UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-4005

February 23, 2007

Charles D. Naslund, Senior Vice
President and Chief Nuclear Officer
Union Electric Company
P.O. Box 620
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT - NRC COMPONENT DESIGN BASES INSPECTION REPORT 05000483/2006009

Dear Mr. Naslund:

On January 11, 2007, the US Nuclear Regulatory Commission (NRC) completed a component design bases inspection at your Callaway Plant. The enclosed report documents our inspection findings. The preliminary findings were discussed on January 11, 2007, with Mr. Tim Herrmann, Vice President, Engineering and other members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The team reviewed selected procedures and records, observed activities, and interviewed cognizant plant personnel.

Based on the results of this inspection, the NRC has identified six findings that were evaluated under the risk significance determination process. Violations were associated with all of the findings. All six of the findings were found to have very low safety significance (Green) and the violations associated with these findings are being treated as noncited violations, consistent with Section VI.A.1 of the NRC Enforcement Policy. In addition, a licensee identified violation, which was determined to be of very low safety significance is described in the report. If you contest any of the noncited violations, or the significance of the violations you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the US Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with copies to the Regional Administrator, U.S. Nuclear Regulatory Commission, Region IV, 611 Ryan Plaza Drive, Suite 400, Arlington, Texas 76011; the Director, Office of Enforcement, US Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector at the Callaway Plant.

In accordance with 10 CFR 2.390 of the NRC's Rules of Practice, a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

William B. Jones, Chief
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Division of Reactor Safety

Dockets: 50-483
License: NPF-30

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w/Attachments: Supplemental Information

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ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket:	50-483
License:	NPF-30
Report Nos.:	05000483/2006009
Licensee:	Union Electric
Facility:	Callaway Plant
Location:	Junction Highway CC and Highway O, Fulton, Missouri
Dates:	December 11, 2006, through January 11, 2007
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NRC Observers:	R. Kopriva, Senior Reactor Inspector, Engineering Branch 1 D. Bollock, Project Engineer, Projects Branch C
Approved By:	William B. Jones, Chief Engineering Branch 1 Division of Reactor Safety

SUMMARY OF FINDINGS

IR 05000483/2006009; December 11, 2006, through January 11, 2007; Callaway Plant: baseline inspection, NRC Inspection Procedure 71111.21, *Component Design Basis Inspection*.

The report covers an announced inspection by a team of three regional inspectors, one operations examiner, two contractors and one resident inspector. Six findings were identified. All of the findings were of very low safety significance. The final significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter 0609, *Significance Determination Process*. Findings for which the significance determination process does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, *Reactor Oversight Process*, Revision 3, dated July 2000.

A. NRC-Identified Findings

Cornerstone: Mitigating Systems; Barrier Integrity

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion III, *Design Control*, for an inadequate refueling water storage tank vent sizing calculation. The calculation assumed that only one low head safety injection pump would operate when it should have assumed that all six emergency core cooling and containment spray pumps would take suction from the tank. When corrected, the revised calculation resulted in reducing the allowable vent blockage area from approximately 68 percent to 30 percent. In response to the teams concerns, the licensee inspected the vent and found a small mesh screen on the vent's exterior, which reduced the available design margin to approximately 5 percent. Subsequently, the licensee performed a new finite element analysis to demonstrate that sufficient margin existed to account for screen blockage scenarios, such as freezing rain. The licensee has entered this finding into their corrective action program as Callaway Action Requests 200610359 and 200700115.

  The failure to meet design control requirements associated with the refueling water storage tank vent design was a performance deficiency. This finding is more than minor because it affected the mitigating system cornerstone objective (design control attribute) to ensure the reliability and capability of the equipment needed to mitigate initiating events. The finding also affected the barrier integrity cornerstone objective (design control attribute) of providing physical design barriers, such as containment, to protect the public from radio nuclide releases caused by accidents or events. The team used the Manual Chapter 0609, Significance Determination Process Phase 1 screening worksheet and determined that the finding required a Phase 2 significance determination because it impacted two different cornerstones (mitigating systems and barrier integrity). The team performed a Phase 2 significance determination and determined that the finding was of very low safety significance. Only the large break loss-of-coolant accident sequence was affected. In addition, the safety injection and containment spray systems remained available (Section 1R21.b.1).

- Green. The team identified a noncited violation of Technical Specifications Surveillance Requirement 3.8.3.3 for the failure to verify that fuel oil testing results were within the specified limits. Consequently, fuel oil that was transferred to the Train A storage tank in October 2005 was out of specification for cetane and no actions were taken to evaluate or otherwise address the concern until identified by the NRC. The licensee has entered this finding into their corrective action program as Callaway Action Request 200700100.

  The failure to follow plant technical specifications and properly verify that the cetane level of new fuel oil was within the limits of the Diesel Fuel Oil Testing Program was a performance deficiency. The finding was more than minor because it was associated with the mitigating systems cornerstone objective (human performance attribute) of ensuring the availability, reliability and capability of systems that respond to initiating events to prevent undesirable consequences. Using the Manual Chapter 0609, Phase 1 screening worksheet, the issue screened as having very low safety significance because it was a design deficiency confirmed not to result in loss-of-operability in accordance with NRC Manual Chapter Part 9900, Technical Guidance*, Operability Determination Process for Operability and Functional Assessment.* This finding had a crosscutting aspect in the area of human performance (work practices attribute), in that the chemistry technician failed to use appropriate self-checking work practices when verifying the sample results (Section 1R21.b.2).

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion III, *Design Control*, for the failure to properly calculate the tube plugging limit for the emergency diesel generator intercooler, jacket water, and lube oil cooler heat exchangers. The calculation determined that approximately 1/3 of the tubes could be plugged without challenging emergency diesel generator operability under worst case design basis conditions. When corrected, the revised calculation resulted in reducing the allowable number of plugged tubes by approximately 40 percent. The licensee has entered this finding into their corrective action program as Callaway Action Requests 200700063 and 200700096.

  The failure to implement appropriate design controls for safety-related tube plugging calculations was a performance deficiency. This finding is more than minor because it affected the mitigating system cornerstone objective (Design Control) to ensure the reliability and capability of the equipment needed to mitigate initiating events. In addition, the finding was more that minor because, if left uncorrected, it could result in a more significant safety concern. Specifically, if the heat exchanger tubes were plugged to the limit the heat exchangers may be inoperable under certain design basis conditions (i.e., higher essential service water temperatures). Using the Manual Chapter 0609, Phase 1 screening worksheet, the issue screened as having very low safety significance because it was a design deficiency confirmed not to result in loss-of-operability in accordance with NRC Manual Chapter Part 9900, Technical Guidance, *Operability Determination Process for Operability and Functional Assessment* (Section 1R21.b.3).

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion III, *Design Control*, for the failure to properly translate design requirements into procedures and instructions. Specifically, the cooling tower sizing calculation specified that a flow rate of 15,000 gallons per minute was necessary to meet design basis accident needs but flow balance procedures only required a flow rate of 11,724 gallons per minute. The licensee has entered this finding into their corrective action program as Callaway Action Request 200700218.

  The team determined that the failure to properly translate design information (essential service water flow rate through the cooling tower) into specifications and procedures was a performance deficiency. This finding was more than minor because it affected the mitigating system cornerstone objective (Procedure Quality Attribute) to ensure the reliability and capability of the equipment needed to mitigate initiating events. Further, if left uncorrected, it could lead to a more significant issue. Specifically, information from the calculation could be used in other design documents and operability determinations. Over-predicting cooling tower capability could mask other operational issues. Using the Manual Chapter 0609, Phase 1 screening worksheet, the team determined that the finding had very low safety significance (Green) because the finding was a design deficiency confirmed not to result in loss of operability in accordance with Part 9900 Technical Guidance*, Operability Determination Process for Operability and Functional Assessment* (Section 1R21.b.4).

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion XVI (Corrective Action) for the failure to take adequate corrective actions following the identification of a condition adverse to quality. Specifically, the licensee had identified, in part, that a safety-related refeuling water storage tank sizing calculation had failed to consider vortexing at the tank suction inlet piping. This phenomena can cause air entrainment in pumps, which can lead to pump failure. The corrective measures were inadequate because engineers inappropriately used the margin associated with instrument uncertainty as if it were available design margin. The licensee has entered this finding into their corrective action program as Callaway Action Request 200700224.

  The team determined that the failure to take effective corrective measures to address a condition adverse to quality (failure to address vortexing in the refeuling water storage tank sizing calculation) was a performance deficiency. The finding was more than minor because it affected the barrier integrity cornerstone objective (design control attribute) to provide reasonable assurance that physical design barriers (including the containment) protect the public from radio nuclide releases caused by accidents or events. The finding had crosscutting aspects in the area of problem identification and resolution (Operating Experience Attribute), in that the licensee had failed to adequately address the industry operating experience (Section 1R21.b.5).

- Green. The team identified a noncited violation of 10 CFR Part 50, Appendix B, Criterion V, *Procedures,* for the failure to follow Callaway Plant procedure requirements associated with operability determinations. Specifically, engineers

had identified that a water hammer was causing two residual heat removal system relief valves to fail and that the water hammer would likely recur in certain situations. The engineers failed to take the procedurally required actions to initiate a formal operability determination to evaluate the potential impact to the residual heat removal system pressure boundary. The licensee has entered this finding into their corrective action program as Callaway Action Request 200609805.

The failure to follow a Callaway Plant procedure was a performance deficiency. The finding was more than minor because it was associated with the mitigating systems cornerstone objective (Equipment Performance Attribute) of ensuring the availability, reliability and capability of systems that respond to initiating events to prevent undesirable consequences. Using the Manual Chapter 0609, Phase 1 screening worksheet, the issue screened as having very low safety significance because it was a design deficiency confirmed not to result in loss-of-operability in accordance with NRC Manual Chapter Part 9900, Technical Guidance*, Operability Determination Process for Operability and Functional Assessment.* This finding had a crosscutting aspect in the area of problem identification and resolution (corrective action program component), in that engineers failed to performed the necessary proceduralized corrective actions to ensure that operability was properly evaluated (Section 1R21.b.6).

B. Licensee-Identified Violations.

A violation of very low safety significance, which was identified by the licensee, has been reviewed by the team. Corrective actions taken or planned by the licensee have been entered into the licensee's corrective action program. This violation and the applicable corrective actions are listed in Section 4OA7.

REPORT DETAILS

1 REACTOR SAFETY

Inspection of component design bases verifies the initial design and subsequent modifications and provides monitoring of the capability of the selected components and operator actions to perform their design bases functions. As plants age, their design bases may be difficult to determine and important design features may be altered or disabled during modifications. The plant risk assessment model assumes the capability of safety systems and components to perform their intended safety function successfully. This inspectable area verifies aspects of the Initiating Events, Mitigating Systems and Barrier Integrity cornerstones for which there are no indicators to measure performance.

