

September 25, 2013

MEMORANDUM TO: Robert Beall, Acting Branch Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: Greg A. Casto, Chief */RA/ Carla P. Roque-Cruz for*
Balance of Plant Branch
Division of Safety Systems
Office of Nuclear Reactor Regulation

SUBJECT: INTERIM STAFF EVALUATION AND REQUEST FOR
ADDITIONAL INFORMATION - CALVERT CLIFFS NUCLEAR
POWER PLANT, UNITS 1 AND 2 REGARDING OVERALL
INTEGRATED PLAN FOR RELIABLE SPENT FUEL POOL
INSTRUMENTATION (ORDER NUMBER EA-12-051) (TAC NOS.
MF1140 AND MF1141)

By letter dated February 28, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13066A172), as supplemented by letters dated July 3, 2013 (ADAMS Accession No. ML13190A017), and August 27, 2013 (ADAMS Accession No. ML13254A279), Constellation Energy Nuclear Group, LLC, submitted its Overall Integrated Plan (OIP) in response to the March 12, 2012, Commission Order modifying licenses with regard to requirements for Reliable Spent Fuel Pool (SFP) Instrumentation (Order Number EA-12-051) for Calvert Cliffs Nuclear Power Plant, Units 1 and 2. The Balance of Plant Branch (SBPB) and the Instrumentation and Controls Branch (EICB) staff have completed their review of this OIP and supplemental information. At this time, the staff is unable to make any final conclusions regarding the acceptability of the licensee's OIP. However, the enclosed interim staff evaluation provides preliminary U.S. Nuclear Regulatory Commission (NRC) staff conclusions in areas where the licensee has provided sufficient information and identifies areas where additional information is needed. In order for the staff to review the final licensee's SFP instrumentation OIP and complete the staff evaluation, all the requested information must be provided no later than September 30, 2014. Our interim staff evaluation input is enclosed.

Docket Nos.: 50-317
50-318

Enclosure:
Interim Staff Evaluation and Request for Additional Information

CONTACT: Carla P. Roque-Cruz, NRR/DSS/SBPB
301-415-1455

Michael E. Waterman, RES/DE/ICEEB
301-251-7451

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INTERIM STAFF EVALUATION AND REQUEST FOR ADDITIONAL INFORMATION
BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO THE OVERALL INTEGRATED PLAN IN RESPONSE TO
ORDER EA-12-051, "RELIABLE SPENT FUEL POOL INSTRUMENTATION"
CONSTELLATION ENERGY NUCLEAR GROUP, LLC
CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2
DOCKET NOS. 50-317 AND 50-318

1.0 INTRODUCTION

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA 12 051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A679), to all power reactor licensees and holders of construction permits in active or deferred status. This order requires, in part, that all operating reactor sites have a reliable means of remotely monitoring wide-range Spent Fuel Pool (SFP) levels to support effective prioritization of event mitigation and recovery actions in the event of a Beyond-Design-Basis (BDB) external event. The order required all holders of operating licenses issued under Title 10 of the Code of Federal Regulations (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," to submit to the NRC an Overall Integrated Plan (OIP) by February 28, 2013.

By letter dated February 28, 2013 (ADAMS Accession No. ML13066A172), Constellation Energy Nuclear Group, LLC (the licensee) provided the OIP for Calvert Cliffs Nuclear Power Plant (CCNPP), Units 1 and 2, describing how it will achieve compliance with Attachment 2 of Order EA-12-51 by Spring 2015. By letter dated June 19, 2013 (ADAMS Accession No. ML13164A393), the NRC staff sent a Request for Additional Information (RAI) to the licensee. The licensee provided supplemental information by letters dated July 3, 2013 (ADAMS Accession No. ML13190A017), and August 27, 2013 (ADAMS Accession No. ML13254A279).

2.0 REGULATORY EVALUATION

Order EA-12-051 requires all holders of operating licenses issued under 10 CFR Part 50, notwithstanding the provisions of any Commission regulation or license to the contrary, to comply with the requirements described in Attachment 2 to this Order except to the extent that a more stringent requirement is set forth in the license. Licensees shall promptly start implementation of the requirements in Attachment 2 to the order and shall complete full implementation no later than two refueling cycles after submittal of the OIP or December 31, 2016, whichever comes first.

Order EA-12-051 required the licensee, by February 28, 2013, to submit to the Commission an OIP, including a description of how compliance with the requirements described in Attachment 2 of the Order will be achieved.

ENCLOSURE

Attachment 2 of Order EA-12-051 requires the license 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.

Attachment 2 of Order EA-12-051, states that the SFP level instrumentation shall include the following design features:

- 1.1 Instruments: The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.
- 1.2 Arrangement: 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 primary instrument channel and fixed portions of the backup instrument channel, if applicable, 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.
- 1.3 Mounting: Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure.
- 1.4 Qualification: The primary and backup 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. This reliability shall be established through use of an augmented quality assurance process (e.g., a process similar to that applied to the site fire protection program).
- 1.5 Independence: The primary instrument channel shall be independent of the backup instrument channel.
- 1.6 Power supplies: Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable 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. 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.

- 1.7 Accuracy: The instrument channels shall maintain their designed accuracy following a power interruption or change in power source without recalibration.
- 1.8 Testing: The instrument channel design shall provide for routine testing and calibration.
- 1.9 Display: Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location. The display shall provide on-demand or continuous indication of spent fuel pool water level.

Attachment 2 of Order EA-12-051, states that the SFP instrumentation shall be maintained available and reliable through appropriate development and implementation of the following programs:

- 2.1 Training: Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.
- 2.2 Procedures: Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.
- 2.3 Testing and Calibration: Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy.

On August 29, 2012, the NRC issued an Interim Staff Guidance document (the ISG), JLD-ISG-2012-03, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12221A339), to describe methods acceptable to the NRC staff for complying with Order EA-12-051. The ISG endorses, with exceptions and clarifications, the methods described in the Nuclear Energy Institute (NEI) guidance document 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,'" dated August 2012 (ADAMS Accession No. ML12240A307). Specifically, the ISG states:

The NRC staff considers that the methodologies and guidance in conformance with the guidelines provided in NEI 12-02, Revision 1, subject to the clarifications and exceptions in Attachment 1 to this ISG, are an acceptable means of meeting the requirements of Order EA-12-051.

3.0 TECHNICAL EVALUATION

3.1 Background and Schedule

CCNPP has a set of two interconnected SFPs. Each pool is approximately 25 feet wide by 43 feet long and 39 feet deep. The SFPs are normally interconnected and at the same water level.

The licensee's OIP was submitted on February 28, 2013. The OIP states that installation of the SFP level instrumentation at CCNPP is scheduled to be completed prior to startup from the Unit 2 Spring 2015 refueling outage, which is before startup from the second refueling outage for each unit.

The NRC staff has reviewed the licensee's schedule for implementation of SFP level instrumentation provided in its OIP. If the licensee completes implementation in accordance with this schedule, it would appear to achieve compliance with Order EA-12-051 within two refueling cycles after submittal of the OIP and before December 31, 2016.

