Westinghouse

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Date: February 18, 2013

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Tel: 412-374-2304

Your Ref: LTR-PFPS-13-3
Revision 0

Subject: **Ameren Missouri Spent Fuel Pool Instrumentation Integrated Plan**

Reference: 1. EA-12-051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," March 12, 2012.

Westinghouse has been contracted by Ameren Missouri to draft the Spent Fuel Pool (SFP) instrumentation integrated plan in response to the Nuclear Regulatory Commission (NRC) Order EA-12-051 (Reference 1).

Attachment 1 contains the SFP instrumentation integrated plan for Ameren Missouri to support their submittal to the NRC by February 28, 2013.

The integrated plan was prepared utilizing industry feedback and lessons learned from the Nuclear Energy Institute (NEI) meeting attended by Westinghouse on January 15, 2013, STARS feedback from the February 6, 2013 benchmark meeting, and feedback provided by Ameren Missouri.

Any questions can be directed to Mike Drudy at drudymp@westinghouse.com or 412-374-2304.

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Attachments:
Attachment 1 – Callaway Unit 1 Integrated Plan for Reliable Spent Fuel Pool Instrumentation

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Callaway Unit 1 Integrated Plan for Reliable Spent Fuel Pool Instrumentation

I. Introduction

The Nuclear Regulatory Commission (NRC) issued Order EA-12-051, "*Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation*," (Reference 1) dated March 12, 2012. The Order requires licenses 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. The Order also requires submission of an overall integrated plan that provides a description of how the requirements of the Order will be achieved.

Nuclear Energy Institute (NEI) 12-02, "*Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation',"* (Reference 2) provides an approach for complying with order EA-12-051. NRC Interim Staff Guidance (ISG) JLD-ISG-2012-03, "*Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation*,*"* (Reference 3) considers that the methodologies and guidance in conformance with the guidelines provided in Reference 2, subject to the clarifications and exceptions specific to Reference 2, Section 3.4, Qualification, are an acceptable means of meeting the requirements of Reference 1.

This integrated plan applies to Callaway Energy Center Unit 1 (hereafter referred to as Callaway) and provides the approach for complying with Reference 1 using the methods described in Reference 3. Consistent with the requirements of Reference 1 and the guidance in Reference 2, six-month reports will delineate progress made, any proposed changes in compliance methods, updates to the schedule, and if needed, requests for relief and basis.

II. Schedule

Installation of reliable spent fuel pool (SFP) level instrumentation will be completed prior to startup from the second refueling outage, after submittal of this plan, or December 31, 2016, whichever occurs first, consistent with *Callaway Plant Unit 1 Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation* (Reference 4).

The following milestone schedule is provided. The dates are planning dates and are subject to change as design and implementation details are developed. Any changes to the following milestones will be reflected in the subsequent six-month status reports.

The current milestones are:

- Commence Engineering and Design 1Q2013
- Complete Design 4Q2013
- Receipt of SFP Instruments 2Q2014
- Complete SFP Instrumentation Procedures & Training 3Q2014
- SFP Instruments Operational 4Q2014

III. Identification of Spent Fuel Pool Water Levels

Key spent fuel pool water levels:

1. **Level adequate to support operation of the normal fuel pool cooling system** – Indicated level on either the primary or backup instrument channel of 24 feet 10.75 inches above the top of the fuel storage racks plus the accuracy of the SFP level instrument channel, which is to be determined. This aligns with the normal SFP level as shown in Callaway Final Safety Analysis Report (FSAR) Figure 1.2-21 (Reference 5) and provides adequate margin to maintain fuel pool cooling pump suction.

2. **Level adequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck** – Indicated level on either the primary or backup instrument channel of greater than 10 feet (+/- 1 foot) above the top of the fuel storage racks based on Reference 2 and Reference 3. This monitoring level ensures there is an adequate water level to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck.

3. **Level where fuel remains covered** - Indicated level on either the primary or backup instrument channel of greater than 1 foot above the top of the fuel storage racks plus the accuracy of the SFP level instrument channel, which is to be determined. This

monitoring level assures that there is adequate water level above the stored fuel seated in the rack.