1R21 Component Design Bases Inspection (71111.21)

The team selected risk-significant components and operator actions for review using information contained in the licensee's probabilistic risk assessment. In general, this included components and operator actions that had a risk achievement worth factor greater than two or a Birnbaum value greater than 1E-6.

a. Inspection Scope

To verify that the selected components would function as required, the team reviewed design basis assumptions, calculations, and procedures. In some instances, the team performed calculations to independently verify the licensee's conclusions. The team also verified that the condition of the components was consistent with the design bases and that the tested capabilities met the required criteria.

The team reviewed maintenance work records, corrective action documents, and industry operating experience records to verify that licensee personnel considered degraded conditions and their impact on the components. For the review of operator actions, the team observed operators during simulator scenarios, as well as during simulated actions in the plant.

The team performed a margin assessment and detailed review of the selected risk-significant components to verify that the design bases have been correctly implemented and maintained. This design margin assessment considered original design issues, margin reductions because of modifications, and margin reductions identified as a result of material condition issues. Equipment reliability issues were also considered in the selection of components for detailed review. These included items such as failed performance test results; significant corrective actions; repeated maintenance; 10 CFR 50.65(a)1 status; operable, but degraded conditions; NRC resident inspector input of problem equipment; system health reports; industry operating experience; and licensee problem equipment lists. Consideration was also given to the uniqueness and complexity of the design, operating experience, and the available defense in-depth margins.

The inspection procedure requires a review of 15-20 risk-significant and low design margin components, 3 to 5 relatively high-risk operator actions, and 4 to 6 operating experience issues. The sample selection for this inspection was 20 components, 5 operator actions, and 5 operating experience issues.

The components selected for review were:

- Breaker NB0113, Magneblast 4160Vac breaker to Transformer XNG01 (480Vac load center)
- Essential service water pond (ultimate heat sink)
- Refeuling water storage tank
- Turbine driven auxiliary feedwater pump
- Train A Channel 4, steam generator Barton level Transmitter AELT0517
- Train A component cooling water heat exchanger
- Train A emergency diesel generator fuel oil
- Train A emergency diesel generator fuel oil transfer pump
- Train A emergency diesel generator intercooler heat exchanger
- Train A emergency service water piping
- Train A load shedder
- Train A motor driven auxiliary feedwater pump
- Train B motor driven auxiliary feedwater pump discharge Valve ABF030
- Train B essential service water cooling tower
- Train B essential service water strainers
- Train B pressurizer power operated relief valve
- Train B residual heat removal relief Valve EJ 8807B, credited for low temperature over-pressure protection
- Train B safety injection containment sump suction Valve 8811B
- Train B undervoltage relays

The risk significant operator actions included:

- Calibration of refeuling water storage tank level instruments
- Feed and bleed operations
- Operators align emergency core cooling systems for cold leg recirculation
- Operator controls steam generator water level after station blackout
- Operator response to a high vibration turbine trip

The operating experience issues were:

- NRC Bulletin 88-04, *Potential Safety-Related Pump Loss*, May 5, 1988

- NRC Information Notice 97-08, *Potential Failures of General Electric Magneblast™ Circuit Breaker Subcomponents,* June 19, 1997

- NRC Information Notice 2004-01, *Auxiliary Feedwater Pump Recirculation Line Orifice Fouling - Potential Common Cause Failure*, January 21, 2004

- NRC Information Notice 2006-21, *Operating Experience Regarding Entrainment of Air Into Emergency Core Cooling and Containment Spray Systems,* September 21, 2006

- Callaway Plant Part 21 Notification, *Prime Measurement Products, Models 763 & 763A Pressure Transmitters and Model 764 Differential Pressure Transmitters*, dated June 19, 2006

b. Findings

b.1 Inadequate Refeuling water Storage Tank Vent Sizing Calculation

Introduction: The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion III, *Design Control*, for an inadequate refeuling water storage tank vent sizing calculation. The calculation assumed that only one low head safety injection pump would operate when it should have assumed that all six emergency core cooling system and containment spray pumps would take suction from the tank. When corrected, the revised calculation resulted in reducing the allowable vent blockage area from approximately 68 to 30 percent. In response to the teams concerns, the licensee inspected the vent and found a small mesh screen on the vent's exterior, which reduced the available design margin to approximately 5 percent. Subsequently, the licensee performed a new finite element analysis to demonstrate that sufficient margin existed to account for screen blockage scenarios, such as freezing rain.

Description: The refeuling water storage tank was vented to atmosphere. The vent stack diameter was 16 inches in diameter and the stack rose 36 inches above the top of tank. The top 4 inches of the vent stack was open to the environment but, per the design, was covered with a No. 4-inch wire mesh (approximate opening size of 0.2 inch) to prevent debris from entering the tank. The top of the mesh was covered with a "hat" that partially protected the very upper portion of the mesh (but not all of it) from the elements.

The function of the refeuling water storage tank vent is to prevent tank failure that could be caused by an excessive internal vacuum. Both Trains A and B emergency core cooling system and containment spray pumps take suction from the tank. The tank vent must be sized to allow sufficient air to enter the tank so that, when pumps are running and removing water from the tank, an excessive vacuum does not develop. All six emergency core cooling and containment spray pumps start simultaneously in response to a large break loss-of-coolant accident.

The team reviewed Calculation M-BN-23, *Blockage of Refeuling water Storage Tank Vent to Atmosphere*, Revision 0. This calculation, in part, determined the maximum amount of vent blockage that could occur without challenging the tank's structural design limit of 2.76 inches of water (vacuum). In accordance with the calculation, the maximum allowable vent blockage was 68 percent.

On December 19, 2006, the team identified that Calculation M-BN-23 was inadequate, in that it erroneously assumed that only one residual heat removal pump would start post accident, at a flow rate of 5,500 gallons per minute, when it should have assumed that all six pumps would operate. In accordance with the Callaway Final Safety Analysis Report, Table 6.3-11, the flow of all six pumps was 19,850 gallons per minute. In response to the team's concerns, the licensee wrote Callaway Action Request 200610359 and recalculated the allowable vent blockage area. Callaway Plant engineers determined that the new limit for vent blockage was 30 percent. Part 50 of Title 10 of the Code of Federal Regulations, Appendix B, Criterion III, *Design Control,* specifies, in part, that the licensee verify the adequacy of design. Acceptable design control measures include calculations. Because Calculation M-BN-23 was inadequate, the licensee had not met this requirement.

In response to the team's concerns, the licensee inspected the vent on January 5, 2007, to verify that no additional vent flow blockages were present. The licensee found a fine mesh screen (No. 24 mesh, 0.027-inch opening size) covering the larger mesh as-built screen. The licensee determined that the additional screen presented an additional obstruction to air flow. The licensee calculated that only 5 percent margin remained, assuming no additional blockage. The licensee was unable to identify work records that installed the fine mesh screen. However, the licensee believed that the screen was installed in 2002 during tank insulation work. Craftsmen likely installed the fine mesh screen to prevent small pieces of foreign materials from entering the tank during the job and the screen was not removed following the work. In response to this finding, the licensee wrote Callaway Action Request 200700115 and removed the fine mesh screen.

Based on the low margin, the team was concerned that the tank differential pressure limit (2.76-inch water gage) could have been exceeded in response to a large break loss-of-coolant accident. In addition, the calculation failed to account for the potential affects of natural phenomena (ice accumulation) on the vent screen. The team noted, however, the tank was only vulnerable for relatively short periods of time when ice could have accumulated on the small mesh screen. Specifically, the most severe challenge would be freezing rain, which could coat a portion of the screen. The team noted that the *American Water Works Association Standard for Welded Steel Tanks (ANSI/AWWAD100)* assumes that the No. 24 wire mesh, commonly used as an insect barrier on tank vents, will become obstructed due to ice accumulation.

NOTE: The licensee was not committed to ANSI/AWWAD100 in their Final Safety Analysis Report. However, the standard provided meaningful information that the team used to assess the potential safety impact of refeuling water storage tank vent icing.

The team determined that freezing concerns were not applicable for smaller break loss-of-coolant accidents or for other design basis accidents and events. During these scenarios, the outflow from the tank would be significantly reduced. Therefore, the tank vent could suffer significantly more blockage without challenging refeuling water storage tank structural integrity.

In response to the team's concerns, the licensee contracted with an independent engineering firm to assess past tank operability. The firm performed finite element analysis of the tank and determined that with the small mesh screen in place and up to half the screen blocked, the differential pressure across the tank could be up to 6 inches water gage (Areva Calculation 51-9041422-000, *Past Operability of Callaway Refeuling water Storage Tank,* dated February 9, 2007). Then the contractor determined that the maximum stress on the stainless steel structure was about 18,000 psig, which is the within the allowable stress for the tank. Therefore, the tank was operable and capable of supporting the safety injection and containment spray functions. The team considered the assumption of a half blocked screen reasonable, as the hat on top of the vent provided some protection from freezing rain.

In addition to the above, the team identified a secondary concern that involved the formation of ice from humid air that was emitted from the tank itself. The refeuling water storage tank water was heated (up to 100°F) and, during extremely cold weather conditions, humid air from the tank could accumulate and freeze on the wire mesh as well as on the internals of vent stack (which was not insulated). This concern had the potential to affect the designed tank configuration, not just the non-conforming condition involving the small mesh screen. However, the Callaway Plant was only vulnerable to extremely cold weather conditions for very short periods during the year. It was unlikely that the entire vent mesh and/or the vent stack would freeze solid. In response to this concern, the licensee installed a temperature instrument on the vent mesh and established a compensatory measure to inspect the vent if the indicated temperature dropped to 32°F or below. With the compensatory measure in place, the licensee determined that the vent and refeuling water storage tank remained operable.

Analysis: The failure to meet design control requirements associated with the refeuling water storage tank vent design was a performance deficiency. This finding is more than minor because it affected the mitigating system cornerstone objective (design control attribute) to ensure the reliability and capability of the equipment needed to mitigate initiating events. The finding also affected the barrier integrity cornerstone objective (design control attribute) of providing physical design barriers, such as containment, to protect the public from radio nuclide releases caused by accidents or events. The team used the Manual Chapter 0609, *Significance Determination Process,* Phase 1 screening worksheet and determined that the finding required a Phase 2 significance determination

because it impacted two different cornerstones (Mitigating Systems and Barrier Integrity). The team performed a Phase 2 significance determination and determined that the finding was of very low safety significance. Only the large break loss-of-coolant accident sequence was affected. In addition, the safety injection and containment spray systems remained available.

Enforcement: Part 50 of Title 10 of the Code of Federal Regulations, Appendix B, Criterion III, requires, in part, that measures be established to provide for the verifying (or checking) the adequacy of design. These measures may include calculations. The licensee used Calculation M-BN-23 to demonstrate the adequacy of the refeuling water storage tank vent design. Contrary to the above, as of December 19, 2006, the design control measures for refeuling water storage tank vent sizing were inadequate, in that Calculation M-BN-23 assumed that one low head safety injection pump was operating, when it should have assumed that six emergency core cooling and safety injection pumps were operating. In addition, the calculation failed to account for the potential affects of natural phenomena (ice accumulation) on the vent screen. Because the violation is of very low safety significance and has been entered into the licensee's corrective action program as Callaway Action Requests 200610359 and 20070115, this violation is being treated as a noncited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy: NCV 05000483//2006009-01, *Inadequate Refeuling water Storage Tank Vent Sizing Calculation.*

b.2 Inadequate Emergency Diesel Generator Fuel Oil Verification

Introduction: The team identified a Green noncited violation of Technical Specifications Surveillance Requirement 3.8.3.3 for the failure to verify that fuel oil testing results were within the specified limits. Consequently, fuel oil that was transferred to the Train A storage tank in October 2005, was out of specification for cetane and no actions were taken to evaluate or otherwise address the concern until identified by the NRC.

