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

November 26, 2013

Vice President, Operations
Entergy Nuclear Operations, Inc.
Vermont Yankee Nuclear Power Station
P.O. Box 250
Governor Hunt Road
Vernon, VT 05354

SUBJECT: VERMONT YANKEE NUCLEAR POWER STATION - INTERIM STAFF EVALUATION AND REQUEST FOR ADDITIONAL INFORMATION REGARDING THE OVERALL INTEGRATED PLAN FOR IMPLEMENTATION OF ORDER EA-12-051, RELIABLE SPENT FUEL POOL INSTRUMENTATION (TAC NO. MF0780)

Dear Sir or Madam:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (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 the licensee to have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the 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.

By letter dated January 23, 2013 (ADAMS Accession No. ML13064A302), Entergy Nuclear Operations, Inc. (the licensee) provided the Overall Integrated Plan (OIP) for the Vermont Yankee Nuclear Power Station describing how it will achieve compliance with Attachment 2 of Order EA-12-051 by fall 2014. By letter dated June 20, 2013 (ADAMS Accession No. ML13165A279), the NRC staff sent a Request for Additional Information (RAI) to the licensee. The licensee provided supplemental information by letters dated July 19, 2013 (ADAMS Accession No. ML13204A386), and August 28, 2013 (ADAMS Accession No. ML13247A029).

The NRC staff has reviewed these submittals with the understanding that the licensee will update its OIP as implementation of the Order progresses. With this in mind, the staff has included an interim staff evaluation with this letter to provide feedback on the OIP. The staff's findings in the interim staff evaluation are considered preliminary and will be revised as the OIP is updated. As such, none of the staff's conclusions are to be considered final. A final NRC staff evaluation will be issued after the licensee has provided the information requested.

The interim staff evaluation also includes RAIs, response to which the NRC staff needs to complete its review. The licensee should provide the information requested in the 6-month status updates, as the information becomes available. However, the staff requests that all information be provided by March 31, 2014, to ensure that any issues are resolved prior to the

date by which the licensee must complete full implementation of Order EA-12-051. The licensee should adjust its schedule for providing information to ensure that all this information is provided by the requested date.

If you have any questions regarding this letter, please contact me at 301-415-1364 or via e-mail at Douglas.Pickett@nrc.gov.

Sincerely,

Douglas V Pickett

Douglas V. Pickett, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-271

Enclosure:
Interim Staff Evaluation and
Request for Additional Information

cc w/encl: Distribution via Listserv

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

ENTERGY NUCLEAR OPERATIONS, INC.

VERMONT YANKEE NUCLEAR POWER STATION

DOCKET NO. 50-271

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 January 23, 2013 (ADAMS Accession No. ML130720690), Entergy Nuclear Operations, Inc., (the licensee) provided the OIP for Vermont Yankee Nuclear Power Station, describing how it will achieve compliance with Attachment 2 of Order EA-12-51 by fall 2014. By letter dated June 20, 2013 (ADAMS Accession No. ML13165A279), the NRC staff sent a Request for Additional Information (RAI) to the licensee. The licensee provided supplemental information by letters dated July 19, 2013 (ADAMS Accession No. ML13204A386), and August 28, 2013 (ADAMS Accession No. ML13247A029).

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 the 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.

Attachment 2 of Order EA-12-051 requires the licensees 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

The Vermont Yankee (VY) Unit 1 has a single SFP located in the reactor building.

The licensee submitted its OIP on January 23, 2013. The OIP stated that the installation of the SFP level instrumentation at VY is scheduled for completion prior to startup from the fall 2014 refueling outage which is the end of the second refueling outage following submittal of the OIP.

The NRC staff has reviewed the licensee's schedule for implementation of SFP level instrumentation. 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, in part, that

> (1) The level at which reliable suction loss occurs due to uncovering the coolant inlet pipe or any weirs or vacuum breakers associated with suction loss. For VY, the level, (1), is established based on the level at which the SFP cooling pumps automatically trip which is at elevation 343 feet 1 inch (Reference 6). This elevation is above the point where the pumps lose suction (Reference 7).
>
> (2) The level at which the normal fuel pool cooling pumps lose required NPSH [net positive suction head] assuming saturated conditions in the pool. An evaluation will be completed to demonstrate that this elevation is below the elevation that defines Level 1.
>
> The higher of the above points is (1). Therefore, LEVEL 1 is elevation 343 feet 1 inch.

