSAR Section 9.1.3.7 and determined that the SFP level instrument will be arranged in a manner that provides reasonable protection against missiles, and therefore, the staff concludes that these features are in conformance with Commission Order EA-12-051, and the guidance provided by JLD-ISG-2012-03.

Qualification:

Commission Order EA-12-051, Attachment 2, Section 1.2 states that the level instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period.

The applicant's response states that the three safety-related SFP level instruments are seismically qualified and are located below the fuel handling area operating deck (AP1000 DCD Revision 19, Section 9.1.3.4.3.4 and Table 7.5-1 (Sheet 7 of 12)).¹ The environment in these areas is mild with respect to safety-related equipment qualification and affords access for post-accident actions. Even though they are not directly exposed to SFP boiling, the instruments are qualified to function at the conditions (temperature, humidity, and radiation) that could be seen where these instruments are located. This provides assurance that the SFP level transmitters exposed to these environmental conditions will remain available and functional for an extended period.

The staff reviewed the applicant's response and concludes that since the SFP level transmitters are not located on the pool area, they are not required to be designed to handle the pool area conditions. However, they must be designed to remain operational under the worst expected conditions for the area in which they are located. The AP1000 DCD does state that the instruments are designed to remain functional at the expected local conditions; therefore, the staff concludes that these features are in conformance with Commission Order EA-12-051, and the guidance provided by JLD-ISG-2012-03.

Power Sources:

Commission Order EA-12-051, Attachment 2, Section 1.3 states that the instrumentation channels shall provide for power connections from sources independent of the plant alternating current (ac) and direct current (dc) power distribution systems, such as portable generators or replaceable batteries. Power supply designs should provide for quick and accessible connection of sources independent of the plant ac and dc power distribution systems. Onsite generators used as an alternate power source and replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

The applicant's response states that the AP1000 SFP level instruments are provided with Class 1E DC power supply for at least 72 hours of post-accident monitoring. One of these safety-related instruments is powered through PMS Division A which contains a 24-hour battery supply. The safety-related SFP level instrument PMS divisions are described in the supplemental information (LNP SUP 9.1-1) added to the LNP FSAR Section 9.1.3.7. A description of the AP1000 Class 1E DC and UPS system is contained in AP1000 DCD Revision 19, Section 8.3.2.1.1. Beyond the initial 72 hours, instrument power can be supplied by the use of onsite permanently installed ancillary diesel generators or offsite portable generators with quick and accessible connection points. Permanently installed onsite ancillary diesel generators are capable of providing power for Class 1E post-accident monitoring including SFP level instrumentation. This capability is described in Westinghouse AP1000 DCD Revision 19, Section 8.3.1.1.1. As described in Westinghouse AP1000 DCD Revision 19, Section 1.9.5.4, offsite portable generators are capable of being connected to distribution panels or to a safety-related connection.

As discussed in the applicant's response and as described in the AP1000 DCD, the safety related power distribution system has the capability of using portable generators to power safety

¹ The RAI responses for this topic discuss a departure from the AP1000 DCD related to environmental zones for the level instruments. The departure is evaluated in FSER section 3.11.4

related distribution panels, which power the level instruments. These panels are Seismic Category I and designed to remain operational following a safe shutdown earthquake. Based on the system description, the staff concludes that these design features are in conformance with Commission Order EA-12-051, and the guidance provided by JLD-ISG-2012-03.

Accuracy:

Commission Order EA-12-051, Attachment 2, Section 1.4 states that the instrument shall maintain its designed accuracy following a power interruption or change in power source without recalibration.

The applicant's response states that the measured range of the SFP level by the safety-related instruments is from the top of the SFP to the top of the fuel racks, the level instruments are calibrated at a reference temperature suitable for normal SFP operation and will read conservatively at elevated temperatures, including during boiling conditions. These instruments are calibrated on a regular basis and their accuracy is not affected by power interruptions. All these design features are described in the supplemental information (LNP SUP 9.1-1) added to LNP FSAR Section 9.1.3.7.