Description Technical Specification Surveillance Requirement 3.8.3.3, requires:

> Verify fuel oil properties of new and stored fuel are tested in accordance with, and maintained within the limits of, the *Diesel Fuel Oil Testing Program*.

The Diesel Fuel Oil Testing Program is described in Technical Specification 5.5.13. The program is governed by Callaway Surveillance Procedure CSP-ZZ-07350*, Diesel Fuel Oil Testing Program*. The procedure states, in part:

> Sample each truckload of new fuel. . . .
>
> Verify sample results from the offsite lab are received and are in specification within 30 days of the sample date. . . .
>
> Analysis and acceptance criteria. . . Cetane greater than or equal to 40.

On January 4, 2007, the team identified that the licensee failed to meet Technical Specification Surveillance Requirement 3.8.3.3 for Train A emergency fuel oil, in that the offsite laboratory results were not properly verified within 30 days of the sample date. A

composite sample was taken from two trucks on October 10, 2005. The laboratory results were received on October 28, 2005, and indicated that the cetain value was 38.9, below the specified limit of 40, but a chemistry technician erroneously signed that the results were satisfactory.

The cetane number is a measure of a diesel fuel's ignition delay or the time period between the start of injection and the start of combustion. Diesel fuels with a cetane number lower than an engine's specified minimum can cause rough operation, accelerate lube oil sludge formation, and can increase engine deposits causing engine wear. Thus, a low cetane number is potentially a long-term operability concern for the diesel generator, specifically for the 30-day required mission time.

Cetane is one of 13 fuel oil properties specified in the Diesel Fuel Oil Testing Program. When truckloads of new fuel arrive on site, the four most important properties are tested immediately, including "water and sediment", "flash point", "specific gravity," and "kinematic viscosity". If these results are within the specified limits, new fuel oil may be added to the fuel oil storage tanks. At the same time, a second sample is sent to an offsite lab for analysis of nine other fuel oil properties, including cetane. The program requires the licensee to verify that these results are within the necessary limits within 30 days of the sample date. The Technical Specification Surveillance Requirement 3.8.3.3 bases explained that the 30-day period is acceptable because the fuel oil properties of interest, even if they were not within limits, would not have an immediate effect on diesel generator operation.

In response to the team's concerns, the licensee wrote Callaway Action Request 200700100. The licensee promptly entered Technical Specification 3.8.3, Condition D, *One or more Diesel Generators with New Fuel Oil Properties Not Within Limits*, and Technical Specification Surveillance Requirement 3.0.3 for a missed surveillance. Technical Specification 3.8.3, Condition D, requires restoring the stored fuel properties to within the limits in 30 days or less. The licensee took a grab sample from the Train A fuel oil storage tank to verify that the cetane value of the fuel currently in the fuel oil storage tank was above the cetane limit. The licensee received the sample results from the offsite laboratory within 24 hours. The sample was satisfactory.

Plant engineers performed an analysis to determine the affects of adding the nonconforming fuel oil to the Train A emergency fuel oil storage tank on October 10, 2005. Engineers considered the test results of the pre-existing fuel and calculated the resulting cetane value. The analysis demonstrated that the average cetane value of the fuel oil in the storage tank was greater than the minimum specification of 40. Therefore, the emergency diesel generator maintained its operability.

The team noted that the licensee had missed an earlier opportunity to self-identify the concern. On November 28, 2005, the Train B sample results were received and were also out of specification for cetane. These results were for fuel oil delivered on October 28, 2005. While the licensee's corrective measures to address those out of specification results were appropriate, the extent of condition evaluation did not perform a second check of the out of specification Train A fuel oil samples, which had arrived about a month earlier. The cause for low cetane values was common in both cases, a shortage of high quality fuel oil due to hurricane Katrina.

Analysis: The failure to follow plant technical specifications and properly verify that the cetane level of new fuel oil was within the limits of the Diesel Fuel Oil Testing Program was a performance deficiency. The finding was more than minor because it was associated with the mitigating systems cornerstone objective (Human Performance Attribute) of ensuring the availability, reliability and capability of systems that respond to initiating events to prevent undesirable consequences. Using the Manual Chapter 0609, Phase 1 screening worksheet, the issue screened as having very low safety significance because it was a design deficiency confirmed not to result in loss-of-operability in accordance with NRC Manual Chapter Part 9900, Technical Guidance*, Operability Determination Process for Operability and Functional Assessment.* This finding had a crosscutting aspect in the area of human performance (Work Practices Attribute), in that the chemistry technician failed to use appropriate self-checking work practices when verifying the sample results.

Enforcement: Technical Specification Surveillance Requirement 3.8.3.3 requires, in part, that new fuel oil test be tested and verified to be within the limits specified by the Diesel Fuel Oil Testing Program. The Diesel Fuel Oil Testing Program specifies, in part, that cetane be verified to be greater than or equal to 40. In addition, the results from the offsite laboratory must be verified to be within the limits within 30 days of the sample date. Contrary to the above, from October 28, 2005, until January 4, 2007, sample results from an offsite laboratory (that documented a cetane value less than 40) were not properly verified to be within the limits of the diesel fuel oil testing program. Because this finding was of very low safety significance and has been entered into the licensee's corrective action program (Callaway Action Request 200700100), it is considered a noncited violation consistent with Section VI.A.1 of the NRC Enforcement Policy: NCV 05000483/2006009-02, *Inadequate Emergency Diesel Generator Fuel Oil Verification*

b.3 Inadequate Emergency Diesel Generator Heat Exchanger Tube Plugging Calculation

Introduction: The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion III, for the failure to properly calculate the tube plugging limit for the emergency diesel generator intercooler, jacket water, and lube oil cooler heat exchangers. The calculation determined that approximately 1/3 of the tubes could be plugged without challenging emergency diesel generator operability under worst case design basis conditions. When corrected, the revised calculation resulted in reducing the allowable number of plugged tubes by approximately 40 percent.

Discussion: The team reviewed diesel generator heat exchanger Calculation KJ-10, *Determine Tube Plugging Limits for Diesel Generator Intercooler Heat Exchangers, EKJ03A/B; Diesel Generator Jacket Water Heat Exchangers, EKJ06A/B; and the Lube Oil Coolers, EKJ04A/B*, Revision 0, dated August, 2002. The calculation determined the maximum number of heat exchanger tubes that could be plugged without challenging the emergency diesel generator safety function under worst-case design basis conditions. The calculation concluded that approximately 1/3 of the tubes could be plugged in the intercooler, jacket water cooler and lube oil cooler heat exchangers. The licensee used the calculation to establish emergency diesel generator operability following instances where tubes were plugged, due to degradation, or were found plugged because of debris blockage.

The team identified two errors in the calculation.

1. The calculation used a tube side fouling factor of 0.0013-0.0015 °F-HR-FT^2/BTU. This was inconsistent with the fouling factor specified in the Callaway Final Safety Analysis Report, Section 9.2.1.2.3, which states, in part:

   > The minimum flow rate is based on the following parameters. . . design fouling factor of 0.002 °F-HR-FT^2/BTU for essential service water tube side.

   The fouling factor is a measure of heat exchanger cleanliness. The higher the assumed fouling factor the less clean the heat exchanger. Poor cleanliness can adversely affect the heat exchanger's heat transfer rate. The value specified in the Final Safety Analysis Report should have been used in the tube plugging design calculation.

2. The tube plugging calculation failed to account for the increase in flow resistance, as well as a corresponding reduction in heat exchanger essential service water flow, that will result from tube plugging. The calculation assumed that flow would be 1100 gpm both before and after tube plugging. Additionally, since the three heat exchangers are in series (the outlet of the first unit is the inlet to the second unit, and so on), the blocked tubes in any one of the three heat exchangers would have an affect on essential service water flow rate through all three heat exchangers. Engineers did not perform a hydraulic analysis to estimate this affect.

In response to the team's concerns, the licensee entered the issues into their corrective action program as Callaway Action Requests 20070063 and 20070096. In addition, the licensee recalculated the tube plugging limits based on the Final Safety Analysis Report fouling factor, with an adjustment for reduced flow. The revised calculation reduced the acceptable number of plugged tube by approximately 40 percent. The licensee verified that at no time had the number of plugged tubes (either by tube plugging or macro-fouling) exceeded the revised limit. Therefore, the licensee determined that the heat exchangers had always remained operable.

Analysis: The failure to implement appropriate design controls for safety-related tube plugging calculations was a performance deficiency. This finding is more than minor because it affected the mitigating system cornerstone objective (design control attribute) to ensure the reliability and capability of the equipment needed to mitigate initiating events. In addition, the finding was more that minor because, if left uncorrected, it could result in a more significant safety concern. Specifically, if the heat exchanger tubes were plugged to the limit the heat exchangers may be inoperable under certain design basis condition (i.e., higher essential service water temperatures). Using the Manual Chapter 0609, Phase 1 screening worksheet, the issue screened as having very low safety significance because it was a design deficiency confirmed not to result in loss-of-operability in accordance with NRC Manual Chapter Part 9900, Technical Guidance, *Operability Determination Process for Operability and Functional Assessment*.

Enforcement: Part 50 of Title 10 of the Code of Federal Regulations, Appendix B, Criterion III, requires, in part, "The design control measures shall provide for verifying or checking the adequacy of design, such as . . . by the use of alternate or simplified calculational methods . . ." Contrary to the above, as of January 4, 2007, the licensee's design control measures associated with the emergency diesel generator heat exchangers were inadequate, in that, Calculation KJ-10 failed to use the fouling factor specified in the Final Safety Analysis Report and failed to properly address essential service water flow changes when calculating the tube plugging limit for emergency diesel generator heat exchangers. Because this violation is of very low safety significance and it has been entered into the licensee's corrective action program as Callaway Action Requests 200700063 and 200700096, this violation is being treated as a noncited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy: NCV 05000483//2006009-03, *Inadequate Emergency Diesel Generator Heat Exchanger Tube Plugging Calculation*

b.4 Failure to Translate Essential Service Water Cooling Tower Design Basis Information into Specifications and Procedures

Introduction: The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion III, *Design Control*, for the failure to properly translate design requirements into procedures and instructions. Specifically, the cooling tower sizing calculation specified that a flow rate of 15,000 gallons per minute was necessary to meet design basis accident needs but flow balance procedures only required a flow rate of 11,724 gallons per minute.

Description: The Callaway Plant ultimate heat sink consists of a pond, that holds essential service water inventory, and a safety-related cooling tower (two trains) that transfers most of the heat load to the atmosphere. Each cooling tower train has "nameplate" flow rate of 15,000 gallons per minute.