3.2 Spent Fuel Pool Water Levels

Attachment 2 of Order EA-12-051 states, in part, that

All licensees identified in Attachment 1 to this Order shall 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 [Level 1], (2) level that is adequate to provide substantial radiation shielding for a person standing on the SFP operating deck [Level 2], and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred [Level 3].

NEI 12-02 states, in part, that

Level 1 represents the HIGHER of the following two points:

- The level at which reliable suction loss occurs due to uncovering of the coolant inlet pipe, weir or vacuum breaker (depending on the design), or
- The level at which the water height, assuming saturated conditions, above the centerline of the cooling pump suction provides the required net positive suction head specified by the pump manufacturer or engineering analysis.

In its OIP, the licensee stated that Level 1 is the indicated water level on either the primary or backup instrument channel of greater than elevation 65 feet (ft.) 8.5 inches (in.), based on ensuring the open end of the normal suction lines will not become uncovered.

In its letter dated July 3, 2013, the licensee stated that the response to NRC staff's RAI 1(a) describing how the identified Level 1 location represents the HIGHER of the two points described in the NEI 12-02 guidance will be provided on February 28, 2014, with the second 6-month update.

The NRC staff notes that the information describing how the identified Level 1 location represents the HIGHER of the two points as described in the NEI 12-02 guidance is not available for review and that this information will be provided to the staff on the February 28, 2014, with the second 6-month update. The staff has identified this request as:

RAI #1

For Level 1, please specify how the identified location represents the HIGHER of the two points described in the NEI 12-02 guidance for this level.

(This information was previously requested as RAI-1(a) in NRC letter dated June 19, 2013)

NEI 12-02 states, in part, that

Level 2 represents the range of water level where any necessary operations in the vicinity of the spent fuel pool can be completed without significant dose consequences from direct gamma radiation from the stored spent fuel. Level 2 is based on either of the following:

- 10 feet (+/- 1 foot) above the highest point of any fuel rack seated in the spent fuel pools, or
- a designated level that provides adequate radiation shielding to maintain personnel radiological dose levels within acceptable limits while performing local operations in the vicinity of the pool. This level shall be based on either plant-specific or appropriate generic shielding calculations, considering the emergency conditions that may apply at the time and the scope of necessary local operations, including installation of portable SFP instrument channel components.

In its OIP, the licensee stated, in part, that

Indicated water level on either the primary or backup instrument channel of greater than elevation 50'-2" plus the accuracy of the SFP water level instrument channel, which will be determined during the engineering and design phase. This elevation is approximately 5' above the top of the fuel racks and ensures a minimum water level of 5' above the top of the Fuel (Reference 10). CCNPP determined that with 5' of water above the top of the racks, the largest calculated dose rate near the edge of the SFP would be well below 100 mrem/hr. ...

Additionally, in its OIP, the licensee stated, in part, that

This monitoring level ensures there is adequate water level to provide substantial radiation shielding for personnel to respond to Beyond-Design-Basis External Events and to initiate SFP makeup strategies.

The NRC staff notes that the licensee designated Level 2 using the second of the two options described in NEI 12-02 for Level 2. This method requires that sufficient level is in the SFP to

provide adequate radiation shielding to maintain personnel radiological dose levels within acceptable limits while performing local operations in the vicinity of the pool. Further, NEI 12-02 states that guidance for performing plant-specific shielding calculations considering the emergency conditions that may apply at the time and the scope of necessary local operations may be found in EPA-400, "Manual of Protective Actions Guides and Protective Actions for Nuclear Incidents". The staff notes that the licensee performed calculations in accordance with EPA-400 guidance to determine dose rates near the edge of the SFP with 5' of water above the top of the fuel racks, and found that the dose rate would be lower than 100 mrem/hr. The staff notes that this dose rate is reasonable for licensees to perform actions in the vicinity of the SFP to maintain total dose within regulatory limits.

NEI 12-02 states, in part, that

Level 3 corresponds nominally (i.e., ± 1 foot) to the highest point of any fuel rack seated in the spent fuel pool. Level 3 is defined in this manner to provide the maximum range of information to operators, decision makers and emergency response personnel.

In its OIP, the licensee stated that Level 3 is the indicated water level on either the primary or backup instrument channel of greater than elevation 45 ft. 2 in.

In its letter dated July 3, 2013, the licensee provided a SFP elevation view sketch. In this figure, the licensee identified various pool elevations and SFP instrumentation levels.

The NRC staff notes that the elevation identified for Level 3 is above the highest point of any spent fuel storage rack seated in the SFP.

The licensee's proposed plan, with respect to identification of Levels 2, and 3, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.3 Design Features: Instruments

Attachment 2 of Order EA-12-051, states, in part, that

The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.

NEI 12-02 states, in part, that

A spent fuel pool level instrument channel is considered reliable when the instrument channel satisfies the design elements listed in Section 3 [Instrumentation Design Features] of this guidance and the plant operator has fully implemented the programmatic features listed in Section 4 [Program Features].

In its OIP, the licensee stated, in part, that

Primary and backup instrument channels will consist of fixed components. The primary and backup instrument channel level sensing components will be located and permanently mounted in the SFP. Measured range will be continuous from the high SFP alarm elevation 67'-2.75" plus the accuracy of the SFP water level instrument channel to the top of the spent fuel racks at elevation 45'-2" minus the accuracy of the SFP water level instrument channel. ...

Primary instrument channel level sensing components will be located in the northeast corner of Unit 1 SFP (No. 11). Backup instrument channel level sensing components will be located in the southwest corner of Unit 2 SFP (No. 21).

The NRC staff notes that the range specified for the licensee's instrumentation will cover Levels 1, 2, and 3 as described in Section 3.2 above. The licensee's proposed plan, with respect to the number of channels for both of its SFPs, appears to be consistent with NEI 12-02, as endorsed by the ISG.

The NRC staff reviewed the sketch provided in the OIP identifying the proposed location for the primary and backup instrument channels. The staff notes that the licensee's proposed location of the instrument channels appears to be consistent with the guidance when the two pools are interconnected.

In its letter dated July 3, 2013, the licensee explained that if a breach occurs in one of the SFPs under severe accident conditions, they would install a bulkhead gate to isolate the SFPs, so water level could be maintained in the unaffected SFP. The NRC staff has concerns regarding this description within the licensee's response and the effects the installation of the bulkhead gate could have on the reliability of the SFP level instrumentation to meet the requirements of Order EA-12-051. The staff has identified this request as:

RAI #2

Please describe the impact of the installation of the bulkhead gate on the reliability of the SFP level instrumentation for each SFP, and what compensatory measures would be taken to ensure reliable level indication in each SFP when the bulkhead gate is installed.

3.4 Design Features: Arrangement

Attachment 2 of Order EA-12-051, states, in part, 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. Such protection may be provided by locating the primary instrument channel and the fixed portions of a portable backup channel, if applicable, to maintain instrument channel separation within the fuel pool area, and by utilizing inherent shielding

from missiles provided by existing recesses and corners in the spent fuel pool structure.

