Southern Nuclear Operating Company

ND-12-2200

Enclosure 2

------NON-PROPRIETARY VERSION------

Westinghouse APP-SFS-M3R-004 (Redacted)

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DOCUMENT STATUS: ☐ PRE ☐ CFC ☐ CAE ☒ DES

Contains redacted withheld Sensitive Unclassified Non-Safeguards Information (SUNSI) relative to the physical protection of an AP1000 nuclear plant that should be withheld from public disclosure pursuant to 10 CRF 2.390 (d).

Westinghouse Acceptance of AP1000 Design Partner Document by:

_____
(Name and Date)

ALTERNATE DOCUMENT NUMBER: NA WORK BREAKDOWN #:

ORIGINATING ORGANIZATION: Westinghouse Electric Co. LLC

TITLE: **Response to NRC Orders EA-12-051 and EA-12-063, and Background Information for Future Licensees on AP1000 Spent Fuel Pool Instrumentation, Redacted**

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VERIFIER(S) WEC 6.1.pdf Adam D. Malinowski	SIGNATURE / DATE **Electronically Approved*** **	Verification Method: Independent Review

Plant Applicability: ☒ All AP1000 plants except: No Exceptions
☐ Only the following plants:

APPLICABILITY REVIEWER WEC 6.1.pdf NA	SIGNATURE / DATE NA
RESPONSIBLE MANAGER* WEC 6.1.pdf Luca Oriani	SIGNATURE / DATE **Electronically Approved*** **

* Approval of the responsible manager signifies that the document and all required reviews are complete, the appropriate proprietary class has been assigned, electronic file has been provided to the EDMS, and the document is released for use.

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REVISION HISTORY

RECORD OF CHANGES

Revision	Author	Description
A	See cover page	Initial issue.

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ACRONYMS AND TRADEMARKS

Acronyms	Definition
AC	alternating current
COL	combined operating license
DC	direct current
DCD	Design Control Document
DG	diesel generator
FLEX	diverse and flexible coping strategies
FSAR	Final Safety Analysis Report
I&C	instrumentation and control
MCR	main control room
NRC	Nuclear Regulatory Commission
PCS	passive containment cooling system
PCCWST	passive containment cooling water storage tank
PMS	protection and safety monitoring system
RSW	remote shutdown workstation
QDPS	qualified data processing system
SBO	station blackout
SFP	spent fuel pool
SSE	safe shutdown earthquake

REFERENCES

1. Order EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, United States Nuclear Regulatory Commission, March 12, 2012.

2. Order EA-12-063, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, United States Nuclear Regulatory Commission, March 30, 2012.

3. NEI 12-02, Rev. 0, Industry Guidance for Compliance with NRC Order EA-12-051, Nuclear Energy Institute, August 2012.

4. Westinghouse document AP1000 Design Control Document, Revision 19, June 11, 2011.

5. Order EA-12-049, Issuance of Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, United States Nuclear Regulatory Commission, March 12, 2012.

RESPONSE TO NRC ORDERS EA-12-051 AND EA-12-063, AND BACKGROUND INFORMATION FOR FUTURE LICENSEES ON AP1000 SPENT FUEL POOL INSTRUMENTATION

1 BACKGROUND

In studying the sequence of events that took place at Fukushima Daiichi during the accident that occurred due to the March 11, 2011 earthquake and resulting tsunami, the U.S. Nuclear Regulatory Commission (NRC) determined that several near-term actions were needed at U.S. commercial nuclear power plants. Among them was to provide spent fuel pools (SFP) with reliable level instrumentation to significantly enhance the knowledge of key decision makers such that resources are allocated effectively in the event of a very low probability beyond design basis event. Consequently, the NRC issued Order EA-12-051 (Reference 1), Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (ML12054A679), on March 12, 2012, for all U.S. nuclear plants with an operating license, construction permit or Combined Construction and Operating License (COL). Order EA-12-063 (Reference 2), Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (ML12089A163) was issued on March 30, 2012 and applies to VC Summer.

Subsequent to the issuance of NRC Orders EA-12-051 and EA-12-063, Nuclear Energy Institute (NEI) developed NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051 (Reference 3). Appendix A-4 of NEI 12-02 provides NRC endorsed Order response guidance for the AP1000 design, to which this report is fully compliant.