Calculation EF-54, *Ultimate Heat Sink Thermal Performance Analysis*, Revision 2 is the design basis calculation for the ultimate heat sink. The calculation's purpose is to demonstrate that the maximum essential service water design temperature is not exceeded. The calculation states that the cooling tower is analyzed using vendor performance curves, which are contained in Attachment 1 of the calculation. The vendor curves were based on a 15,000 gallon per minute flow rate per train.

The team identified that the required flow rate through the cooling tower, as specified in Procedure ESP-EF-0002B, *Essential Service Ater Train B Flow Verification*, Revision 1, was less than the minimum specified in the design calculation. Specifically, the flow balance procedure only required 11,720 gallons per minute whereas the calculation specified 15,000 gallons per minute per train. Per the latest essential service water flow balance, the flow rates were actually 14,900 gallons per minute for Train A and 13,800 gallons per minute for the Train B. The team also noted that the licensee had not otherwise performed meaningful thermal performance testing to demonstrate cooling tower capability at the lower flow rates. While the licensee had performed some testing during the early 1990s, the licensee did not obtain usable information from the testing. The results were "inconclusive."

In response to the team's concerns, the licensee initiated Callaway Action Request 200700218 on January 10, 2007. The licensee determined that the essential service water system remained operable because of the excess capacity of the essential service water pond. The pond was originally designed for two nuclear units but only one unit was built. The licensee also noted that because of the low seasonal temperatures (winter, fall and spring), the cooling towers would not need as much flow to accomplish the safety function. The licensee planned to revise Calculation EF-54 and make necessary procedural changes prior to restarting from their spring 2007 outage - before the hotter summer months.

Part 50 of Title 10 of the Code of Federal Regulations, Appendix B, Criterion III, *Design Control,* specifies that design information be properly translated into specifications and procedures. Because the design flow rate was 15,000 gallons per minute and the procedure specified a lower flow rate, the licensee failed to meet this requirement.

Analysis: The team determined that the failure to properly translate design information (essential service water flow rate through the cooling tower) into specifications and procedures was a performance deficiency. This finding was more than minor because it affected the mitigating system cornerstone objective (procedure quality attribute) to ensure the reliability and capability of the equipment needed to mitigate initiating events. Further, if left uncorrected, it could lead to a more significant issue. Specifically, information from the calculation could be used in other design documents and operability determinations. Over-predicting cooling tower capability could mask other operational issues. Using the Manual Chapter 0609, Phase 1 screening worksheet, the team determined that the finding had very low safety significance (Green) because the finding was a design deficiency confirmed not to result in loss of operability per *Part 9900 Technical Guidance, Operability Determination Process for Operability and Functional Assessment*.

Enforcement: Part 50 of Title 10 of the Code of Federal Regulations, Appendix B, Criterion III, requires, in part, that measures be established to assure that applicable regulatory requirements and the design basis are correctly translated into specifications, drawings, procedures, and instructions. Contrary to the above, as of January 10, 2007, the licensee failed to assure that the analyzed essential service water flow rate through the cooling tower was correctly translated into specifications, drawings, procedures, and instructions. Specifically, Procedure ESP-EF-0002B specified a lower than design essential service water cooling tower flow rate. Because this violation is of very low safety significance and it has been entered into the licensee's corrective action program as Callaway Action Request 200700218 , this violation is being treated as a noncited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy:
NCV 05000483/2006009-04, *Failure to Translate Essential Service Water Cooling Tower Design Basis Information into Specifications and Procedures.*

b.5 Inadequate Corrective Action for Refeuling water Storage Tank Vortexing Concerns.

Introduction: The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion XVI (Corrective Action), for the failure to take adequate corrective actions following the identification of a condition adverse to quality. Specifically, the licensee had identified, in part, that a safety-related refeuling water storage tank sizing

calculation had failed to consider vortexing at the tank suction inlet piping. This phenomena can cause air entrainment in pumps, which can lead to pump failure. The corrective measures were inadequate because engineers inappropriately used the margin associated with instrument uncertainty as if it were available design margin.

Discussion: The refueling water storage tank provides reactor injection water for emergency core cooling and containment spray pumps. The pumps use the water to mitigate loss-of-coolant accidents. One tank supplies both Trains A and B.

In accordance with Callaway Action Request 200600074, dated January 4, 2006, the licensee had identified that some design calculations had failed to account for vortexing, including the sizing calculation for the refeuling water storage tank (Calculation BN-16, *Basis for Numerical Values Found in Tables 6.2.2-4, 6.3-11, and 6.3-12. In addition, Minimum Refeuling water Storage Tank Transfer Volume Required for Containment Sump Switchover and Minimum Post-Loss of Coolant Accident Containment Sump Flood Depth at the Completion of Switchover are Determined*, Revision 0). Vortexing occurs when liquid in a tank reaches a low level and a characteristic tornado shaped vortex forms near the tank discharge point. Vortexing causes air entrainment in piping systems. Consequently, pumps are at risk of air binding and, in some cases, damage and/or failure.

One of the water sources addressed in Callaway Action Request 200600074 was the refeuling water storage tank. In response to the noted vortexing concern, engineers noted that Calculation BN-16, as well as the Final Safety Analysis Report, Figure 6.3-7, allotted 3 percent of tank volume for instrument uncertainty at the bottom of the tank. The engineers treated the instrument uncertainty as if it were available design margin. Since the calculated margin for vortexing was less than that assumed for instrument uncertainty, the engineers concluded that adequate design margin existed. The calculation was contained in the Callaway action request in its entirety and no other formal calculation adjustments were made.

The team identified that the licensee had taken inadequate corrective measures to address the refeuling water storage tank vortexing concern. Engineers should have considered instrument uncertainty and vortexing as separate components in the calculation - because instrument uncertainty and vortexing are separate phenomena that can occur at the same time. For example, the swap-over of the containment spray pumps to the containment recirculation mode is performed manually by plant operators. The tank level instruments do not provide exact tank level indication but will typically vary a small amount. If the error of this instrumentation was actually 3 percent (consistent with Final Safety Analysis Report assumptions), there would be no margin for vortexing. Three percent of tank volume equates to about 17 inches of tank volume and the licensee had calculated that vortexing could require an adjustment of about 11 inches. Since vortexing would occur, the pumps would be at risk to air entrainment related damage and failure mechanisms.

The team also noted that several NRC Information Notices addressed the failure to address vortexing in design calculations. Those information notices included:

- NRC Information Notice 2006-21, *Operating Experience Regarding Entrainment of Air into Emergency Core Cooling and Containment Spray Systems*," dated September 21, 2006

- NRC Information Notice 1998-40, *Design Deficiencies can Lead to Reduced Emergency Core Cooling System Pump Net Positive Suction Head*, dated October 26, 1998

- NRC Information Notice 1997-60, *Incorrect Unreviewed Safety question Determination Related to Emergency Core Cooling System Swap-Over from the Injection Mode to the Recirculation Mode,* dated August 1, 1997

In response to the team's concerns, the licensee initiated Callaway Action Request 200700224 and evaluated containment spray pump operability. The licensee performed a calibration drift and statistical analysis and determined that the tank level instruments had only experienced approximately 1 percent drift between calibrations. Based on 1 percent instrument uncertainty, the licensee determined the remaining 2 percent of margin was sufficient to ensure containment spray pump operability. The licensee formalized this assessment in Calculation BN-24, *Required Submergence for Refeuling water Storage Tank Suction Pipe for Vortex Prevention*, Revision 0. The licensee planned to initiate a Final Safety Analysis Report change to reflect the evaluation results.

Analysis: The team determined that the failure to take effective corrective measures to address a condition adverse to quality (failure to address vortexing in the refeuling water storage tank sizing calculation) was a performance deficiency. The finding was more than minor because it affected the barrier integrity cornerstone objective (design control attribute) to provide reasonable assurance that physical design barriers (including the containment) protect the public from radio nuclide releases caused by accidents or events. The finding had crosscutting aspects in the area of problem identification and resolution (Operating Experience Attribute), in that the licensee had failed to adequately address the industry operating experience.

Enforcement: Part 50 of Title 10 of the Code of Federal Regulations, Appendix B, Criterion XVI, *Corrective Actions*, requires, in part, that measures be established to assure conditions adverse to quality are promptly identified and corrected. Contrary to the above, as of January 10, 2007, the failure to address vortexing in the refeuling water storage tank during design basis accidents (a condition adverse to quality) was identified but was not promptly corrected. The licensee had identified the failure to address vortexing on January 4, 2006, but the evaluation to addressing the issue was inadequate. Because this violation is of very low safety significance and has been entered into the licensee's corrective action program as Callaway Action Request 200700224, this violation is being treated as a noncited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy: NCV 05000483//2006009-05, *Inadequate Corrective Action for Refeuling water Storage Tank Vortexing Concerns.*

b.6 Failure to Initiate an Operability Evaluation for Water Hammer Concerns

Introduction: The team identified a Green noncited violation of 10 CFR Part 50, Appendix B, Criterion V, *Procedures,* for the failure to follow Callaway Plant procedure requirements associated with operability determinations. Specifically, engineers had identified that a water hammer was causing two residual heat removal system relief valves to fail and that the water hammer would likely recur in certain situations. The engineers failed to take the procedurally required actions to initiate a formal operability determination to evaluate the potential impact to the residual heat removal system pressure boundary.

Description: In accordance with Technical Specification 3.4.12, *Cold Overpressure Mitigating System,* the licensee is required to maintain at least two cold temperature overpressure protection pathways operable in Operational Modes 4, 5, and 6 (with the head in place). Available means include two power operated relief valves and the two residual heat removal relief valves. The two residual heat removal system relief valves (Valves EJ8708A and B) are located in the shutdown cooling suction lines to the residual heat removal Train A and B pumps. For the low temperature overpressure protection function, the relief valves are required to lift between 436.5 and 463.5 psig.

As documented in Licensee Event Report 2006-001-00, the power operated relief valves were found inoperable for the cold overpressure protection function on November 14, 2005. The licensee then credited the residual heat removal system relief valves for that function.

As documented in Licensee Event Report 2006-008-00, during surveillance testing of the relief valves on August 30, 2006, the licensee identified that one of the residual heat removal valves (EJ8708B) lifted approximately 146 psig higher than its required lift setpoint. This condition rendered the valve inoperable for the low temperature overpressure protection safety function. The other relief valve (EJ8708A) lifted within the specified range. However, a nonsafety-related spacing pin was sheared in both valves. The pin fragments had affected the lift setpoints for both valves, but the A valve remained operable.

On October 30, 2006, the licensee reported that the relief valve problems were caused by a pressurizer power operated relief valve initiated water hammer event. The power operated relief valves and the residual heat removal relief valves discharge to a common header, which is then routed to the pressurizer relief tank. The licensee determined that power operated relief valves had repeatedly lifted on February 11, 2004, and had set into motion a sequence of events, which caused water to accumulate in the residual heat removal relief valve discharge lines. When the power operated relief valves lifted again during the same event, water was propelled down the line and caused a pressure spike in the two piping runs on the downstream side of the residual heat removal valves. This pressure spike was sufficient to pull two parts of the valve internals apart and shear the spacing pin. Fragments from the pins were caught between the valve seat and spring/bellows assemblies, effectively compressing the relief springs slightly and raising the relief setpoints. The pin fragments were trapped within a small space and were not able to migrate to other parts of the valve assemblies.

