UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 E LAMAR BLVD
ARLINGTON, TX 76011-4511

January 22, 2015

EA-14-228

Mr. Michael R. Chisum
Site Vice President
Entergy Operations, Inc.
17265 River Road
Killona, LA 70057-0751

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 – NRC COMPONENT DESIGN BASES INSPECTION REPORT 05000382/2014007 AND PRELIMINARY GREATER THAN GREEN FINDING

Dear Mr. Chisum:

On November 6, 2014, the U.S. Nuclear Regulatory Commission (NRC) completed the onsite portion of an inspection at the Waterford Steam Electric Station, Unit 3. The NRC inspectors discussed the results of this inspection with you and members of your staff at the conclusion of the onsite inspection and again on December 17, 2014, after additional in-office inspection. A final telephonic exit meeting was conducted on January 12, 2015, with you and members of your staff. The inspectors documented the results of this inspection in the enclosed inspection report.

The enclosed report documents an NRC-identified finding that has been preliminarily determined to be of greater than very low safety significance (greater than Green), which may require additional inspections, regulatory actions, and oversight. This finding also constitutes an apparent violation of NRC requirements, which is being considered for escalated enforcement action in accordance with the NRC Enforcement Policy, which is available on the NRC's Web site at http://www.nrc.gov/about-nrc/regulatory/enforcement/enforce-pol.html.

As described in Section 1R21.2.12.3 of the enclosed report, this finding is associated with through-wall corrosion on the emergency diesel generator fuel oil day tank vents. The holes in these vent pipes could allow water to enter the day tanks and contaminate the diesel fuel oil, challenging the operability and functionality of both safety-related emergency diesel generators. While developing permanent corrective actions, your staff established compensatory measures to address the NRC's immediate safety concerns. These measures included installation of a temporary rubber wrap to cover the holes and a berm to direct water away from the vent pipes.

The preliminary risk significance of this finding was assessed using the NRC's significance determination process. This assessment was based on qualitative criteria and quantitative risk calculations. Both were required due to two areas of significant uncertainty in the risk model: (1) the conditional probability of a loss of off-site power given a rain event of 5 inches per hour or more, and (2) the sensitivity of the station's diesel generators to water in the fuel stream.

These uncertainties in the risk model resulted in possible significance outcomes from low-to-moderate safety significance (White) to high safety significance (Red). The qualitative criteria considered are described in the preliminary detailed risk evaluation, which is attached to the enclosed report. We recognize that because of the large uncertainties associated with the preliminary risk determination for this finding, more information is needed to determine its final risk significance. If you have any further information that might clarify these uncertainties, we request that you provide it either in writing or during a scheduled regulatory conference.

We intend to complete and issue our final risk significance determination within 90 days from the date of this letter. The NRC's significance determination process is designed to encourage an open dialogue between your staff and the NRC; however, the dialogue should not affect the timeliness of our final determination.

Before the NRC makes a final decision on this matter, you may choose (1) to attend a regulatory conference, where you can present to the NRC your point of view on the facts and assumptions used to arrive at the finding and assess its significance; or (2) to submit your position on the finding to the NRC in writing. If you request a regulatory conference, it should be held within 30 days of your receipt of this letter. We encourage you to submit supporting documentation at least one week prior to the conference in an effort to make the conference more efficient and effective.

If you choose to attend a regulatory conference, it will be open for public observation. The NRC will issue a public meeting notice and press release to announce the conference. If you decide to submit only a written response, it should be sent to the NRC within 30 days of your receipt of this letter. If you choose not to request a regulatory conference or to submit a written response, you will not be allowed to appeal the NRC's final significance determination.

Please contact Mr. Eric Ruesch, Branch Chief (Acting), Engineering Branch 1, within 10 days from the issue date of this letter at 817-200-1126 or eric.ruesch@nrc.gov, and in writing, to notify the NRC of your intentions. If we have not heard from you within 10 days, we will continue with our significance determination and enforcement decision. Because the NRC has not made a final determination in this matter, no notice of violation is being issued with this report. Please be advised that the characterization of the apparent violation may change based on further NRC review.

In addition to this finding, NRC inspectors documented six findings of very low safety significance (Green) in the enclosed report. Five of these findings involved violations of NRC requirements. The NRC is treating these violations as non-cited violations consistent with Section 2.3.2.a of the Enforcement Policy.

If you contest any of these violations or their significance, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001; with copies to the Regional Administrator, Region IV; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC resident inspector at the Waterford Steam Electric Station, Unit 3.

If you disagree with a cross-cutting aspect assignment or a finding not associated with a regulatory requirement in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region IV; and the NRC resident inspector at the Waterford Steam Electric Station, Unit 3.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390, “Public Inspections, Exemptions, Requests for Withholding,” of the NRC’s “Rules of Practice,” a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC’s Public Document Room or from the Publicly Available Records (PARS) component of the NRC’s Agencywide Documents Access and Management 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/

Anton Vegel, Director
Division of Reactor Safety

Docket: 50-382
License: NPF-38

Enclosure:
Inspection Report 05000382/2014007
w/Attachments:
1. Supplemental Information
2. Detailed Risk Evaluation

Distribution for Waterford Steam
Electric Station, Unit 3

**U.S. NUCLEAR REGULATORY COMMISSION**
**REGION IV**

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| Docket: | 05000382 |
| License: | NPF-38 |
| Report No.: | 05000382/2014007 |
| Licensee: | Entergy Operations, Inc. |
| Facility: | Waterford Steam Electric Station, Unit 3 |
| Location: | 17265 River Road<br>Killona, LA 70057 |
| Dates: | October 6, 2014, through January 12, 2015 |
| Team Leader: | J. Dixon, Senior Reactor Inspector, Engineering Branch 1 |
| Inspectors: | B. Larson, Senior Operations Engineer, Operations Branch<br>S. Makor, Reactor Inspector, Engineering Branch 1<br>G. Ottenberg, Senior Reactor Inspector, Engineering Branch 1, Region II |
| Accompanying Personnel: | G. Gardner, Contractor, Beckman and Associates<br>P. Wagner, Contractor, Beckman and Associates |
| Approved By: | Eric Ruesch, Chief (Acting)<br>Engineering Branch 1<br>Division of Reactor Safety |

## SUMMARY


IR 05000382/2014007; 10/06/2014 – 1/12/2015; Waterford Steam Electric Station, Unit 3; Component Design Basis Inspection

The inspection activities described in this report were performed between October 6, 2014, and January 12, 2015, by three inspectors from the NRC's Region IV office, one inspector from the NRC's Region II office, and two contractors. Additional in-office inspection was performed through December 17, 2014. The enclosed inspection report documents one finding that has been preliminarily determined to be greater than very low safety significance (greater than Green) and may require additional inspections, regulatory actions, and oversight. The finding is also an apparent violation of NRC requirements and is being considered for escalated enforcement action in accordance with the Enforcement Policy. In addition, six findings of very low safety significance (Green) are documented in this report. Five of these findings involved violations of NRC requirements. The NRC is treating these violations as non-cited violations (NCVs) consistent with Section 2.3.2.a of the Enforcement Policy.

The significance of inspection findings is indicated by their color (Green, White, Yellow, or Red), which is determined using Inspection Manual Chapter 0609, "Significance Determination Process." Their cross-cutting aspects are determined using Inspection Manual Chapter 0310, "Components Within the Cross-Cutting Areas." Violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process."

**Cornerstone: Mitigating Systems**

- Green. The team identified a Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," which states, in part, that measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance are promptly identified and corrected. Specifically, from October 27 through December 13, 2012, and on May 1, 2014, the licensee failed to identify and evaluate the impact of elevated bus voltages that exceeded the allowable voltage on the 480 VAC Class 1E Bus 3B31, a condition adverse to quality. In response to this issue, the licensee completed an operability determination with plans to evaluate any trends requiring additional actions. This finding was entered into the licensee's corrective action program as Condition Report CR-WF3-2014-05458.

  The team determined that the failure to identify and evaluate the impact of elevated bus voltages was a performance deficiency. This performance deficiency was more than minor because it was associated with the equipment performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to identify and evaluate elevated voltages on the 480 VAC Class 1E Bus 3B31 that exceeded allowable operability limits.

  In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," this finding screened as having very low safety

significance (Green) because it was a design or qualification deficiency that did not represent a loss of operability or functionality; did not represent an actual loss of safety function of the system or train; did not result in the loss of one or more trains of non-technical specification equipment; and did not screen as potentially risk-significant due to seismic, flooding, or severe weather. This finding had a cross-cutting aspect in the area of problem identification and resolution associated with trending because the licensee failed to periodically analyze information in the aggregate to identify programmatic and common cause issues (P.4). (Section 1R21.2.2)

- Green. The team identified a Green finding for inadequate station procedures for the temporary emergency diesel generators. Specifically, the licensee failed to ensure that Procedures OP-TEM-008, "Emergency Diesel Generator A(B) Backup Temporary Diesel Generators," and ME-001-012, "Temporary Power from Temporary Diesel for 3A2 and 3B2 4kV Buses (MODES 1-6)," were maintained to ensure that the temporary diesels had enough capacity to supply auxiliary power to the required safe-shutdown loads. The team determined that the licensee failed to clearly establish appropriate instructions to ensure that operators would be running and verifying loads according to the prime rating, that three temporary diesels were capable of operating/connecting in parallel, and that required and desired loads were consistent among procedures and evaluations.

  In response to this issue, the licensee evaluated and updated station procedures, specified prime loading limitations, updated vendor contracts, incorporated procedure improvements as a result of training, and updated the adverse weather procedure. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05662 and CR-WF3-2014-05582.

  The team determined that failure to maintain procedures to ensure the temporary diesels have enough capacity to supply auxiliary power to required safe-shutdown loads was a performance deficiency. This performance deficiency was more than minor because it was associated with the equipment performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to update Procedures OP-TEM-008 and ME-001-012, and vendor documents in accordance with engineering evaluation EC-47496 in a timely manner and prior to performance of the emergency diesel generator outage in January 2014.

  In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," this finding screened as having very low safety significance (Green) because it was a design or qualification deficiency that did not represent a loss of operability or functionality; did not represent an actual loss of safety function of the system or train; did not result in the loss of one or more trains of non-technical specification equipment; and did not screen as potentially risk-significant due to seismic, flooding, or severe weather. This finding had a cross-cutting aspect in the area of human performance associated with teamwork because the licensee failed to ensure that individuals and work groups communicate and coordinate their activities within and across organizational boundaries to ensure nuclear safety is maintained (H.4). (Section 1R21.2.7)

- Green. The team identified a Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," which states, in part, that measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance are promptly identified and corrected. Specifically, between October 8 and 16, 2014, the licensee failed to initiate a condition report to evaluate the lack of missile protection on the emergency diesel generator A and B storage tank vents, a nonconformance that is a condition adverse to quality. In response to this issue, the licensee performed an operability determination to address the team's concerns and initiated a separate condition report to document the failure to initiate a report for a condition adverse to quality. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05341 and CR-WF3-2014-05738.

  The team determined that the failure to initiate a condition report to evaluate the lack of missile protection on the emergency diesel generator A and B storage tank vents for 8 days was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to promptly initiate and evaluate a condition adverse to quality, a design nonconformance on the emergency diesel generator A and B storage tank vents for missile protection.

  In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," this finding screened as having very low safety significance (Green) because it was a design or qualification deficiency that did not represent a loss of operability or functionality; did not represent an actual loss of safety function of the system or train; did not result in the loss of one or more trains of non-technical specification equipment; and did not screen as potentially risk-significant due to seismic, flooding, or severe weather. This finding had a cross-cutting aspect in the area of human performance associated with work management because the licensee failed to implement a process where nuclear safety is the overriding priority and the need for coordinating with different work groups (H.5). (Section 1R21.2.12.1)

- Green. The team identified a Green, non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," which states, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Specifically, prior to November 6, 2014, the licensee failed to verify the adequacy of design of the vents for the emergency diesel generator A and B day tanks and storage tanks to withstand impact from a wind-driven missile, or to evaluate for exemption from missile protection requirements using an approved methodology. In response to this issue, the licensee performed an evaluation using the TORMIS computer simulation code that supported a determination of operability and a future licensing basis change. TORMIS is a methodology described in Electric Power Research Institute (EPRI) Technical Report NP-2005, "Tornado Missile Simulation and Design Methodology," dated August 1981, which was approved for use by Waterford in the Safety Evaluation related to License Amendment 168. This finding was entered into the licensee's corrective action program as CR-WF-2014-05131, CR-WF3-2014-5341, and CR WF3-2014-5412.

The team determined that the failure to evaluate the lack of missile protection on the emergency diesel generator A and B day and storage tank vents was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to evaluate a design nonconformance on the emergency diesel generator A and B day and storage tank vents for lack of missile protection.

In accordance with Inspection Manual Chapter 0609, Appendix A, “The Significance Determination Process (SDP) for Findings At-Power,” dated June 19, 2012, Exhibit 2, “Mitigating Systems Screening Questions,” this finding screened as having very low safety significance (Green) because it was a design or qualification deficiency that did not represent a loss of operability or functionality; did not represent an actual loss of safety function of the system or train; did not result in the loss of one or more trains of non-technical specification equipment; and did not screen as potentially risk-significant due to seismic, flooding, or severe weather. The team determined that this finding did not have a cross-cutting aspect because the most significant contributor did not reflect current licensee performance. (Section 1R21.2.12.2)

TBD. The team identified an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI, “Corrective Action,” which states, in part, that measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance are promptly identified and corrected. Specifically, prior to October 22, 2014, the licensee failed to identify and correct through-wall corrosion on the emergency diesel generator A and B day tank vents, a condition adverse to quality. Prior to discovery by the team, the licensee had been unaware of the corrosion, which was significant enough that a through-wall hole had formed at the base of the each vent pipe where it penetrates the roof. Consequently, any water that collects on the roof of the building would have the potential to drain into the day tanks.

The licensee performed an immediate operability determination and concluded that the diesel and its support systems were operable based on no severe weather in the area. While evaluating permanent corrective actions, the licensee installed a temporary repair to the vent pipes using a rubber wrap and installed a small concrete berm to minimize the potential amount of water in the immediate area. This finding was entered in to the licensee’s corrective action program as CR-WF3-2014-05413.

The team determined that the failure to identify and correct through-wall corrosion on the emergency diesel generator A and B day tank vents was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control and equipment performance attributes of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences.

Specifically, the licensee failed to identify, evaluate, and correct through-wall corrosion on the emergency diesel generator A and B day tank vents. In accordance with Inspection Manual Chapter 0609, Appendix A, “The Significance Determination Process (SDP) for Findings At-Power,” dated June 19, 2012, Exhibit 2, “Mitigating Systems Screening Questions,” the issue screened to Exhibit 4, “External Events Screening Questions,” because it was potentially risk-significant due to seismic, flooding, or severe weather. Per Exhibit 4 this finding screened to a Detailed Risk Evaluation because if the safety function were assumed completely failed it would degrade two trains of a multi-train system and it would degrade one or more trains of a system that supports a risk-significant system.

A Region IV senior reactor analyst performed a detailed risk evaluation. The finding was preliminarily determined to be of greater than very low safety significance (greater than Green). The risk-important sequences included heavy-rain-induced losses of off-site power with the consequential failure of both emergency diesel generators. The ability to restore off-site power within four hours was important to avoid core damage. The finding was not significant to the large early release frequency. See Attachment 2, "Detailed Risk Evaluation," for a detailed review of qualitative criteria also considered.

This finding had a cross-cutting aspect in the area of human performance associated with procedure adherence because the licensee failed to ensure that individuals follow process, procedures, and work instructions (H.8). (Section 1R21.2.12.3)

**Cornerstone: Barrier Integrity**

- Green. The team identified a Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," which states in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program.

  Specifically, since January 18, 2006, the licensee has failed to evaluate the adequacy of design of the main feedwater isolation valve operators to provide adequate thrust in accordance with the licensee's analysis methodology described in EPRI topical report TR 103237-R2, "EPRI MOV Performance Prediction Program." In response to this issue, the licensee recalculated the required thrust and performed an evaluation that supported a determination that the valves remained operable. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05690.

  The team determined that the failure to evaluate the required thrust for operation of the main feedwater isolation valves, assuming an appropriate valve-disk-to-seat coefficient of friction, was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control attribute of the Barrier Integrity cornerstone and adversely affected the cornerstone objective to provide reasonable assurance that physical design barriers (containment) protect the public from radionuclide releases caused by accidents or events.