NEI 12-02 states, in part, that

The intent of the arrangement requirement is to specify reasonable separation and missile protection requirements for permanently installed instrumentation used to meet the order. Although additional missile barriers are not required to be installed, separation and shielding can help minimize the probability that damage due to an explosion or extreme natural phenomena (e.g., falling or wind-driven missiles) will render fixed channels of SFP instrumentation unavailable. Installation of the SFP instrument channels shall be consistent with the plant-specific SFP design requirements and should not impair normal SFP functions. Channel separation should be maintained by locating the installed sensors in different places in the spent fuel pool area.

Channel separation should be maintained by locating the installed sensors in different places in the spent fuel pool area.

In its OIP, the licensee stated, in part, that

SFP water level sensors will be installed in the northeast corner of Unit 1 SFP (No. 11) and southwest corner of Unit 2 SFP (No. 21). Transmitters will be located on the 45' elevation of the Auxiliary Building, which is below the SFP operating level. This location will provide protection from external missiles and offer lower dose, temperature and humidity levels when compared to equipment located directly above the SFP (Elevation 69'). ...

Based on the above, external missiles will not penetrate the SFP enclosure at the 69' or the 45' elevation. No event-generated missiles are postulated with the exception of items that could fail during a severe earthquake such as glass/plastic portions of light fixtures and pipe insulation. The design will provide adequate protection against these items.

The sensor supports will be designed to shield the sensor from event-generated missiles. The sensor will be located such that they cannot interfere with movement of the spent fuel handling machine and the transfer system carriage.

In its letter dated July 3, 2013, the licensee stated, in part, that

The proposed routing of the cables that will extend from the sensors toward the location of the read-out/display device has not been determined. The final system component locations and cable routing will be available upon completion of the final design. This information will be forwarded to the Nuclear Regulatory Commission (NRC) on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

The NRC staff notes that this arrangement provides for approximately 90 ft. of horizontal separation between the primary sensor and the backup sensor. The staff also notes that the

proposed routing of the cables that would extend from the sensors toward the location of the read-out/display device is not available for review and will be provided to the staff on February 28, 2014 with the second CCNPP Overall Integrated Plan status update. The staff has identified this request as:

RAI #3

Please provide additional information describing how the proposed arrangement of the conduit and routing of the cabling between the spent fuel and the location of the read-out/display device meet the guidance to arrange the SFP level instrument channels 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.

The licensee's proposed location of the primary and backup level instruments for both of its SFPs appears to be consistent with NEI 12-02, as endorsed by the ISG, when the two pools are not isolated from one another through the installation of a bulkhead gate. In Section 3.3 the NRC staff identified additional information that is required regarding reliability of the level instrument when the pools are isolated (RAI #2).

3.5 Design Features: Mounting

Attachment 2 of Order EA-12-051 states, in part, that

Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure.

NEI 12-02 states, in part, that

The mounting shall be designed to be consistent with the highest seismic or safety classification of the SFP. An evaluation of other hardware stored in the SFP shall be conducted to ensure it will not create adverse interaction with the fixed instrument location(s).

The basis for the seismic design for mountings in the SFP shall be the plant seismic design basis at the time of submittal of the Integrated Plan for implementing NRC Order EA-12-051.

In its OIP, the licensee stated, in part, that

Mounting will be Seismic Class 1. Installed equipment will be seismically qualified to withstand the maximum seismic motion considered in the design of the plant area in which it is installed. An engineering analysis will be conducted during the design to ensure any other hardware stored in the SFP area will not create an adverse interaction with the fixed instrument location.

In its letter dated July 3, 2013, the licensee stated, in part, that

The radar horn antenna is positioned above the SFP water surface. The loading on the mounting bracket includes the static weight loads and dynamic loads of the horn antenna, waveguide assembly and attached waveguide pipe up to the nearest pipe support. The dynamic loads on the mounting bracket consist of design basis maximum seismic loads of the bracket and the mounted components, along with hydrodynamic loads produced by impinging surface waves caused by seismically-induced pool sloshing. The design criteria to be used to estimate the total loading on the mounting devices will be based on the plant seismic design bases.

The methodology for ensuring that the mounting bracket and attached equipment can withstand the seismic dynamic forces will be by analysis and/or test of the combined maximum seismic and hydrodynamic forces on the cantilevered portion of the waveguide assembly and horn antenna exposed to potential seismically induced wave action. In addition to the analysis described above, seismic qualification testing will be performed to seismic response spectra that envelope the maximum seismic ground motion for the installed location.

Further details of the will be provided by the vendor in accordance with the final procurement specification. It is anticipated that the full qualification will be available upon completion of the final design and will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

Further, in its letter dated July 3, 2013, the licensee stated, in part, that

The horn antenna is cantilevered over the edge of the pool and firmly fixed in a direction perpendicular to the pool water surface, although the horn assembly mounting bolts can be loosened and the horn rotated away from the pool surface for instrument calibration (see Response 9.a). The bracket provides the attachment point for the horn and waveguide assembly to the refueling floor. Four bolts at the base of the bracket fasten the bracket to the refueling floor. For mounting to a concrete floor, the bolts may be anchor bolts in a range of sizes from 3/8 inch to 3/4 inch. The distance of the two nearest bolts to the pool edge will be determined by the specific requirements of the anchor bolt size used. For mounting to metal floor, the bracket base may be fastened to the floor by welding. The horn can be away from or next to the pool liner without impacting the functionality of the level measurement.

The final mounting details for the horn antenna and waveguide assembly will be available upon completion of the final design. They will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

Additionally, in its letter dated July 3, 2013, the licensee stated, in part, that

Figure 5 provides a standard conceptual arrangement of the elements of the AREVA VEGAPULS 62ER Through Air Radar system. The waveguide piping that is connected between the waveguide assembly at the pool edge and the

remotely located sensor will be attached to building structures using the applicable site design standards for small bore pipe supports and small bore pipe in accordance with the design change process.

The radar sensor is mounted on a mounting bracket that is fastened to seismically-qualified mounting points, either building structural steel or a concrete wall. Four bolts at the base of the bracket fasten the bracket to the building structure. The fastening method described for the pool edge mounting bracket applies also to the sensor mounting bracket. Electrical connections to the sensor are made using flexible conduit into one of two available ½ inch NPT threaded openings in the sensor housing.

The final mounting details for the waveguide piping and radar sensor will be available upon completion of the final design. They will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

The NRC staff notes that the licensee's proposed installation and mounting of the instrument appear to be consistent with NEI 12-02, as endorsed by the ISG and that the proposed mounting would meet the seismic design criteria described in the guidance. The staff notes that the final mounting design details are not available for review and will be provided to the staff on February 28, 2014 with the second CCNPP Overall Integrated Plan status update. The staff plans to verify the final design and the results of the licensee's seismic testing and analysis report. The staff has identified these requests as:

RAI #4

Please provide the results of the analyses used to verify the design criteria and methodology for seismic testing of the SFP instrumentation and the electronics units, including, design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.

RAI #5

For each of the mounting attachments required to attach SFP Level equipment to plant structures, please describe the design inputs, and the methodology that was used to qualify the structural integrity of the affected structures/equipment.

3.6 Design Features: Qualification

Attachment 2 of Order EA-12-051 states, in part, that

The primary and backup 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. This reliability shall be established through use of an augmented quality assurance process (e.g. a process similar to that applied to the site fire protection program).