On November 30, 2006, the team identified that engineers had failed to ensure that an operability determination was performed to address the water hammer affect on the residual heat removal system. A water hammer involving the residual heat removal relief valves had the potential to damage the valves, such that, the residual heat removal pressure boundary was compromised. Since the water hammer could recur, and water hammers do not typically distribute consistent forces every time, the licensee had not adequately addressed the impact of the water hammer on the residual heat removal pressure boundary. An event where a piping system had suffered a water hammer related failure was documented in NRC Information Notice 98-31, *Fire Protection System Design Deficiencies and Common-Mode Flooding of Emergency Core Cooling System Rooms at Washington Nuclear Project Unit 2.*

The team noted that the engineers had failed to follow Callaway Plant Procedure APA-ZZ-00500, *Corrective Action Program*, Revision 41, Step 3.1, which states, in part:

> All Personnel. . . Immediately notify Shift Manager or your supervisor upon discovery of a condition believed to have an immediate impact on operability. . . Promptly initiate a Callaway Action Request document.
>
> Inspector Note: The intent of notifying the supervisor is that the supervisor would contact the shift manager to ensure that the prompt operability determination was performed.

In response to the team's concerns, the licensee wrote Callaway Action Request 200609805 and evaluated operability. The licensee performed a rigorous engineering evaluation of the noted water-hammer and determined that the forces applied to the residual heat removal valves would not challenge the pressure boundary integrity. The engineering evaluation is documented in *Evaluation of the Water Hammer on Residual Heat Removal Suction Relief Valve Discharge Piping Following Multiple Pressurizer Power operated Relief Valve Actuations,* dated December 19, 2006.

Analysis: The failure to follow a licensee procedure was a performance deficiency. The finding was more than minor because it was associated with the mitigating systems cornerstone objective (equipment performance attribute) of ensuring the availability, reliability and capability of systems that respond to initiating events to prevent undesirable consequences. Using the Manual Chapter 0609, Phase 1 screening worksheet, the issue screened as having very low safety significance because it was a design deficiency confirmed not to result in loss-of-operability in accordance with NRC Manual Chapter Part 9900, Technical Guidance*, Operability Determination Process for Operability and Functional Assessment.* This finding had a crosscutting aspect in the area of problem identification and resolution (corrective action program component), in that engineers failed to performed the necessary proceduralized corrective actions to ensure that operability was properly evaluated.

Enforcement: Part 50 of Title 10 of the Code of Federal Regulations, Appendix B, Criterion V, requires, in part, that activities affecting quality be performed in accordance with procedures that are appropriate to the circumstances. Callaway Plant Procedure APA-ZZ-00500, Revision 41, Step 3.1 states, in part, "All Personnel. . .

Immediately notify Shift Manager or your supervisor upon discovery of a condition believed to have an immediate impact on operability. . .Promptly initiate a Callaway Action Request document." No later than October 30, 2006, plant engineers identified that residual heat removal relief valves were being subjected to a water-hammer, which could recur (a condition that could have an immediate impact on residual heat removal system operability). Contrary to the above, as of November 30, 2006, engineers had failed to immediately notify the shift manager or their supervisor so that an operability determination could be initiated. Because this violation is of very low safety significance and has been entered into the licensee's corrective action program as Callaway Action Request 200609805, this violation is being treated as a noncited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy: NCV 05000483/2006009-06, *Failure to Initiate an Operability Evaluation for Water Hammer Concerns.*

4 OTHER ACTIVITIES

4OA2 Identification and Resolution of Problems

The team reviewed Callaway actions requests associated with the selected components, operator actions and operating experience notifications. In addition, this report contains the following issue that have problem identification cross-cutting aspects.

> Section 1R21.b.5 documents an issue where the licensee failed to take effective corrective measures in response to vortexing in the refeuling water storage tank.
>
> Section 1R21.b.6 documents a finding where engineers failed to follow Callaway Plant a correction action program procedure and initiate actions to evaluate residual heat removal system operability.

4OA3 Event Followup

(Closed) Licensee Event Report 05000483/2006-008-00. Technical Specification Violation for Inoperable Cold Overpressure Mitigation System. This issue is address in Section 4OA7 of this report.

4OA6 Meetings, Including Exit

On January 11, 2007, the team leader presented the preliminary inspection results to Mr. Tim Hermann, Vice President, Engineering, and other members of the licensee's staff. The licensee acknowledged the findings during each meeting. While some proprietary information was reviewed during this inspection, no proprietary information was included in this report.

4OA7 Licensee Identified Violations

The following violation of very low safety significance (Green) was identified by the licensee and is a violation of NRC requirements which meets the criteria of Section VI of the NRC Enforcement Policy, NUREG-1600, for being dispositioned as a licensee identified noncited violation.

- Licensee Event Report 2006-008-00: Technical Specification 3.4.1, *Cold Overpressure Mitigation System,* requires that as least two pressure relief pathways be operable during Modes 4, 5, and 6 (when the reactor vessel head is on). The purpose of the system is to prevent brittle fracture failure of the reactor coolant system. Credited relief devices include two pressurizer power operated relief valves and two residual heat removal suction relief valves. Contrary to this requirements, the licensee identified that during a portion of outage periods between October 23, 2002, to November 13, 2005, that at least two relief pathways were not operable. The problems were identified as a result of licensee initiated surveillances. The finding was not risk significant because, although technical specification limits were exceeded, devices were still capable of relieving reactor pressure to prevent reactor coolant system brittle fracture.

Attachments: Supplemental Information

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee personnel

T. Hermann, Vice President, Engineering
A. Hefflin, Vice President, Nuclear
F. Diya, Director, Plant Operations
D. Fitzgerald, Manager, Regulatory Affairs
J. Hiller, Regulatory Affairs Engineer
B. Huhmann, Supervising Engineer, Nuclear Systems, Mechanical
S. Maglio, Superintendent, Systems Engineering
M. Mclachlan, Engineering Service Manager
K. Mills, Supervising Engineer, Regional Regulatory Affairs/Safety Analysis
T. Moser, Manager, Plant Engineering
S. Petzel, Regulatory Affairs Engineer
L. Stendebach, Supervisor, Engineering Services
D. Waller, Supervisor, Engineering Systems
R. Wink, Supervising Engineer, Systems Engineering

NRC personnel

M. Peck, Senior Resident Inspector

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened and Closed

05000483/2006009-01	NCV	Inadequate Refeuling water Storage Tank Vent Sizing Calculation (Section 1R21.b.1)
05000483/2006009-02	NCV	Inadequate Emergency Diesel Generator Fuel Oil Verification (Section 1R21.b.2)
05000483/2006009-03	NCV	Inadequate Emergency Diesel Generator Heat Exchanger Tube Plugging Calculation (Section 1R21.b.3)
05000483/2006009-04	NCV	Failure to Translate Essential Service Water Cooling Tower Design Basis Information into Specifications and Procedures (Section 1R21.b.4)
05000483/2006009-05	NCV	Inadequate Corrective Action for Refeuling water Storage Tank Vortexing Concerns (Section 1R21.b.5)
05000483/2006009-06	NCV	Failure to Initiate an Operability Evaluation for Water Hammer Concerns (Section 1R21.b.6)

Closed

05000483/2006-008-00	LER	Inoperable Low Temperature Over-Pressure Protection Systems (Section 4OA7)

LIST OF DOCUMENTS REVIEWED

Action Requests

1988000452	200505368	200602287	200607188	200610359
00107423	200505062	200602539	200607985	200610488
200107511	200505692	200602886	200608086	200700009
200201916	200508987	200603734	200608222	200700040
200401076	200506433	200604120	200608614	200700052
200404465	200506987	200604242	200608629	200700063
200303427	200507160	200608334	200608630	200700076
200307329	200507161	200604248	200608659	200700094
200400497	200507443	200604274	200608665	200700096
200401550	200508393	200604356	200608666	200700100
200405599	200509033	200604472	200608736	200700115
200407439	200509251	200604500	200608861	200700123
200407982	200509288	200605025	200609075	200700160
200502080	200509340	200605143	200609157	200700194
200502472	200510147	200605170	200609177	200700201
200503224	200600074	200605279	200609688	200700218
200503397	200601140	200605491	200609805	200700224
200504045	200601987	200607015	200609994	200700238
200504163				

Calculations

AL-18, *Verification of Adequate Water Inventory for Turbine Driven Auxiliary Feedwater Pump Startup Without Condensate Storage Tank Availability and Loss of Offsite Power*, Revision 0

AL-22, *Auxiliary Feedwater - Condensate Storage Tank Level Setpoints*, Revision 2

AL-24, *Determine the Effect of Dissolved Nitrogen on the Net Positive Suction Head for AL Pumps*, Revision 0, and Addendums Number 1, 2, and 3

AL-25, *Instrument Uncertainty and Setpoint Calculation for Motor Driven Auxiliary Feedwater Pump Flow Control Valve Flow Controllers*, Revision 0

AL-36, *Accident Analysis - Auxiliary Feedwater Basis Calculation*, Revision 0

AP-5, *Calculate the Volume of the Condensate Storage Tank*, Revision 0, Addendum 1

AP-6, *Condensate Storage Tank Vent*, Revision 0

Areva 51-9041422-000, *Past Operability of Callaway Plant Refeuling water Storage Tank Vent,* February 9, 2007

BB-54, *Residual Heat Removal Suction Relief Valve to Pressurizer Relief Tank Delta Pressure*, Revision 0

BN-14, *Refeuling water Storage Tank Level Channels*, Revision 0

BN-16, *Basis for Numerical Values Found in Tables 6.2.2-4, 6.3-11, and 6.3-12. In addition, Minimum Refeuling water Storage Tank Transfer Volume Required for Containment Sump Switchover and Minimum Post-Loss of Coolant Accident Containment Sump Flood Depth at the Completion of Switchover are Determined*, Revision 0

BN-24, *Required Submergence for Refeuling water Storage Tank Suction Pipe for Vortex Prevention*, Revision 0

E-B-10, *Voltage Drop in Motor Control Center Control Circuits*, Revision 3 and Addenda 1, 2, and 3

E-B-15, *Voltage Drop for Class 1E and non-Class 1E Distribution Transformers*, Revision 1

EF-38, Heat Rejected to the Ultimate Heat Sink Post-Loss of Coolant Accident, Revision 1

EF-45, *Essential Service Water Flow Acceptance Criteria*, Revision 6 and Addendum 1

EF-54, *Ultimate Heat Sink Thermal Performance Analysis*, Revision 2

EJ-42, *Motor Operated Valve Sizing Calculation for EJHV8811A and 8811B,* Revision 1

EJ-M-009, *EJHV8811 A/B Motor Operated Valve Bounding Pressure Conditions Determination*, Revision 3

J-2601, *Accuracy: CCC Bistable and Sensing Resistor*, Revision 0

J-USA06, *Instrument Loop Uncertainty Estimate, Rack Allowance, Sensor Allowance for System AL Loops 37, 38, 39*, Revision 1