In its letter dated July 19, 2013, the licensee stated, in part, that

a) Additional analysis is in progress for NPSH at saturated conditions for establishment of Level 1. The updated information is currently scheduled to be included in the second six-month status report on February 28, 2014.

The NRC staff notes Level 1 was established based on the level at which the SFP cooling pumps automatically trip, which is at elevation 343 feet (ft.) 1 inch (in.). However, as stated in NEI 12-02, Level 1 should be established at the higher of two SFP elevations. At this time, the elevation necessary to provide the required NPSH specified by the pump manufacturer or engineering analysis is not available. The staff plans to review the results of the calculation performed by the licensee to determine that the elevation identified as Level 1 in the licensee's OIP is consistent with the guidance. The staff has identified this request as:

RAI# 1

Please provide the results of the calculation used to determine the water elevation necessary for the pump's required NPSH to confirm that Level 1 has been adequately identified.

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 Level 2 may be based on either of the following:

(1) 10 feet ± 1 foot above the highest point of any fuel rack seated in the spent fuel pool. The elevation associated with this level is 331 feet 3 inches± 1 foot (i.e. Level 3 + 10 feet).

(2) A designated level that provides adequate radiation shielding to maintain personnel dose within acceptable limits while performing local operations in the vicinity of the pool. This level is based on plant-specific or appropriate generic shielding calculations. The elevation associated with this level is not calculated since item (1) is used to establish Level 2 as permitted by NEI 12-02 Revision 1.

> Therefore, LEVEL 2 is elevation 331 feet 3 inches ± 1 foot (i.e. 10 feet above Level 3).

In its letter dated July 19, 2013, the licensee stated, in part, that

> NEI 12-02 gives two options to determine Level 2. The first option defines Level 2 as ten feet above the highest point of any fuel rack, based on the guidance in Regulatory Guide 1.13, Revision 2. The second option states that Level 2 is based on the need to provide adequate radiation shielding to maintain personnel radiological dose levels within acceptable limits while performing local operations in the vicinity of the pool. The evaluation of the level needed to provide personnel protection should consider the scope of the local operations, including installation of portable SFP instrument channel components, along with the emergency conditions that may apply at the time of operator actions.

In its letter dated August 28, 2013, the licensee stated, in part, that

> The current Level 2 elevation is now 342'-5" El. The previous Level 2 elevation was 10 ft. above the top of the spent fuel rack at 331'-3" El. This differs from the conceptual design VY initially submitted to the NRC. The Level 2 elevation is raised to 342'-5" to account for non-special nuclear material stored above 331'-3" in the Spent Fuel Pool.

In its letter dated July 19, 2013, the licensee provided a sketch depicting the elevations identified as Levels 1, 2 and 3 and the SFP level instrumentation measurement range. The NRC staff reviewed this sketch and notes the licensee adjusted the elevation for Level 2 to 342 ft. 5 in. The new elevation for Level 2 is more than 10 ft. above the top of the fuel rack, to account for the potential dose rate impact of other irradiated material stored in the SFP.

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, in part, that

> The highest point of any fuel rack seated in the spent fuel pool is elevation 321 feet 3 inches (Reference 8). Therefore, Level 3 is elevation 321 feet 3 inches ± 1 foot.
>
> The SFP level instrument span will extend down to at least 3 inches below the upper limit of the range of LEVEL 3 to account for accuracy or instrument loop uncertainty. Therefore, the SFP level probe will extend down to at least 322 feet 0 inches.

In its letter dated July 19, 2013, the licensee provided a sketch depicting the elevations for Levels 1, 2, and 3, and the SFP level instrumentation measurement range. The NRC staff reviewed this sketch and notes the licensee identified Level 3 at an elevation of 322 ft. 3 in., which is 1 foot 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 1, 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 the primary and backup instrument channel would be permanent, fixed channels. The licensee also stated the instrument would provide a single continuous span from above Level 1 to within 1 foot of the top of the spent fuel racks.

In its letter dated July 19, 2013, the licensee stated, in part, that

> The spent fuel pool (SFP) level lower instrument span or probe bottom extends down to at least three inches below the upper limit of the range of Level 3 to account for channel accuracy or instrument loop uncertainty. Therefore, the SFP level probe bottom/span extends down to at least elevation 322 feet (see Figure 1). The SFP level upper instrument span, at a minimum, includes normal water level high alarm. Note that Level 3 is shown in accordance with Nuclear Energy Institute (NEI) 12-02 Revision 1 guidance relative to the top of the rack; the top of the fuel is not shown.