NEI 12-02 states, in part, that

The instrument channel reliability shall be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the following sets of parameters, as described in the paragraphs below:

- conditions in the area of instrument channel component use for all instrument components,
- effects of shock and vibration on instrument channel components used during any applicable event for only installed components, and
- seismic effects on instrument channel components used during and following a potential seismic event for only installed components...

The NRC staff assessment of the instrument qualification is discussed in the following subsections below: (3.6.1) Augmented Quality Process, (3.6.2) Post Event Conditions, (3.6.3) Shock and Vibration, and (3.6.4) Seismic Reliability.

3.6.1 Augmented Quality Process

Appendix A-1 of the guidance in NEI 12-02 describes a quality assurance process for non-safety systems and equipment that is not already covered by existing quality assurance requirements. Within the ISG, the NRC staff found the use of this quality assurance process to be an acceptable means of meeting the augmented quality requirements of Order EA-12-051.

In its OIP, the licensee stated that augmented quality requirements, similar to those applied to fire protection equipment will be applied to this project.

The licensee's proposed augmented quality assurance requirements appear to be consistent with NEI 12-02, as endorsed by the ISG.

3.6.2 Post Event Conditions

NEI 12-02 states, in part, that

The temperature, humidity and radiation levels consistent with conditions in the vicinity of the [SFP] and the area of use considering normal operational, event and post-event conditions for no fewer than seven days post-event or until off-site resources can be deployed by the mitigating strategies resulting from Order EA-12-049 should be considered. Examples of post-event (beyond-design-basis) conditions to be considered are:

- radiological conditions for a normal refueling quantity of freshly discharged (100 hours) fuel with the SFP water level 3 as described in this order,

- temperatures of 212 degrees F and 100% relative humidity environment,
- boiling water and/or steam environment

- a concentrated borated water environment, and...

In its OIP, the licensee stated, consistent with NEI 12-02, in part, that

Temperature, humidity and radiation levels consistent with conditions in the vicinity of the SFP and the area of use considering normal operational, event and post-event conditions for no fewer than seven days post-event or until off-site resources can be deployed by the mitigating strategies resulting from Order EA-12-049 (Reference 2) will be addressed in the engineering and design phase. Examples of post-event (beyond-design-basis) conditions that will be considered are:

- radiological conditions for a normal refueling quantity of freshly discharged (100 hours) fuel with the SFP water at level 3 as described in this plan,
- temperatures of 212°F and 100% relative humidity environment,
- boiling water and/or steam environment,
- a concentrated borated water environment, and...

Related to radiological conditions, in its OIP the licensee stated, in part, that

Equipment located in the vicinity of the SFP will be qualified to withstand peak and total integrated radiation dose levels for its installed location assuming that post-event SFP water level is equal to the top of the spent fuel racks (Level 3) for an extended period of time. ...

The radiation dose at the transmitters locations will also be less as the concrete SFP walls will provide significant radiation shielding.

In its letter dated July 3, 2013, the licensee stated, in part, that

The area above and around the pool will be subject to elevated levels of radiation in the event that the fuel becomes uncovered. The only parts of the measurement channel in the pool radiation environment are the metallic waveguide and horn, which are not susceptible to the expected levels of radiation. The electronics will be located in an area that does not exceed their 1×10^3 rad analyzed limit.

The NRC staff has concerns with the licensee's lack of information regarding its analysis of the maximum expected radiological conditions where the electronics will be located. The staff is also concerned with the lack of documentation indicating how it was determined that the electronics can withstand a total integrated dose of 1×10^3 Rads. The staff has identified this request as:

RAI #6

Please provide analysis of the maximum expected radiological conditions (dose rate and total integrated dose) to which the electronics will be exposed. Also, please provide documentation indicating how it was determined that the electronics for this equipment is capable of withstanding a total integrated dose of 1×10^3 Rads. Please discuss the time period over which the analyzed total integrated dose was applied.

While addressing post-event temperature conditions, in its OIP, the licensee stated that saturation temperature at the bottom of the SFP assuming normal water level will be approximately 255 °F and Post-event temperature at sensors located above the SFP is assumed to be 212 °F.

In its letter dated July 3, 2013, the licensee stated, in part, that

The postulated temperature in the SFP area that results from a boiling pool is 100°C (212°F). The electronics in the sensor are rated for a maximum ambient temperature of 80°C (176°F) on the condition that the process temperature (that which the flange connection is in contact with) is no greater than 130°C (266°F). The level sensor electronics will be located outside of the SFP area in an area where the temperature will not exceed the rated temperature.

The NRC staff has concerns with the licensee's lack of information regarding the ambient temperature in the vicinity where the electronics equipment will be located under normal and worst case postulated conditions. The staff has identified this request as:

RAI #7

Please provide information indicating a) whether the 80°C rating for the sensor electronics is a continuous duty rating; and, b) what the maximum expected ambient temperature will be in the room in which the sensor electronics will be located under BDB conditions in which there is no ac power available to run Heating Ventilation and Air Conditioning (HVAC) systems.

In its OIP, the licensee stated that post-event humidity near and above the SFP is assumed to be 100% with condensing steam.

In its letter dated July 3, 2013, the licensee stated, in part, that

The maximum humidity postulated for the SFP room is 100% RH, saturated steam. The VEGA electronics will be located outside of the SFP room in an area away from the steam atmosphere. The waveguide pipe can withstand condensation formed on the inside walls provided there is no pooling of the condensate in the waveguide pipe. This is ensured by installing a weep hole(s) at the low spots in the wave guide pipe.

The ability of the radar to "see through" the steam has been demonstrated by testing performed by AREVA. In addition to the AREVA test, VEGA Through Air Radar has been used in numerous applications that involve measuring the level of boiling liquids. The VEGA Operating Instructions Manual contains a table that provides accuracy correction factors for superimposed gas or vapor including saturated steam at various pressures. Therefore, operating experience has shown that the Through Air Radar functions at high levels of steam saturation.

The NRC staff has concerns with the licensee's lack of information regarding whether the sensor electronics is capable of continuously performing its required functions under this expected humidity condition. The staff has identified this request as:

RAI #8

Please provide information indicating the maximum expected relative humidity in the room in which the sensor electronics will be located under BDB conditions, in which there is no ac power available to run HVAC systems, and whether the sensor electronics is capable of continuously performing its required functions under this expected humidity condition.

3.6.3 Shock and Vibration

NEI 12-02 states, in part, that

Applicable components of the instrument channels are rated by the manufacturer (or otherwise tested) for shock and vibration at levels commensurate with those of postulated design basis event conditions in the area of instrument channel component use using one or more of the following methods:

- instrument channel components use known operating principles, are supplied by manufacturers with commercial quality programs (such as ISO9001) with shock and vibration requirements included in the purchase specification and/or instrument design, and commercial design and testing for operation in environments where significant shock and vibration loadings are common, such as for portable hand-held devices or transportation applications;
- substantial history of operational reliability in environments with significant shock and vibration loading, such as transportation applications, or
- use of component inherently resistant to shock and vibration loadings or are seismically reliable such as cables.