J-USA06A, *Determination of the Safety Setpoint, Rack Allowable Value, and the System Allowable Value for System AL Loops 37, 38, 39*, Revision 2 and Revision 2 Addendum 1

JE-13, *Emergency Fuel Oil Storage Tank and Day Tank Volume Requirements*, Revision 0

KA -32, *Determine Maximum Permissible Rate of Pressure Decay for the Nitrogen Accumulators, Assuming that the Power Operated Relief Valve/Control Valves Are Not Stroked*, Revision 0, and Addendum Number 1

KA-35, *Past Operability of TKA04*, Revision 0

KJ-10, *Determine Tube Plugging Limits for Diesel Generator Intercooler Heat Exchangers, EKJ03A/B; Diesel Generator Jacket Water Heat Exchangers, EKJ06A/B; and the Lube Oil Coolers, EKJ04A/B*, Revision 0; and Addendum Number 1 to KJ-10

M-BN-23, *Blockage of Refueling Water Storage Tank to Atmosphere*, Revision 1

M-EF-52, *Heat Exchanger Performance Based on Reduced Essential Service Water Temperature and Flow*, Revision 1

M-EG-14, *Component Cooling Water System Hydraulic Calculation*, Revision 0, and Addenda 1 and 2

M-EG-42, *Component Cooling Water Heat Exchanger Tube Plugging Limit*, Revision 0

M-FL-13, *Auxiliary Building Area 5 Flooding*, Revision 0

M-JE-11, *Emergency Fuel Oil Day Tank Instrumentation Scaling and Setpoints*, Revsion 0, and Addenda 1 and 2

M-JE-13, *Emergency Fuel Oil Storage Tank and Day Tank Volume Requirements*, Revision 0

M-JE-321, *Determine Capacities & Level Settings for Emergency Fuel Oil Storage Tanks*, Revision 0

M-JE-356, *Emergency Fuel Oil System Pressure Drop Calculation*, Revision 0

MOVC0072, *Application Guide for Motor Operated Valves in Nuclear Power Plants*, Revision 1

NB-05, *System NB Protective Relay Setpoints*, Section 14, Revision 4 and Revision 4, and Addendum 1

NG-02, *Voltage Drop in Control Circuits Fed from MCC Class 1E Distribution Panels*, pp. 1, 12, Revision 0

NG-12, *NG Motor Control Center Setpoint Calculation*, Revision 3

SNP(UE)-565, *Westinghouse Setpoint Methodology for Protection Systems*, Callaway, May 1, 1984

ZZ-214, *Motor Operated Valve Voltage Drop Calculation* [for valves EJHV 8811A / B], Revision 8

ZZ-224, *Motor Operated Valve Sizing Calculation*, Revision 11

ZZ-62, *Plant Load Flow Calculation*, Attachment 23, Case NB01 Safe Limit and Attachment 4, Case NB02 Safe Limit (for selected loads),Revision 9

Completed Calibrations and Tests

CA-#1527 (EDP-ZZ-01114 and EDP-ZZ-01111), *Motor Operated Valve Predictive Performance Report for EJHV8811A*, April 17, 1998

CA-#1527 (EDP-ZZ-01114 and EDP-ZZ-01111), *Motor Operated Valve Predictive Performance Report for EJHV8811B*, November 11, 1999

EDP-ZZ-01114, *Motor Operated Valve Predictive Performance Report for EJHV8811A*, May 7, 2004

ESP-EF-00002A, *Essential Service Water Train A Flow Verification*, Revision 0, Performance Copy RF 14, Dated October 25, 2005

ESP-EF-00002B, *Essential Service Water Train A Flow Verification*, Revision 1, Performance Copy RF 14, Dated October 25, 2005

ETP-EF-00001, *Ultimate Heat Sink Cooling Tower Performance Test*, Revision 0, Performance Copy dated June 5, 1995

ISF-BN-0L930, *Refeuling water Storage Tank Level Channel Calibration Protection 1(A)*; dated August 30, 2002, January 13, 2004, and July 30, 2006

ISF-BN-0L931*, Refeuling water Storage Tank Level Channel Calibration Protection 2(B)*; dated December 1, 2003, and July 11, 2005

ISF-BN-0L932*, Refeuling water Storage Tank Level Channel Calibration Protection 3(A)*; dated May 27, 2003, October 11, 2004, and May 26, 2006

ISF-BN-0L933, *Refeuling water Storage Tank Level Channel Calibration Protection 4(B)*; dated September 29, 2003, February 15, 2005, and May 29, 2006

ISL-AL-00P37, *Instrument and Controls Functional Test Surveillance Procedure; Auxiliary Feedwater Pumps Suction Pressure*; Jobs 04500269, S686531, S713439, 06527911, 06528945, 06530018, dated August 26, 2003, October 18, 2004, and September 18, 2006

ISL-AL-00P38, *Instrument and Controls Functional Test Surveillance Procedure; Auxiliary Feedwater Pumps Suction Pressure*; Jobs 05509987, S689522, S716935, 06531101, 065229181, S715856, dated November 24, 2003, and April 5, 2005

ISL-AL-00P39, *Instrument and Controls Functional Test Surveillance Procedure; Auxiliary Feedwater Pumps Suction Pressure*; Jobs S668573, S719635, 06528417, 06529436, 06530468, dated May 20, 2002, January 30, 2004, and August 8, 2005

ISL-NF-NB02A, *NB02 Degraded and Undervoltage to LSELS Channel I*; Job 06529485 dated October 26, 2006, Job 06530544 dated November 21, 2006, and Job 06531208 dated December 21, 2006

ISL-NF-NB02B, *NB02 Degraded and Undervoltage to LSELS Channel II*; Job 06529486 dated October 26, 2006, Job 06530545 dated November 21, 2006, and Job 06531209 dated December 21, 2006

ISL-NF-NB02C, *NB02 Degraded and Undervoltage to LSELS Channel III*; Job 06529487 dated October 26, 2006, Job 06530546 dated November 21, 2006, and Job 06531210 dated December 21, 2006

ISL-NF-NB02D, *NB02 Degraded and Undervoltage to LSELS Channel IV*; Job 06529488 dated October 26, 2006, Job 06530547 dated November 21, 2006, and Job 06531211 dated December 21, 2006

ISP-SA-2413A, *Diesel Generator and Sequencer Testing (Train A)*; dated September 19, 2005

ISP-SA-2413B, *Diesel Generator and Sequencer Testing (Train B)*; dated September 19, 2005

ITL-AL-000F9, *Loop Calibration for ALF-009 (P697116)*; dated August 19, 2004

Motor Circuit Evaluator Test Results for Safety Injection Pump B Motor, performed June 5, 2006

Motor Circuit Evaluator Test Results for Auxiliary Feedwater Pump A Motor, performed March 8, 2006

OSP-KA-V0003, *Nitrogen Accumulator Test Data Sheet*, Revision 15, Performance Copy dated November 22, 2006

PD04491.05, Record of Eddy Current Inspection of CCW Heat Exchanger B, November 2002

PD04594.03, Record of Eddy Current Inspection of CCW Heat Exchanger A, April 2004

Phoenix Chemical Laboratory, Inc., Sample Results of #2 Diesel Fuel Oil, July 12, 2006

Performance Test Data Sheet, *Turbine Driven Auxiliary Feedwater Pump*, October 16, 2006

Performance Test Data Sheet, *Auxiliary Feedwater Pump A*, August 22, 2006

Performance Test Data Sheet, *Auxiliary Feedwater Pump A*, May 30, 2006

Performance Test Data Sheet, *Turbine Driven Auxiliary Feedwater Pump*, September 27, 2006

Performance Test Data Sheet, *Turbine Driven Auxiliary Feedwater Pump*, July 2, 2006

Performance Test Data Sheet, *Auxiliary Feedwater Pump A*, November 14, 2006

Phoenix Chemical Laboratory, Inc., Sample Results of #2 Diesel Fuel Oil, October 26, 2005

Phoenix Chemical Laboratory, Inc., Sample Results of #2 Diesel Fuel Oil, December 22, 2006

Phoenix Chemical Laboratory, Inc., Sample Results of #2 Diesel Fuel Oil, May 23, 2006

Phoenix Chemical Laboratory, Inc., Sample Results of #2 Diesel Fuel Oil, November 11,2005

Signature Analysis Report for Valve EJHV8811B, October 22, 2005

Signature Analysis Report for Valve EJHV8811A, October 22, 2005

Drawings

C-300D438YX16, *Orifice Assembly,* September 15, 1997

D-6HMTA32IX84B, *Seal and Manifold Piping,* Revision 2

D-76-81, *Refueling Water Storage Tank*, Revision 7

E-018-00005, *Special Note Drawing - Standardized Nuclear Unit Power Plant System Project*, Sheet 3, Revision 12

E-21NB01(Q), *Lower Medium Voltage System Class 1E 4.16 kV Single Line Meter and Relay Diagram,* Revision 7

E-22NF01(Q), *Load Shedding and Emergency Load Sequencing Logic*, Revision 3

E-23AL01A(Q), *Schematic Diagram, Motor Driven Auxiliary Feedwater Pump A*, Revision 6

E-23AL02A(Q), *Schematic Diagram, Motor Operated Valves [ALHV-35]*, Revision 7

E-23AL03A(Q), *Schematic Diagram, Auxiliary Feedwater Pumps Discharge Control Motor Operated Valves*, Revision 5

E-23AL03B(Q), *Schematic Diagram, Auxiliary Feedwater Pumps Discharge Control Motor Operated Valves,* Revision 5

E-23AL04B(Q), *Schematic Diagram, Motor Operated Valves [ALHV-30, -33]*, Revision 8

E-23AL09(Q), *Schematic Diagram, Miscellaneous Circuits [Modutronic-10A™ Controller*], Revision 4

E-23BB40(Q), *Schematic Diagram, Pressurizer Power Relief Valves*, Revision 3

E-23BG25, *Schematic Diagram, Charging Pump Auxiliary Lube Oil Pumps A & B*, Revision 2,

E-23EJ06A(Q), *Schematic Diagram, Sump to Number 1 Residual Heat Removal Pump*, Revision 11

E-23EJ06B(Q), *Schematic Diagram, Sump to Number 2 Residual Heat Removal Pump*, Revision 14

E-23FC23(Q), *Schematic Diagram, Auxiliary Feedwater Pump Turbine Trip & Throttle Valve*, Revision 17

J-04AL20(Q), *Instrument Isometric Drawing, Emergency Safety Feature Actuation System Low Suction Pressure*, Revision 3

J-04AL21(Q), *Instrument Isometric Drawing, Emergency Safety Feature Actuation System Low Suction Pressure*, Revision 3

J-04AL22(Q), *Instrument Isometric Drawing, Emergency Safety Feature Actuation System Low Suction Pressure*, Revision 3

J-104-00199, *Emergency Load Shedder and Emergency Load Sequencer Schematic Diagram*, Revision 7

J-24BN03(Q), *Instrument Isometric Drawing, Refueling Water Storage Tank Level Transmitter*, Revision 0