IV. Instruments

The design of the instruments will be consistent with the guidelines of Reference 2 and Reference 3 as discussed below.

Primary and Backup Instrument Channels:

The Callaway SFP Instrumentation System (SFPIS) will utilize fixed primary and backup guided wave radar (GWR) sensors. The GWR technology meets the requirements of Reference 1 and Reference 3 by providing the capability to reliably monitor the SFP water level under adverse environmental conditions.

GWR technology uses the principle of time domain reflectometry to detect the SFP water level. A microwave signal is sent down the cable probe sensor, and when it reaches the water, it is reflected back to the sensor electronics. This is due to the difference between the dielectric constants of air and water. Using the total signal travel time, the sensor electronics embedded firmware computes the level of the water in the SFP. The probe, which is located in the SFP, is separated from the sensor electronics, and connected by an interconnecting cable that is routed into an adjacent building. By placing the sensor electronics outside of the SFP area it is not subject to the harsh environment resulting from the boiling or loss of water in the pool during a postulated loss of inventory event that creates high humidity, steam and/or radiation.

The primary and backup instrument channels will provide continuous level indication over a range of 23 feet 10.75 inches, from 12 inches above the top of the fuel storage racks (plant elevation 2,022 feet 1.25 inches) to the normal pool level elevation (plant elevation 2,046 feet) as shown in the Callaway FSAR Figure 1.2-21 (Reference 5).

V. Reliability

Reliability of the primary and backup instrument channels will be assured by conformance with the guidelines of Reference 3 and Reference 2, Section 3.4, Qualification, and Section 4.3, Testing and Calibration.

VI. Instrument Channel Design Criteria:

Instrument channel design criteria will meet the guidelines of Reference 2 and Reference 3.

The primary and backup measurement systems will consist of a flexible stainless-steel sensor cable probe, suspended in the SFP from a bracket attached to the operating deck or to a raised curb at the side of the pool. The cable probe will extend from slightly above the normal pool level elevation to less than 1 foot above the top of the fuel storage racks. The sensor electronics will be mounted in an adjacent building, to prevent instrument exposure to radiation and high temperatures which could result from a postulated loss of water inventory in the pool. There are also two mounted panels, providing sensor and display interfaces and wireless transmission and reception capabilities.

The 4-20 milliamp (mA) signal from the sensor electronics module is connected to a mounted, seismically qualified power supply and transmitter panel. The panel contains a 24-volt (V) direct current (dc) (Vdc) uninterruptible power supply (UPS), a wireless transmitter for the sensor signal, and batteries for continued system operation during a loss of alternating current (ac) power for a minimum of 72 hours, in which time an alternate external source of power can be supplied. A bulkhead connector and transfer switch is externally accessible for the connection of an alternate power source. The panel is located with or near the sensor electronics housing, outside of the spent fuel pool area. The interface between the sensor electronics and the mounted panel is a twisted, shielded pair cable.

The transmitter panel will send a signal to the wireless receiver panel. The mounted seismically qualified wireless receiver panel contains a 24-Vdc UPS, door-mounted digital display of SFP level, and batteries for continued system operation during a loss of ac power until an alternate external source of power can be supplied. A bulkhead connector and transfer switch is externally accessible for the connection of an alternate power source. The mounted receiver panel is located in one of the accessible locations in the vicinity of the control room.

VII. Arrangement

The primary and backup instrument sensing components will be separated consistent with the guidelines of Reference 2 and Reference 3. Design of the mounting bracket will allow the fuel handling machine to pass over it without interference.

A SFP walkdown identified preliminary locations for the primary and backup level sensing components. The preliminary locations of the primary and backup instrument sensing components are at the plant northeast and northwest corners of the SFP. The design for

installation will include physical separation of the two sensors, separate extension cables from the electronics to the sensors, routing all cables in separate conduit / trays, separate UPS power supplied from different ac sources, and seismically qualified mounting with physical separation of both the level sensing electronics and indications.

The final location of the primary and backup system mounting brackets will be determined during the design phase with consideration of power availability and separation requirements to protect against missiles.

The level sensing electronics for both primary and backup systems will be located in the auxiliary building, compliant with Reference 2 and Reference 3 for separation and accessibility.