2 INTRODUCTION

The referenced NRC Orders noted that the NRC is now requiring 10 CFR Part 50 licensees to provide 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 spent fuel pool operating deck, and
3) Level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

The NRC Order further noted that the AP1000 plant described in Westinghouse AP1000 Design Control Document (DCD) Revision 19 (Reference 4), addresses 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 above requirements by providing three safety-related spent fuel pool level instrument channels. The instruments measure the water level from the top of the spent fuel pool to the top of the fuel racks to address the range requirements listed above. The AP1000 safety-related spent fuel pool instrumentation provides for the following design features:

- Continuous measurement range from the normal pool level down to just above the top of the fuel
- Accurate measurement with boiling water in the pool
- Seismic and environmental qualification of the channels (power supplies, sensors, and displays)
- Protection from physical hazards, including internal and external floods
- Three independent, safety-related battery power supplies, two rated for 72 hours and one for 24 hours with connections provided for an offsite diesel generator (DG) to continue the power supply after 72 hours
- Electrical isolation and physical separation between instrument channels
- Display in the control room as part of the post-accident monitoring instrumentation
- [ ]^{a,c}
- Available in all modes
- Provisions to perform required routine calibration and testing

3 REQUIREMENTS

The AP1000 plant must address the following requirements that were not specified in the certified design.

3.1 ARRANGEMENT

Order Requirement

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.

NEI 12-02 AP1000 Guidance

Protection against missiles should be described, noting the protection that may be provided by location of the safety-related instruments and their associated connections below the operating deck. Describe the arrangement and basis for why the operating deck provides protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. Alternatively, provide description of the features for additional protection that may be provided by the location of 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.

AP1000 Design Response

The AP1000 design has three safety-related spent fuel pool level instrument channels. All three channels and associated instrument tubing lines are located below the fuel handling area operating deck and the cask washdown pit. The operating deck is at Elevation 135'-3" and the cask washdown pit floor is at Elevation 117'-6". Level instruments associated with protection and safety monitoring system (PMS) divisions A and C are located in Room 12365, which can be seen on Westinghouse AP1000 DCD Revision 19, Figure 1.2-7 and as referenced in the FSAR of each COL holder or applicant. The level instrument associated with PMS division B is located in the middle annulus (Room 12341, as seen on Westinghouse AP1000 DCD Revision 19 Figure 1.2-7 and as referenced in the FSAR of each COL holder or applicant). The SFP connection and tubing for level instruments associated with PMS divisions A and C is physically separated from the SFP connection and tubing for the level instrument associated with PMS division B within Room 12365.

The cask washdown pit is normally covered by a removable hatch located on the operating deck. The floor of the cask washdown pit is a two-foot thick steel-concrete composite structure. Location of these instrument channels below the operating deck and cask washdown pit provides protection for the level indication function against missiles that may result from damage to the structure over the spent fuel pool. See Figure 1.

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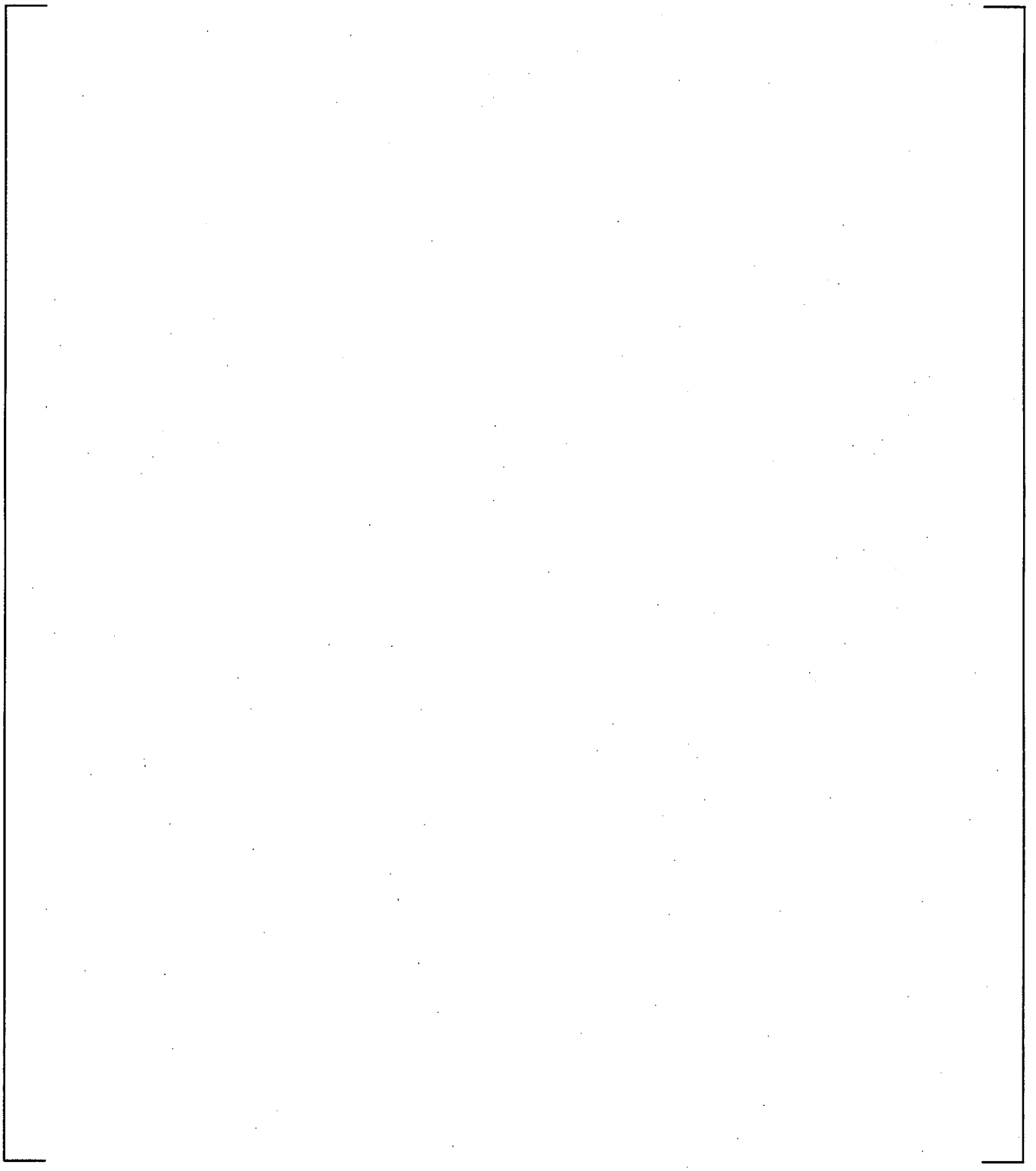