In its letter dated July 19, 2013, the licensee provided a sketch depicting the elevations for Levels 1, 2, and 3, and the SFP level instrumentation measurement range. The NRC reviewed this sketch and notes the identified measurement range goes from an elevation of 344 ft. 2 in. to 322 ft. 0 in.

The NRC staff notes 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 and the range of the instrumentation for the SFP, appears to be consistent with NEI 12-02, as endorsed by the ISG.

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. This protection may be provided by locating the primary instrument channel and the 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.

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 this 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 function.
>
> Channel separation should be maintained by locating the installed sensors in different places in the SFP area.

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

> In the SFP area, cables shall be routed in seismically mounted rigid metal conduit. Outside the pool area, cables shall be routed in seismically mounted rigid metal conduit, trays, or raceways....
>
> Channels shall be physically separated by routing instrument cables in separate conduits, trays, or raceways, locating sensors on opposite sides of the pool near the corners, etc. Physical channel separation will be maintained down through and including each channel display/processor where convergence may be allowed so the display/processors can be located in close proximity or side by side.

In its letter dated July 19, 2013, the licensee stated, in part, that

> ...Due to physical configuration issues, the planned locations for the level sensors have been changed from the corners to positions along the east and west walls at the south end. Also included is the change to the conduit/cable route from the reactor building south wall to the reactor building north wall. A new sketch is in preparation which will be included in a six-month status update.
>
> Similar to separation requirements for existing safety systems, sufficient electrical and physical separation between SFPI channels will be implemented to prevent environmental factors, electrical transients, and physical events from impairing the ability of the system to respond correctly when required.

The NRC staff notes the licensee modified the conduit/cable route to accommodate the new location for the level sensors and a new sketch is in preparation which will be provided to the staff in a six-month status update. The staff has identified this request as:

RAI #2

Please provide the updated sketch or marked-up plant drawing of the SFP level instrumentation arrangement. Include the plan view of the SFP area, depicting the SFP inside dimensions, the planned locations/placement of the primary and back-up SFP level sensor, and the proposed routing of the cables that will extend from these sensors toward the location of the read-out/display device.

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 that both the primary and backup system will be installed as seismic Category I to meet the NRC JLD-ISG-2012-03 and NEI 12-02 guidance requirements. The licensee also stated that other hardware stored in the SFP will be evaluated to ensure that it does not adversely interact with the SFP instrument probes during a seismic event.

In its letter dated July 19, 2013, the licensee stated, in part, that

> The loading on the probe mount and probe body includes both seismic and hydrodynamic loading using seismic response spectra that bounds the Vermont Yankee design basis maximum seismic loads applicable to the installation location(s). The static weight load is also accounted for in the modeling described below but is insignificant in comparison to seismic and hydrodynamic loads. Analytic modeling is being performed by the instrument vendor using Institute of Electrical and Electronic Engineers IEEE 344-2004 methodology.
>
> The simple unibody structure of the probe assembly make it a candidate for analytic modeling and the dimensions of the probe and complex hydrodynamic loading terms in any case preclude meaningful physical testing.

> A detailed computational SFP hydrodynamic model has been developed for the instrument vendor by Numerical Applications, Inc., author of the GOTHIC computational fluid dynamics code. The computational model accounts for multi-dimensional fluid motion, pool sloshing, and loss of water from the pool.
>
> Seismic loading response of the probe and mount is separately modeled using finite element modeling software. The GOTHIC-derived fluid motion profile in the pool at the installation site and resultant distributed hydrodynamic loading terms are added to the calculated seismic loading terms in the finite element model to provide a conservative estimate of the combined seismic and hydrodynamic loading terms for the probe and probe mount, specific to the chosen installation location for the probe.
>
> The proximal portion of the level probe is designed to be attached near its upper end (refer to vendor schematic Figure 2) to a Seismic Category I mounting bracket configured to suit the requirements of a particular SFP. The bracket may be bolted and/or welded to the SFP deck and/or SFP liner/wall according to the requirements of the particular installation per Seismic Category I requirements.