  Specifically, the incorrect coefficient of friction assumption resulted in a reasonable question of operability of the main feedwater isolation valves to operate under the design basis condition of a main steam line break while auxiliary feedwater is supplying inventory to the steam generators. In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, Exhibit 3, "Barrier Integrity Screening Questions," this finding screened as having very low safety significance (Green) because the finding did not represent an actual open pathway in the physical integrity of reactor containment and did not involve an actual reduction in function of the hydrogen igniters in reactor containment. The team determined that this finding did not have a cross-cutting aspect because the most significant contributor did not reflect current licensee performance. (Section 1R21.2.15)

- Green. The team reviewed a self-revealing Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, “Design Control,” which states, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Specifically, prior to the failure of main steam isolation valve MS-124A on January 5, 2013, the licensee failed to have an adequate weak-link evaluation for the main steam isolation valves. In response to this event, the licensee performed a seismic weak-link evaluation of the main steam isolation valves that supported a determination that the valves were operable. This finding was entered into the licensee’s corrective action program as CR-WF3-2014-05708.

  The team determined that the failure to evaluate the main steam isolation valve maximum allowed thrust, assuming appropriate values for the structural limitations of the valve and actuator, was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control attribute of the Barrier Integrity cornerstone and adversely affected the cornerstone objective to provide reasonable assurance that physical design barriers (containment) protect the public from radionuclide releases caused by accidents or events.

  Specifically, the licensee used a non-conservative value for the maximum allowed thrust, and the error resulted in a failure of main steam isolation valve MS-124A, because the allowable nitrogen pressure for the valve actuator was inappropriate. In accordance with Inspection Manual Chapter 0609, Appendix A, “The Significance Determination Process (SDP) for Findings At-Power,” issued June 19, 2012, Exhibit 3, “Barrier Integrity Screening Questions,” this finding screened as having very low safety significance (Green) because the finding did not represent an actual open pathway in the physical integrity of reactor containment and did not involve an actual reduction in function of the hydrogen igniters in reactor containment. The team determined that this finding did not have a cross-cutting aspect because the most significant contributor did not reflect current licensee performance. (Section 1R21.2.16)

## REPORT DETAILS

## 1. REACTOR SAFETY

**Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity**

This inspection of component design bases verifies that plant components are maintained within their design basis. Additionally, this inspection provides monitoring of the capability of the selected components and operator actions to perform their design basis functions. As plants age, modifications may alter or disable important design features making the design bases difficult to determine or obsolete. 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 Basis Inspection (71111.21)

.1 Overall Scope

To assess the ability of the Waterford Steam Electric Station, Unit 3, equipment, and operators to perform their required safety functions, the team inspected risk-significant components and the licensee's responses to industry operating experience. The team selected risk-significant components for review using information contained in the Waterford Steam Electric Station, Unit 3, probabilistic risk assessments and the U. S. Nuclear Regulatory Commission's (NRC) standardized plant analysis risk model. In general, the selection process focused on components that had a risk achievement worth factor greater than 1.3 or a risk reduction worth factor greater than 1.005. The items selected included components in both safety-related and nonsafety-related systems including pumps, circuit breakers, heat exchangers, transformers, and valves. The team selected the risk-significant operating experience to be inspected based on its collective past experience.

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 basis 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 selected components, 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 basis 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; Title 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 to 25 total samples that include risk-significant and low design margin components, components that affect the large-early-release-frequency (LERF), and operating experience issues. The sample selection for this inspection was 18 components, 3 components that affect LERF, 6 operating experience items, and 3 event based activities associated with the components. The selected inspection and associated operating experience items supported risk-significant functions including the following:

a. Electrical power to mitigation systems: The team selected several components in the electrical power distribution systems to verify operability to supply alternating current (ac) and direct current (dc) power to risk-significant and safety-related loads in support of safety system operation in response to initiating events such as loss of off-site power, station blackout, and a loss-of-coolant accident with off-site power available. As such the team selected:

    - 4160 Vac Class 1E switchgear, Bus 3A3
    - 480 Vac Class 1E switchgear, Bus 3B31
    - Emergency Feedwater Pump Motor EMTR-3A10A
    - Fast Bus Transfer Station Start-up Transformer 3B Breakers
    - Static Uninterruptible Power Supply B ID-EUPSB
    - Static Uninterruptible Power Supply MA ID-EUPSMA
    - Temporary Emergency Diesel Generators used during Emergency Diesel Generator Maintenance

b. Components that affect LERF: The team reviewed components required to perform functions that mitigate or prevent an unmonitored release of radiation. The team selected the following components:

    - Containment Atmosphere Purge Make-up Air Isolation Valves CAP-MVAAA-103, and -104; and Exhaust Isolation Valves CAP-MVAAA-203, and -204
    - Maintenance Hatch CB-MEAH-0001 O-Rings
    - Reactor Containment Building – Steel Containment Vessel

c. Mitigating systems needed to attain safe shutdown: The team reviewed components required to perform the safe shutdown of the plant. As such the team selected:

- Containment Coolers CCS-MAHU-0001A, B, C, and D
- Emergency Diesel Generator Day Tank and Storage Tank Vents
- Emergency Feedwater Primary Isolation Valves EFW-228A and 229A
- Essential Chiller RFR-MCHL-0001A
- Main Feedwater Isolation Valve FW-184A
- Main Steam Isolation Valve MS-124A
- Shield Building Concrete Structure
- Steam Generator Power Operated Atmospheric Dump Valve MS-116A

## .2 Results of Detailed Reviews for Components:

### .2.1 4160 Vac Class 1E Switchgear Bus 3A3

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings and calculations, maintenance and test procedures, and condition reports associated with 4160 Vac Class 1E Switchgear Bus 3A3. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Distribution system one-line diagrams.
- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.
- Calculations for electrical distribution, system load flow/voltage drop, short-circuit, and electrical protection to verify that bus capacity and voltages remained within minimum acceptable limits.
- The protective device settings and circuit breaker ratings to ensure adequate selective protection coordination of connected equipment during worst-case short circuit conditions.
- Procedures for preventive maintenance, inspection, and testing of the bus, transformer, and associated circuit breakers to compare maintenance practices against industry and vendor guidance.

- Cable sizing for selected loads.

- Evaluation of the most recent grid stability study.

- Waterford's response to NRC Information Notice 2010-26, "Submerged Electrical Cables."

b. Findings

No findings were identified.

.2.2 480 Vac Class 1E Switchgear Bus 3B31

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with 480 Vac Class 1E Switchgear Bus 3B31. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- System load flow/voltage drop and short circuit studies, under normal and design basis accident load conditions.

- Calculations for electrical distribution, system load flow/voltage drop, short-circuit, and electrical protection to verify that bus capacity and voltages remained within minimum acceptable limits.

- The protective device settings and circuit breaker ratings to ensure adequate selective protection coordination of connected equipment during worst-case short circuit conditions.

- Vendor and station single line, schematic, wiring, and layout drawings, including available short circuit current.

- Preventative maintenance, inspection, and testing procedures, including recently completed work orders.

- Cable sizing for the load center bus.

b. Findings

Introduction. The team identified a Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," for the licensee's failure to identify and correct a condition adverse to quality. Specifically, the licensee failed to identify and evaluate the impact of elevated bus voltages during the period of October 27 through December 13, 2012, and on May 1, 2014, that exceeded the allowable voltage on the 480 Vac Class 1E Bus 3B31.

Description. The team reviewed the performance indicator data for the 480 Vac Class 1E Bus 3B31 and identified instances during refueling outages 18 and 19 where the licensee exceeded the voltage limit acceptance criteria. The team noted multiple instances where the voltage limit was exceeded, but there were two instances where a condition report had not been generated and the condition had not been evaluated. The first occurred during refueling outage 18—from October 27 through December 13, 2012, the bus voltage rose above the 506 VAC limit several times with the longest period being 10 hours. The sustained voltage ranged from 508-514 VAC. The second occurred during Refueling Outage 19, on May 1, 2014, with a sustained elevated bus voltage of between 506–509 VAC for about an hour. Neither of these conditions was identified or addressed in the corrective action program until identified by the team. The lack of trending and periodically analyzing information that the licensee knows could become an issue contributed to the cross-cutting aspect.

Procedure EN-LI-102, "Corrective Action Program," Revision 24, requires that a condition report be initiated promptly for conditions adverse to quality, and that operability, functionality, and immediate reportability be reviewed for the condition. Attachment 9.2, Section 4, "Design and Licensing Basis Issues," specifically provides examples of adverse conditions as they concern design basis issues. The licensee's corrective actions included evaluating the missed events by comparing Bus 3B31 and 3A31 voltages to ensure that Bus 3A31 was within the required band of 450–506 Vac, and performing an operability determination. The licensee generated CR-WF3-2014-05458 to address this performance deficiency and to identify any trends requiring additional actions.

Analysis. The team determined that the failure to identify and evaluate the impact of elevated bus voltages was a performance deficiency. This performance deficiency was more than minor because it was associated with the equipment performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to identify and evaluate voltages on the 480 Vac Class 1E Bus 3B31 that exceeded allowable operability limits. In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," this finding screened as having very low safety significance (Green) because it was a design or qualification deficiency that did not represent a loss of operability or functionality; did not represent an actual loss of safety function of the system or train; did not result in the loss of one or more trains of non-technical specification equipment; and did not screen as potentially risk-significant due to seismic, flooding, or severe weather. This finding had a cross-cutting aspect in the area of problem identification and resolution associated with trending because the licensee failed to periodically analyze information in the aggregate to identify programmatic and common cause issues (P.4).

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," states in part, that measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance are promptly identified and corrected. Contrary to the above, the licensee failed to establish measures to assure that a condition adverse to quality was promptly identified and corrected. Specifically, during the period of October 27 through December 13, 2012, and on May 1, 2014, the licensee failed to identify and evaluate the impact of elevated bus voltages that exceeded the allowable voltage on the 480 VAC Class 1E Bus 3B31, a condition adverse to quality. In response to this issue, the licensee completed an operability determination with plans to evaluate any trends requiring additional actions. This finding was entered into the licensee's corrective action program as CR WF3 2014-05458. Because this finding was of very low safety significance and has been entered into the licensee's corrective action program, this violation is being treated as a non-cited violation consistent with Section 2.3.2.a of the NRC Enforcement Policy: NCV 05000382/2014007-01, "Failure to Identify and Evaluate Elevated Bus Voltages."

.2.3 Emergency Feedwater Pump Motor EMTR-3A10A

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with Emergency Feedwater Pump Motor EMTR-3A10A. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.
- Vendor technical information and specifications, including usage in motor loading calculations, operating, maintenance, and testing procedures.
- Emergency diesel generator loading calculations associated with the motor.
- Completed surveillance and maintenance procedures to verify adequate testing.
- Electrical schematics and control wiring diagrams to verify the automatic start features.

b. Findings

No findings were identified.

.2.4 Fast Bus Transfer Station Start-up Transformer 3B Breakers

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with Fast Bus Transfer Station Start-up Transformer 3B Breakers. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Distribution system one-line diagrams and relevant electrical schematics.
- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.
- Procedures for circuit breaker preventive maintenance, inspection, and testing to compare maintenance practices against industry and vendor guidance.
- Completed surveillance and maintenance procedures to verify adequate testing.

b. Findings

No findings were identified.

.2.5 Static Uninterruptible Power Supply B ID-EUPSB

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings and calculations, maintenance and test procedures, and condition reports associated with Static Uninterruptible Power Supply B ID-EUPSB. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- One-line diagrams and design basis documents for the inverters' electrical distribution systems to identify requirements and interfaces.
- Preventive maintenance activities to verify the inverter system was maintained in accordance with manufacturer recommendations including replacement of age-sensitive components, and corrective action program reports to verify the monitoring of potential degradation.
- Short circuit calculations, inverter sizing calculations, coordination studies, and voltage drop calculations.
- Calculations to verify that branch circuit load and load voltage requirements had been properly translated into inverter sizing and voltage drop calculations.

- Station blackout calculations to verify that the inverters' output would remain adequate to power associated instrumentation and control loads at reduced battery voltage levels.

- As part of the station blackout review, the team evaluated the adequacy of the Train B battery to supply sufficient power at the conclusion of the four hour coping cycle to energize required loads, such as the ability to flash the field of its associated emergency diesel generator.

- Procedures for circuit breaker preventive maintenance, inspection, and testing to compare maintenance practices against industry and vendor guidance.

b. Findings

No findings were identified.

.2.6 Static Uninterruptible Power Supply MA ID-EUPSMA

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings and calculations, maintenance and test procedures, and condition reports associated with Static Uninterruptible Power Supply MA ID-EUPSMA. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- One-line diagrams and design basis documents for the inverters' electrical distribution systems to identify requirements and interfaces.

- Preventive maintenance activities to verify the inverter system was maintained in accordance with manufacturer recommendations including replacement of age-sensitive components, and corrective action program reports to verify the monitoring of potential degradation.

- Short circuit calculations, inverter sizing calculations, coordination studies, and voltage drop calculations.

- Calculations to verify that branch circuit load and load voltage requirements had been properly translated into inverter sizing and voltage drop calculations.

- Procedures for circuit breaker preventive maintenance, inspection, and testing to compare maintenance practices against industry and vendor guidance.

b. Findings

No findings were identified.

.2.7 <u>Temporary Emergency Diesel Generators used During Emergency Diesel Generator Maintenance</u>

a. <u>Inspection Scope</u>

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with the temporary emergency diesel generators used during emergency diesel generator maintenance. The team also conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Procedures for operations and maintenance
- Vendor manual and specifications
- Schematics and control wiring diagrams
- Load calculations of record and supporting documentation
- Coordination study and required/desired loads sizing
- Completed preventive maintenance and surveillance tests
- Corrective actions

b. <u>Findings</u>

<u>Introduction</u>. The team identified a Green finding for inadequate station procedures for the temporary emergency diesel generators. Specifically, the licensee failed to ensure that Procedures OP-TEM-008, “Emergency Diesel Generator A(B) Backup Temporary Diesel Generators,” Revision 7, and ME-001-012, “Temporary Power from Temporary Diesel for 3A2 and 3B2 4kV Buses (MODES 1-6),” Revision 308, were maintained and updated to ensure that the temporary diesels had enough capacity to supply auxiliary power to the required safe-shutdown loads.

<u>Description</u>. The team reviewed the loading requirements and procedures associated with the temporary emergency diesel generators. The purpose of the temporary diesels is to provide the licensee with flexibility in the performance of both corrective and preventative maintenance during power operation. The availability of the temporary diesels allows the site to extend the Technical Specification 3.8.1 allowed outage time from 72 hours to 10 days as approved in the safety evaluation related to License Amendment 166. The temporary diesels are commercial-grade diesels capable of supplying auxiliary power to, at a minimum, required safe-shutdown load on the emergency diesel generator train that was removed from service for maintenance.

During the review, the team identified that Procedures OP-TEM-008 and ME-001-012 had not been maintained and updated prior to the performance of the emergency diesel generator outage in January 2014, nor in a timely manner. The most current engineering evaluation EC-47496, “Capability of TEDG to Start Large Motor,” approved on December 19, 2013, recommended three temporary diesels connected in parallel with 70 percent average load factor and prime power ratings, and that changes be made to the vendor contract and applicable procedures. The licensee noted that two diesels connected in parallel could support the loads, but recommended that three diesels be used to increase operation margin.

The engineering evaluation also described the capability of the temporary diesel running load based on mode of operation and that they can be classified as continuous, prime, or standby. The team found that the licensee never clearly established appropriate instructions to ensure that the operators would be running and verifying the loads according to the prime rating, that three temporary diesels were capable of operating/connecting in parallel, and that the required and desired loads were consistent between procedures and evaluations. The procedure owner identified that a revision was required, but did not make any changes or inform other organizations about the necessary updates. This contributed to the cross-cutting aspect.

The licensee's corrective actions included evaluating the inconsistencies in the procedures, evaluations, and contracts. As a result, the licensee generated condition report CR-WF3-2014-05662 to update ME-001-012 to specify 2500kW prime loading, update OP-TEM-008 to specify prime loading limitations, and update just-in-time training material, and condition report CR-WF3-2014-05582 to address the vendor contract and adverse weather concerns.

Analysis. The licensee's failure to include in station procedures the requirements that ensure the temporary diesels have enough capacity to supply auxiliary power to the required safe-shutdown loads was a performance deficiency. This performance deficiency was more than minor because it was associated with the equipment performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to update Procedures OP-TEM-008, "Emergency Diesel Generator A(B) Backup Temporary Diesel Generators," Revision 7, and ME-001-012, "Temporary Power from Temporary Diesel for 3A2 and 3B2 4kV Buses (MODES 1-6)," Revision 308, and vendor documents in accordance with engineering evaluation EC-47496, prior to the performance of the emergency diesel generator outage in January 2014, and in a timely manner. In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," this finding screened as having very low safety significance (Green) because it was a design or qualification deficiency that did not represent a loss of operability or functionality; did not represent an actual loss of safety function of the system or train; did not result in the loss of one or more trains of non-technical specification equipment; and did not screen as potentially risk-significant due to seismic, flooding, or severe weather. This finding had a cross-cutting aspect in the area of human performance associated with teamwork because the licensee failed to ensure that individuals and work groups communicate and coordinate their activities within and across organizational boundaries to ensure nuclear safety is maintained (H.4).