In its OIP, the licensee stated, in part, that

Components of the instrument channels will be qualified for shock and vibration using one or more of the following methods:

- Components will be supplied by manufacturers using commercial quality programs (such as ISO9001, *Quality management systems - Requirements* (Reference 8)) with shock and vibration requirements included in the purchase specification at levels commensurate with portable handheld device or transportation applications;
- Components will have a substantial history of operational reliability in environments with significant shock and vibration loading, such as portable hand-held device or transportation applications; or
- Components will be inherently resistant to shock and vibration loadings, such as cables.

Sensor Shock

In its letter dated July 3, 2013, the licensee stated, in part, that

The AREVA VEGAPULS 62ER Through Air Radar sensor is similar in form, fit, and function to the VEGAPULS 66 that was shock and vibration tested in accordance with MIL-STD-901D and MIL-STD-167-1. This shock and vibration testing only applies to the sensor. The waveguide piping is not shock or vibration sensitive.

In its later dated July 3, 2013, the licensee also stated that the sensor is similar in form, fit, and function to a version of the sensor that was previously shock tested in accordance with MIL-STD-901D, "Requirements for High-Impact Shock Tests, Shipboard Machinery, Equipment, and Systems," dated March 17, 1989. The licensee also indicated that the proposed waveguide piping is not shock sensitive.

The NRC staff notes that the use of MIL-STD-901D is an acceptable method for shock testing. However, the staff has concerns regarding the lack of information describing the tests, applied forces, and the operability condition of the sensor after the tests were completed. The staff has identified this request as:

RAI #9

Please provide information describing the evaluation of the comparative sensor design, the shock test method, test results, and forces applied to the sensor applicable to its successful tests demonstrating that the referenced previous testing provides an appropriate means to demonstrate reliability of the sensor under the effects of severe shock.

Sensor Vibration

In its letter dated July 3, 2013, the licensee stated that the sensor is similar in form, fit, and function to a version of the sensor that was previously vibration tested in accordance with MIL-STD-167-1, ["Department of Defense Test Method Standard--Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited), May 1, 1974."] This vibration testing only applies to the sensor. The licensee also indicated that the proposed waveguide piping is not vibration sensitive.

The NRC staff notes that the use of MIL-STD-167-1 is an acceptable method for vibration testing. However, the staff has concerns with the lack of information describing the tests, applied forces and their directions and frequency ranges, or the operability condition of the sensor after the tests were completed. The staff has identified this request as:

RAI #10

Please provide information describing the evaluation of the comparative sensor design, the vibration test method, test results, and the forces and their frequency ranges and directions applied to the sensor applicable to its successful tests, demonstrating that the referenced previous testing provides an appropriate means to demonstrate reliability of the sensor under the effects of high vibration.

Electronics Panel Shock and Vibration

In its letter dated July 3, 2013, licensee described the power and control panel it plans to install, which is similar in form, fit, and function to a mobile version of this product. The readout portion of the display for the mobile version was previously shock and vibration tested with the sensor as described above. The display unit for the mobile version of this product is designed for mobile applications subject to shock and vibration resulting from normal handling, transportation, and setup.

The NRC staff has concerns with the licensee's lack of information regarding description of the manufacturer's shock and vibration ratings for this equipment and the results of any testing performed by the manufacturer to achieve those ratings. The staff also plans to verify the licensee's comparison of the magnitude of the manufacturer's ratings against postulated plant conditions under design basis events. The staff has identified this request as:

RAI #11

Please provide information describing the evaluation of the comparative display panel ratings against postulated plant conditions. Also provide results of the manufacturer's shock and vibration test methods, test results, and the forces and their frequency ranges and directions applied to the display panel associated with its successful tests.

Additionally, in its letter dated, July 3, 2013, the licensee stated, in part, that

Further details of the qualification and test program used to confirm the reliability of the permanently installed equipment during and following BDB events will be available upon completion of the final design. They will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

The NRC staff notes that further of the qualification and test program used to confirm the reliability of the permanently installed equipment during and following BDB events are not available for review and will be provided to the staff on the February 28, 2014 with the second CCNPP Overall Integrated Plan status update. The staff has identified this request as:

RAI #12

Please provide the following:

- a) **Description of the specific method or combination of methods you intend to apply to demonstrate the reliability of the permanently installed equipment under BDB ambient temperature, humidity, shock, vibration, and radiation conditions.**
- b) **Results for the selected methods, tests and analyses utilized to demonstrate the qualification and reliability of the installed equipment in accordance with the Order requirements.**

3.6.4 Seismic Reliability

The ISG recommends the use of Sections 7, 8, 9, and 10 of IEEE 344-2004 for seismic qualification of the SFP level instrumentation.

In its OIP, the licensee stated, in part, that

The following measures will be used to verify that the design and installation is adequate for seismic effects on instrument channel components used after a potential seismic event for installed components (with the exception of battery chargers and replaceable batteries). Applicable components of the instrument channels will be rated by the manufacturer (or otherwise tested) for seismic effects at levels commensurate with those of postulated design basis event conditions in the location of the instrument channel component using one or more of the following methods:

- a substantial history of operational reliability in environments with significant vibration, such as for portable hand-held devices or transportation applications. Such a vibration design envelope will be inclusive of the effects of seismic motion imparted to the components proposed at the locations of the proposed installation;
- adequacy of seismic design and installation will be demonstrated based on the guidance in Sections 7, 8, 9, and 10 of IEEE Standard 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations, (Reference 9) or a substantially similar industrial standard;
- proposed devices will be demonstrated to be substantially similar in design to models that have been previously tested for seismic effects in excess of the plant design basis at the locations where the instruments will be installed (g-levels and frequency ranges); or

- the capability to withstand seismic motion consistent with that of existing design basis loads at the installed locations will be demonstrated.

In its letter dated July 3, 2013, the licensee stated, in part, that

A seismic shake test will be performed to the requirements of Institute of Electrical and Electronics Engineers 344-2004 for elements of the AREVA VEGAPULS 62ER Through Air Radar to levels anticipated to envelop most, if not all plants in the United States. The equipment to be tested includes the readout and power control panel, and the level sensor electronics. The items will be tested to the Required Response Spectra (RRS) contained in Electric Power Research Institute TR-107330 to account for the potentially high seismic motion that could occur to the cabinet-mounted readout and power control panel. This RRS will also envelop the seismic ground motion for items mounted to the building structure, pool edge, etc.

Further, in its letter dated July 3, 2013, the licensee stated, in part, that

The seismic testing described in Part b) [above] includes testing the AREVA VEGAPULS 62ER Through Air Radar for functionality prior to and post-seismic testing, which includes verification of the instrument accuracy.

Further details of the qualification and test program used to confirm the reliability of the permanently installed equipment during and following seismic conditions will be available upon completion of the final design. They will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

The licensee's planned approach with respect to the seismic reliability of the instrumentation appears to be consistent NEI 12-02, as endorsed by the ISG. However, the staff plans to verify the results of the licensee's seismic test when it is completed. The staff has identified this request as:

RAI #13

Please provide analysis of the seismic testing results and show that the instrument performance reliability, following exposure to simulated seismic conditions representative of the environment anticipated for the SFP structures at CCNPP, has been adequately demonstrated.