Figure 1: Location of SFP Instrumentation for PMS Divisions A and C and Connections to the SFP For PMS Divisions A, B, and C

3.2 QUALIFICATION

Order Requirement

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.

NEI 12-02 AP1000 Guidance

Provide a description of the instrumentation sensors and their capability to operate in the environmental conditions that they will experience during design basis events, noting that for the AP1000 design basis conditions include a SBO with steaming in the SFP. The environmental conditions to be addressed should include appropriate consideration for temperature, humidity, steaming, radiation, and seismic activity (SSE) levels where the sensors are located. Provide information to demonstrate the reliability of the instrument under these conditions.

Appropriate evaluations should also be provided to demonstrate the operability of these sensors for indefinite SBO durations.

AP1000 Design Response

The three safety-related, seismically qualified spent fuel pool level instruments are located in rooms below the fuel handling area operating deck as described in Section 3.1. As stated in Westinghouse AP1000 DCD Revision 19, Section 9.1.3.4.3.4 and PAMS Table 7.5-1 (Sheet 7 of 12) and as referenced in the FSAR of each COL holder or applicant, the environment in these areas during spent fuel pool steaming is mild with respect to safety-related equipment qualification and affords access for post-accident actions. This is because the fuel handling area, rail car bay, and spent resin area do not have connecting ductwork with other radioactively controlled areas of the auxiliary building, which prevents steam migration into the areas housing the SFP instruments. In addition, there is a vent path between the fuel handling area and outside environment to vent steam generated by elevated spent fuel pool water temperature. Even though they are not directly exposed to spent fuel pool boiling, the instruments are qualified to function at the conditions (temperature, humidity, radiation) that could be seen at the lower elevations in the spent fuel building where these instruments are located. For example, they are qualified for 100 percent humidity. This provides assurance that the SFP level transmitters exposed to these environmental conditions will remain available and functional for an extended period, as specified in the Order.

3.3 POWER SUPPLIES

Order Requirement

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.

NEI 12-02 AP1000 Guidance

Provide a description of the design features provided to ensure continuous power supply to the instrumentation for extended loss of power conditions. The AP1000 design provides extended SFP monitoring capability with two trains of dedicated class 1E DC power supply for at least 72 hours of post accident monitoring. Beyond the initial 72 hours, the response shall detail how the instrument power supply can be met by the use of offsite portable generators with quick and accessible connection points and sufficient capacity to maintain level indication indefinitely. The capability to use both onsite and offsite equipment should be discussed as well as the availability of clear guidance for the operator as part of the AP1000 post-72 hours procedures per AP1000 DCD Section 1.9.5.4.

AP1000 Design Response

The AP1000 design provides extended SFP level monitoring capability with two trains of dedicated 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 B, and the other is powered through PMS Division C. A third safety-related instrument is powered through PMS Division A; however, PMS Division A contains only a 24-hour battery supply.