Enforcement. This finding does not involve enforcement action because no violation of a regulatory requirement was identified. In response to this issue, the licensee evaluated and updated station procedures, specified prime loading limitations, updated vendor contracts, incorporated procedure improvements as a result of training, and updated the adverse weather procedure. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05662 and CR-WF3-2014-05582. Because this finding does not involve a violation and was of very low safety significance, it is identified as FIN 05000382/2014007-02, "Inadequate Station Procedures for Temporary Emergency Diesel Generator."

.2.8 Containment Atmosphere Purge Make-up Air Isolation Valves CAP-MVAAA-103 and -104, and Exhaust Isolation Valves CAP-MVAAA-203, and -204

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, seismic weak link analysis, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with Containment Atmosphere Purge Make-up Air Isolation Valves CAP-MVAAA-103 and -104, and Exhaust Isolation Valves CAP-MVAAA-203 and -204. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Calculation EC-M97-041, Design Basis Review for Containment Purge Isolation Valves CAP-102, CAP-103, CAP-104, CAP-203, CAP-204, and CAP-205.

- Weak link analyses for the containment purge isolation valves.

- Local leak rate testing procedure and results of recent testing performed to meet the requirements of 10 CFR Part 50, Appendix J.

b. Findings

No findings were identified.

.2.9 Maintenance Hatch CB-MEAH-0001 O-Rings

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with the Maintenance Hatch CB-MEAH-0001 O-Rings. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Detailed vendor drawings of the maintenance hatch and seals.

- Previous two work orders for inspection, cleaning, and buffing of the maintenance hatch seal seating surfaces.

- Containment leak-rate testing program and the past two containment integrated leak-rate tests.

- Quarterly inservice test results for the maintenance hatch seals.

b. Findings

No findings were identified.

.2.10 Reactor Containment Building – Steel Containment Vessel

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with the reactor containment building, the steel containment vessel. The team conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Nuclear island and building design associated with the reactor containment building.

- Maintenance rule structural monitoring, scoping, and basis.

- Containment in-service inspection and testing program.

- Containment isolation and leakage rate testing.

- Reactor containment surface inspection layout for the inside and outside surfaces.

- Past two ASME Section XI visual inspection reports.

- Waterford's response to NRC Information Notice 2004-09, "Corrosion of Steel Containment and Containment Liner."

b. Findings

No findings were identified.

.2.11 Containment Coolers CCS-MAHU-0001A, B, C, and D

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with Containment Coolers CCS-MAHU-0001A, B, C, and D. The team also conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Design calculations for maximum reactor containment building temperature and pressure.

- Detailed plant drawings, purchase specifications, and operating, preventative maintenance and testing procedures.

- Control room indications for containment cooler operation and performance during normal and accident conditions.

- Waterford's response to NRC Information Notice 1996-45, "Potential Common-Mode Post-Accident Failure of Containment Coolers."

b. Findings

No findings were identified.

.2.12 Emergency Diesel Generator Day Tank and Storage Tank Vents

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with the emergency diesel generator day and storage tank vents. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Design basis adverse weather protection requirements.

- Normal and alternate diesel fuel oil fill procedures, including during site area flooding.

- Detailed plant drawings and operating, preventative maintenance, and testing procedures.

b. Findings

.1 Failure to Generate a Condition Report or to Evaluate Emergency Diesel Generator Storage Tank Operability in a Timely Manner

Introduction. The team identified a Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," for the licensee's failure to identify and correct a condition adverse to quality. Specifically, the licensee failed to initiate a condition report for a nonconformance on the emergency diesel generator A and B storage tank vents, a condition adverse to quality, for 8 days.

Description. On October 8, 2014, during a plant walkdown the team identified that the emergency diesel generator A and B storage tank vents were outside the nuclear island plant structure and were not missile protected. The team shared this concern with the licensee and expected that a condition report and subsequent operability determination would be performed to address the apparent nonconforming condition.

On October 16, 2014, the team had still not been given a condition report that addressed the lack of missile protection. Upon questioning the licensee on the delay of the condition report, licensee personnel realized that they had still not generated a condition report. Procedure EN-LI-102, "Corrective Action Program," Revision 24, requires for conditions adverse to quality that a condition report be initiated promptly/timely, and that operability, functionality, and immediate reportability determinations be reviewed for the event. Attachment 9.2, Section 4, "Design and Licensing Basis Issues," specifically provides examples of adverse conditions as they concern design basis issues; a nonconforming condition is a specific example cited. Because the licensee failed to timely initiate a condition report on October 8, no determination of system operability was performed for more than a week after licensee personnel became aware of the nonconforming condition.

On October 16, 2014, the licensee initiated CR-WF3-2014-05341 and performed an operability determination to address the team's concerns. Additionally the licensee generated CR-WF3-2014-05738 to document the lack of initiating and evaluating a condition report for a nonconforming condition, a condition adverse to quality, in a timely manner.

Analysis. The failure to initiate a condition report to evaluate the lack of missile protection on the emergency diesel generator A and B storage tank vents was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to initiate and evaluate a design nonconformance on the emergency diesel generator storage tank vents for missile protection for 8 days. In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," this finding screened as having very low safety significance (Green) because it was a design or qualification deficiency that did not represent a loss of operability or functionality; did not represent an actual loss of safety function of the system or train; did not result in the loss of one or more trains of non-technical specification equipment; and did not screen as potentially risk-significant due to seismic, flooding, or severe weather. This finding had a cross-cutting aspect in the area of human performance associated with work management because the licensee failed to implement a process where nuclear safety is the overriding priority and the need for coordinating with different work groups (H.5).

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," states in part, that measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance are promptly identified and corrected. The licensee's measures are established by Procedure EN-LI-102 "Corrective Action Program," Revision 24, which requires for conditions adverse to quality that a condition report be initiated promptly/timely, and that operability, functionality, and immediate reportability be reviewed for the event. Attachment 9.2, Section 4, "Design and Licensing Basis Issues," specifically provides examples of adverse conditions as they concern design basis issues. Contrary to the above, from October 8 through October 16, 2014, the licensee failed to initiate a condition report to document and evaluate a condition adverse to quality. Specifically, the licensee failed to initiate a condition report to evaluate the lack of missile protection on the emergency diesel generator A and B storage tank vents, a nonconformance that is a condition adverse to quality, for 8 days. In response to this issue, the licensee performed an operability determination to address the team's concerns and initiated a separate condition report to document the lack of initiating and evaluating a condition report for a condition adverse to quality. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05341 and CR-WF3-2014-05738. Because this finding was of very low safety significance and was entered into the licensee's corrective action program, this violation is being treated as a non-cited violation consistent with Section 2.3.2.a of the NRC Enforcement Policy: NCV 05000382/2014007-03, "Failure to Initiate a Condition Report for a Condition Adverse to Quality."

.2 Failure to Evaluate Missile Protection Requirements for Emergency Diesel Generator Day Tank and Storage Tank Vents

Introduction. The team identified a Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to evaluate the missile protection requirements for the emergency diesel generator A and B day tank and storage tank vents.

Description. On October 8, 2014, the team identified during a plant walk-down that the emergency diesel generator A and B storage tank vents were outside the nuclear island plant structure and were not missile protected. On October 22, 2014, the team questioned the missile protection of the emergency diesel generator A and B day tanks and determined that they were also not protected.

Appendix A to 10 CFR Part 50 contains the general design criteria for nuclear power plants. Specifically, Criterion 2, "Design bases for protection against natural phenomena," states, in part, "Structures, systems and components important to safety shall be designed to withstand the effects of natural phenomena such as…tornados [and] hurricanes," and, "The design bases for these structures, systems and components shall reflect: . . . (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena." Criterion 4, "Environmental and dynamic effects design bases," states, in part, "Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions," and, "These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles."

Upon reviewing the licensee's design basis documents and general responses to General Design Criteria 2 and 4, the team determined that the licensee failed to properly protect the emergency diesel generator A and B day tank and storage tank vents from weather-related missiles. These vents do not have missile protection and the licensee does not have an exemption from the missile protection requirement. The licensee initiated CR-WF3-2014-05131, CR-WF3-2014-5341, and CR-WF3-2014-5412 to determine the protection requirements and perform an immediate operability determination. The licensee determined that missile protection was required for these locations. Subsequently, the licensee performed an evaluation using the TORMIS computer simulation code that supported a determination of operability and a future licensing basis change. TORMIS is a methodology described in Electric Power Research Institute (EPRI) Technical Report NP-2005, "Tornado Missile Simulation and Design Methodology," dated August 1981, which was approved for use by Waterford in the Safety Evaluation related to License Amendment 168.

The TORMIS evaluation calculates a total probability per year of damage to all important structures, systems, and components due to a missile-generating wind event. It evaluates in the aggregate all known structures, systems, and components that are required to be missile protected and are not. This probability of damage must be less than the maximum allowed threshold provided for in the safety evaluation of $1.0 \times 10^{-6}$ per year. Waterford Unit 3's TORMIS calculation resulted in a damage probability of $7.95 \times 10^{-7}$ per year, which is below the allowable probability value. Therefore, now that the condition has been evaluated by an approved methodology and was determined to be acceptable, no missile protection is required to be installed on these vents.

Analysis. The failure to evaluate the lack of missile protection on the emergency diesel generator A and B day tank and storage tank vents was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to evaluate a design nonconformance on the emergency diesel generator A and B day tank and storage tank vents for lack of missile protection. In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," this finding screened as having very low safety significance (Green) because it was a design or qualification deficiency that did not represent a loss of operability or functionality; did not represent an actual loss of safety function of the system or train; did not result in the loss of one or more trains of non-technical specification equipment; and did not screen as potentially risk-significant due to seismic, flooding, or severe weather. The team determined that this finding did not have a cross-cutting aspect because the most significant contributor did not reflect current licensee performance.

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," states in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program" Contrary to the above, prior to November 6, 2014, the licensee did not verify the adequacy of design of the emergency diesel generator A and B day tank and storage tank vents. Specifically, the licensee failed to have missile protection installed or an approved exemption excluding missile protection requirements. In response to this issue, the licensee performed a TORMIS evaluation that supported a determination of operability, and a licensing basis change. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05131, CR-WF3-2014-5341, and CR-WF3-2014-5412. Because this finding was of very low safety significance and has been entered into the licensee's corrective action program, this violation is being treated as a non-cited violation consistent with Section 2.3.2.a of the NRC Enforcement Policy: NCV 05000382/2014007-04, "Failure to Evaluate Missile Protection Requirements for Emergency Diesel Generator Day and Storage Tank Vents."

.3 Failure to Identify and Correct Through-Wall Corrosion on Emergency Diesel Generator A and B Day Tank Vents

Introduction. The team identified an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," for the licensee's failure to identify and correct a condition adverse to quality. Specifically, the licensee failed to identify and correct through-wall corrosion on the emergency diesel generator A and B day tank vents.

Description. On October 8, 2014, the team identified during a plant walkdown that the emergency diesel generator A and B storage tank vents were outside the nuclear island plant structure and were not missile protected. On October 22, 2014, the team questioned the missile protection of the emergency diesel generator A and B day tank vents and determined that they were also not protected. The team also observed that the day tank vent pipes were significantly corroded.

Prior to discovery by the team, the licensee had not identified or evaluated the vent pipe corrosion. The team determined that the licensee failed to follow Procedure EN-LI-102, "Corrective Action Program," Revision 24, which requires for conditions adverse to quality that a condition report be initiated promptly/timely, and that operability, functionality, and immediate reportability be reviewed for the condition. Attachment 9.2, Section 4, "Design and Licensing Basis Issues," specifically provides examples of adverse conditions as they concern design basis issues; corrosion is a specific example cited.

The licensee documented the corrosion in CR-WF3-2014-05413 and determined that significant corrosion had occurred on both emergency diesel generator A and B day tank vent pipes. Both day tank vent pipes are located on the same roof approximately 9 feet apart. The corrosion was significant enough that a through-wall hole had formed at the base of each pipe where it penetrates the roof. Consequently, any water that collects on the roof of the building would have the potential to drain into the day tanks. The team also identified that a piece of foreign material was located approximately 2 feet from the roof drain, the roof coating was degraded, the roof drain scupper appeared to be inadequate for the size of the roof, and the roof slope appeared inconsistent with specifications in the construction drawings. The licensee documented these concerns in CR-WF3-2014-05529.

The licensee's immediate operability determination concluded that the emergency diesel generators were operable since there was no severe weather in the forecast for the immediate future. Other corrective actions that the licensee performed included removing the foreign material from the roof, installing a rubber wrap around the vent pipes to cover the open holes, and creating small concrete berms immediately around the vent pipes to direct water away from the vent pipes. These corrective actions addressed the team's immediate safety concerns.

Additionally, to support the prompt operability determination, the licensee contracted with multiple engineering firms to determine the magnitude of precipitation event that would need to occur to allow water to enter the vent pipe holes. This in turn could be used to determine how much water enters the emergency diesel generator day tanks and whether the emergency diesel generators would become inoperable due to excessive water content in the fuel oil. Diesel engine vendor (Cooper Bessemer) documentation specifies that the fuel oil is limited to less than 0.1 percent water/sediment content. The team used this specification as the limit for operability. At water/sediment content values above 0.1 percent the capacity of the emergency diesel generator would be de-rated by some amount, which would be variable based on multiple parameters. In these evaluations, the licensee's contractors concluded that rainfall events less severe than those described in the updated safety analysis report would likely result in water contamination of both emergency diesel generator day tanks to approximately 5-10 percent water content, significantly greater than allowed by the vendor specification.

The team determined that had system engineering been performing walkdowns as required by EN-DC-178, "System Walkdowns," Revision 7, the licensee would likely have identified the corrosion. The procedure specifically requires walking down all accessible areas of the system; it provides specific instructions for using permanently installed ladders, coordinating with other organizations, etc., to walk down accessible areas that are not normally accessed. In addition, the procedure specifically requires inspection for corrosion. The team determined that system engineering failed to follow the procedure or did not adequately implement the procedure.

Analysis. The failure to identify and correct through-wall corrosion on the emergency diesel generator A and B day tank vents was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control and equipment performance attributes of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to events to prevent undesirable consequences. Specifically, the licensee failed to identify, evaluate, and correct through-wall corrosion on the emergency diesel generator A and B day tank vents. In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," dated June 19, 2012, Exhibit 2, "Mitigating Systems Screening Questions," the finding screened to Exhibit 4, "External Events Screening Questions," because it screened as potentially risk-significant due to seismic, flooding, or severe weather. Per Exhibit 4, the finding screened to a detailed risk evaluation because if the safety functions of emergency diesel generators A and B were assumed completely lost, it would degrade two trains of a multi-train system and it would degrade one or more trains of a system that supports a risk-significant system.

A Region IV senior reactor analyst performed a detailed risk evaluation. The finding was preliminarily determined to be of greater than very low safety significance (greater than Green). The risk-important sequences included heavy-rain-induced losses of off-site power with the consequential failure of both emergency diesel generators. The ability to restore off-site power within 4 hours was important to avoid core damage. The finding was not significant to the large early release frequency. See Attachment 2, "Detailed Risk Evaluation," for a detailed review of qualitative criteria also considered.

This finding had a cross-cutting aspect in the area of human performance associated with procedure adherence because the licensee failed to ensure that individuals follow process, procedures, and work instructions (H.8).

Enforcement. The team identified an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," which states, in part, that measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance are promptly identified and corrected. The licensee's measures are established by Procedures EN-DC-178, "System Walkdowns," which requires inspection for corrosion, and EN-LI-102 "Corrective Action Program," which requires that a condition report be initiated promptly/timely for a condition adverse to quality, and that operability, functionality, and immediate reportability be reviewed. Attachment 9.2 of EN-LI-102, Section 4, "Design and Licensing Basis Issues," specifically provides examples of adverse conditions as they concern design basis issues, corrosion is a specific example cited. Contrary to the above, prior to October 22, 2014, the licensee failed to identify and correct a condition adverse to quality. Specifically, the licensee failed to identify and correct through-wall corrosion on the emergency diesel generator A and B day tank vents. In response to this issue, the licensee performed an immediate operability determination based on severe weather in the area, installed a temporary repair using a rubber wrap, and installed a small concrete berm to minimize the potential amount of water in the immediate area. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05413 and CR-WF3-2014-05529. Because this finding has been preliminarily determined to be of greater than very low safety significance (greater than Green), it will be treated as an apparent violation and tracked as: AV 05000382/2014007-05, "Failure to Identify and Correct Through Wall Corrosion on Emergency Diesel Generator A and B Day Tank Vents."