J-24BN04(Q), *Instrument Isometric Drawing, Refueling Water Storage Tank Level Transmitter*, Revision 0

J-24BN05(Q), *Instrument Isometric Drawing, Refueling Water Storage Tank Level Transmitter*, Revision 0

J-24BN06(Q), *Instrument Isometric Drawing, Refueling Water Storage Tank Level Transmitter*, Revision 0

J-601A-00165, *Limitorque Corporation Wiring Diagram [Modutronic-10A™ Controller*], Revision 9

M-015-U0003-07, *Ultimate Heat Sink Cooling Tower Cross Section*, Revision H

M-018-00096, *Fuel Oil System*, Revision 12

M-04AL01 (Q), *Piping Isometrics Auxiliary Feedwater Pumps Suction Piping*, Revision 10

M-087-00020, *Crane Drawing of Fuel Oil Transfer Pump*, Revision 7

M-087-002101, *Crane Drawing of Fuel Oil Transfer Pump*, Revision 0

M-105A-00015, *Emergency Fuel Oil Day Tank*, Revision 10

M-109-00003, *Field Erected Tank, Refeuling water Storage Tank*, Revision 8

M-1190-00011, *Motor Driven Auxiliary Feedwater ARC Valve*, Revision 0

M-224B-00049, *3-6 Inch Glove Valves Pressure Seal Forged Manual,* Revision 6

M-22AB02(Q), *Main Steam System,* Revision 14

M-22AL01(Q), *Auxiliary Feedwater System*, Revision 33

M-22EJ01 (Q), *Residual Heat Removal System*, Revision 54

M-23AL01(Q), *Piping Isometric, Auxiliary Feedwater Pumps Suction Piping*, Revision 11

M-23BN01 (Q), *Piping Isometric Borated Refueling Water Storage System*, Revision 12

M-23BN02 (Q), *Piping Isometric Borated Refueling Water Storage System*, Revision 2

M-23JE02(Q), *Piping Isometric Emergency Fuel Oil System Train A*, Revision 8

M-23JE03(Q), *Piping Isometric Emergency Fuel Oil System Train B*, Revision 8

M-25JE02(Q), *Hanger Location Emergency Fuel Oil System Train A*, Revision 5

M-29JE02(Q), *Hanger Location Small Pipe Emergency Fuel Oil System Train A*, Revision 8

M-29JE03(Q), *Hanger Location Small Pipe Emergency Fuel Oil System Train B*, Revision 10

M-2P1151, *Drainage System, Auxiliary Building*, Area 5, Revision 0

M-U2EF01 (Q), *Essential Service Water System*, Revision 55

MPM-16-000-11-D-1685, *Control Head,* August 26, 1999

Human Factor Risk Determinations

AL-XHE-FO-SBOSGL, Operator Fails to Control S/G Level After Complex Event, November 11, 2005

BN-XHE-MC-Refeuling water Storage Tank, Miscalibration of all Refeuling water Storage Tank Level Channels, November 11, 2005

FB-XHE-FO-FANDB, Operator Fails to Establish Feed and Bleed, November 11, 2005

OP-XHE-FO-ECLRS2, Operator Fails to Align Emergency Core Cooling System Systems for Cold Leg Recirc, November 11, 2005

Modifications

MP 02-1018A, Installation of Motor Driven Auxiliary Feedwater Pumps Discharge Automatic Recirculation Control Check Valves, January 22, 2003

Operator Training Scenarios

URO-AEO-2, *Respond to a Loss of Reactor or Secondary Coolant*, December 18, 2006

URO-AEO-5, *Respond to a Loss of All AC per ECA-0.0*, December 18, 2006

URO-AEO-5, *Maintain Steam Generator Level per ECA-0.0*, December 18, 2006

URO-AEO-9, *Respond to a Loss of Heat Sink per FR-H*.1, , December 18, 2006

URO-AEO-9, *Initiate RCS Feed and Bleed per FR-H.1*, December 18, 2006

URO-COT-9, *Operator Response Time to a Large Break Loss of Coolant Accident*, December 18, 2006

URO-SAC-4, *Respond to a Main Turbine Trip Below P-9 per OTO-AC-00001*, December 18, 2006

Procedures

APA-ZZ-00356, *Pump and Valve Inservice Test Program*, Revision 12

APA-ZZ-00500, *Corrective Action Program,* Revision 41

APA-ZZ-0604, *Requests for Resolution,* Revision 20

CSF-1, *Critical Safety Function Status Trees*, Revision 8

CSP-ZZ-02135, *Specific Gravity Determination*, Revision 10

CSP-ZZ-07350, *Diesel Fuel Oil Testing Program*, Revision 16

CTP-JE-01230, *Diesel Fuel Oil Sampling*, Revision 33

E-0, *Reactor Trip or Safety Injection*, Revision 8

E-1, *Loss of Reactor or Secondary Coolant*, Revision 8

ECA-0.0, *Loss of all AC Power*, Revision 6

ECA-1.1, *Loss of Emergency Coolant Recirculation*, Revision 7

ECA-1.3, *Sump Blockage Mitigation*, Revision 7

ECA-2.1, *Uncontrolled Depressurization of all Steam Generators*, Revision 7

EDP-ZZ-01112, *Heat Exchanger Predictive Performance Manual*, Revision 11

EDP-ZZ-01121 Appendix 1, *Raw Water System Leak or Degradation History*, Revision 0

EDP-ZZ-01121 Appendix 2, *Non-Trended Monitored Locations for Raw Water Program*, Revision 0

EDP-ZZ-01121, *Raw Water Systems Predictive Performance Program*, Revision 9

EDP-ZZ-04015, *Evaluating and Processing Requests for Resolution,* Revision 45

EDP-ZZ-04023, *Calculations,* Revision 20

EOP Addendum 19, *Aligning Essential Service Water to Auxiliary Feedwater Suction*, Revision 1

ES-0.1, *Reactor Trip Response*, Revision 7

ES-0.2, *Natural Circulation Cooldown,* Revision 7

ES-0.3, *Natural Circulation Cooldown with Steam Void in Vessel,* Revision 7

ES-0.4, *Natural circulatino Cooldown with Steam Void in Vessel (without Reactor Vessel Level Indication System),* Revision 7

ES-1.3, *Transfer to Cold Leg Recirculation*, Revision 8

ETP-EG-00001, *Component Cooling Water Heat Exchanger Test*, Revision 5

ETP-KJ-00003, *Diesel Generator Heat Exchanger Test*, Revision 4

FR-H.1, *Response to Loss of Secondary Heat Sink*, Revision 7

ISL-BN-OL930, *Refeuling water Storage Tank Level Channel Calibration Protection 1(A)*, Major Revision 12

Job 04502232, *Inspect Tray Supports in Manhole MH01 North / A Train*, July 20, 2006

Job P602024, *Inspect Tray Supports in Manhole MH01 North / A Train*, May 3, 2000

Job 04502233, *Inspect Tray Supports in Manhole MH01 South / B Train*, May 19, 2006

Job P655809, *Inspect Tray Supports in Manhole MH01 North / A Train*, July 24, 2003

Job P657300, *Inspect Tray Supports in Manhole MH01 South / B Train*, July 9, 2003

Job P621860, *Inspect Tray Supports in Manhole MH01 South / B Train*, June 5, 2000

Job P726099, *Flush Essential Service Water Train A to Turbine Driven Auxiliary Feedwater Pump,* October 12, 2005

Job P726126, *Flush Essential Service Water Train B to Turbine Driven Auxiliary Feedwater Pump,* October 12, 2005

Job P724533, *A Motor Drivent Auxiliary Feedwater Pump Suction Line Flush,* October 12, 2005

Job P724919, *B Motor Drivent Auxiliary Feedwater Pump Suction Line Flush,* October 11, 2005

MPE-ZZ-QS005, *Test, Clean, and Inspect 4160 V Circuit Breaker [NB0113*], performed by Work Order A677644A, May 4, 2004

MPE-ZZ-QS006, *Overhaul 4160 V Circuit Breaker [NB0113],* performed by Work Order W204934,November 29, 2000

MSM-JE-QP001, *Emergency Fuel Oil Transfer Pump Inspection*, Revision 4

ODP-ZZ-00014, *Operational Mode Change Requirements*, Revision 28

OSP-BB-00003, *Power Operated Relief Valve/Residual Heat Removal Cold Overpressure Mitigating System Allignment Verification*, Revision 12

OSP-EF-P001A, *Essential Service Water Train A Inservice Test - Group A*, Revision 47

OSP-EJ-V002A, *Residual Heat Removal Pump Containment Sump Suction and Refueling Water Storage Tank Suction Inservice Test - IPTE*, Revision 22

OSP-KA-V0003, *Nitrogen Accumulator Inservice Leak Rate Test*, Revision 15

OTA-RK-00020 Addendum 55C, *Essential Service Water Strainer Differential Pressure High*, Revision 1

OTG-ZZ-00002, *Reactor Startup - IPTE*, Major Revision 36

OTG-ZZ-00006, *Plant Cooldown Hot Standby to Cold Shutdown*, Revision 42

OTN-AL-00001, *Auxiliary Feedwater System*, Revision 21

OTN-JE-00001, *Emergency Fuel Oil Storage and Transfer System*, Revision 5

OTO-AC-00001, *Turbine Trip Below P-9*, Revision 12

OTO-AC-00002, *Turbine Vibration*, Revision 13

OTS-AL-00002, *Essential Service Water Train B to Turbine Drivent Auxiliary Feedwater Pump Flush (High Flow)*, Revision 012

PM0818214, *Clean Inspect Governor Valve & Trip Throttle Valve*, Revision 2

PM0818214, *Clean Inspect Governor Valve & Trip Throttle Valve*, Revision 2

PM1000249, *Lubricate Motor and Perform MCE Test, PMB Fan 1-20.1-3 & 1-20.1-4*, performed May 2-3, 2006; September 8, 2005; September 8, 2004

ZZ-0006, *Engineering Design Guide,* November 14, 2006

Miscellaneous Documents

05515765, *Surveillance Requirement Task Sheet*, October 10, 2005

10466-M-072(Q), *Component Cooling Water Heat Exchanger Data Sheet*, Revision 5

10466-M-087(Q), *Design Specification for Emergency Fuel Oil Transfer Pumps for the Standardized Nuclear Unit Power Plant*, Revision 5

10466-M-087-0014-02, *Centrifugal Pump Data Sheet*, Revision 1

97-1028, *Union Electric Company Design Input Report, FCHV0312 Limit Switch Adjustment*, Revision 0.

