

-SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS
RELATED TO FUKUSHIMA NEAR-TERM TASK FORCE RECOMMENDATION 7.1
RELIABLE SPENT FUEL POOL INSTRUMENTATION
SOUTHERN NUCLEAR OPERATING COMPANY, INC.
GEORGIA POWER COMPANY
OGLETHORPE POWER COMPANY
MUNICIPAL ELECTRIC AUTHORITY OF GEORGIA
CITY OF DALTON, GEORGIA
VOGTLE ELECTRIC GENERATING PLANT UNITS 3 AND 4
DOCKET NOS.: 52-025 AND 52-026

1.0 INTRODUCTION:

On March 11, 2011, a magnitude 9.0 earthquake struck off the coast of the Japanese island of Honshu. The earthquake resulted in a large tsunami that is estimated to have exceeded 14 meters (45 feet) in height, which inundated the Fukushima Dai-ichi Nuclear Power Plant site. The tsunami caused extensive damage to site facilities and resulted in a complete loss of all alternating current (ac) electrical power at 5 of the 6 units on the site. In responding to and managing this damage, the plant operators lacked, among other things, reliable instrumentation to determine the water level in the spent fuel pools (SFPs) on the site. The lack of reliable SFP instrumentation, combined with the operators' inability to visually observe SFPs because of the conditions in the plant, raised concerns that at least one 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 SFP 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.

Staff requirements memorandum (SRM) 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" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12039A111), states that the staff will issue orders to all reactor licensees,

including holders of active or deferred construction permits under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and holders of combined licenses (COLs) under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," regarding installation of enhanced SFP instrumentation. With regard to the Near Term Task Force Recommendation 7.1 for reliable SFP 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.

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12054A679), to all power reactor licensees and holders of construction permits in active or deferred status. This order requires the licensee to have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the SFP operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

The staff's Interim Staff Guidance, JLD-ISG-2012-03, Revision 0, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," (ADAMS Accession No. ML12221A339), endorses with exceptions and clarifications the methodologies described in the industry guidance document, Nuclear Energy Institute (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.

Note that the Vogtle Electric Generating Plant (VEGP), Units 3 and 4 Updated Final Safety Analysis Report (UFSAR) incorporates by reference the AP1000 Design Control Document, Revision 19 as required by 10 CFR Part 52, Appendix D. Therefore, any reference to the AP1000 Design Control Document section corresponds to the same section in the VEGP Units 3 and 4 UFSAR.

2.0 SUMMARY OF RESPONSE TO ORDER EA-12-051:

Southern Nuclear Operating Company (the licensee) responded to Order EA-12-051 by letter dated October 23, 2012 (ADAMS Accession No. ML12300A094). As part of the response, the licensee submitted a proprietary Westinghouse report, APP-SFS-M3R-003, "Response to NRC Orders EA-12-051 and EA-12-063 and Background Information for Future Licensees on AP1000 Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12300A096). A non-proprietary version of APP-SFS-M3R-003 was also submitted as an attachment to the October 23, 2013 letter and designated as APP-SFS-M3R-004 (ADAMS Accession No. ML12300A095). The licensee supplemented their response to Order EA-12-051 by letter dated October 31, 2013 (ADAMS Accession No. ML13308A935) which proposed adding supplemental information to the VEGP Units 3 and 4, UFSAR Section 9.1.3.7 concerning the reliable SFP instrument design. In addition, the licensee proposed associated requirements related to calibration, testing and training which were added to the licensee's action tracking system.

3.0 REGULATORY BASIS AND GUIDANCE:

The requirements and guidance for reliable SFP instrumentation are established or described in the following:

- NRC Order EA-12-051, “Order Modifying Licenses With Regard to Reliable Spent Fuel Pool Instrumentation,” March 12, 2012 (ADAMS Accession No. ML12054A679).
- The VEGP Units 3 and 4 combined licenses (COLs) incorporate the requirements of 10 CFR Part 52, Appendix D, “Design Certification Rule for the AP1000 Design,” by reference.
- 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.