.2.13 Emergency Feedwater Primary Isolation Valves EFW-228A and 229A

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with Emergency Feedwater Primary Isolation Valves EFW-228A and -229A. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Calculation EC-M97-054, Design Basis Review for Emergency Feedwater Valves EFW-223A, EFW-223B, EFW-224A, EFW-224B, EFW-228A, EFW-228B, EFW-229A, EFW-229B.

- Documentation regarding high-energy line break analyses and assumptions for the isolation valve areas.

- Actuator nitrogen accumulator sizing evaluations.

b. Findings

No findings were identified.

.2.14 Essential Chiller RFR-MCHL-0001A

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with Essential Chiller RFR-MCHL-0001A. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Design calculations for essential chilled water cooling loads and cooling coil performance.

- Recent condition reports concerning various issues with the essential chilled water system.

- Completed work orders for the preventative maintenance and surveillance testing.

- Operability checks.

- Modifications to the essential chillers and the chilled water system.

- Margin issues and recovery plans for the chilled water outlet temperature instrument accuracy.

b. Findings

No findings were identified.

.2.15 Main Feedwater Isolation Valve FW-184A

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, seismic and design basis event loading, maintenance and test procedures, and condition reports associated with Main Feedwater Isolation Valve FW-184A. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Calculation EC-M98-003, Design Basis Review for Feedwater Isolation Valves FW-184A & B.

- Documentation regarding high-energy line break analyses and line break assumptions for the isolation valve areas.

- Weak link analyses for the main feedwater isolation valves.

- Valve closure time evaluations.

- Recent modifications to the component and supporting systems to verify the changes did not have an adverse impact on the ability of the component to perform its safety function.

- Waterford's response to NRC Information Notice 2002-26, Supplement 2, "Additional Flow-Induced Vibration Failures after a Recent Power Uprate."

b. Findings

Introduction. The team identified a Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to evaluate the thrust required to operate the main feedwater isolation valves assuming an appropriate valve-disk-to-seat coefficient of friction.

Description. The team reviewed the licensee's analysis of the main feedwater isolation valves contained in calculation EC-M98-003, "Design Basis Review for Feedwater Isolation Valves FW-184A & B," Revision 2, dated January 18, 2006. In this calculation, the licensee used the evaluation methodology presented in EPRI topical report TR-103237, "EPRI MOV Performance Prediction Program," Revision 2, to determine the design basis required thrust of valves FW-184A and FW-184B. The team questioned the basis of the licensee's assumption in the calculation for valve disk-to-seat coefficient of friction. The coefficient of friction is an input into the calculation of the valves' required thrust during design basis events. The calculated required thrust is then compared to the pneumatic/hydraulic actuator available thrust during the event to determine the valves' design margin.

In response to the team's questioning, the licensee determined the assumed values in the calculation were given in EPRI TR-103237, Table 11-1, "Friction Coefficients for Anchor/Darling Double Disk Gate Valve Model," which tabulates values of coefficient of friction depending on disk-to-seat contact stress and temperature. The licensee further determined that they used an incorrect value for the coefficient of friction for a main steam line break scenario in which the reactor is operating at low power, such as during reactor startup or shutdown, and the auxiliary feedwater system is supplying feedwater to the steam generators. The correct value for coefficient of friction during this scenario was higher than those assumed in the calculation due to elevated differential pressures and therefore contact stresses, as well as lower feedwater temperatures from the operation of the auxiliary feedwater system.

Following identification, the licensee's corrective actions included re-performing the calculation of required thrust using the correct coefficient of friction value, and reevaluating the valves' available margin during the affected scenario. The licensee determined that the valves continued to remain operable, since margin was still available, though it was reduced from approximately 21 percent to approximately 6.5 percent.

Analysis. The failure to evaluate the main feedwater isolation valve required thrust assuming an appropriate valve disk-to-seat coefficient of friction was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control attribute of the Barrier Integrity cornerstone and adversely affected the cornerstone objective to provide reasonable assurance that physical design barriers (containment) protect the public from radionuclide releases caused by accidents or events. Specifically, the incorrect coefficient of friction assumption resulted in a reasonable question of operability of the main feedwater isolation valves to operate under design basis conditions during a main steam line break when auxiliary feedwater was supplying inventory to the steam generators. In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, Exhibit 3, "Barrier Integrity Screening Questions," this finding screened as having very low safety significance (Green) because the finding did not represent an actual open pathway in the physical integrity of reactor containment and did not involve an actual reduction in function of the hydrogen igniters in reactor containment. The team determined that this finding did not have a cross-cutting aspect because the most significant contributor did not reflect current licensee performance.

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," states, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Contrary to the above, since January 18, 2006, the licensee did not verify the adequacy of design of the main feedwater isolation valves. Specifically, the licensee failed to evaluate the required thrust in accordance with the licensee's analysis methodology presented in EPRI TR-103237-R2, "EPRI MOV Performance Prediction Program." In response to this issue, the licensee recalculated the required thrust and performed an evaluation of the remaining margin on the main feedwater isolation valves that supported an immediate operability determination. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05690. Because this finding was of very low safety significance and has been entered into the licensee's corrective action program, this violation is being treated as a non-cited violation consistent with Section 2.3.2.a of the NRC Enforcement Policy: NCV 05000382/2014007-06, "Failure to Properly Evaluate Main Feedwater Isolation Valve Required Thrust."

.2.16 Main Steam Isolation Valve MS-124A

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, seismic qualification reports, maintenance and test procedures, and condition reports associated with Main Steam Isolation Valve MS-124A. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.

- Calculation EC-M98-004, Design Basis Review for Main Steam Isolation Valve MS-124A & B.

- Documentation regarding high-energy line break analyses and line break assumptions for the isolation valve areas.

- Weak link analyses for the main steam isolation valves to assess whether appropriate limits were applied to the allowable actuator setup parameters.

- Valve closure time and actuator nitrogen set-point evaluations.

- Recent modifications to the component and supporting systems to verify the changes did not have an adverse impact on the ability of the component to perform its safety function.

b. Findings

Introduction. The team reviewed a self-revealing Green non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to have an adequate seismic weak link evaluation for the main steam isolation valves.

Description. During post-maintenance testing on January 5, 2013, following a preventive maintenance activity for actuator elastomer replacement, main steam isolation valve MS-124A failed. The threads of the valve actuator's pneumatic/hydraulic piston sheared at the valve stem connection due to high differential pressure across the actuator piston. The licensee documented this failure in CR-WF3-2013-00107. The high differential pressure was caused by low initial nitrogen pressure when the valve was initially taken open. In response to the valve's failure, the licensee's corrective actions included performing a seismic weak link analysis in calculation A13068-C-001, "Weak Link Analysis of 40" x 30" x 30" CL 600 Main Steam Isolation Valve."

The team reviewed the licensee's analysis of the main steam isolation valves contained in calculation EC-M98-004, "Design Basis Review for Main Steam Isolation Valve MS-124A & B," Revision 0, dated November 14, 2000, and noted that the seismic thrust limit in the "Allowable Thrust Determination" section of the calculation was listed as "not available." Appendix A to 10 CFR Part 50 contains the general design criteria for nuclear power plants. Specifically, General Design Criterion 2, "Design bases for protection against natural phenomena," states in part, "Structures, systems and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes," and, "The design bases for these structures, systems and components shall reflect . . . (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena."

Upon review, the team determined that prior to the failure on January 5, 2013, the limits for setting up the main steam isolation valve pneumatic/hydraulic actuator parameters, including allowable nitrogen pressure, to prevent structural damage were based on an evaluation that was performed on only the valve stem. The evaluation did not evaluate all of the valve and actuator sub-components, nor did it include consideration of seismic-event-induced stresses. After the seismic weak link analysis was completed, appropriate maximum allowable thrust values for the main steam isolation valves were determined and the corresponding allowable actuator nitrogen pressure settings were updated.

Analysis. The failure to evaluate the main steam isolation valve maximum allowable thrust, assuming appropriate values for the structural limitations of the valve and actuator, was a performance deficiency. This performance deficiency was more than minor because it was associated with the design control attribute of the Barrier Integrity cornerstone and adversely affected the cornerstone objective to provide reasonable assurance that physical design barriers (containment) protect the public from radionuclide releases caused by accidents or events. Specifically, the licensee used a non-conservative value for the maximum allowed thrust, and the error resulted in the failure of main steam isolation valve MS-124A on January 5, 2013, because the allowable nitrogen pressure for the valve actuator was inappropriate. In accordance with Inspection Manual Chapter 0609, Appendix A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, Exhibit 3, "Barrier Integrity

Screening Questions," this finding screened as having very low safety significance (Green) because the finding did not represent an actual open pathway in the physical integrity of reactor containment and did not involve an actual reduction in function of the hydrogen igniters in reactor containment. The team determined that this finding did not have a cross-cutting aspect because the most significant contributor did not reflect current licensee performance.

Enforcement. Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," states, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program." Contrary to the above, prior to failure of main steam isolation valve MS-124A on January 5, 2013, the licensee did not verify or check the adequacy of its design. Specifically, the licensee failed to have an adequate seismic weak link evaluation. In response to this event, the licensee performed a seismic weak link evaluation of the main steam isolation valves that supported a determination that the valve was operable. This finding was entered into the licensee's corrective action program as CR-WF3-2014-05708. Because this finding was of very low safety significance and has been entered into the licensee's corrective action program, this violation is being treated as a non-cited violation consistent with Section 2.3.2.a of the NRC Enforcement Policy: NCV 05000382/2014007-07, "Failure to Properly Evaluate Main Steam Isolation Valve Weak Link."

.2.17 Shield Building Concrete Structure

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with the shield building concrete structure. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.
- Design calculations for the shield building.
- Nuclear Island and building design associated with the shield building.
- Maintenance rule structural monitoring, scoping, and basis.
- Procedures for preventative maintenance and inspection.
- Previous two shield building integrity inspection reports.
- Condition reports concerning the shield building concrete cracking following steam generator replacement.

- Waterford's response to NRC Information Notice 2010-20, "Concrete Degradation by Alkali-Silica Reaction."

b. Findings

No findings were identified.

.2.18 Steam Generator Power Operated Atmospheric Dump Valve MS-116A

a. Inspection Scope

The team reviewed the updated safety analysis report, system description, design basis documents, the current system health report, selected drawings, maintenance and test procedures, and condition reports associated with Steam Generator Power Operated Atmospheric Dump Valve MS-116A. The team also performed walkdowns and conducted interviews with system engineering personnel to ensure the capability of this component to perform its desired design basis function. Specifically, the team reviewed:

- Component maintenance history and corrective action program reports to verify the monitoring of potential degradation.
- Purchase specifications, purchase orders, and vendor supplied documentation verifying the valve pedigree and requirements.
- Main steam system piping isometric, detailed valve internal and pneumatic operator drawings.
- Start-up integrated test SIT-TP-707 verifying the minimum and maximum capacity of the atmospheric dump valves.
- Air-operated valve testing, maintenance, and trending program.
- Design change package for resolving valve binding during stroke testing.

b. Findings

No findings were identified.

.3 Results of Reviews for Operating Experience

.3.1 Inspection of NRC Information Notice 1996-45, "Potential Common-Mode Post-Accident Failure of Containment Coolers"

a. Inspection Scope

The team reviewed the licensee's evaluation of Information Notice 1996-45, "Common-Mode Post-Accident Failure of Containment Coolers," to verify the licensee performed an applicability review and took corrective actions, if appropriate, to address the concerns described in the information notice. This information notice discusses a potential water-hammer issue on the cooling coils of the containment fan coolers due to steam voiding of the component cooling water inside the coils.  The concerns results from post-accident conditions where high temperature containment atmosphere would be forced across the cooling coils for several seconds with no component cooling water causing the water to boil and create steam voids.  The team verified that the licensee's review adequately addressed the issues in the information notice.

b. Findings

No findings were identified.

.3.2 Inspection of NRC Information Notice 2002-26, Supplement 2, "Additional Flow-Induced Vibration Failures After a Recent Power Uprate"

a. Inspection Scope

The team reviewed the licensee's evaluation of Information Notice 2002-26, Supplement 2, "Additional Flow-Induced Vibration Failures After a Recent Power Uprate," to verify the licensee performed an applicability review and took corrective actions, if appropriate, to address the concerns described in the information notice.  This information notice discusses concerns that could result from vibration due to changing parameters following power uprate.  The team verified that the licensee's review adequately addressed the issues in the information notice.

b. Findings

No findings were identified.

.3.3 Inspection of NRC Information Notice 2004-09, "Corrosion of Steel Containment and Containment Liner"

a. Inspection Scope

The team reviewed the licensee's evaluation of Information Notice 2004-09, "Corrosion of Steel Containment and Containment Liner," to verify the licensee performed an applicability review and took corrective actions, if appropriate, to address the concerns described in the information notice.  This information notice discusses concerns that corrosion in the vicinity of the moisture barrier at the floor-to-containment junction could result in corrosion and thinning of the steel containment structure.  The team verified that the licensee's review adequately addressed the issues in the information notice.

b. Findings

No findings were identified.

.3.4 Inspection of NRC Information Notice 2010-26, "Submerged Electrical Cables"

a. Inspection Scope

The team reviewed the licensee's evaluation of Information Notice 2010-26, "Submerged Electrical Cables," to verify the licensee performed an applicability review and took corrective actions, if appropriate, to address the concerns described in the information notice. This information notice discusses electrical cable degradation and potential failures resulting from cables being submerged for extended periods of time. The team verified that the licensee's cable monitoring program adequately addressed the issues in the information notice.

b. Findings

No findings were identified.

.3.5 Inspection of NRC Information Notice 2011-20, "Concrete Degradation by Alkali-Silica Reaction"

a. Inspection Scope

The team reviewed the licensee's evaluation of Information Notice 2011-20, "Concrete Degradation by Alkali-Silica Reaction," to verify the licensee performed an applicability review and took corrective actions, if appropriate, to address the concerns described in the information notice. This information notice discusses potential degradation of mechanical properties of concrete due to Alkali-Silica reaction. The team verified that the licensee's review, as documented in CR-WF3-2012-00569, adequately addressed the issues in the information notice.

b. Findings

No findings were identified.

.3.6 Inspection of NRC Information Notice 2013-04, "Shield Building Concrete Subsurface Laminar Cracking Caused by Moisture Intrusion and Freezing"

a. Inspection Scope

The team reviewed the licensee's evaluation of Information Notice 2013-04, "Shield Building Concrete Subsurface Laminar Cracking Caused by Moisture Intrusion and Freezing," to verify that the licensee performed an applicability review and took appropriate corrective actions, if appropriate, to address the concerns described in the information notice. This information notice discusses the potential for subsurface cracking in concrete shield building structures during some winter weather conditions. The team verified that the licensee's review, as documented in CR-WF3-2012-06038 and CR-WF3-2012-07645; and calculation EC 41691, adequately addressed the issues in the information notice.

b. Findings

No findings were identified.

.4 Results of Reviews for Operator Actions

a. Inspection Scope

The team selected risk-significant components and operator actions for review using information contained in the licensee's probabilistic risk assessment. This included components and operator actions that had a risk achievement worth factor greater than two or Birnbaum value greater than $1 \times 10^{-6}$.

For the review of operator actions, the team observed operators during a simulator scenario associated with the selected components as well as observing simulated actions in the plant.

The selected operator actions were:

- Scenario: The crew was provided turnover with the plant at 100 percent rated thermal power and emergency diesel generator B out of service. One temporary emergency diesel generator was onsite and available to supply loads through Bus 22B.

  After the crew took the shift, a reactor coolant pump was tripped which resulted in a reactor trip. Within seconds of the reactor trip, a loss of off-site power occurred. Emergency Diesel Generator A started but did not load onto Bus 3A due to two failures: output voltage was out of range low requiring manual action to restore, and Tie Breaker 3-2 failed to open automatically, requiring operator action to open.

  Following completion of both operator actions, Emergency Diesel Generator A output breaker automatically closed. A non-licensed auxiliary operator was expected to be dispatched to acknowledge the emergency diesel generator A alarms resulting from degraded jacket water flow causing a Jacket Water Temperature off-normal alarm on the local annunciator panel and the A EDG Trouble alarm in the control room. After several minutes, the High Jacket Water Temperature alarmed on the local annunciator panel and the crew was expected to stop the running emergency diesel generator, placing the unit in a station blackout.

  The crew was expected to enter Procedure OP-902-005, "Station Blackout Recovery," and take appropriate actions. The crew was then expected to enter Procedure OP-TEM-008, "Emergency Diesel Generator A(B) Backup Temporary Diesel Generators (TED)," and align the temporary emergency diesel generator to supply Bus 3B from Bus 2B.