Based on the system description provided above, the staff concludes that these design features are in conformance with Commission Order EA-12-051, and the guidance provided by JLD-ISG-2012-03.

Display:

Commission Order EA-12-051, Attachment 2, Section 1.5 states that the display shall provide on-demand or continuous indication of spent fuel pool water level.

The applicant's response states that the safety-related SFP level sensors provide continuous indication of the SFP level to the main control room (MCR) as well as the Remote Shutdown Workstation (RSW) and are included in the Qualified Data Processing System (QDPS) PMS display as indicated in Westinghouse AP1000 DCD Revision 19, Table 7.5-1 (Sheet 7 of 12). Safety-related instrumentation gives an alarm in the MCR when the water level in the SFP reaches the low-low-level setpoint as stated in AP1000 DCD Revision 19, Section 9.1.3.7.D.

Based on the system description provided above, the staff concludes that these design features are in conformance with Commission Order EA-12-051, and the guidance provided by JLD-ISG-2012-03.

License Condition

Commission Order EA-12-051, Attachment 2, Section 2 states that the spent fuel pool instrumentation shall be maintained available and reliable through appropriate development and implementation of a training program. Personnel shall be trained in the use and the provision of alternate power to the safety-related level instrument channels.

The applicant proposed to revise COLA Part 10, to include License Condition 12.B, which requires the development and implementation of a training program in accordance with the guidance contained in JLD-ISG-2012-03.

The proposed license condition states:

B. RELIABLE SPENT FUEL POOL LEVEL INSTRUMENTATION

Prior to initial fuel load, PEF shall fully implement the following requirements for spent fuel pool level indication using the guidance contained in JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, Revision 0. The spent fuel pool instrumentation shall be maintained available and reliable through the development and implementation of a training program. The training program shall include provisions to ensure trained personnel can route the temporary power lines from the alternate power source to the appropriate connection points and connect the alternate power source to the safety-related level instrument channels.

The proposed license condition is consistent with the guidance provided in JLD-ISG-2012-03, and is intended to ensure that the operators will be properly trained in the adequate equipment maintenance procedures and the proper operational procedures in order to establish the necessary alternate power connections. Based on this, the staff concludes that the proposed license condition is acceptable because the development and implementation of a training program is consistent with Commission Order EA-12-051 and the guidance provided by JLD-ISG-2012-03.

20.3.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff proposes to include the following license condition related to development and implementation of a training program:

- License Condition (20-2) - Prior to initial fuel load, PEF shall fully implement the following requirements for spent fuel pool level indication using the guidance contained in JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, Revision 0. The spent fuel pool instrumentation shall be maintained available and reliable through the development and implementation of a training program. The training program shall include provisions to ensure trained personnel can route the temporary power lines from the alternate power source to the appropriate connection points and connect the alternate power source to the safety-related level instrument channels.

20.3.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to SFP instrument reliability, and there is no outstanding information expected to be addressed in the LNP COL FSAR.

The staff evaluated the applicant's and the AP1000 design description of the SFP water level instrument and determined that the instruments are in accordance with the guidance provided in JLD-ISG-2012-03. Therefore, the staff concludes that the applicant's SFP level instruments are considered reliable, able to withstand design-basis natural phenomena and monitor key spent fuel pool level parameters as described in Commission Order EA-12-051. In addition, the staff concludes that the information presented in the LNP COL FSAR is acceptable because it

conforms to the guidance provided in JLD-ISG-2012-03. The staff based its conclusions on the following:

- LNP SUP 9.1-1 is acceptable because, when combined with the information in Table 7.5-1 and Sections 8.3.1.1.1 and 9.1.3.7.D of the AP1000 DCD, it includes provisions for SFP instrumentation arrangement, qualification, power sources, accuracy and display that are consistent with the requirements described in SECY-12-0025 and Commission Order EA-12-051.
- The proposed license condition is acceptable because it provides that, prior to fuel load, the licensee will have in place procedures for the proper maintenance of the level instruments and for the connection and use of an alternate power source in order to power the level instruments.