The NRC staff notes the licensee's proposed plan, with respect to the seismic design of the mounting, appears to be consistent with NEI 12-02, as endorsed by the ISG. The staff plans to verify the results of the licensee's seismic analysis report when it is completed based on the licensee's response to the following RAIs.

RAI #3

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 #4

For each of the mounting attachments required to fasten 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.

While addressing how the potential for other material stored in the SFP to adversely interact with the fixed SFP level instrument location(s), in its letter dated July 19, 2013, the licensee stated, in part, that

> An evaluation of non-special nuclear material inventory located in the SFP will be performed during the SFPI modification process. Non-special nuclear material access to the SFP is governed by DP 0545, Fuel Pool Storage Requirements. This procedure will be used to prevent any instrument interference from non-nuclear materials.

The NRC staff notes an evaluation to address the potential for interaction between non-special nuclear material located in the SFP and the SFP level instruments will be performed during the SFPI modification process. The staff has identified this request as:

RAI #5

Please provide further information to describe how other material stored in the SFP will not create adverse interaction with the fixed instrument location(s).

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, in part, that

> Augmented quality requirements will be applied to all components in the instrumentation channels for:
>
> - design control
> - procurement document control
> - instructions, procedures, and drawings
> - control of purchased material, equipment, and services

- inspection, testing, and test control
- inspections, test, and operating status
- nonconforming items
- corrective actions
- records
- audits

The licensee's proposed commitment to an augmented quality assurance process appears 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

> Components in the area of the SFP will be designed for the temperature, humidity, and radiation levels expected during normal, 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 12-049 Revision 0, *Order Modifying Licenses With Regard to Requirements for Mitigation for Beyond-Design-Basis External Events.* 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 level within 1 foot of the top of the SFP racks (Level 3),
> - Temperature of 212 degrees F and 100% relative humidity environment,
> - boiling water and steam environment...

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

> Equipment located in the SFP will be qualified to withstand a total accumulated dose of expected lifetime at normal conditions plus accident dose received at post event conditions with SFP water level within 1 foot of the top of the fuel rack seated in the spent fuel pool (Level 3).
>
> The metal probe and cable in the spent fuel pool area are robust components that are not adversely affected by expected radiation, temperature, or humidity. The areas selected for display/processor installation are considered mild environments, such that personnel access is not prohibited by radiation, temperature or humidity, and are readily accessible by operators during or after a BDBE event.

In its letter dated July 19, 2013, the licensee stated, in part, that

> Radiation:
>
> Signal processor: The signal processor is installed in a mild environment with radiation levels similar to background radiation, with the acknowledgement that the radiation limit for the signal processor is similar to other commercial-grade complementary-metal-oxide-semiconductor (CMOS)-based electronics. Radiation testing is not planned. It should be noted that the instrument performs self-diagnostics before measurements are obtained and the electronics are easily accessible for periodic replacement.
>
> Probe assembly: Materials properties qualification is used.

The NRC staff has concerns with the licensee's lack of information regarding its analysis of the maximum expected radiological conditions for the location of the sensor electronics. The staff has identified this request as:

RAI #6

Please provide an evaluation of the maximum expected radiological conditions (dose rate and total integrated dose) to which the sensor electronics (including power boxes, signal processors, and display panels) will be exposed. Also, provide documentation indicating the maximum total integrated dose the sensor electronics can withstand and how it was determined. Discuss the time period over which the analyzed total integrated dose was applied.

While addressing post-event temperature and humidity conditions, in its letter dated July 19, 2013, the licensee stated, in part, that

> Temperature:
>
> Signal processor: Designed for mild environment installation. Physical testing in an environmental chamber to demonstrate normal operation at the operating temperatures specified for the instrument.

Probe assembly: Qualification by materials properties and use history of substantially similar probe designs in steam generator applications at significantly higher temperatures and pressures and saturated steam environments.

Humidity:

Signal processor: Designed for mild environment installation. Physical testing in an environmental chamber to demonstrate normal operation at the operating humidity specified for the instrument.

Probe assembly: Qualification by materials properties and use history as noted above.

The NRC staff notes that information related to the qualification and test program to confirm the reliability of the permanently installed equipment during and following BDB events are not available for review. The staff has identified these requests as:

RAI #7

Please provide information indicating a) the maximum expected ambient temperature in the room in which the sensor electronics will be located under BDB conditions, when there is no ac power available to run Heating Ventilation and Air Conditioning (HVAC) systems; and, b) whether the sensor electronics are capable of continuously performing required functions under this expected temperature condition.