  After the crew restored power to Bus 3B from the temporary emergency diesel generator, off-site power was restored and the crew was expected to restore power to Bus 3A from off-site using Appendix 12 of Procedure OP-902-009, “Standard Appendices.”

- In-plant job performance measures included:
    - Reduce unnecessary loads during station blackout
    - Transfer emergency feedwater suction to auxiliary component cooling wet towers
    - Local manual operation of emergency feedwater flow control valve
    - Local operation of steam generator atmospheric dump valve

b. Findings

No findings were identified.

## 4. OTHER ACTIVITIES

**Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity**

### 4OA2 Problem Identification and Resolution (71152)

The team reviewed action requests associated with the selected components, operator actions and operating experience notifications. Any related findings are documented in prior sections of this report.

### 4OA6 Meetings, Including Exit

Exit Meeting Summary

On November 6, 2014, the team leader presented the inspection results to Mr. M. Chisum, Site Vice President, and other members of the licensee staff. On December 17, 2014, following additional in-office inspection, the team leader presented the updated inspection results to Mr. M. Chisum, and other members of the licensee staff. On January 12, 2015, the team leader presented the final inspection results to Mr. M. Chisum and other members of the licensee staff. The licensee acknowledged the findings during each meeting. The licensee confirmed that any proprietary information reviewed by the inspectors had been returned or destroyed; no proprietary information has been included in this report.

## SUPPLEMENTAL INFORMATION

### KEY POINTS OF CONTACT

Licensee Personnel

M. Barreto, Design Engineering, Engineer
B. Briner, Systems Engineering, Engineer
M. Chisum, Site Vice President
W. Crowley, Operations, Procedures
K. Dolese, Systems Engineering, Engineer
D. Gallodoro, Design Engineering, Engineer
R. Gilmore, Acting Engineering Director
A. Griffin, Systems Engineering, Engineer
M. Haydel, Design Engineering Manager
J. Hoss, Design Engineering, Engineer
J. Jarrell, Regulatory Assurance Manager
B. Lindsey, Operations Manager
D. Litolff, Operations, Control Room Supervisor
C. Lunk, Systems Engineering, Engineer
L. Milster, Regulatory Assurance, Licensing Engineer
N. Petit, Design Engineering Mechanical/Civil, Supervisor
S. Picard, Design Engineering, Engineer
C. Pickering, Design Engineering Programs, Supervisor
C. Pratt, Operations, Auxiliary Operator
J. Russo, Design Engineering Electrical/I&C, Supervisor
J. Signorelli, Operations Training, Superintendent
L. Smith, Systems Engineering, Engineer
M. Thigpen, Design Engineering, Engineer
R. Tran, Design Engineering, Engineer
E. Wilbur, Systems Engineering, Engineer
J. Williams, Regulatory Assurance, Specialist

### LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

| | | |
|---|---|---|
| 05000382/2014007-05 | AV | Failure to Identify and Correct Through Wall Corrosion on Emergency Diesel Generator A and B Day Tank Vents (Section 1R21.2.12.3) |

Opened and Closed

| | | |
|---|---|---|
| 05000382/2014007-01 | NCV | Failure to Identify and Evaluate Elevated Bus Voltages (Section 1R21.2.2) |
| 05000382/2014007-02 | FIN | Inadequate Station Procedures for Temporary Emergency Diesel Generator (Section 1R21.2.7) |
| 05000382/2014007-03 | NCV | Failure to Initiate a Condition Report for a Condition Adverse to Quality (Section 1R21.2.12.1) |

Opened and Closed

| | | |
|---|---|---|
| 05000382/2014007-04 | NCV | Failure to Evaluate Missile Protection Requirements for Emergency Diesel Generator Day and Storage Tank Vents (Section 1R21.2.12.2) |
| 05000382/2014007-06 | NCV | Failure to Properly Evaluate Main Feedwater Isolation Valve Required Thrust (Section 1R21.2.15) |
| 05000382/2014007-07 | NCV | Failure to Properly Evaluate Main Steam Isolation Valve Weak Link (Section 1R21.2.16) |

**LIST OF DOCUMENTS REVIEWED**

Calculations

| Number | Title | Revision/Date |
|---|---|---|
| 1-B | Containment Fan Cooler Sizing | 6 |
| 3E9-9 | Louisiana Power and Light Company Waterford unit No. 3 Containment Purge Valve Analysis | 0 |
| 5-T | Essential Chilled Water Cooling Loads & Coil Performance Determination | 5 |
| 6W12-RB-0011 | Reactor Building Design Calculation, Volume 1, Shield Structure | 2 |
| 9-C-2.2-J3 | Press Drop Thru Isolation Valves at 1500scfm Flow and 40 degree Open Valves | 0 |
| 9-C-2.2-J4 | Pressure Loss Calcs in Purge Intake Section at 20,000 scfm Flow and 52 degrees Open B/F Isolation Valves | 0 |
| 9-C-2.2-J5 | Determination of Pressure Losses in Containment Purge Make-up at Various Open Positions of B/F Valves | 0 |
| A13068-C-001 | Weak Link Analysis of 40” x 30” x 40” CL 600 Main Steam Isolation Valve | 0 |
| EBA01-49 | Main Steam and Feedwater Piping Evaluation | 0 |
| EC-8458 | Containment Fan Cooler Sizing | 6 |
| EC-43936 | Battery 3B-S “B” Train Calculation for Station Blackout | 6 |
| EC-53772 | TORMIS Analysis: Tornado Generated Missile Strike at Waterford 3 | 1 |
| EC-E89-008 | Electrical Design Criteria, Attachment I | 3 |
| EC-E89-016 | Station Blackout Response for Waterford 3 | 3 |
| EC-E91-050 | Degraded Voltage Relay Setpoint & Plant Load Study | 6 |
| EC-E91-056 | Relay Settings & Coordination Curves for 6.9 & 4.16KV and 480 Buses | 3 |

Calculations

| Number | Title | Revision/Date |
|---|---|---|
| EC-E91-059 | Battery 3B-S “B” Train Calculation for Station Blackout | 6 |
| EC-E91-177 | Load Study for PDP-391-SB | 6 |
| EC-E91-181 | Load Study for PDP-391-3MA-S | 5 |
| EC-E91-182 | Load Study for PDP-391-3MB-S | 3 |
| EC-E91-183 | Load Study for PDP-391-3MD-S | 5 |
| EC-M00-006 | Closure Time Analysis for Main Feedwater Isolation Valves FW-184A & B | 1 |
| EC-M00-009 | Closure Time Analysis for Main Steam Isolation Valves MS-124A & B | 1 |
| EC-M01-001 | Seismic and Weak Link Analysis for Feedwater Isolation Valves | 0 |
| ECM13-001 | MSIV Area Flooding Analysis | 0 |
| EC-M89-002 | Nitrogen Accumulator Leak Rate Calculation | 3 |
| EC-M-89047 | MSIV Actuator Design Pressure Calculation | 0 |
| EC-M94-006 | DC-3420 MSIV Operator Packing Retainer Enhancement | 0 |
| EC-M97-041 | Design Basis Review for Containment Purge Isolation Valves CAP-102, CAP-103, CAP-104, CAP-203, CAP-204, and CAP-205 | 0 |
| EC-M97-054 | Design Basis Review for Emergency Feedwater Valves EFW-223A, EFW-223B, EFW-224A, EFW-224B, EFW-228A, EFW-228B, EFW-229A, EFW-229B | 0 |
| ECM98-003 | Design Basis Review for Feedwater Isolation Valves FW 184A & B | 2 |
| ECM98-004 | Design Basis Review for Main Steam Isolation Valve | 1 |
| EC-S96-015 | Containment Cooler Performance Analysis | 0, C |
| EC-WF3-43396 | Clarifications Regarding the Importance of Nitrogen Dome Pressure and Piston Thread Dimensions to Prevent MSIV Damage When Opening CR-WF3-2013-107 | March 27, 2013 |
| MNQ3-5 | Flooding Analysis Outside Containment | 4 |

Condition Reports (WF3)

| | | | | |
|---|---|---|---|---|
| 1998-00184 | 2011-06852 | 2012-07645 | 2013-04565 | 2014-05173 |
| 2000-00117 | 2011-06870 | 2013-00090 | 2013-04670 | 2014-05374 |
| 2000-00159 | 2012-00569 | 2013-00107 | 2013-05190 | 2014-05392 |

| | | | | |
|---|---|---|---|---|
| 2003-02439 | 2012-01157 | 2013-00295 | 2014-00095 | 2014-05385 |
| 2003-02846 | 2012-02079 | 2013-00445 | 2014-00543 | 2014-05390 |
| 2007-01683 | 2012-02876 | 2013-00627 | 2014-01208 | 2014-5407 |
| 2009-06422 | 2012-04069 | 2013-01811 | 2014-02960 | 2014-5670 |
| 2011-02005 | 2012-04229 | 2013-02498 | 2014-03046 | |
| 2011-02054 | 2012-05836 | 2013-03082 | 2014-03756 | |
| 2011-02522 | 2012-06038 | 2013-04433 | 2014-03813 | |
| 2011-06832 | 2012-06308 | 2013-04523 | 2014-04930 | |

Condition Reports (WF3) Generated during the Inspection

| | | | | |
|---|---|---|---|---|
| 2014-5162 | 2014-5375 | 2014-5414 | 2014-5446 | 2014-5662 |
| 2014-5173 | 2014-5377 | 2014-5417 | 2014-5448 | 2014-5670 |
| 2014-5175 | 2014-5384 | 2014-5419 | 2014-5450 | 2014-5690 |
| 2014-5212 | 2014-5385 | 2014-5420 | 2014-5452 | 2014-5704 |
| 2014-5213 | 2014-5388 | 2014-5421 | 2014-5458 | 2014-5708 |
| 2014-5224 | 2014-5390 | 2014-5422 | 2014-5497 | 2014-5714 |
| 2014-5304 | 2014-5392 | 2014-5423 | 2014-5520 | 2014-5720 |
| 2014-5341 | 2014-5407 | 2014-5429 | 2014-5529 | 2014-5725 |
| 2014-5343 | 2014-5412 | 2014-5441 | 2014-5582 | 2014-5730 |
| 2014-5374 | 2014-5413 | 2014-5445 | 2014-5584 | 2014-5732 |

Drawings

| Number | Title | Revision/Date |
|---|---|---|
| 1564-3363 | 48 in 150 lb Butterfly V SC 2 Bettis OPR HVAC | 11 |
| 1564-3707 | Main Steam isolation Valve | 19 |
| 1564-3707, Sh. 2 | Main Steam isolation Valve MS-124A Additional Details | 0 |
| 1564-7303 | Emergency Feedwater Pump Motor Ratings | 1 |
| 1564-7434 | 6.9 KV Switchgear 3A1 Connection Diagram | 3 |
| 1564-7557 | 6.9 KV Switchgear 3A Elementary Diagram | 0 |
| 1564-8887 | A/D Hydraulic Actuator Schematic | 10 |
| 4305-8331 | Main Steam ADV Discharge Piping Isometric | 7 |
| 5817-232 | Atmospheric Dump Valves PCV-MS-303 A&B Outline | 10 |
| 5817-423 | Atmospheric Vent Body Assembly PCV-MS-303 A&B | 6 |

Drawings

| Number | Title | Revision/Date |
|---|---|---|
| 5817-523, Sh. 1 | 20 Inch Isolation Valve W/A 2FW-V823A & 2FW-824B | 12 |
| 5817-828 | BM & Data Sheet for PCV-MS-0303 A&B Sheets and Cover | January 22, 1982 |
| 5817-3571 | Control VA Tag 2FW-V847B -8B -9A- 50B | 0 |
| 5817-3744 | 4 in Control Valve 2FWV847B, 848A, 849A, 850B | 1 |
| 5817-9444 | Protec Control Schematic | 2 |
| 20-105404, Sh. 1 | 20KVA Static Inverter Schematic | E |
| 20-105404, Sh. 2 | 20KVA Static Inverter Schematic | E |
| 20-105404, Sh. 3 | 20KVA Static Inverter Schematic | E |
| 20-105405 | 20KVA Static Inverter Static Switch | C |
| 20-105406 | 20KVA Static Inverter Regulated Rectifier | E |
| 20-105407 | 20KVA Static Inverter Isolimiter | C |
| B288, Sh. 4 | Cable and Conduit List Installation Notes Conduit Installation Notes and Underground Concrete Encased Cndts | 18 |
| B288, Sh. 34 | Low and Medium Voltage Splices | 12 |
| B289, Sh.15A | 4.16 KV Switchgear 3A3-S Protective Relay Settings | 9 |
| B289, Sh. 16 | Power Distribution and Motor Data 4.16 Swgr. 3B3-S | 12 |
| B289, Sh. 21 | Power Distribution and Motor Data 480V Swgr. 3B31-S | 19 |
| B289, Sh. 16 | 4.16 Swgr. 3B3-S Power Distribution & Motor Data | 12 |
| B289, Sh. 21 | 480V Swgr. 3B31-S Power Distribution & Motor Data | 19 |
| B289, Sh. 21-1 | 480V Swgr. 3B31-S Power Distribution & Motor Data | 4 |
| B289, Sh. 109 | 125 VDC Distribution Panel 3B-DC-S | 16 |
| B289, Sh. 109A | 125 VDC Distribution Panel 3B-DC-S | 14 |
| B289, Sh. 143 | 120V Distribution Panel 3MA-S | 12 |
| B289, Sh. 145 | 120V Distribution Panel 3MAG-S | 8 |
| B289, Sh. 147 | 120V Distribution Panel 390-SA | 13 |
| B289, Sh. 147A | 120V Distribution Panel 390-SA | 12 |
| B424 | Station Service Transformer 3B22 Feeder | 8 |
| B424, Sh. 1045 | Control Wiring Diagram Water Chiller Compressor | 20 |
| B424, Sh. 1531 | Control Wiring Diagram EFW Pump A | 13 |
| B424, Sh. E1531 | Control Wiring Diagram EFW Pump A | 6 |

Drawings

| Number | Title | Revision/Date |
|---|---|---|
| B424, Sh. 1532 | Control Wiring Diagram EFW Pump A | 12 |
| B424, Sh. 2201 | Generator Lockout Relay 86G1 | 17 |
| B424, Sh. 2205 | Generator Lockout Relay 86G2 | 18 |
| B424, Sh. 2231 | Control Wiring Diagram Auxiliary Transfer 3B to Bus 3A1 Circuit Breaker | 20 |
| B424, Sh.2233 | Aux. Transformer 3A to Bus 3A2 Circuit Breaker | 22 |
| B424, Sh. 2237 | Aux. Transformer 3B to Bus 3B2 Circuit Breaker | 19 |
| B424, Sh. 2255 | Startup Transformer Lockout Relay | 16 |
| B424, Sh. 2256 | Startup Transformer to Bus 3B1 Circuit Breaker | 21 |
| B424, Sh. 2269 | Control Wiring Diagram Bus 3A1 | 10 |
| B424, Sh. 2343 | Sequencer A Sheet 3 | 12 |
| G151, Sh. 1 | Flow Diagram Main and Extractions Steam | 38, 45 |
| G151, Sh. 2 | Flow Diagram Main and Extraction Steam System | 38 |
| G151, Sh. 3 | Flow Diagram Main and Extraction Steam System | 32 |
| G151, Sh. 4 | Flow Diagram Main and Extraction Steam System | 7 |
| G152, Sh. 5 | Flow Diagram- Instrument Air Sys. Reactor Aux. Bldg. El 21.00’ & Up | 21 |
| G153, Sh. 1 | Flow Diagram Feedwater, Condensate, and Air Evacuation Systems | 40 |
| G153, Sh. 2 | Flow Diagram Feedwater, Condensate, and Air Evacuation Systems | 31 |
| G153, Sh. 3 | Flow Diagram Feedwater, Condensate, and Air Evacuation Systems | 42 |
| G153, Sh. 4 | Flow Diagram Feedwater, Condensate, and Air Evacuation Systems | 46 |
| G164, Sh. 1 | Flow Diagram Miscellaneous Reactor Auxiliary Systems | 45 |
| G166, Sh. 2 | Flow Diagram- N2, H2, CO2 Systems | 18 |
| G286 | Key Auxiliary One Line Diagram | 17 |
| G287, Sh. 1 | 125VDC and 120VAC One Line Diagram | 21 |
| G287, Sh. 2 | 125VDC and 120VAC One Line Diagram | 3 |
| G289 | Key Auxiliary One Line Diagram | 17 |
| G428 S05 | Reactor Building Instrument Location Arrangement | 13 |