Amendment Number 100, *Amendment to Facility Operating License*, July 6, 1995

AUCA 06-014, *Root Cause Evaluation for Corrective Action Request 200600553 (Leak on "B" Train Essential Service Water)*, February 27, 2006

AUCA 05-012, *Root Cause Evaluation for Corrective Action Request 200501838 (Pin Hole Leak on "B" Essential Service Water Pump Discharge)*, 5/16/2005

Bechtel Number 10884-M-015(Q), *Mechanical Draft Cooling Tower Data Sheet*, Standardized Nuclear Unit Power Plant System, Appendix A

Callaway Engineering Action Item Transmittal 86-00034, IE Notice 86-65- *Malfunction of Barton Model 580 Switches*, September 9, 1986

Callaway Plant Response Form, NRC IE Notice 85-02 *Improper Installation & Testing of D/P Transmitters*, July 30, 1985

Callaway Plant Part 21 Notification, *Prime Measurement Products, Models 763 & 763A Pressure Transmitters and Model 764 Differential Pressure Transmitters*, dated June 19, 2006

Callaway Plant Part 21 Notification, *Prime Measurement Products, Models 763 & 763A Pressure Transmitters and Model 764 Differential Pressure Transmitters*, dated November 16, 2005

Callaway Final Safety Analysis Report

Callaway Plant Technical Specifications

CN 98-064, *Revise Refueling Water Storage Tank Outflow Analysis and Emergency Core Cooling System/Containment Spray Injection and Switchover Times as a result of Calculation BN-16*, Revision 0. *Also Revise the Refueling Water Storage Tank Low-Low-2 Level Alarm Setpoint as a Result of Calculation M-BN-20,* Revision 1, Addendum 2, Revision 0

Dampening Devices are Installed, April 30, 1992

DEI-825, *Callaway Refuel 13 Buried Piping Inspections*, Revision 0

E-009(Q), *Technical Specification for Metal-Clad Switchgear for the Standardized Nuclear Unit Power Plant System*, page A-2, Revision 7.

E-00NF(Q), *System Description - Load Shedding and Emergency Load Sequencing*, Revision 2.

E-029-00003, Power Cable - 5KV Non-Shielded & 15 KV Shielded Qualification, Revision 3

E-092(Q), Technical Specification for Load Shedder and Emergency Load Sequencer for the Standardized Nuclear Power Plant System, Revision 9

EAI C0124, Information Notice 90-41, *Potential Failure of General Electric Magne-Blast™ Circuit Breakers and AK Circuit Breakers*, 1990

Environmentally Qualified Equipment, July 26, 1989

Equipment Out of Service Log #14493, January 5, 2007

Evaluation of the Water Hammer of Residual Heat Removal Suction Relief Valve Discharge Piping Following Multiple Pressurizer Power Operated Relief Valve Actuations, December 19, 2006

Foxboro 10 CFR Part 21 Notification, *Model N-2A0-L2C-R Contact Output Isolator*, July 14, 1999

Heat Exchanger Inspection Report, *Train B Emergency Diesel Generator*, November 28, 2006

J-104-00347, Instruction Manual: *Installation, Operation, Maintenance - Engineered Safety Features Actuation System Load Shedder and Emergency Load Sequencer for Standardized Nuclear Power Plant System, Callaway Number 1 Generating Station*, Revision 18

Letter from Reedy Engineering, Inc. To Nick Sutherland, AmerenUE, Subject: *Relief Valve Discharge Piping,* December 7, 2006

Letter from the Licensee to the NRC Docket Number 50-483, Subject: *Close-Out of Generic Letter 96-01*, February 13, 1998

Letter from the Licensee to the NRC Docket Number 50-483, Subject: *Callaway Response to Generic Letter 96-01, Testing of Safety-Related Logic Circuits*, April 18, 1996

M-087-00032, *Design Report & Seismic Analysis Chempump Model GA-1.5K-1S*, Revision 0

MOD-10A-INST, *Limitorque Operating and Instruction Manual for Modutronic 10A Electronic Positioner for Automated Operators*, July 1, 1974

Modification System Testing , March 22,1985

NES-94-073, Information Notice 94-02, *General Electric Magne-Blast™ Circuit Breaker Latch Monitor Spring*, April 11, 1994

NES-94-269, Information Notice 94-54, *Failures of General Electric Magne-Blast™ Circuit Breakers to Latch Closed*, September 14, 1994

NES-96-200, Information Notice 96-43, *Failures of General Electric Magne-Blast™ Circuit Breakers and Information Notice 96-46, Zinc Plating of Hardened Metal Parts and Removal of Protective Coatings in Refurbished Circuit Breakers*, December 2, 1996

NES-97-111, Information Notice 97-08, *Potential Failures of General Electric Magne-Blast™ Circuit Breaker Subcomponents,* June 19, 1997

NRC I.E. Circular 79-05, *Moisture Leakage in Stranded Wire Conductors*, March 14, 1979

NRC Information Notice 81-29, *Equipment Qualification Testing Experience*, September 24,1981

NRC Information Notice 85-02, *Improper Installation and Testing of Differential Pressure Transmitters*, January 11,1985

NRC Information Notice 89-57, *Unqualified Electrical Splices in Vendor-Supplied Environmentally Qualified Equipment*, July 26, 1989

NRC Information Notice 04-01, *Auxiliary Feedwater Pump Recirculation Line Orifice Fouling - Potential Common Cause Failure*, January 21, 2004

NRC Information Notice 06-21, *Operating Experience Regarding Entrainment of Air Into Emergency Core Cooling and Containment Spray Systems*, September 21, 2006

NRC Regulatory Issue Summary 2005-20, *Revision to Guidance Formerly Contained in NRC Generic Letter 91-18*, September 26, 2005

Nuclear Industry Advisory Letter, *Barton Transmitter Defective Connectors*, dated May 18, 2006

Nuclear Industry Advisory Letter, *Barton Model 763, Model 763A and Model 764 Zener Diodes*, dated November 2, 2005

P699243, *Component Cooling Water Heat Exchanger Task Sheet*, Revision 5b

Quality Assurance Audt of Design Control AP06-006, Component Design Basis, July 31, 2006
Requalification Testing, August 14, 1986

Request for Resolution 14020, *Operability of Turbine Driven Auxiliary Feedwater Pump after Safe Shutdown Earthquake and Loss of Offsite Power*, Revision B.

Request for Resolution 19025, *Document Basis for Spray Duration Times in Final Safety Analysis Report*, Revision A

Request for Resolution 200403683, *Perform Evaluation of Foreign Material Found in Essential Service Water Piping,* May 17, 2004

Request for Resolution Number 5728 B, *Compliance With Bulletin 88-04 for BG, EJ, EM Systems,* March 27, 2003

Request for Resolution 200505692, EJHV8811 A/B - *Determine Parameters associated with OE 20893*, 3/8/2006

Request for Resolution Number 5728C, *Compliance With Bulletin 88-04 for AL System*, December 18, 2003

Request for Resolution 1351, *Components Included in Engineered Safety Features Response Time*, Revision A

Request for Resolution Number 22364 B, *Document GL 89-13 Compliance*, September 4, 2003

Request for Resolution 7627, *In-service Testing Program Stroke Time Limits*, Revision A

Request for Resolution 22364, *Clarification to Callaway's Response to (GL) 89-13*, Revision B

Request for Resolution 8746, *Justification for Motor Operated Valve Analysis Test System Differential Pressure Database for Motor Operated Valves*, Revision A

Request for Resolution 20600, *Technical Specification Surveillance Requirement 3.8.1.4 Acceptance Criteria,* Revision A

Request for Resolution 8746, *Verify the Thrust Requirement for Motor Operated Valves using Grouping*, Revision I

Request for Resolution-5353, Attachment 8, Revision F

Request for Resolution 8746, Attachments 1 through 9 and *Determination of Thrust Values, Verify the Thrust Requirement for Motor Operated Valves using Grouping*, Revision I

Request for Resolution Number 14020 C, *Operability of Turbine Driven Auxiliary Feedwater Pump After Safe Shutdown Earthquake and Loss of Offsite Power*, October 23, 1997

Special Turbine Driven Pump Bearing Temperature Test, May 3, 1972

STARS-ENG-5001-8.7 for Request for Resolution 200505692, *EJHV8811 A/B - Determine Parameters associated with OE208893*, Revision 0

STARS-ENG-5001-8.7 for Request for Resolution 200505692, *Determine Parameters associated with OE208893 for EJHV8811 A/B*, Revision 0

TDB-001, Tank Data Book, Revision 44

Top Equipment Issues List, December 13, 2006

Truck Loading Manifest and Bill of Lading for # 2 Diesel Fuel, October 12, 2005

Truck Loading Manifest and Bill of Lading for # 2 Diesel Fuel, October 10, 2005

ULNRC-2324, *Response to Generic Letter 89-13 Service Water System Problems Affecting Safety-Related Equipment*, November 14, 1990

Ultimate Heat Sink Cooling Tower Data, Microfilm roll number 01703,

UOTE 94-018,Information Notice 93-91, *Misadjustment between General Electric 4.16 kV Circuit Breakers and their Associated Cubicles*, January 27, 1994

USNRC Regulatory Guide 1.27, *Ultimate Heat Sink for Nuclear Power Plants*

WCAP 13097 Volume 2, *System Operating Basis for Motor -Operated Valves*, Revision 0

The team provided the following information request in writing to the licensee prior to the inspection.

Initial Information Request
Component Design Basis Inspection (71111.21)
Callaway

Please provide the following information in order to support the NRC's component design basis inspection effort at your facility. If there are problems obtaining any of this information, please call the Team Leader, George Replogle at (817) 860-8249 to discuss alternate arrangements. We would like to have the information ready when we arrive on site for the "bag-man" portion of the inspection on November 28, 2006.

We prefer, but it's not required, that the information be provided electronically and in a searchable format, such as Adobe, Word, Word Perfect, or Excel. Other licensee's have found that providing the information on a CD is effective and efficient.

1. The risk ranking of components from your site specific probabilistic safety analysis sorted by Risk Achievement Worth and by Birnbaum Importance.

2. A list of your top 500 cutsets from your probabilistic safety analysis.

3. Risk ranking of operator actions from you site specific probabilistic safety analysis sorted by Risk Achievement Worth. Provide copies of your human reliability worksheets for these items (you may limit this list to the 100 most risk significant actions).

4. If you have an external events or fire probabilistic safety analysis model, provide the information requested in Items 1 and 2 for external events and fire.

5. Any pre-existing evaluation or list of components and calculations with low design margins (i.e. pumps closest to the design limit for flow or pressure, diesel generators close to design required output, heat exchangers close to rated design heat removal etc.)

6. For the last two years, a list of operating experience evaluations, modifications and corrective actions sorted by component or system. A one line, or short, description is acceptable.

7. A list of any common-cause failures of components in the last 5 years at your facility.

8. A list of Maintenance Rule functions.

9. A list of your Maintenance Rule a(1) components.

10. A list of your current temporary modifications.

11. A current list of "operator work arounds."

12. Piping and instrument drawings for your emergency core cooling systems, emergency diesel generators and off-site power supplies. At this time, only the mechanical piping drawings are needed for the emergency core cooling systems and the emergency diesel generators.

In addition to the above, if available electronically, please provide a copy of each of the following on CD.

1. Final/Updated Safety Analysis Reports

2. Technical Specifications

3. Design Bases Documents for the emergency core cooling systems (including auxiliary feedwater), emergency diesel generators and off-site power supplies

4. System descriptions or operator training manuals for the emergency core cooling systems, emergency diesel generators and off-site power supply systems

Thank you for your cooperation in these matters.