3.6.5 Qualification Evaluation Summary

Upon acceptable resolution of the RAIs in Section 3.6, the NRC staff will be able to make a conclusion regarding the instrument qualification.

3.7 Design Features: Independence

Attachment 2 of Order EA-12-051 states, in part, that

The primary instrument channel shall be independent of the backup instrument channel.

NEI 12-02 states, in part, that

Independence of permanently installed instrumentation, and primary and backup channels, is obtained by physical and power separation commensurate with the hazard and electrical isolation needs. If plant AC or DC power sources are used then the power sources shall be from different buses and preferably different divisions/channels depending on available sources of power.

In its OIP, the licensee stated that the primary instrument channel would be redundant to and independent of the backup instrument channel.

In its letter dated July 3, 2013, the licensee stated, in part, that

The instrumentation power sources are provided with independent and battery backed-up supplies. The 120 VAC power sources will be determined in the final design process. Independence will be maintained throughout the entire train for each channel. Therefore, failure of one power source will not result in a loss of both instrument channels.

Further, in its letter dated July 3, 2013, the licensee stated, in part, that

The two channels of the AREVA VEGAPULS 62ER Through Air Radar Spent Fuel Pool Level Measurement system meet the requirement for independence in accordance with the guidance in NRC JLD-ISG-2012-03 and NEI 12-02 through separation by distance and electrical independence of one another. The horn antenna for each level instrument will be installed on opposite corners of the SFP. This separation will be maintained for the routing of the stainless steel waveguide piping and each channel's sensor electronics. Wiring from the sensors and wiring to the power control panels and displays located in the Main Control Room for each channel will be routed in separate conduits and cable raceways to maintain separation.

Further details on independence and channel separation of the permanently installed equipment will be available upon completion of the final design. They will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

The NRC staff notes that the licensee's proposed independence and physical and power separation appears to be consistent with NEI 12-02, as endorsed by the ISG. This proposed arrangement would not affect the operation of the independent channel under BDB event conditions, and the electrical functional performance of each level measurement channel would be considered independent of the other channel. This independence would result in a reliable SFP level measurement. However, the NRC staff plans to review the final electrical power supply design information to complete its review. The NRC staff has identified this request as:

RAI #14

Please provide the NRC staff with the final configuration of the power supply source for each channel so that the staff may conclude that the two channels are independent from a power supply assignment perspective.

3.8 Design Features: Power Supplies

Attachment 2 of Order EA-12-051, states in part, that

Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant ac and dc power distribution systems, such as portable generators or replaceable batteries. 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 states, in part, that

The normal electrical power supply for each channel shall be provided by different sources such that the loss of one of the channels primary power supply will not result in a loss of power supply function to both channels of SFP level instrumentation.

All channels of SFP level instrumentation shall provide the capability of connecting the channel to a source of power (e.g., portable generators or replaceable batteries) independent of the normal plant AC and DC power systems. For fixed channels this alternate capability shall include the ability to isolate the installed channel from its normal power supply or supplies. The portable power sources for the portable and installed channels shall be stored at separate locations, consistent with the reasonable protection requirements associated with NEI 12-06 (Order EA-12-049). The portable generator or replaceable batteries should be accessible and have sufficient capacity to support reliable instrument channel operation until off-site resources can be deployed by the mitigating strategies resulting from Order EA-12-049.

If adequate power supply for either an installed or portable level instrument credits intermittent operation, then the provisions shall be made for quickly and reliably taking the channel out of service and restoring it to service. For example, a switch on the power supply to the channel is adequate provided the power can be periodically interrupted without significantly affecting the accuracy and reliability of the instrument reading. Continuous indication of SFP level is acceptable only if the power for such indication is demonstrably adequate for the time duration specified in section 3.1[.]

In its OIP, the licensee stated, in part, that

The primary and backup channels will be powered from dedicated batteries and local battery chargers. The battery chargers for both channels will normally be powered from non-safety related 120 VAC power. Minimum battery life of 72 hours will be provided. The battery systems will include provision for battery replacement should the battery charger be unavailable following the event.

During the loss of normal power the battery chargers will be connectable to another 120 VAC power source. This will be from portable generators stored onsite, consistent with the reasonable protection requirements associated with NEI 12-06 (Reference 5), or from generators deployed from off-site by the mitigating strategies resulting from Order EA-12-049, at approximately 24 hours after the event.

In its letter dated July 3, 2013, the licensee stated, in part, that

The primary power supply will be from station 120 VAC panels and will be connected to the display panel which will be located in the Main Control Room. As required in NEI 12-02, in the event of loss of primary power the instruments can be manually switched to backup power. The AREVA VEGAPULS 62ER Through Air Radar has a self-contained battery (eight standard AA lithium cells) backup source which is included in the display panel. It will support 2.5 years with 30 minutes of operation per day, or > 300 hours of continuous operation. During this time, it supplies the power to the whole system, i.e., sensor electronics and the display with a power consumption of < 0.5Watts.

The sizing of the battery back-up for the AREVA VEGAPULS 62ER Through Air Radar is based on the ability of the sensor to supply full load (20mA) for the duration specified in the FLEX program of at least seven days after station blackout, with built-in safety margin. The sizing of the battery will be verified by calculation and/or test prior to installation. The self-contained battery system is independent from existing station batteries.

Further details on the AC and DC power supplies of the permanently installed equipment will be available upon completion of the final design and will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

The NRC staff notes that the proposed criteria for sizing of the battery backup appears to be consistent with NEI 12-02, as endorsed by the ISG. However, the staff plans to verify the results of the licensee's calculation for required duty cycle given the final design load of the instrument channel for its installed configuration. The staff has identified this request as:

RAI #15

Please provide the results of the calculation depicting the battery backup duty cycle requirements demonstrating that its capacity is sufficient to maintain the level indication function until offsite resource availability is reasonably assured.

3.9 Design Features: Accuracy

Attachment 2 of Order EA-12-051 states, in part, that

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

NEI 12-02 states, in part, that

Accuracy should consider operations while under SFP conditions, e.g., saturated water, steam environment, or concentrated borated water. Additionally, instrument accuracy should be sufficient to allow trained personnel to determine when the actual level exceeds the specified lower level of each indicating range (levels 1, 2 and 3) without conflicting or ambiguous indication.

In its OIP, the licensee stated, in part, that

The accuracy will be consistent with the guidelines of NRC JLD-ISG-2012-03 and NEI 12-02. Instrument channels will be designed such that they will maintain their design accuracy following a power interruption or change in power source without recalibration.

Accuracy will consider SFP conditions, e.g., saturated water, steam environment, or concentrated borated water. Additionally, instrument accuracy will be sufficient to allow trained personnel to determine when the actual water level exceeds the specified lower level of each indicating range (levels 1, 2 and 3) without conflicting or ambiguous indication. The accuracy will consider the resolution requirements of Figure 1 of NEI 12-02. Actual accuracy for the indication under all required conditions will be determined during the engineering and design phase.