Drawings

| Number | Title | Revision/Date |
|---|---|---|
| G428 S06 | Reactor Building Instrument Location Arrangement | 11 |
| G428 S07 | Reactor Building Instrument Location Arrangement | 16 |
| G428 S08 | Reactor Building Instrument Location Arrangement | 11 |
| G853, Sh. 1 | HVAC Chilled Water Flow Diagram | 21 |
| G853, Sh. 8 | Aux. Air Handling Units | 2 |
| G853 S01 | HVAC Air Flow Diagram Reactor Containment Building | 23 |
| G853 S04 | HVAC Chilled Water Flow Diagram Sh-2 | 16 |
| G853 S05 | HVAC Chilled Water Flow Diagram Sh-3 | 15 |
| G853 S06 | HVAC Chilled Water Flow Diagram Sh-4 | 20 |
| G889 | Roof Plan Plumbing & Drainage | 8 |
| IWE-11 | Reactor Containment Surface Inspection Layout Inside Surface | 0 |
| IWE-12 | Reactor Containment Surface Inspection Layout Outside Surface | 0 |
| IWE-13 | ASME Containment Location of Moisture Barrier Segments | 0 |

Design Basis Documents

| Number | Title | Revision |
|---|---|---|
| EN-DC-346 | Cable Reliability Program | 6 |
| W3-DBD-003 | Emergency Feedwater System | 301 |
| W3-DBD-005 | Containment Gas Control and Measurement System | 2 |
| W3-DBD-006 | Main Steam System | 301 |
| W3-DBD-008 | Electrical Distribution (DC Portion) | 1 |
| W3-DBD-010 | Containment Cooling HVAC and Related Systems | 2 |
| W3-DBD-011 | Electrical Distribution (AC Portion) | 1 |
| W3-DBD-014 | Safety Related, Air Operated Valves | 302 |
| W3-DBD-020 | Feedwater System | 1-12 |
| W3-DBD-026 | Containment Isolation and Leakage Rate Testing | 9 |
| W3-DBD-027 | Nuclear Island and Building Design – Reactor Containment Building | 301 |
| W3-DBD-028 | Nuclear Island and Building Design – Shield Building | 2-4 |
| W3-DBD-037 | Essential Chilled Water System | 1 |

Design Change Packages

| Number | Title | Revision/Date |
|---|---|---|
| EC-13262 | Potter & Brumfield MDR Relay Replacement | 0 |
| EC-32193 | Containment Spray Pump Design Flow Testing Uncertainty Consideration | 0 |
| EC-32908 | Modify the Main Feedwater Isolation Valves M and M1 4 Way Valves. CR-WF3-2011-2005 | 0 |
| EC-33918 | Revise MNQ6-41 to Account for Upper Design Basis Containment Spray Flow Rate Limit CR-WF3-2011-6859 | 0 |
| EC-35562 | ESFAS Relay Replacement | 0 |
| EC-38553 | Containment Spray Pumps Design Basis Acceptance Criteria CR-WF3-2011-06852 and CR-WF3-2011-06956 | 0 |
| EC-40281 | Ebasco Specification Containment Fan Coolers | 8 |
| EC-42312 | Provide Vibration Dampener to Dampen Vibration on Valve EFW 227A | 0 |
| EC-42642 | Essential Chiller Sequential Start Bypass Relay | 0 |
| EC-42944 | Provide Vibration Dampening for FW-184A Actuator Air Control Valve | 0 |
| EC-45678 | Provide Permanent Vibration Support for Pneumatic/Hydraulic Pump located Inside FW-184A Actuator Shroud | 0 |
| EC-45995 | MSIV #2 (MS-124B) Bonnet Vent Plug Leak Repair | 0 |
| EC-46411 | Nitrogen Supply to MSIV / MFIV Valve Actuators | 0 |
| EC-46914 | Remove Abandoned Pr. Gauges and Nitrogen Lines from FW184A to Facilitate Repair of Accumulator Leak | 0 |
| EC-47496 | CR-WF3-2013-04565 – Capability of TEDG to Start Large Motor Identified in OP-TEM-008 | October 28, 2013 |
| EC-47971 | Off-site Grid Reliability Study | December 4, 2013 |
| EC-51160 | Atmospheric Dump Valve Binding During Closing Stroke | 0 |
| ER-W3-01-0096-00-00 | Evaluation of Temporary Emergency Diesel (TED) at Power Ops condition | January 29, 2001 |
| ER-W3-95-0955 | Use of Butt (In-Line) Splices | August 5, 1998 |
| ER-W3-2002-0460 | Appropriate Vendor Drawings for EDG | 0 |

Design Change Packages

| Number | Title | Revision/Date |
|---|---|---|
| ER-W3-2003-0662-000 | Evaluate the impact of elevated bus voltages during refueling outages and establish the allowable voltages | 0 |
| ER-W3-2003-0662-001 | Revise DBD-011 to be consistent with Design Information in ER-W3-2003-0662-000 | 0 |
| ER-W3-2004-0331 | Containment Fan Cooler Sizing | 6 |

Miscellaneous

| Number | Title | Revision/Date |
|---|---|---|
| | Louisiana Power and Light Company Waterford SES Unit #3, Response to NUREG-0588 | 1 |
| | Maintenance Rule Table for Waterford 3 S.E.S | October 23, 2014 |
| | Margin Issue #200 CHW (Chilled Water) Outlet Temperature Instrument Accuracy | October 14, 2014 |
| 00-00100 | Waterford Steam Electric Station, Unit 3 – Issuance of Amendment Re: Emergency Diesel Generator Allowed Outage Time Increase (TAC NO. MA6176) | July 21, 2000 |
| 00-00123 | Waterford Steam Electric Station, Unit 3 – Correction to Amendment No.166 Re: Emergency Diesel Generator Allowed Outage Time Increase (TAC NO. MA6176) | October 4, 2000 |
| 1564.109a | Butterfly Valves | 21 |
| 1564.110a | Control Valves and Accessories and Line Service Solenoid Valves Safety Class 1, 2, 3 and Nonnuclear Safety Class | 16 |
| AOVDR AOV ID: 228A | Emergency Feedwater Hdr A to SG1 Primary Isolation Valve | 1 |
| AOVDR AOV ID: 229A | Emergency Feedwater Hdr A to SG1 Backup Isolation Valve | 1 |
| C-CE-2414 | Minutes of CE – Ebasco Meeting of July 22 and 23, 1975 | August 7, 1975 |
| C-CE-2559 | CCW Requirement for Equipment in CE's Scope | October 9, 1975 |
| CFG-40B-10 | Revised Torque Equation in Closed Position for Series 9200 and 9280 BFV's with Adjustable Elastomer T-Rings | January 1973 |
| ECR-32184 | Aluminum to Copper Electrical Connections | October 5, 2011 |
| EPRI TR-103237 | EPRI MOV Performance Prediction Program | 2 |

Miscellaneous

| Number | Title | Revision/Date |
|---|---|---|
| EPRI TR-107322 | Air-Operated Valve Evaluation Guide | May 1999 |
| ER-W3-2003-0289-000 | New IST Reference Values needed for various valves | October 31, 2003 |
| FIST 3-3 | Electrical Connections for Power Circuits | November 1991 |
| IPS 379.1 | Addendum to Qualification Report for Containment Penetration Assemblies (Conax) | C |
| IVS-83-26 | Containment Purge Valve Operability Review of Fisher Analysis Addendum 2 | July 26, 1983 |
| LO-WLO-2002-00156 | Assessment Report Maintenance Rule Assessment | January 20, 2003 |
| LO-WLO-2013-00128 | Design Engineering CDBI Pre NRC Inspection Assessment | July 29, 2014 |
| LOU 1564.108 | Specification EBASCO Main Steam Isolation Valves Nuclear- Safety Class 2 | 11 |
| LOU 1564.110A | Louisiana Power and Light Company Waterford SES Unit No. 3 1165MW Installation Control Valves and Accessories | 4 |
| LOU 1564.714 | Ebasco Control Valves and Accessories Specification | 9 |
| LOU 1564.765 | Ebasco Specification Containment Fan Coolers | 8 |
| LPL-EQA-04.01 | Environmental Qualification Assessment for Reliance Containment Cooling Fan Motors | 5 |
| LPL-EQA-04.01A | Environmental Qualification Assessment for Reliance Containment Cooling Fan Motors with EPRI RW74038 HML Insulation System | 0 |
| NCR W3-339 | Conduit 32336C-SA | July 8, 1980 |
| NUREG-0787 | Safety Evaluation Report related to the operation of Waterford Steam Electric Station, Unit No. 3 | July 1981 |
| NUREG-0787, Supplement 6 | Safety Evaluation Report related to the operation of Waterford Steam Electric Station, Unit No. 3 | June 1984 |
| OE-NOE-2004-00031 | IN-02-026 S2 Additional Flow-Induced Vibration Failures After A Recent Power Uprate | January 27, 2004 |
| SD-480 | 480 VAC Distribution | 4 |
| SD-4KV | Electrical Distribution | 6 |
| SD-EFW | Emergency Feedwater | 12 |
| SD-ID | Inverters and Distribution | 6 |

Miscellaneous

| Number | Title | Revision/Date |
|---|---|---|
| SEG – CDBI | Simulator Exercise Guide – CDBI | |
| SwRI Project No. 18.180856.14.404 | Examination of a Failed Nitrogen Tube Fitting | December 2013 |
| W3-NAO-EFW-EMERG-7 | Transfer EFW Suction to ACC Wet Towers | |
| W3-NAO-EFW-EMERG-8 | Local Manual Operation of an EFW Flow Control Valve | |
| W3-NAO-MS-OFFNORM-8 | Atmospheric Dump Valve Local Operation | |
| W3F1-99-0022 | Technical Specification Change Request NPF-38-220 Emergency Diesel Generator Allowed Outage Time Increase | July 29, 1999 |
| W3F1-99-0135 | Correction for Technical Specification Change Requests NPF-38-220, Emergency Diesel Generator Allowed Outage Time Increase, and NPF-38-221, Containment Spray Allowed Outage Time Increase | August 24, 1999 |
| W3F1-2000-0006 | Request for Additional Information Technical Specification Change Request NPF-38-220 Emergency Diesel Generator Allowed Outage Time Increase | January 27, 2000 |
| W3F1-2000-0065 | Technical Specification Change Request NPF-38-220 Supplement to Emergency Diesel Generator Allowed Outage Time Increase | May 22, 2000 |
| W3F1-2000-0077 | Technical Specification Change Request NPF-38-220 Supplemental Information to Emergency Diesel Generator Allowed Outage Time Increase | May 31, 2000 |
| WHO-AOR-144MISC | NAO Miscellaneous Tasks | 0 |
| WLP-AOR-144MISC | NAO Miscellaneous Tasks (in plant) | 0 |

Procedures

| Number | Title | Revision/Date |
|---|---|---|
| CEP-APJ-001 | Primary Containment Leakage Rate Testing (10 CFR-50 Appendix J) Program Plan | 2 |
| CEP-CII-002 | Waterford 3 – Containment Inservice Inspection (CII) Program | 3 |
| CEP-CII-003 | General Visual Examination of Class MC Components | 304 |

Procedures

| Number | Title | Revision/Date |
|---|---|---|
| CEP-CII-004 | General and Detailed Visual Examination of Concrete Containments | 306 |
| CIV-A-002 | Maintenance Rule Structural Monitoring | 2 |
| EN-AD-101 | Procedure Process | 21 |
| EN-DC-126 | Engineering Calculation Process | 5 |
| EN-DC-140 | Air Operated Valve Program | 5 |
| EN-DC-141 | Design Inputs | 15 |
| EN-DC-150 | Condition Monitoring of Maintenance Rule Structures | 6 |
| EN-DC-178 | System Walkdowns | 7 |
| EN-DC-195 | Margin Management | 7 |
| EN-DC-196 | AOV Setpoint Control, Signature Analysis, and Trending Evaluation | 1 |
| EN-DC-203 | Maintenance Rule Program | 2 |
| EN-DC-204 | Maintenance Rule Scope and Basis | 3 |
| EN-DC-205 | Maintenance Rule Monitoring | 5 |
| EN-DC-210 | Environmental Qualification Maser List Control | 2 |
| EN-DC-302 | Engineering Methodologies for Design Basis Review (DBR) of Air Operated Valves (AOV) | 1 |
| EN-LI-102 | Corrective Action Program | 24 |
| EN-OP-104 | Operability Determination Process | 7 |
| EN-OP-115 | Conduct of Operations | 15 |
| EN-OP-115-01 | Operator Rounds | 0 |
| EN-TQ-112 | Non-Licensed Operator Training Program Description | 8 |
| EN-TQ-114 | Licensed Operator Requalification Training Program Description | 9 |
| EP-001-001 | Recognition and Classification of Emergency Conditions | 30 |
| ME-001-012 | Temporary Power from Temporary Diesel for 3A2 and 3B2 4kV Buses (MODES 1-6) | 308 |
| ME-003-327 | 4.16KV GE Magne-Blast Circuit Breaker Maintenance | 12, 17 |
| ME-003-330 | 480 Volt G.E. Switchgear Breakers | 308 |
| ME-004-021 | Emergency Diesel Generator | 22 |
| ME-004-085 | Station Service Transformer | 7 |

Procedures

| Number | Title | Revision/Date |
|---|---|---|
| ME-004-115 | 4.16 & 6.9 KV Magne-Blast Circuit Breaker Overhaul | 3 |
| ME-004-121 | 4.16 KV Switchgear Maintenance | 15 |
| ME-004-141 | Low Voltage Switchgear | 302 |
| ME-004-142 | 480 V G.E. Switchgear AKR Breaker Overhaul | 3 |
| ME-004-143 | 480 VAC G.E. Type AK-4A-100 Switchgear Breaker | 7 |
| ME-004-151 | 480-VAC Motor-Control Center (MCC) | 304 |
| ME-004-201 | Station Battery and Charger Maintenance | 18 |
| ME-004-231 | Station Battery Charging | 22 |
| ME-013-016 | Inverter Capacitor Replacement | 9 |
| MEAH0001 | Inspect, Clean & Buff Seating Surface (Maintenance Hatch) | December 29, 2012, August 15, 2014 |
| MM-008-001 | (Inside) Maintenance Access Hatch and (Outside) Maintenance Hatch Shield Door | 11 |
| MSPE-I-004 | AOV Design Basis Review Guideline | 0 |
| OI-038-000 | Emergency Operating Procedures Operations Expectations/Guidance | 8 |
| OI-042-000 | Watch Station Processes | 33 |
| OP-002-004 | Chilled Water System | 311 |
| OP-002-010 | System Operating Procedure Reactor Auxiliary Building HVAC and Containment Purge | 308 |
| OP-003-009 | Fuel Oil Receipt and Transfer | 307 |
| OP-006-001 | Plant Distribution (7KV, 4KV, and SSD) Systems | 316 |
| OP-009-002 | Emergency Diesel Generator | 324 |
| OP-009-003 | Emergency Feedwater | 305 |
| OP-100-014 | Technical Specification and Technical Requirements Compliance | 325 |
| OP-901-131 | Shutdown Cooling Malfunction | 303 |
| OP-901-521 | Severe Weather and Flooding | 311 |
| OP-902-005 | Station Blackout Recovery | 17 |
| OP-902-008 | Functional Recovery | 22 |
| OP-902-009 | Standard Appendices | 309 |

Procedures

| Number | Title | Revision/Date |
|---|---|---|
| OP-903-014 | Emergency Feedwater Flow Verification | 306 |
| OP-903-035 | Containment Spray Pump Operability Check | 17, 21 |
| OP-903-037 | Containment Cooling Fan Operability Verification | 6 |
| OP-903-046 | Emergency Feedwater Pump Operability Check | 310 |
| OP-903 062 | Chilled Water System Valve Lineup Check | 303 |
| OP-903-063 | Chilled Water Pump Operability Verification | 306 |
| OP-903-067 | Unit Power Supply Transfer Check | 9 |
| OP-903-094 | Train A ESFAS Subgroup Relay Test | 21 |
| OP-903-120 | Containment and Miscellaneous Systems Quarterly IST Valve Tests | 18 |
| OP-903-121 | Safety Systems Quarterly IST Valve Tests | 16 |
| OP-TEM-008 | Emergency Diesel Generator A(B) Backup Temporary Diesel Generators | 7 |
| PE-004-024 | CCW/ACCW System Flow Balance | 304 |
| PE-005-001 | Containment Integrated Leak Rate Test (performed May 20, 2005) | 4 |
| PE-005-001 | Containment Integrated Leak Rate Test (completed August 14, 1991) | 3 |
| SEP-APJ-005 | Waterford 3 Primary Containment Leakage Rate Testing (Appendix J) Program | 5 |
| SEP-CISI-104 | ASME Section XI, Division 1 WF3 Containment Inservice Inspection Program | 1 |
| SEP-WF3-IST-1 | WF3 Inservice Testing Bases Document | 1 |
| SEP-WF3-IST-2 | WF3 Inservice Testing Plan | 1 |
| SEP-WF3-IST-3 | WF3 Inservice Testing Cross Reference Document | 1 |
| SIT-TP-707 | Startup Test SIT-TP-707 Atmospheric Steam Dump and Turbine Bypass Valve Capacity Checks | June 19, 1985 |
| SQ-MN-42 | Valve WKM 40” | 1 |
| STA-001-002 | Containment Purge Valve Leakage Test | 303 |
| STA-001-004 | Local Leak Rate Test (LLRT) | 311 |
| TG-OP-902-005 | Technical Guide for OP-902-005, Station Blackout Recovery Procedure | 306 |
| TM-OP-100 | Operations Training Manual | 29 |