The primary system indicator will be located in the vicinity of the control room. The backup system indicator will be located in an accessible location. The locations will allow for reading of the indicators following an event.

VIII. Mounting

The mounting of both the primary and backup system will be installed to maintain its integrity during and following a design basis seismic event. All locations will be reviewed for two-over-one seismic interference.

IX. Qualification

Reliability of both instrument channels will be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the following sets of parameters:

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

The normal operational, event, and post-event conditions for temperature, humidity, and radiation, will be addressed for no fewer than seven days post-event or until off-site resources can be deployed by the mitigating strategies resulting from the NRC issued Order EA-12-049, "*Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for*

Beyond-Design-Basis External Events," dated March 12, 2012 (Reference 6). Examples of post-event (beyond-design-basis) conditions to be considered are:

(1) radiological conditions for a normal refueling quantity of freshly discharged (100 hours) fuel with the SFP water level 3 (Section III, Item 3) as described in Reference 1,
(2) temperatures of 212°F and 100 percent relative humidity environment,
(3) boiling water and/or steam environment,
(4) a concentrated borated water environment,
(5) impact of FLEX mitigating strategies.

The instrument channel reliability will be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the effects of shock and vibration. Demonstration of shock and vibration adequacy will be consistent with the guidelines in Reference 2 and Reference 3.

Demonstration of seismic adequacy will be achieved using one or more of the following methods:

(1) demonstration of seismic motion consistent with that of existing design basis loads at the installed location;
(2) 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 shall be inclusive of the effects of seismic motion imparted to the components proposed at the location of the proposed installation;
(3) adequacy of seismic design and installation is 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 7) or a substantially similar industrial standard;
(4) demonstration that proposed devices are substantially similar in design to models that have been previously tested for seismic effects in excess of the plant design basis at the location where the instrument is to be installed (g-levels and frequency ranges); or
(5) seismic qualification using seismic motion consistent with that of existing design basis loading at the installation location.

X. Independence

The backup instrument system will be redundant to and independent of the primary instrument system.

Independence of the two systems includes: location, mounting, power sources, power and signal wiring, and indications, to prevent any failure of one system from affecting the other system.

XI. Power Supplies

An ac source will be selected for each system's 24-Vdc UPS, with power cables routed separately through existing or new tray / conduit and penetrations.

Both channels will be powered by independent batteries following a loss-of-ac power. The minimum battery life will be 72 hours. The 72 hour battery life is a sufficient amount of time for an alternate source of power to be provided by the plant-specific procedures to address Reference 6. Each channel will include an externally accessible bulkhead connector and transfer switch for connection of an alternate power source.

XII. Accuracy

Instrument channels will be designed such that they will maintain their specified accuracy without recalibration following a power interruption or change in power source.

The accuracy will be within the resolution requirements of Reference 2, Figure 1.

The instrument accuracy will be sufficient to allow personnel using plant procedures to determine when the water level reaches levels 1, 2, and 3 without conflicting or ambiguous indication.

XIII. Testing

Instrument channel design will provide for routine testing and calibration consistent with Reference 2 and Reference 3.

XIV. Display

The primary system indicator will be located in the vicinity of the control room. The backup system indicator will be located in an accessible location. The locations will allow for reading of the indicators following an event. The display will provide continuous indication of the SFP water level and will be consistent with the guidelines of Reference 2 and Reference 3.

XV. Instrument Channel Program Criteria

Instrument channel program criteria will be consistent with the guidelines of Reference 2 and Reference 3.

A. Training

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.

B. Procedures

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

FLEX Support Guidelines will address a strategy to ensure the SFP water makeup is initiated at an appropriate time consistent with implementation of NEI 12-06, "*Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,"* (Reference 8).

C. Testing and Calibration

Processes will 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. Testing and calibration of the instrumentation will be consistent with vendor recommendations and any other documented basis.