In its letter dated July 3, 2013, the licensee stated, in part, that

The reference accuracy for the instrument defined by the manufacturer is ± 2 mm based on sensor horn without a waveguide using a metal target. However, with a waveguide and water as a target, accuracy under normal SFP level conditions has been demonstrated to be ± 1 inch based on tests performed by AREVA. This is the design accuracy value that will be used for the SFP level instrument channels. This accuracy value is subject to change dependent on the actual performance with the installed waveguide constructed to support the desired installation location for each channel. The final instrument accuracy will be determined following installation testing implemented as part of the design change acceptance process.

The accuracy of the instrument channel is little affected under BDB conditions (i.e., radiation, temperature, humidity, post-seismic and post-shock conditions). It

will maintain its design accuracy following a power interruption without the need for recalibration. The stainless steel horn antenna and waveguide pipe that is exposed to BDB conditions is largely unaffected by radiation, temperature and humidity other than a minor effect of condensation forming on the waveguide inner walls which will have a slight slowing effect on the radar pulse velocity. Condensation is prevented from pooling in the waveguide and thus blocking the radar signal by placement of weep holes at low points in the waveguide pipe. A minor effect on the accuracy based on the length of the overall measurement path can occur due to temperature related expansion of the waveguide pipe. The waveguide pipe permits the sensor to be located on the elevation below the refuel floor in mild environment conditions so that the effect of elevated refuel floor temperatures on accuracy is also limited. A small correction factor is applied to account for the impact of saturated steam at atmospheric pressure on the radar beam velocity. Testing performed by AREVA using saturated steam and saturated steam combined with smoke indicate that the overall effect on the instrument accuracy is minimal. The overall accuracy during the BDB conditions described above is conservatively estimated to not exceed ± 3 inches or 0.926% of the 27 foot instrument span, which is within the required ± 1 foot described in NEI 12-02.

Further, in its letter dated July 3, 2013, the licensee stated, in part, that

The maximum allowed deviation from the instrument channel design accuracy that will be employed under normal operating conditions as an acceptance criterion for a calibration procedure to flag to operators and to technicians that the channel requires adjustment to within the normal condition design accuracy will be based upon the difference between readings from the primary and backup level instruments. The estimated design accuracy for each instrument is ± 1 inch. The combined maximum deviation between the two instruments after which calibration is needed is therefore ± 2 inches based on a still water level in the pool. A change to design accuracy will likewise cause a proportionate change to the maximum allowable deviation value. The final instrument accuracy will be determined following installation testing implemented as part of the design change acceptance process.

The NRC staff notes that the estimated instrument channel design accuracies and methodology are reasonable since it would be expected to result in maintaining the instrument channels to within their design basis accuracies before significant drift can occur. This appears to be consistent with NEI 12-02, as endorsed by the ISG. The NRC staff plans to verify that the licensee's proposed instrument performance is consistent with these estimated accuracy values. Further, the NRC staff plans to verify that the channels will retain these accuracy performance values following a loss of power and subsequent restoration of power. The staff has identified this request as:

RAI #16

Please provide analysis verifying that the proposed instrument performance is consistent with these estimated accuracy normal and BDB values. Please demonstrate

that the channels will retain these accuracy performance values following a loss of power and subsequent restoration of power.

3.10 Design Features: Testing

Attachment 2 of Order EA-12-051 states, in part, that

The instrument channel design shall provide for routine testing and calibration.

NEI 12-02 states, in part, that

Static or non-active installed (fixed) sensors can be used and should be designed such that testing and/or calibration can be performed in-situ. For microprocessor based channels the instrument channel design shall be capable of testing while mounted in the pool.

In its OIP, the licensee stated, in part, that

Instrument channel design will provide for routine testing and calibration that can, be performed in-situ consistent with Order EA-12-051 and the guidance in NEI 12-02. Details will be determined during the engineering and design phase. Additional testing and calibration information is provided in Section XV of this plan.

In its letter dated July 3, 2013, the licensee stated, in part, that

Calibration of the SFP level system is performed in-situ. Channel check and calibration tolerances will be developed as part of the detailed design and incorporated into station maintenance procedures. The final calibration methodology will be available upon completion of the final design. It will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

Further, in its letter dated July 3, 2013, the licensee stated, in part, that

Multi-point testing is enabled by means of a radar horn antenna capable of being rotated away from the SFP water surface and aimed at a movable metal target that is positioned at known distances from the horn. This allows checking for correct readings of all indicators along a measurement range and validates the functionality of the installed system.

In its letter dated July 3, 2013, the licensee also explained that the instrument channels would have indicators to allow operators to compare the level indicated against other SFP level instrumentation currently installed. According to the licensee, with this information and the maximum level allowed deviation for the instrument channel design accuracy, the operators could determine if recalibration or troubleshooting is needed.

The NRC staff notes that the licensee's proposed design, with respect to routine in-situ instrument channel functional and calibration tests, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.11 Design Features: Display

Attachment 2 of Order EA-12-051 states, in part, that

Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location. The display shall provide on-demand or continuous indication of spent fuel pool water level.

NEI 12-02 states, in part, that

The intent of this guidance is to ensure that information on SFP level is reasonably available to the plant staff and decision makers. Ideally there will be an indication from at least one channel of instrumentation in the control room. While it is generally recognized (as demonstrated by the events at Fukushima Daiichi) that SFP level will not change rapidly during a loss of spent fuel pool cooling scenario more rapid SFP drain down cannot be entirely discounted. Therefore, the fact that plant personnel are able to determine the SFP level will satisfy this requirement, provided the personnel are available and trained in the use of the SFP level instrumentation (see Section 4.1) and that they can accomplish the task when required without unreasonable delay.

SFP level indication from the installed channel shall be displayed in the control room, at the alternate shutdown panel, or another appropriate and accessible location (reference NEI 12-06). An appropriate and accessible location shall have the following characteristics:

- occupied or promptly accessible to the appropriate plant staff giving appropriate consideration to various drain down scenarios,
- outside of the area surrounding the SFP floor, e.g., an appropriate distance from the radiological sources resulting from an event impacting the SFP,
- inside a structure providing protection against adverse weather, and
- outside of any very high radiation areas or LOCKED HIGH RAD AREA during normal operation.

If multiple display locations beyond the required "appropriate and accessible location" are desired, then the instrument channel shall be designed with the capability to drive the multiple display locations without impacting the primary "appropriate and accessible" display.

In its OIP, the licensee stated that the credited SFP water level indication will be provided in the common Control Room. The licensee also explained how the control room met the characteristics identified in NEI 12-02 for an accessible location.

In its letter dated July 3, 2013, the licensee confirmed that the credited SFP level instrument displays will be located in the common Control Room.

The NRC staff notes that the NEI guidance for "Display" specifically mentions the control room as an acceptable location for SFP instrumentation displays as it is occupied or promptly accessible, outside the area surrounding the SFP, inside a structure providing protection against adverse weather and outside of any very high radiation areas or LOCKED HIGH RAD AREA during normal operation. The licensee's proposed location for the primary and backup SFP instrumentation displays appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.12 Programmatic Controls: Training

Attachment 2 of Order EA 12 051 states, in part, that

Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.