Procedures

| Number | Title | Revision/Date |
|---|---|---|
| UNT-005-031 | AOV Testing, Maintenance, and Trending Program | 5 |
| UNT-006-010 | Event Notification and Reporting | 305 |

System Health Reports

| Title | Date |
|---|---|
| 7KV – 6.9 KV Distribution | Q4-2013 |
| 4KV – 4.16KV Distribution | Q2-2014 |
| CCS – Containment Cooling HVAC | Q3-2014 |
| EFW – Emergency Feedwater | Q2-2014 |
| FW – Feedwater | Q2-2014 |
| MS – Main Steam | Q3-2014 |
| RFR – Refrigeration (Essential Cooling) | Q2-2014 |

Vendor Documents

| Number | Title | Revision |
|---|---|---|
| 457002440 | Paul Monroe Main Steam Isolation Valve Hydraulic Power Unit | 9 |
| TD-B237.0205 | GH Bettis Service Instructions Disassembly and Reassembly for the Following Models T3XX-SRX & T4XX-SRX Spring Return Series Actuators, Part Number SE-004 | 0 |
| TD-C310.0035 | Chicago Bridge & Iron Containment Vessel Airlock Closure Maintenance Hatch Closure | 0 |
| TD-C490-0055 | Plant Protective System Operating Instructions | 0 |
| TD-C490-0075 | Plant Protective System PM Recommendations | 0 |
| TD-C490-0105 | Plant Protective System Drawings | 2 |
| TD-E127.0015 | Main Feedwater Isolation Valve Maintenance Guide, NP-7212s | 0 |
| TD-F130.0015 | Fisher Controls Valve Bodies | 9 |
| TD-G080.0095 | GE Magne-Blast Circuit Breakers (GEK 7320) | 6 |
| TD-G080.0125 | GE  Switchgear Service Advisories | 7 |
| TD-G080-0625 | GE Service Transformers | 0 |
| TD-M120.0545 | Masoneilan 41400, 41500, 41600 Series Control Valve Instruction No. EH3020E Rev A 11/86 | 0 |
| TD-M120.0565 | Masoneilan Sigma F Actuator Instructions No. ER2000E Rev. B 10/86 | 2 |

Vendor Documents

| Number | Title | Revision |
|---|---|---|
| TD-M120.0695 | Masoneilan Parts Supplement to Instruction ER2000E Actuator | 0 |
| TD-S250-0015 | Solid State Controls Sect. 1 – Correspondence | 2 |
| TD-S250-0025 | Solid State Controls Sect. 2 – Technical Manual | 3 |
| TD-S250-0035 | Solid State Controls Sect. 3 –Installation and Operating Manual | 3 |
| TD-S250-0075 | Solid State Controls Technical Manual | 0 |
| TD-S250-0085 | Solid State Controls Equipment Specifications | 1 |
| TD-S250-0135 | Solid State Controls Component Maintenance | 0 |
| TD-S250-0145 | Solid State Controls Component Replacement Schedule | 0 |
| TD-S250-0155 | Solid State Controls Inverter Schematics | 0 |
| TD-W255.0125 | W-K-M Customer Product Data Instruction Manual 40 x 30 Model “D-2” Pow-R-Seal | 0 |
| TM-C629-0905 | Emergency Diesel Generator Electrical Control Equipment | 0 |

Work Orders

| | | | | |
|---|---|---|---|---|
| WM-105-00 | 234976 | 427038 | 52370449 | 52487511 |
| 13894 | 236825 | 1165220 | 52379793 | 52512588 |
| 26599 | 286809 | 1167280 | 52383535 | 52536607 |
| 41676 | 303632 | 1175031 | 52404295 | 52552227 |
| 44731 | 305049 | 1176429 | 52405920 | 52552729 |
| 48693 | 322471 | 52274219 | 52422980 | 52561026 |
| 48695 | 330388 | 52320738 | 52428344 | 52562301 |
| 51906 | 337454 | 52333000 | 52470923 | 52563707 |
| 52465 | 349635 | 52345306 | 52471091 | 52564075 |
| 77100 | 357364 | 52347229 | 52472202 | 52565094 |
| 229855 | 358688 | 52348770 | 52475167 | 52571490 |
| 234960 | 367534 | 52361858 | 52479238 | 52577450 |
| 234964 | 368175 | 52366636 | 52485263 | |
| 234967 | 410386 | 52368672 | 52485264 | |

**Detailed Risk Evaluation**
**Waterford-3, Diesel Day Tank Vents**

**Summary:** The analyst completed a detailed risk evaluation in accordance with Inspection Manual Chapter 0609, Appendix A, “The Significance Determination Process for Findings At-Power,” dated June 19, 2012. The analyst also used Appendix M, “Significance Determination Process Using Qualitative Criteria,” dated April 12, 2012. The use of Appendix M was necessary because of significant uncertainties in two areas.

- The conditional probability (CP) of a loss of off-site power (LOOP) given a rain event of 5 inches/hour or more.

- The tolerance of the Cooper Bessemer diesel generators to water in the fuel stream.

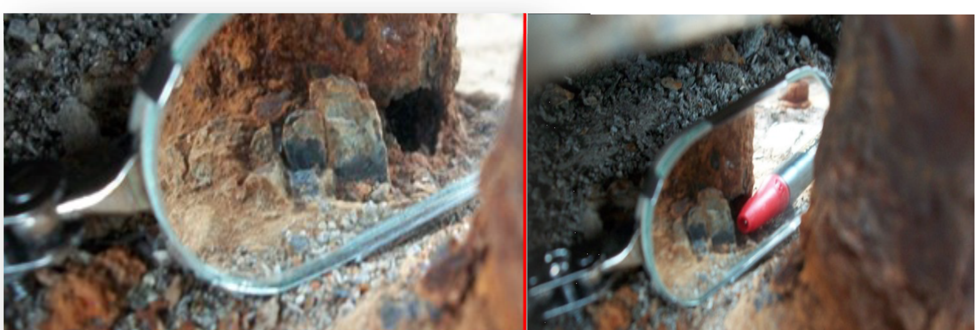
To accommodate for the uncertainty in CP, the analyst established a range of values for CP and then calculated a resultant change to the core damage frequency (ΔCDF) based on these ranges. The best estimates were Yellow to Red, but the range of possible outcomes ranged from White to Red. The primary risk driver was the very high CCDP (0.2); assuming a loss of off-site power (LOOP) and the failure of both emergency diesel generators.

To account for the unknown tolerance to water in the fuel oil, the analyst increased the rain intensity threshold that was assumed to result in failure. While the vendor calculations indicated that a rain event of 3 to 4 inches/hour would result in water intrusion into the day tanks, the analyst used a threshold of 5 inches/hour for the calculations (for both day tanks). This resulted in decreasing the rain intensity initiating event frequency. The team had also identified inappropriate assumptions in the vendor’s calculations, such that the calculations likely underestimated the amount of water that would actually enter the day tanks. This resulted in additional uncertainty.

**Performance Deficiency (preliminary)**: The licensee failed to promptly identify a condition adverse to quality as required by 10 CFR Part 50, Appendix B, Criterion XVI, “Corrective Action.” Consequently, the diesel generator day tank vents had corroded to the extent that water on the roof could have transited down the vent pipes during heavy rains, collected at the bottom of the diesel generator day tanks and be drawn into the fuel oil lines to the fuel injectors. During an actual event, the licensee would not have likely identified the problem until at least one of the emergency diesel generators had failed. With water all the way up to the fuel injectors and within the diesel generator pistons, recovery within a reasonable time was unlikely.

Both the train A and B vents were located on the roof of the same structure.  The roof has a berm along the top of the perimeter.  The photo on the right captures the scupper enclosure.  All of the roof water would drain through this single drainage point.  A piece of foreign material was also found on the roof.  This material could block a portion of the scupper.

The above photos capture the thru-wall holes at the base of each 1 inch diameter vent pipe, where they exit the roof.  A head-on view of the West vent hole is provided in the two pictures below.  The East hole is not shown and was reported by the team as being the larger hole.  An ink pen is shown in the right picture for perspective.



**Licensee Evaluations:**  The licensee contracted with three vendors to evaluate this condition. The first two vendors determined the amount of water that is expected to migrate down the vents, given certain rain intensities.  The calculations were performed in parallel, but they were not entirely independent. The licensee provided some of the assumptions to the vendors. The third contractor determined the amount of water contamination in the fuel oil that the diesels could tolerate.

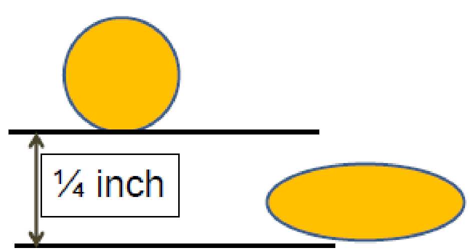
**Vendors 1 and 2:** The vendors used typical engineering equations to determine the amount of water that could be expected to transit through the holes and down each vent. The analyst found two of the assumptions questionable. Because of the configuration and the manner that rain water would collect and enter the holes, these assumptions would tend to reduce the calculated amount of water entering the tanks.

First, the vendors assumed that a ¼ inch lip preceded the holes. To the analyst, the holes appeared to be even with the roof. There was some dirt and debris around the holes. This did not appear to have a solid foundation and would likely have been carried up by water flow.

Second, the vendors assumed that the holes were circular. In the second row of pictures above, the hole seemed circular in the picture. However, a flake of material hid a portion of the hole on the left. In addition, this was the smaller of the two holes. The team had reported that the holes were oblong, with the major axis being horizontal.

Third, the vendors assumed that the holes were ¼ inch in diameter. This was based on the pen that was used for perspective and appeared to be a best judgment case. There were no dimensions given for the pen. The hole appeared to be larger than the diameter of the pen. The team estimated that the holes could be 1/2 inch in diameter.

The following diagram demonstrates the differences between the hole position and the shape, discussed above. The vendor's representation is the circular hole whereas the oblong hole was that described by the inspection team. As one can see, water will start to enter the oblong hole earlier and a larger cross section would be exposed to the surface water. Considering that the most important variable is the water level at the edge of a hole, the importance of this assumption can't be minimized. In addition, the elevation of water near the hole is dependent on the rain intensity and the rate at which water drains away from the vents. It's important to note that an inch per hour increase in rain intensity only amounts to a fraction of an inch change in water level at the piping holes.




One of the vendors noted that the site had experienced a heavy rain event in the past two years. In this case, it would have been 3.8 inches/hour if it had continued for an entire hour. The quantity of rain water was not specifically known. Nonetheless, this demonstrates some resilience with respect to water accumulation in the fuel oil.

**Vendor 3:** Vendor 3 determined the amount of water contamination that the diesels could tolerate in the fuel oil prior to losing functionality. The vendor had concluded that as much as 40 percent of the fuel oil stream could be water and the diesel would continue to function. The vendor report, “Start-up and Performance Assessment due to Increased Water Content in Diesel Fuel for the Emergency Diesel Engine Generators,” dated December 15, 2014, stated, in part:

> The literature study indicates that diesel engines can operate satisfactorily for long periods of time with 10 percent water in the fuel and they can sustain efficient combustion with more than 40 percent water in the fuel.
>
> The WAVE [predictive computer program] engine performance simulations predict misfire at water concentrations above 70 percent and that the engine can sustain combustion up to a water concentration of around 46 percent at high load and 38 percent at mid load.
>
> The calculations which are intended to predict the acceptable water levels are inherently theoretical in nature as they are subject to a range of assumptions and approximations. Physical measurements of the water concentration and combustion stability may vary for a variety of reasons, some being outside the control of Ricardo or the capability of the predictive methodology.

In addition, the report had noted that diesel output power would decrease linearly with the fuel fraction of the fuel/water. A 60 percent fuel fraction would result in an approximate 40 percent reduction in output power.

The analyst noted that the vendor relied on available research documents. However, the tested equipment and fuel mixtures were not similar to those associated with the Cooper-Bessemer diesel generators at Waterford 3. Other than demonstrating that the diesel engines likely had some unknown tolerance to water intrusion, the documents did not provide meaningful information. In one case, the research team used an emulsified mixture of oil and water. This was not applicable because the fuel oil mix at Waterford 3 would not be emulsified. The second case involved the injection of water into the fuel stream, just prior to entering the cylinders. The fuel injection system was specifically designed for this purpose. The research study, performed by Daimler Chrysler Research, was intended, in part, to show that water injection could help to reduce air pollutants. The test diesels were not shown to be similar to the Waterford 3 diesels.

While some of the vendors’ initial assumptions were questionable, there were portions of the engineering evaluations that provided important considerations. For example, the expected amount of water intrusion would be in terms of gallons per hour (gph), versus gallons per minute (gpm). For example, it may be 9-12 gallons per hour for a 5 inch per hour rain event. A fully loaded diesel generator uses about 5 gallons per minute, 300 gallons per hour. Conversely, a diesel responding to a LOOP may operate at a reduced load (perhaps 50 percent of the rated load). If the water intrusion remains in a steady stream, engine functionality would be more likely.

Diesel generator industry documents commonly warn against the introduction of water directly to the diesels. The vast majority of available diesel generators were not designed or tested to support water contamination in the fuel oil. In cases where liquid water could contaminate the fuel oil, marine fuel oil separators are available to resolve this problem. In addition, periodic checks for water in the fuel oil tanks are recommended.

Fuel guidance contained in Wikipedia at http://en.wikipedia.org/wiki/fuel_filter stated, in part:

> It is especially undesirable for water in the fuel to be drawn into a diesel engine fuel system, as the system relies on the diesel for lubrication of the moving parts, and if water gets into a moving part which requires constant lubrication (for example an injector valve), it will quickly cause overheating and unnecessary wear.

"Diesel Fuel Basics," by Alex Marcus, dated fall 1999 stated, in part:

> Consider that water is much denser than fuel. When this encapsulated water hits a hot injector tip, it quickly expands into steam. Potentially, this can result in cracked, damaged, or blow-out fuel injectors, to name just a few of the potential problems.

**Appendix M Discussion: Note:** Appendix M, Table 4.1, "Qualitative Decision-Making Attributes for NRC Management Review," is provided on the last page of this risk evaluation.

Normally, the CDF can be calculated by multiplying the initiating event frequency (λ) by the conditional core damage probability (CCDP) given the initiating event (LOOP, in this case) and the failed equipment (train A and train B emergency diesel generators).

$$CDF = \lambda * CCDP$$

The analyst could not determine a best estimate for the initiating event frequency. The initiating event of interest was a rain induced LOOP. The frequency for rain events was known but the conditional probability (CP) for the LOOP, given the rain event, was not known. For this evaluation, the analyst broke the initiating event into two components, such that:

$$\lambda = \lambda_{rain} * CP$$

The equation for CDF expanded to:

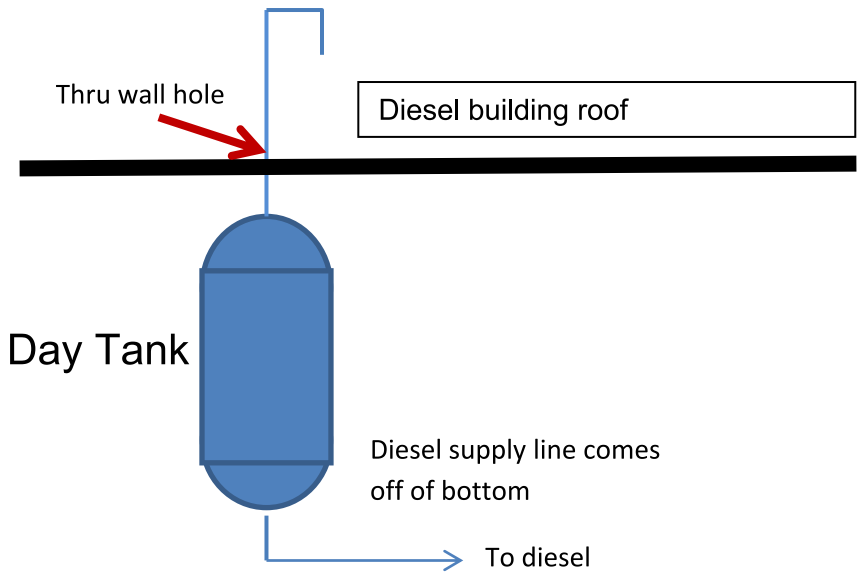
$$CDF = \lambda_{rain} * CP * CCDP$$

Because of the uncertainty in CP, the analyst use approximate ranges for CP. Qualitative information was considered when determining the preliminary color for this finding.