The relevant guidance for reliable SFP instrumentation is set forth in JLD-ISG-2012-03, Revision 0, “Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation,” issued August 29, 2012, which 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.

4.0 TECHNICAL EVALUATION:

On March 12, 2012, the Commission issued NRC Order Number EA-12-051, “Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation” to the licensee. The Order was immediately effective and directed the licensee to have a reliable indication of the water level in associated spent fuel storage pools. Attachment 3 to Order EA-12-051 contains, “Requirements for Reliable Spent Fuel Pool Level Instrumentation at Combined License Holder Reactor Sites” which is applicable to VEGP Units 3 and 4, and states the following:

The design bases of Vogtle Units 3 and 4 address many of these attributes of spent fuel pool level instrumentation. The NRC staff reviewed these design features prior to issuance of the combined licenses for these facilities and certification of the AP1000 design referenced therein. The AP1000 certified design largely addresses the requirements in Attachment 2 by providing two safety-related spent fuel pool level instrument channels. The instruments measure level from the top of the spent fuel pool to the top of the fuel racks to address the range requirements listed above. The safety-related classification provides for the following additional design features:

- Seismic and environmental qualification of the instruments
- Independent power supplies

- Electrical isolation and physical separation between instrument channels
- Display in the control room as part of the post-accident monitoring instrumentation
- Routine calibration and testing

Attachment 3 to Order EA-12-051 requires holders of COLs to address the following design features not specified in the certified design: arrangement, qualification, power supplies, accuracy, display, and training.

4.1 Arrangement

Commission Order EA-12-051, Attachment 3, Section 1.1 states that the SFP 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 SFP. This protection may be provided by locating the safety-related instruments to maintain instrument channel separation within the SFP area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the SFP structure.

The licensee's response in Section 3.1, "Arrangement," of APP-SFS-M3R-003 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. This location provides level indication function protection from missiles that may result from damage to the structure over the SFP. 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. In supplemental response letter dated October 31, 2013, the licensee proposed to add this information to Tier 2 UFSAR Section 9.1.3.7.

The staff evaluated the instrument description provided in the APP-SFS-M3R-003 and the proposed changes to the UFSAR 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.

4.2 Qualification

Commission Order EA-12-051, Attachment 3, Section 1.2 states that the level instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the SFP water at saturation conditions for an extended period.

The licensee's response in Section 3.2, "Qualification," of APP-SFS-M3R-003, states that the three safety-related SFP level instruments are seismically qualified and are located below the fuel handling area operating deck as described in Section 3.1 (AP1000 DCD Revision 19, Section 9.1.3.4.3.4 and Table 7.5-1 (Sheet 7 of 12)). 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 licensee's response and concludes that since the SFP level transmitters are not located on the pool area and, 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 Revision 19, Section 9.1.3.4.3.4 and Table 7.5-1 (sheet 7 of 12) states: "The environment in these other areas [where the instruments are located] during spent fuel pool steaming is mild with respect to safety equipment qualifications and affords access for post – accident actions." 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.

4.3 Power Sources

Commission Order EA-12-051, Attachment 3, Section 1.3 states that the instrumentation channels shall provide for power connections from sources independent of the plant 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 licensee's response in APP-SFS-M3R-003 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. Regarding the independent power supplies, as stated APP-SFS-M3R-003 Section 3.3, "Power Supplies," 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 to provide an electrical power supply for the spent fuel pool monitoring instrumentation for beyond-72-hour operation.

As discussed in the licensee's response in APP-SFS-M3R-003 and as described in the AP1000 DCD, the safety-related power distribution system has the capability of using portable generators to power safety related distribution panels, which power the spent fuel pool 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.

4.4 Accuracy

Commission Order EA-12-051, Attachment 3, Section 1.4 states that the instrument shall maintain its designed accuracy following a power interruption or change in power source without recalibration.

The licensee's supplemental 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.