XVI. Need for Relief and Basis

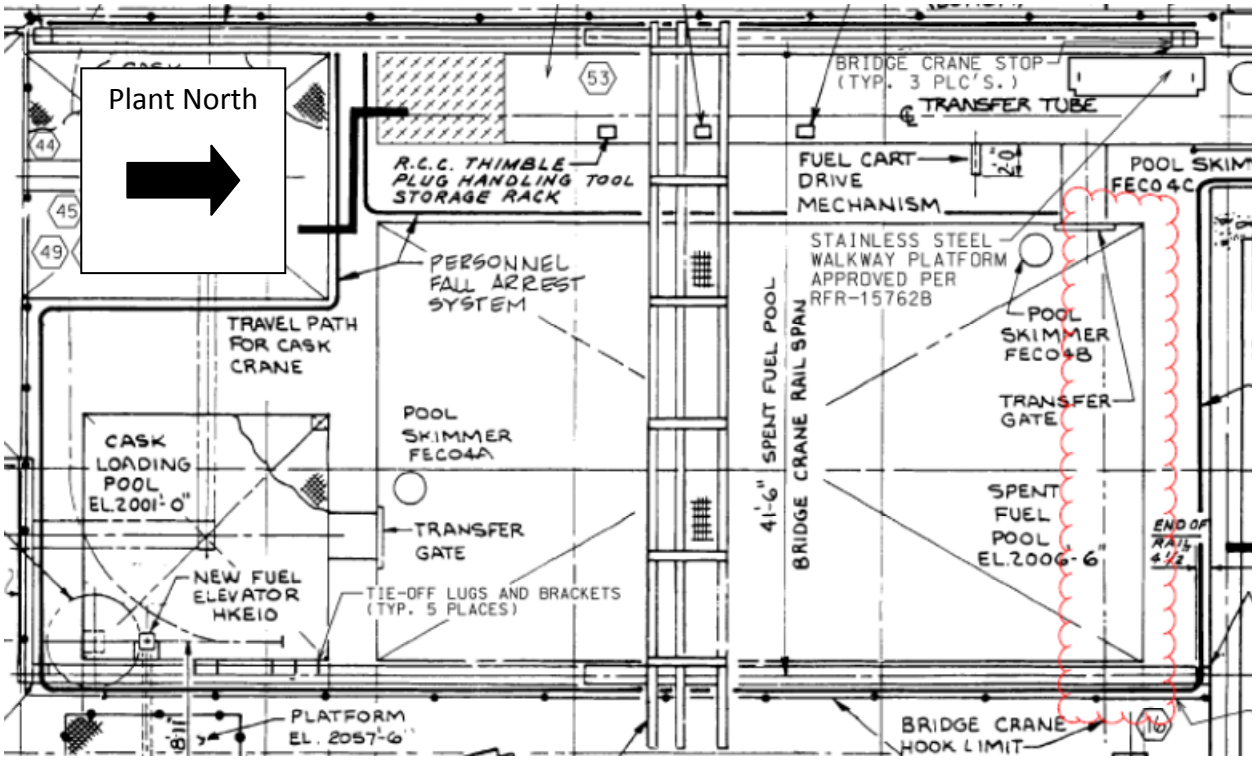
Ameren Missouri is not requesting relief from the requirements of Reference 1 or the guidance in Reference 3 at this time.

Consistent with the requirements of Reference 1 and the guidance in Reference 2, the six-month reports will delineate progress made, any proposed changes in the compliance methods, updates to the schedule, and if needed, requests for relief and their bases.

XVII. References

1) EA-12-051, “Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,” March 12, 2012.
2) NEI 12-02, “Industry Guidance for Compliance with NRC Order EA-12-051, ’To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation’,” Revision 1, August 2012.
3) NRC JLD-ISG-2012-03, “Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation,” Revision 0, August 29, 2012.
4) Ameren Missouri Letter ULNRC-05925, “Docket Number 50-483, Callaway Plant Unit 1, Union Electric Co., Facility Operating License NPF-30, Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051),” October 29, 2012.
5) Callaway Final Safety Analysis Report, Revision OL-19a, July 2012.
6) EA-12-049, “Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” March 12, 2012.
7) IEEE Standard 344-2004, “IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.”
8) NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,” Revision 0, August 2012.

XVIII. Sketches



Sketch 1
Preliminary Probe Locations for Callaway Unit 1

XIX. Open Items

There are no open items.