RAI #8

Please provide information indicating a) the maximum expected relative humidity in the room in which the sensor electronics will be located under BDB conditions, when there is no ac power available to run HVAC systems; and, b) whether the sensor electronics are capable of continuously performing 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 that implement commercial quality programs (such as ISO9001, Quality Management Systems – Requirements) with shock and vibration requirements included in the purchase specification at levels commensurate with portable hand-held devices or transportation applications;
>
> - Components have a history of operational reliability in environments with significant shock and vibration loading, such as portable hand-held device or transportation applications; or
>
> - Components are inherently resistant to shock and vibration loadings, such as cables.

In its letter dated July 19, 2013, the licensee stated, in part, that

> Shock:
> Signal processor: Physical testing to commercial and/or military standards using shake-table and drop testing.
>
> Probe assembly: Finite element analysis in conjunction with seismic modeling described above.
>
> Vibration:
> Signal processor: Physical testing to applicable commercial and/or military standards using shake-table and drop testing.
>
> Probe assembly: The probe assembly and bracket together form a simple static unibody structure with intrinsic vibration resistance that is additionally subject to substantial damping due to the surrounding water medium. This is planned to be modeled using finite element modeling in conjunction with seismic modeling described above.

The NRC staff also has concerns with the licensee's lack of information regarding description of the manufacturer's shock and vibration ratings for the electronics cabinet equipment and the results of any testing performed by the manufacturer to achieve those ratings. The staff 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 these requests as:

RAI #9

Please provide information describing the evaluation of the local electronics cabinet and display panel shock and vibration 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. Include a description of the specific method or combination of methods to demonstrate the reliability of the permanently installed local and electronics cabinet equipment under BDB shock and vibration conditions. Identify the specific commercial or military standards that will be used to define shock and vibration testing requirements, along with the proposed g-force test levels and frequency response spectra.

RAI #10

For RAI #9 above, please provide the results for the selected methods, tests and analyses used 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

> For seismic effects on instrument channel components used after a potential seismic event for only installed components (with the exception of replaceable batteries and chargers), the following measures will be used to verify that the design and installation is adequate:
>
> - Components 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 area of instrument channel component...
>
> - Augmented quality requirements will be applied to all components in the instrumentation channels...

In its letter dated July 19, 2013, the licensee stated regarding seismic testing, in part, that

> Signal processor (electronics): Triaxial shake-table testing is planned to be performed by the vendor to envelope seismic category 1 safe shutdown earthquake (SSE) conditions or VY design basis maximum seismic loads (relative to the location where the equipment is mounted) using IEEE 344-2004 methodology.
>
> Probe assembly (level sensor): Seismic and hydrodynamic finite element analysis is performed by the vendor using relevant IEEE 344-2004 methodology (using enveloping seismic category 1 SSE conditions or VY design basis maximum seismic loads relative to the location where the equipment is mounted), as described in the RAI-3.a response above.
>
> With respect to the probe assembly, combined seismic and hydrodynamic analysis will be used to demonstrate that the probe waveguide's geometric dimensions do not change significantly as a result of the seismic conditions.

> In the absence of alteration to the geometric configuration of the probe waveguide there is no mechanism for seismic excitation of the probe assembly to alter system accuracy.
>
> The accuracy of system electronics will be demonstrated following seismic excitation as part of the seismic testing protocol.

The NRC staff notes the licensee will demonstrate the reliability of the seismic design and installation in accordance with NEI 12-02, as endorsed by the ISG. 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 testing and analysis when it is completed. The staff has identified this request as:

RAI #11

Please provide an evaluation of the vendor analysis and seismic testing results and show that SFP level instrument performance reliability, following exposure to simulated seismic conditions representative of the environment anticipated for the SFP structures at Vermont Yankee 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, in part, that

> The primary instrument channel will be independent of the backup instrument channel. Independence is obtained by physical separation of components between channels and the use of normal power supplied from separate 480V buses. Independence of power sources is described in Section 11. The two (2) permanently mounted instruments in the pool are physically separated as described in Section 6 and 7.

The licensee also stated in its OIP that the display/processors will be normally powered using 120VAC provided from separate 480V buses at a minimum, and that on loss of normal AC power, each processor automatically continues to operate on its own dedicated backup battery supply.