NEI 12 02 states, in part, that

The personnel performing functions associated with these SFP level instrumentation channels shall be trained to perform the job specific functions necessary for their assigned tasks (maintenance, calibration, surveillance, etc.). SFP instrumentation should be installed via the normal modification processes. In some cases, utilities may choose to utilize portable instrumentation as a portion of their SFP instrumentation response. In either case utilities should use the Systematic Approach to Training (SAT) to identify the population to be trained. The SAT process should also determine both the initial and continuing elements of the required training.

In its OIP, the licensee stated, in part, that

The Systematic Approach to Training (SAT) will be used to identify the population to be trained and to determine both the initial and continuing elements of the required training. Training will be completed prior to placing the instrumentation in service.

The licensee's proposed plan, with respect to the training personnel in the use and the provision of alternate power to the primary and backup instrument channels, including the approach to identifying the population to be trained, appears to be consistent with NEI 12-02, as endorsed by the ISG.

3.13 Programmatic Controls: Procedures

Attachment 2 of Order EA-12-051 states, in part, that

Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.

NEI 12-02 states, in part, that

Procedures will be developed using guidelines and vendor instructions to address the maintenance, operation and abnormal response issues associated with the new SFP instrumentation.

In its OIP, the licensee stated, in part, that

Procedures will be developed using guidelines and vendor instructions to address the maintenance, operation, and abnormal response issues associated with the new SFP instrumentation.

Procedures will address a strategy to ensure SFP water level addition is initiated at an appropriate time consistent with implementation of NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide* (References 5 and 7).

In its letter dated July 3, 2013, the licensee stated, in part, that

Procedures for inspection, maintenance, repair, operation, abnormal response, and administrative controls associated with the SFP level instrumentation will be developed utilizing vendor instructions in accordance with existing controlled station administrative procedures that govern procedure development. These procedures ensure standardization of format, content, terminology and human performance considerations.

There are no portable level channel instruments associated with the new SFP level instrumentation system that will be installed. Consequently, procedures for storage and installation will not be required.

The NRC staff notes that the procedures for inspection, maintenance, repair, operation, abnormal response, and administrative controls associated with the SFP level instrumentation are not available for review. The staff has identified this request as:

RAI #17

Please provide a list of the procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection procedures that will be developed for use of the spent SFP instrumentation. The licensee is requested to include a brief description of the specific technical objectives to be achieved within each procedure.

3.14 Programmatic Controls: Testing and Calibration

Attachment 2 of Order EA-12-051 states, in part, that

Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy. NEI 12-02 states, in part, that

Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup SFP level instrument channels to maintain the instrument channels at the design accuracy. The testing and calibration of the instrumentation shall be consistent with vendor recommendations or other documented basis.

In its OIP, the licensee stated, in part, that

Processes will be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup SFP water level instrument channels to maintain the instrument channels at the design accuracy. Testing and calibration of the instrumentation will be consistent with vendor recommendations and any other documented basis. Calibration will be specific to the mounted instrument and the monitor. Out of service time as identified in NEI 12-02 will be incorporated consistent with the programmatic process used for compliance with NRC Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design Basis External Events (Reference 2). Functionality testing will be performed at the frequency specified in NEI 12-02. Additional testing and calibration information is provided in Section XI of this plan.

Instrument channel out of service times as identified in NEI 12-02 will be implemented and controlled consistent with the programmatic process used for compliance with NRC Order EA-12-051.

In its letter dated July 3, 2013, the licensee stated, in part, that

The maintenance and testing of the SFP level instrumentation system will be incorporated into the normal station work control processes based on vendor recommendations for maintenance and periodic testing. The calibration and maintenance program will include testing to validate the functionality of each instrument channel within 60 days of a planned refueling outage considering normal testing scheduling allowances (e.g., 25%).

The preventive maintenance, test and calibration program will be developed consistent with the vendor's recommendations. This information will be available following completion of the final design and will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

Instrument channel out of service times as identified in NEI 12-02 will be implemented and controlled consistent with the programmatic process used for compliance with NRC Order EA-12-051.

While addressing compensatory actions for a channel being out of service, in its letter dated July 3, 2013, the licensee stated, in part, that

In the event a channel of SFP level instrumentation is out-of-service for any reason, the time out-of- service will be administratively tracked with an action to restore the channel to service within 90 days. Functionality of the other channel will be confirmed via appropriate testing measures within the following 7 days and every 90 days thereafter until the non-functioning channel is restored to service.

The appropriate compensatory actions have not yet been specified for both channels out-of-service. The determination of these actions, administrative requirements, and implementation procedures will be available following completion of the final design and will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update. ...

In the event that a channel cannot be restored to service within the 90 day period, expedited actions to restore the channel would be initiated and tracked via CCNPP's Corrective Action Program. If both channels are determined to be non-functional, CCNPP will initiate appropriate compensatory actions within 24 hours. The expedited and compensatory actions will be defined in the applicable maintenance procedure.

The appropriate compensatory actions have not yet been specified. The determination of these actions, administrative requirements, and implementation procedures will be available following completion of the final design and will be forwarded to the NRC on February 28, 2014 with the second CCNPP Overall Integrated Plan status update.

The licensee's proposed plan, with respect to defining processes for scheduling and implementing necessary testing and calibration and compensatory actions when a channel is out of service or when one of the instrument channels cannot be restored to functional status within 90 days appears to be consistent with NEI 12-02, as endorsed by the ISG. The NRC staff notes further information with regard to testing, calibration and compensatory actions will be provided on February 28, 2014 with the second CCNPP Overall Integrated Plan status update. The staff has identified these requests as:

RAI #18

Please provide the following:

- a) **Further information describing the maintenance and testing program the licensee will establish and implement to ensure that regular testing and calibration is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. Please include a description of the plans for ensuring that necessary channel checks, functional tests, periodic**

calibration, and maintenance will be conducted for the level measurement system and its supporting equipment.

- b) Information describing compensatory actions when both channels are out-of-order, and the implementation procedures.**
- c) Additional information describing expedited and compensatory actions in the maintenance procedure to address when one of the instrument channels cannot be restored to functional status within 90 days.**

The NRC staff has concerns regarding the feasibility of the licensee's process for in-situ calibration to ensure that the design accuracy will be maintained. The staff has identified the following requests as:

RAI #19

Please provide a description of the in-situ calibration process at the SFP location that will result in the channel calibration being maintained at its design accuracy.

3.15 Instrument Reliability

NEI 12-02 states, in part, that

A spent fuel pool level instrument channel is considered reliable when the instrument channel satisfies the design elements listed in Section 3 [Instrument Design Features] of this guidance and the plant operator has fully implemented the programmatic features listed in Section 4 [Program Features].

In its OIP, the licensee stated that the reliability of the primary and backup instrument channels will be assured by conformance with the guidelines of NRC JLD-ISG-2012-03 and NEI 12-02 as discussed under Design Features and Program Features. The licensee stated instrument channel design will be consistent with the guidance of the ISG and NEI 12-02.

Upon acceptable resolution of the RAIs noted above, the NRC staff will be able to make a conclusion regarding the reliability of the SFP instrumentation.

4.0 CONCLUSION

The NRC staff is unable to complete its evaluation regarding the acceptability of the licensee's plans for implementing the requirements of Order EA-12-051 due to the need for additional information as described above. The staff will issue an evaluation with its conclusion after the licensee has provided the requested information.