APP-SFS-M3R-003 indicates that during pool boiling, the void fraction and increased temperature will decrease the average liquid density in the SFP which will have a conservative impact on the pool level which is in the main control room (MCR) because the instruments are calibrated to the temperature (and corresponding density) of the pool during normal operations. The indicated level will be representative of the collapsed liquid level in the pool and is a sufficient measurement to ensure that the spent fuel is protected. These instruments are calibrated on a regular basis and their accuracy is not affected by power interruptions.

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.

4.5 Display

Commission Order EA-12-051, Attachment 3, Section 1.5 states that the display shall provide on-demand or continuous indication of SFP water level.

APP-SFS-M3R-003, Section 3.5, "Display," states that the safety-related SFP level sensors provide continuous indication of the SFP level to the 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.

4.6 Training

Commission Order EA-12-051, Attachment 3, Section 2 states that the SFP 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 supplemental information provided by the licensee in the letter dated October 31, 2013 proposed to add the following requirements to the licensee's action tracking system:

The safety-related classification of the spent fuel pool level instrumentation requires routine calibration and testing of the instrumentation which maintains the equipment as available and reliable. The training program shall provide training to personnel in the use, routing and connection of the temporary power lines from the alternate power source to the appropriate connection points of the safety related level instrument channels.

In addition, as stated in APP-SFS-M3R-003, Section 3.6, "Programmatic Controls," the training program utilized for implementation of the NEI 06-12, "Diverse and Flexible Coping Strategies

(FLEX) Implementation Guide,” Revision 0, will contain the programmatic and training considerations required to deploy and utilize the offsite portable generator that is credited above to continue the SFP level indication function post 72 hours. No additional operational or training requirements are necessary to implement the strategies described above beyond the commitments required as part of the response to EA-12-049, “Issuance of Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events.”

The staff concludes that provisions for training are in accordance 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 these design features are in conformance with Commission Order EA-12-051, and the guidance provided by JLD-ISG-2012-03.

5.0 PROPOSED CHANGES TO THE VEGP UNITS 3 AND 4 UFSAR

In the supplemental response, the licensee committed to adding the following to Section 9.1.3.7 of the VEGP Units 3 and 4 UFSAR to describe the reliable SFP instrumentation attributes:

All three safety-related SFP level instruments and associated instrument tubing lines are located below the fuel handling area operating deck and the cask washdown pit. This location provides protection from missiles that may result from damage to the structure over the SFP. The SFP level instruments associated with PMS divisions A and C are physically separated from the SFP level instrument associated with PMS division B. The safety-related spent fuel pool level instruments measure the water level from the top of the spent fuel pool to the top of the fuel racks. These instruments are conservatively calibrated at a reference temperature suitable for normal spent fuel pool operation on a regular basis and accuracy is not affected by power interruptions.

The staff notes that the proposed addition to the Section 9.1.3.7 of the VEGP Units 3 and 4 UFSAR adequately reflects the major attributes for reliable SFP level monitoring that were not already addressed in the AP1000 DCD, Revision 19.

6.0 CONCLUSION

The NRC staff reviewed the VEGP Units 3 and 4 UFSAR, checked the referenced AP1000 DCD, Revision 19, and the response to Order EA-12-051. The NRC staff’s review confirmed that the licensee addressed the required information relating to SFP instrument reliability, and there is no outstanding information that is required to be addressed.

The staff evaluated the licensee’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 licensee’s SFP level instruments are considered reliable, able to withstand beyond design-basis natural phenomena and monitor key SFP level parameters as described in Commission Order EA-12-051. In addition, the staff concludes that the information presented in the VEGP Units 3 and 4 UFSAR, with the addition of the information noted above, together with the requirements related to calibration, testing and training entered into the licensee’s action tracking system, is acceptable because it conforms to the guidance provided in JLD-ISG-2012-03. The staff based its conclusions on the following:

- The licensee's response to EA-12-051 is acceptable because, as described in APP-SFS-M3R-003, 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 provisions for training related to the reliable SFP instrumentation are acceptable because they provide for the instrumentation to be maintained available and reliable through appropriate development and implementation of a training program including provisions for use of alternate power to the safety-related level instrument channels.