In its letter dated July 19, 2013, the licensee stated, in part, that

> The primary instrument (Channel A) will be along the east wall and the backup instrument (Channel B) will be along the west wall of the SFP, both at the south end. Locating the new instruments along opposite walls of the SFP takes advantage of the distance between the probes (approximately 39 feet) for missile and debris protection. Channel A and B displays will be located in the main control room on the existing panels containing the Containment Atmospheric Dilution (CAD) System components.
>
> The conceptual design provides two independent level instruments in the SFP with cabling routed to two display/processors mounted in the Main Control Room (MCR). Power for each channel is provided from independent 120VAC, 60 Hz power sources. Backup power is provided by a battery capable of providing continuous display operation for at least three days. The battery will be provided with the display/processor. The design prevents failure of a single channel from causing the alternate channel to fail. Channel separation and independence are maintained consistent with existing design basis requirements.
>
> The design provides two identical non-safety related wide-range level instruments which feed two independent trains of non-safety cable and indicators to provide a highly reliable remote display of SFP water level in the main control room. Physical separation of the two channels will be accomplished by separately routing cable and conduit as much as practical. The use of raceways (i.e., conduit or covered trays where appropriate for existing hazards) will provide additional protection from damage due to debris during a BDB event.
>
> Each Control Room display/processor will have a battery installed in the display enclosure which is capable of providing power for at least three days.

The NRC staff notes that with this arrangement, the loss of one backup power supply will not affect the operation of the independent channel under BDB event conditions. The implementation of such design provisions appears to be consistent with the guidance and the electrical functional performance of each level measurement channel and would be considered independent of the other channel. The NRC staff plans to verify the final electrical power supply design information when it is provided. The NRC staff has identified this request as:

RAI #12

Please provide the final configuration of the power supply source for each channel so the staff may conclude 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 power supplies for the instrument channels are shown on Attachment 2 and arranged as follows:
>
> - Each instrument channel is normally powered from 120VAC 60 Hz plant power to support continuous monitoring of SFP level. The primary channel receives power from a different 480V bus than the backup channel. Therefore, loss of any one 480V bus does not result in loss of normal 120VAC power for both instrument channels.

- On loss of normal 120VAC power, each channel's UPS automatically transfers to a dedicated backup battery. If normal power is restored, the channel will automatically transfer back to the normal AC power.

- The backup batteries are maintained in a charged state by commercial-grade uninterruptible power supplies. The batteries are sized to be capable of supporting intermittent monitoring for a minimum of 3 days of operation. This provides adequate time to allow the batteries to be replaced or until off-site resources can be deployed by the mitigating strategies resulting from Order EA-12-049 Revision 0.

- An external connection permits powering the system from any portable DC source.

- Instrument accuracy and performance are not affected by restoration of power or restarting the processor.

In describing the design criteria to size the battery, in its letter dated July 19, 2013, the licensee stated, in part, that

> The sample rate estimates have been developed by the vendor using conservative instrument power requirements and measured battery capacity with draw-downs during and following exposure of the batteries to their maximum operating temperature for up to seven days. The instrument configuration is planned to be established for an automated sample rate when under battery power consistent with seven days continuous operation. Permanent installed battery capacity for seven days continuous operation is planned consistent with NEI 12-02 duration without reliance on or crediting of potentially more rapid FLEX Program power restoration. Batteries are readily replaceable via spare stock without the need for recalibration to maintain accuracy of the instrument. These measures ensure adequate power capacity and margin

The NRC staff notes the proposed power supply design and criteria for sizing of the battery appear to be consistent with NEI 12-02, as endorsed by the ISG. However, the staff plans to verify the final configuration of the electrical design and 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 #13

Please provide the results of the calculation depicting the battery backup duty cycle requirements, demonstrating battery 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

> Accuracy will be consistent with the guidelines of NRC JLD-ISG-2012-03 Revision 0 and NEI 12-02 Revision 1. Accuracy and indication features are as follows:
>
> - Accuracy: The absolute system accuracy is better than ± 3 inches. This accuracy is applicable for normal conditions and the temperature, humidity, chemistry, and radiation levels expected for BDBE event conditions.
>
> - Trending: The display trends and retains data when on either normal or backup power.
>
> - Restoration after Loss of Power: The system automatically swaps to available power (backup battery power or external DC source) when normal power is lost. Neither the source of power nor system restoration impact accuracy. Previously collected data is retained.
>
> - Diagnostics: The system performs and displays the results of real-time information related to the integrity of the cable, probe, and instrument channel.