As stated in NRC Order EA-12-051 and Order EA-12-063, the safety-related classification of the SFP instrumentation provides for the following 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
- Required routine calibration and testing

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 located in the annex building are capable of providing power for Class 1E post-accident monitoring (including SFP level instrumentation), MCR lighting, MCR and I&C room ventilation, and power to refill the passive containment cooling water storage tank (PCCWST) using the PCS recirculation pumps. This capability is described in Westinghouse AP1000 DCD Revision 19, Section 8.3.1.1.1 and as referenced in the FSAR of each COL

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holder or applicant. Each ancillary diesel generator output is connected to a distribution panel in the same room as the ancillary diesel generators. The distribution panel contains outgoing feeder circuit breakers directly connected to the PMS Division B and PMS Division C voltage regulating transformers that power the post-accident monitoring loads, the lighting in the MCR, and the ventilation in the MCR and PMS Division B and C I&C rooms. This configuration is depicted in Westinghouse AP1000 DCD Revision 19, Figures 8.3.1-3 and 8.3.2-2 (Reference 4) and as referenced in the FSAR of each COL holder or applicant. The post-72 hour procedures discussed in Section 3.6 of this report include provisions to start and connect the ancillary diesel generators.

The AP1000 design does not require that the ancillary diesel generators be safety related. Their operation is not required following a loss of all AC power for 72 hours because they are easily replaced with offsite portable generators, which are capable of being connected to the distribution panel in the same room or to a safety-related connection as described in Westinghouse AP1000 DCD Revision 19, Section 1.9.5.4 and as referenced in the FSAR of each COL holder or applicant. This section of the Westinghouse AP1000 DCD states: "the AP1000 design includes both onsite equipment and safety-related connections for use with transportable equipment." [

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Figure 2: [ ]a,c

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Figure 3: [

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3.4 ACCURACY

Order Requirement

The instrument shall maintain its designed accuracy following a power interruption or change in power source without recalibration.

NEI 12-02 AP1000 Guidance

As discussed under NEI 12-02 Section A-4-3.3 the AP1000 design provides means for continued power supply to the spent fuel pool level instrumentation, relying for the first 72 hours only on class 1E batteries. The power supply can then be extended indefinitely by various means as described in NEI 12-02 Section A-4-3.3.

Additionally, the potential impact on temporary loss of power to the level instrument shall be discussed and evaluated in this section including confirmation that the instruments would not need to be re-calibrated following a loss of power.

The instrument should be discussed to address sufficient accuracy during SBO conditions which includes boiling of the SFP water.

AP1000 Design Response

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3.5 DISPLAY

Order Requirement

The display shall provide on-demand or continuous indication of spent fuel pool water level.

NEI 12-02 AP1000 Guidance

For the first 72 hours, provide details regarding the continuous display provided in the Main Control Room with power provided by the class 1E batteries. For Post 72 hours, describe the features of the Main Control Room display and use of power supplies described in NEI 12-02 Section A-4-3.3. Describe the SFP water level display features. Provide a description of appropriate alarms for low water level. The display requirement may be described by reference to appropriate instrumentation datasheets, specifications, and other relevant documentation.

AP1000 Design Response

Three safety-related SFP level sensors provide continuous indication of the SFP level to the MCR as well as the Remote Shutdown Workstation (RSW). Note that though three safety-related instruments are provided, the number of instruments required to meet single failure criteria after stable plant conditions is two. Therefore, two channels are provided with power from separate 1E DC power supplies for at least 72 hours of post-accident monitoring and a third channel is available with power from a 1E DC power supply for at least 24 hours. The redundant sensors are capable of measuring the SFP level continuously from the top of the spent fuel racks up to the operating deck. The continuous level is easily accessed by the operators in the MCR via the Qualified Data Processing System (QDPS) PMS display. In order to alert the operators of abnormally low levels in the SFP, [

]^{a,c} As described in Section 3.3 of this report, the level instruments are powered by the class 1E batteries for the first 72 hours. After 72 hours, the permanently installed ancillary diesel generators will be used if available or offsite portable generators can be used to power two of the PMS divisions, and thus two of the SFP level transmitters as well as the MCR continuous indication.

3.6 PROGRAMMATIC CONTROLS

Order Requirement

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.

NEI 12-02 AP1000 Guidance

As noted in the background, the safety-related classification of the AP1000 spent fuel level instrumentation ensures routine calibration and testing of the instrumentation, which maintains the equipment as available and reliable. The training program shall be described to provide training to personnel in the use and the provision of alternate power supplies to the existing ac or dc power distribution system to power the instrument channels consistent with the post-72 hours procedures detailed in DCD Section 1.9.5.4. Implemented procedures consistent with the training program shall be summarized and clarified as part of the response.

AP1000 Design Response

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 (Reference 5).

4 CONCLUSIONS

The AP1000 design currently meets, or its design allows for the plant to meet (for the interface of FLEX equipment), all additional requirements set forth by NRC Order EA-12-051 (Reference 1) and NRC Order EA-12-063 (Reference 2). These requirements cover the arrangement, qualification, power supplies, accuracy, display, and programmatic controls for the AP1000 safety-related spent fuel pool level instrumentation.