In its letter dated July 19, 2013, the licensee stated, in part, that

> The instrument channel level accuracy will be specified as less than ± 3.0 inches for all expected conditions. The expected instrument channel accuracy performance would be approximately ±1% of span (based on the sensitive range of the detector).
>
> In general relative to normal operating conditions, any applicable calibration procedure tolerances (or acceptance criterion) are planned to be established based on manufacturer's stated/recommended reference accuracy (or design accuracy). The methodology used is planned to be captured in plant procedures and/or programs.

The NRC staff notes the estimated instrument channel design accuracies and methodology appear to be sufficient to maintain the instrument channels to within their designed accuracies before significant drift can occur. The staff plans to verify the licensee's proposed instrument performance is consistent with these estimated accuracy values. Further, the staff plans to verify 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 #14

Please provide analysis verifying the proposed instrument performance is consistent with these estimated accuracy normal and BDB values. Demonstrate the channels will retain these accuracy performance values following a loss of power and subsequent restoration of power.

RAI #15

Please provide a description of the methodology to be used for determining the maximum allowed deviation from the instrument channel design accuracy under normal operating conditions. Staff understands this allowed deviation will serve as an acceptance criterion for a calibration procedure to alert operators and technicians that the channel requires adjustment to within normal design accuracy.

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 that the display/processor performs automatic in-situ calibration and automatically monitors for cable, connector, and probe faults using time domain reflectometry (TDR) technology. The licensee also stated that channel degradation due to age or corrosion is not expected but can be identified by monitoring trends.

In its letter dated July 19, 2013, the licensee stated, in part, that

> The level instrument automatically monitors the integrity of its level measurement system using in-situ capability. Deviation of measured test parameters from manufactured or as-installed configuration beyond a configurable threshold prompts operator intervention.
>
> Periodic calibration checks of the signal processor electronics to extrinsic National Institute of Standards and Technology (NIST)-traceable standards can be achieved through the use of standard measurement and test equipment.
>
> The probe itself is a perforated tubular coaxial waveguide with defined geometry and is not calibrated. It is planned to be periodically inspected electromagnetically using time-domain reflectometry (TDR) at the probe hardline cable connector to demonstrate that the probe assembly meets manufactured specification and visually to demonstrate that there has been no mechanical deformation or fouling.

> Each instrument electronically logs a record of measurement values over time in non-volatile memory that is compared to demonstrate constancy, including any changes in pool level, such as that associated with the normal evaporative loss/refilling cycle. The channel level measurements can be directly compared to each other (i.e., regular cross-channel comparisons). The two displays are installed in close proximity to each other, thus simplifying cross-channel checks. Direct measurements of SFP level may be used for diagnostic purposes if cross-channel comparisons are anomalous.

The NRC staff notes the SFP level instrument channels can be compared with the acceptance criteria described in Section 3.9 above to determine if recalibration or troubleshooting is needed. However, the NRC staff has concerns with the lack of information 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 this request as:

RAI #16

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.

3.11 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 primary and backup instrument displays will be located in the Main Control Room (MCR).

In its letter dated July 19, 2013, the licensee restated, that the SFP level instrumentation, Channel A and B displays will be located in the MCR on the existing panels containing the Containment Atmospheric Dilution (CAD) System components.

The NRC staff notes 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 to train personnel in the use and the provision of alternate power to the primary and backup instrument channels, including the approach to identify 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 that procedures for maintenance and testing will be developed using regulatory guidelines and vendor instructions.

In its letter dated July 19, 2013, the licensee stated, in part, that

> Vendor recommended inspection, maintenance, and repair procedures for the liquid level measurement system have been developed through the vendor's 30-year experience developing and manufacturing liquid level measurement and cable testing instrumentation. These are for the most part specific to the system's proprietary electronics, subject to relevant industry standards for electronics fabrication and inspection and vendor's quality management system.
>
> Where relevant, standards for naval shipboard liquid level indicating equipment have been used to develop procedures for operation, abnormal response, and administrative controls.
>
> Portable instrumentation is not utilized. Both primary and backup SFPI channels incorporate permanent hard-wired installation.
>
> The specific procedures to be used to capture the required activities described in this RAI response have not yet been developed but are planned to be developed in accordance with the vendor recommendations and Entergy processes and procedures

The NRC staff has concerns with the licensee's lack of information on the procedures for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels. The staff previously requested this information as RAI-10 in NRC letter dated June 20, 2013. However, based on feedback from licensees, the staff revised this RAI as follows:

RAI #17

Please provide a list of the procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection that will be developed for use of the SFP instrumentation. 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 that testing and calibration will be consistent with the guidelines of NRC JLD-ISG-2012-03 Revision 0 and NEI 12-02 Revision 1 and vendor recommendations.

In its letter dated July 19, 2013, the licensee stated, in part, that

> Performance tests (functional checks) are automated and/or semi-automated (requiring limited operator interaction) and are performed through the instrument menu software and initiated by the operator. There are a number of other internal system tests that are performed by system software on an essentially continuous basis without user intervention but which can also be performed on an on-demand basis with diagnostic output to the display for the operator to review. Other tests such as menu button tests, level alarm, and alarm relay tests are only initiated manually by the operator. Performance checks are described in detail in the Vendor Operator's Manual, and the applicable information is planned to be contained in plant operating procedures.
>
> Performance tests are planned to be performed periodically as recommended by the equipment vendor, for instance quarterly but no less often than the calibration interval of two years.
>
> Channel functional tests per operations procedures with limits established in consideration of vendor equipment specifications are planned to be performed at appropriate frequencies established equivalent to or more frequently than existing spent fuel pool instrumentation.
>
> Manual calibration and operator performance checks are planned to be performed in a periodic scheduled fashion with additional maintenance on an

as-needed basis when flagged by the system's automated diagnostic testing features.

Channel calibration tests per maintenance procedures with limits established in consideration of vendor equipment specifications are planned to be performed at frequencies established in consideration of vendor recommendations.

Periodic (e.g., quarterly or monthly) review of the system level history and log files and routine attention to any warning message on the system display is recommended by the vendor. Formal calibration checks are recommended by the vendor on a two-year interval to demonstrate calibration to external NIST-traceable standards. Formal calibration check surveillance interval and timing would be established consistent with applicable guidance [i.e., NEI 12-02 Section 4.3; on a refueling outage interval basis and within 60 days of a planned refueling outage]. Items such as system batteries are planned to be assessed under the Preventive Maintenance (PM) program for establishment of replacement frequency. Surveillance/PM timing/performance are planned to be controlled via tasks in the PM program.

In addition, in its letter dated July 19, 2013, the licensee stated, in part,

> ... SFPI channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness are planned to be established in accordance with Entergy's processes and procedures and in consideration of vendor recommendations to ensure that appropriate regular testing, channel checks, functional tests, periodic calibration, and maintenance is performed. Subject maintenance and testing program requirements are planned to be developed during the SFPI modification design process.
>
> Both primary and backup SFPI channels incorporate permanent installation (with no reliance on portable, post-event installation) of relatively simple and robust augmented quality equipment. Permanent installation coupled with stocking of adequate spare parts reasonably diminishes the likelihood that a single channel (and greatly diminishes the likelihood that both channels) is (are) out-of-service for an extended period of time....

In its letter dated July 19, 2013, the licensee also provided a table with compensatory actions for unlikely extended out-of-service events.

The NRC staff notes that the licensee proposed approach regarding compensatory actions with respect to testing and calibration appears to be consistent with NEI 12-02, as endorsed by the ISG. The staff has concerns regarding the 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 staff has identified this request as:

RAI #18

Please provide further information describing the maintenance and testing program to be established and implemented to ensure regular testing and calibration is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. Include a description of plans to ensure necessary channel

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

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 reliability of the primary and backup instrument channels will be assured by conformance with the guidelines of NRC JLD-ISG-2012-03 Revision 0 and NEI 12-02 Revision 1, as discussed in Section 9, Qualification.

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.

date by which the licensee must complete full implementation of Order EA-12-051. The licensee should adjust its schedule for providing information to ensure that all this information is provided by the requested date.

If you have any questions regarding this letter, please contact me at 301-415-1364 or via e-mail at Douglas.Pickett@nrc.gov.

Sincerely,

/ra/

Douglas V. Pickett, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-271

Enclosure:
Interim Staff Evaluation and
Request for Additional Information

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