In addition, there was considerable uncertainty concerning the tolerance of the diesel generator to water contamination in the fuel oil stream. Some small contamination could be tolerated, but there was no reliable information that could help the analyst determine the probability that the diesels would catastrophically fail. To accommodate for this uncertainty, the analyst assumed that rain events less than 5 inches/hour would not harm the diesels. The diesels would start to receive water close to 3 inches/hour rain intensity.

**Influential Assumptions and Design Considerations:**

- The simplified drawing below is typical of both day tank configurations. The vents protrude through the diesel generator building roof and into the same drainage area.




- The analyst used the Waterford 3 at-power Standardized Plant Analysis Risk (SPAR) model, Revision 8.16 for this analysis. In addition, Sapphire Revision 8.1.2 was utilized. The analyst used a truncation limit of $10^{-11}$. Only the LOOP events were affected. Therefore, the analyst only solved the LOOP sequences.

- During a heavy rainfall event, water entering the through-wall vent holes would fall into the day tank. Since water is heavier than oil, the water would proceed to the bottom of the day tank. The fuel oil supply lines were attached to the very bottom of the tanks. Consequently, water that entered the tanks would transit directly to the supply lines and to the diesels. Both diesel generators were vulnerable to this problem.

- If sufficient water transited to the fuel injectors, the diesels could become non-functional. The licensee's contractors determined that water could start draining into the vents around 3 to 4 inches/hour. This estimate included 50 percent blockage of the scupper's face to account for foreign material in the area.

- Diesel recovery within the 24 hour diesel mission time was not feasible. Operators would not initially know why the diesel generators failed. In addition, dismantling the fuel injectors and flushing the lines to rid the system of water would be a time intensive task.

- The performance deficiency could have existed for several years. The licensee's vendors estimated that the condition had existed for at least two years. Therefore, the analyst used the 1.0 year maximum exposure period.

- The equipment that could have been lost included the train A and B emergency diesel generators. The scenario of interest included a heavy rain event that caused a LOOP concurrent with the loss of the A and B diesel generators.

- The analyst assumed that small amounts of water in the day tanks would not affect diesel functionality. Larger amounts of water in the fuel oil stream could affect functionality. The analyst used rain intensity of 5 inches/hour as the threshold that would result in diesel failure. For each additional inch of rain intensity, the ΔCDF would decrease by approximately a factor of 3. For example, increase the threshold rain intensity by 2 inches/hour and the ΔCDF would decrease by about a factor of 9.

- At full load conditions, a diesel generator would consume approximately 300 gallons per hour of fuel oil. The fuel usage was assumed to be linear at lower diesel generator loads.

- The licensee had suggested that hurricane-related events should not be evaluated using the online risk model because the plant would be shutdown at least two hours prior to a hurricane. However, the licensee was unable to demonstrate that by shutting down two hours prior to a hurricane that operators could consistently establish the shutdown cooling entry conditions prior to hurricane landfall. The shutdown cooling entry conditions are the prerequisite for using the shutdown risk evaluation procedures. In addition, since the time after shutdown would be very short, using the shutdown procedures would not have significantly altered the outcome. Finally, the analyst did not have sufficient data to determine what subset of all analyzed heavy rain events would be hurricanes and would thus prompt operators to shut down the plant prior to the onset of the rain.

- The National Oceanic and Atmospheric Administration (NOAA) provided site specific tables for rain events (inches/hour) and the expected return period (years). For the Hahnville, Louisiana area, a 5 inch per hour rain event had a 75 year return period. The frequency ($\lambda_1$) was 1/75 = $1.3 \times 10^{-2}$/year. The applicable NOAA table is provided at the back of this risk evaluation.

- The analyst allowed the off-site power recoveries to occur.

**Qualitative Considerations:**

- The emergency diesel generators have design margin available. The highest loading occurs in response to a LOOP/Loss of Coolant Accident (LOCA), which is not considered in probabilistic risk assessment evaluations. The LOOP scenario (without LOCA) is credible, but the diesel loading is less.

- The emergency diesel generators have some <u>unknown</u> tolerance to water in the fuel stream. A steady and even distribution of water into each cylinder is better than an uneven stream of water in the fuel stream. The way that water would settle, collect and enter the fuel injectors was not known.

- In the past two years, the site did experience a heavy intensity storm, over 3.5 inches per hour, if it had continued for an hour. The contractors did not specify the actual per hour rain intensity or the duration. At least some minimal amount of water likely entered the day tanks.

- The vent line through-wall holes had slowly developed and had existed for some time. It is expected that some rain water would have already fallen into the day tanks during rain storms. This would have transited through the diesel fuel system during surveillances.

- The area of the through-wall holes was larger than the licensee had estimated and the holes were lower. This would increase the amount of calculated water into the day tanks.

- Day tank water is checked after the emergency diesel generators are operated. Therefore, any water initially in the day tanks would transit through the fuel system prior to the check for water in the day tanks.

- Leakage into the day tanks should be on the order of gallons per hour (gph), versus gallons per minute (gpm). The licensee initially determined that the flow rate could be about 9-12 gph for a 5 inch per hour rain event. However, if the assumptions for hole size and location were adjusted to assume a larger hole, this could be 40 gph or more. This does not take into account any errors in location or geometry.

- Independent failures of the single drainage line were not considered in the risk evaluation. This would include failures due to wind-blown debris onto the scupper faces. The analyst could find no documented reference for these events.

**Quantification:** The analyst calculated the ΔCDF that was caused by the performance deficiency. There were two scenarios to consider.

- The first scenario involved a heavy rain event that resulted in water intrusion into the day tanks. This rain event did not cause a LOOP. A random LOOP then occurred (at the nominal frequencies).

- The second scenario included a heavy rain initiating event followed by a consequential LOOP. Both diesels subsequently failed because of water intrusion into the day tanks. The analyst used the heavy rain initiating event frequency.

The following definitions are utilized in this risk evaluation:

ΔCDF – the change to the core damage frequency that was caused by the performance deficiency.

$\Delta CDF = CDF_{\text{current case}} - CDF_{\text{nominal}}$

$CDF_{\text{current case}}$ = the core damage frequency calculation that accounts for the performance deficiency

$CDF_{\text{nominal}}$ = the core damage frequency calculation associated with the baseline nominal case (assumes that there is no performance deficiency)

In general terms:

$\Delta CDF = \lambda * CP * ICCDP *$ exposure period, where

$\lambda$ = the initiating event frequency for the rain event
CP = the conditional probability of a LOOP given the rain event

ICCDP = the difference between the nominal case CCDP and current case CCDP

Exposure period = the fraction of 1.0 year that the performance deficiency had existed such that equipment failure was possible

The analyst made the following additional assumptions:

The current case CCDP assumed unity values for the LOOP and the loss of the diesels.

The nominal case CCDP assumed a unity value for the LOOP.

For the current case, the analyst set the common cause diesel failure to start basic event to 1.0.

**Scenario 1: Random LOOP occurring after a heavy rain event:**

**Note:** As shown later in this risk evaluation, this scenario was not a major contributor to ΔCDF. Other scenarios were more dominant.

For this event, the analyst assumed that a heavy rain event would occur with the frequency $\lambda_{rain} = 1.3 \times 10^{-2}$ (5 inch/hour rain event). The event would cause both diesel generators to become non-functional and unrecoverable. The LOOP event would not be initiated by the same rain event, but would occur randomly afterwards. The analyst used the SPAR model and allowed the nominal LOOP initiating event frequencies to occur. The analyst failed both emergency diesel generators (common cause failure to start = 1.0). The $CCDP_{current\ case}$ was = $4.2 \times 10^{-3}$. The nominal case CCDP was $5.6 \times 10^{-6}$. The ICCDP was $4.2 \times 10^{-3}$.

The analyst calculated the exposure period for this scenario. The licensee staggered their diesel generator surveillances such that one diesel (either A or B) would be tested every two weeks. The analyst assumed that the rain event would cause both diesels to become non-functional. Therefore, the maximum time that would elapse with the diesels being non-functional was two weeks. The average exposure would be T/2 = 1 week.

The ΔCDF was:

$$\Delta CDF = \lambda_{rain} * ICCDP * \text{exposure period} = 1.0 \times 10^{-6}/\text{year}$$

Going forward, this ΔCDF will be referred to as $\Delta CDF_1$.

**Licensee Estimate:** The licensee stated that their value for $\Delta CDF_1$ was approximately $6 \times 10^{-6}$/year. This was contingent on the diesels becoming non-functional in response to the assumed rain event. If future work demonstrates that the diesels would remain functional for the events, this estimate would change.

**Scenario 2: Heavy Rain with Consequential LOOP:** Appendix M was needed to estimate the ΔCDF for this scenario. The analyst used two different methods to estimate the ΔCDF.

- Based on a fraction of the rain frequency.
- Based on a fraction of the weather related LOOP frequency.

$\Delta CDF = \lambda_{rain} * CP * (CCDP_{current\ case} – CCDP_{nominal)})$

**CCDP Calculations:** First, the analyst calculated the $CCDP_{nominal}$, assuming a LOOP. $CCDP_{nominal}$ was 2E-4.

Next, the analyst calculated the current case CCDP given a LOOP and the concurrent loss of the A and B emergency diesel generators. $CCDP_{current\ case}$ was $2.0 \times 10^{-1}$.

$\boldsymbol{\lambda_{rain:}} = 1.3 \times 10^{-2}$/year for a 5 inch/hour rain event.

$\Delta CDF = \lambda_{rain} * CP * (CCDP_{current\ case} – CCDP_{nominal)})$

The CP was not specifically known. In addition, the uncertainty with this estimate could be considerable. For example, it's possible to have a heavy rain event that renders both diesels non-functional but does not cause a LOOP. In addition, it's possible to have weather events that cause a LOOP but do not disperse sufficient rain to render the diesels non-functional.

**Method 1: Based on a fraction of $\boldsymbol{\lambda_{rain}}$:** For the best estimate, the analyst assumed that the CP was 0.1 * $\boldsymbol{\lambda_{rain}}$. In other words, if a five inch/hour rain event occurred, the probability that a LOOP would also occur was 0.1.

$\lambda_{rain} * CP = 1.3 \times 10^{-3}$/year.

Note: This value is close to the weather related LOOP frequency of 4.8E-3/year. Louisiana has a relatively high frequency of heavy rain events compared with other parts of the United States.

Considering the ΔCDF equation:

$\Delta CDF = 1.3 \times 10^{-2} * 0.1 * (2.0 \times 10^{-1} – 2 \times 10^{-4}) = 2.6 \times 10^{-4}$ (Red)

Going forward, this will be referred to as $\Delta CDF_{2A}$.

The analyst assumed that the actual initiating event frequency would be bounded by 50 percent and 1 percent of the 5 inch/hour frequency. With each of these bounds, the analyst attempted to use values that were unreasonably low or high. For example, assuming that both diesels would fail 50 percent of the time during a 5 inch per hour rain intensity event appeared overly conservative. In addition, there was overlap between heavy rain events and weather related losses of off-site power, such as tornados, hurricanes, and large thunderstorms. Assuming that off-site power would be lost in only 1 percent of the instances seemed unreasonably low.

The range of frequencies was $1.3 \times 10^{-3}$/year to $6.5 \times 10^{-2}$/year. The range for $\Delta CDF_2$ was:

$$2.6 \times 10^{-5} \text{ (Yellow)} < \Delta CDF_{2A} < 1.3 \times 10^{-3} \text{ (Red)}$$

**Method 2: Based on Weather Related LOOP Frequency:** The SPAR model included the weather related LOOP frequency of $4.8 \times 10^{-3}$/year. This was from all weather related causes, including hurricanes, tornados, high winds, heavy rains, lightning strikes, and freezing. This value was an average value for all commercial nuclear sites in the United States. The frequency for only the heavy rain caused LOOPs would be expected to be smaller than $4.8 \times 10^{-3}$/year.

Similar to Method 1, the analyst initially assumed that the best estimate frequency should be a factor of 10 smaller (or 10 percent). The resultant frequency was $4.8 \times 10^{-4}$/year. The analyst assumed that this only applied to the 5 inch/hour, or higher, rain events.

The analyst assumed that for $CCDP_{\text{current case}}$, the frequency for a LOOP was one and that both diesels failed from common cause.

$$\Delta CDF = 4.8 \times 10^{-4}\text{/year} * (2 \times 10^{-1} - 2 \times 10^{-4})] = 9.6 \times 10^{-5} \text{ (Yellow)}$$

This will be referred to as $\Delta CDF_{2B}$. The above calculation represents a best estimate value. Since there was considerable uncertainty with this estimate, the analyst assumed that reasonable bounds were 50 percent and 1 percent of the weather related LOOP frequency. The range resulted in a range of ΔCDFs:

$$9.6 \times 10^{-6}\text{/year (White)} < \Delta CDF_{2B} < 4.8 \times 10^{-4}\text{/year (Red)}$$

**Total ΔCDF:**

The total change to the core damage frequency was:

$$\Delta CDF_{\text{total}} = \Delta CDF_1 + \Delta CDF_{2a}$$

OR

$$\Delta CDF_{\text{total}} = \Delta CDF_1 + \Delta CDF_{2b}$$

Based on the above:

$$\Delta CDF_{\text{total-A}} = 1.5 \times 10^{-6} + 2.6 \times 10^{-4} = 2.6 \times 10^{-4}\text{/year (Red)}$$

OR

$$\Delta CDF_{\text{total-B}} = 1.5 \times 10^{-6} + 9.6 \times 10^{-5} = 9.7 \times 10^{-5} \text{ (Yellow)}$$

The ranges for ΔCDF were:

$2.7 \times 10^{-5}$ (Yellow) < $\Delta CDF_{2A}$ < $1.3 \times 10^{-3}$ (Red)

OR

$1.1 \times 10^{-5}$/year (Yellow) < $\Delta CDF_{2B}$ < $4.8 \times 10^{-4}$/year (Red)

**Additional Sensitivity Cases:** The analyst performed sensitivity studies based on other rainfall events.

As can be seen on the NOAA rain table, for each additional inch of water per hour in rain intensity, the frequency drops by approximately a factor of 3 (sometimes less). Therefore ΔCDF would decrease by a factor of 3 for a 6 inches/hour target rainfall and by a factor of 9 for a 7 inch/hour rainfall.

Two additional events included 8 inches/hour and the probable maximum precipitation, which was 11.5 inches/hour.

**8 inches/hour rain:** According to the same NOAA document referenced earlier, the frequency for an 8 inches/hour rain event was approximately 1E-4/year. If the diesels lost functionality during this event, $\Delta CDF_2$ would equal:

$\Delta CDF_8 = 1 \times 10^{-4} * 2 \times 10^{-1} = 2 \times 10^{-5}$ (Yellow)

Since this rain event was so heavy, the analyst assumed that a LOOP would also occur (CP = 1). If CP were assumed to be 0.1, $\Delta CDF_8 = 2 \times 10^{-6}$ (White).

**Probable Maximum Precipitation:** The estimate for the probable maximum precipitation at Waterford-3 was 11.7 inches/hour, occurring in the fourth hour of the heavy rain event. This precipitation event was intended to bound all precipitation events. Some experts believe that the probable maximum precipitation event would never occur. NUREG 1407, “Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for severe accident Vulnerabilities,” states, in part:

… the probable maximum flood has a E-5/year or less frequency.

The analyst assumed an $10^{-5}$/year frequency for this event. Based on this assumption, ΔCDF for the probable maximum precipitation event was:

$\Delta CDF_{11.7} = 1 \times 10^{-5} * 2 \times 10^{-1} = 2 \times 10^{-6}$ (White)

**Large Early Release Frequency (LERF):** This finding was not a significant contributor to the LERF. The analyst utilized the event trees and the corresponding LERF factors for the loss of off-site power sequences. None of the LERF factors were greater than zero.

**Risk Important Sequences:** The risk important sequences included weather related LOOPs that lead to station blackout conditions. The ability to recover off-site power within 4 hours was important to avoiding core damage.

Summary Page

**Best Estimates:**

**Based on NOAA Rain Intensity Table (5 inches/hour):**

$\Delta CDF_B = 2.6 \times 10^{-4}$ (**RED**)

**Based on Weather Related LOOP Frequency:**

$\Delta CDF_A = 9.7 \times 10^{-5}$ (**Yellow**)

**Ranges:**

**Based on NOAA Rain Intensity Table (5 inches/hour):**

$2.7 \times 10^{-5}$ (**Yellow**) $< \Delta CDF_{2A} < 1.3 \times 10^{-3}$ (**Red**)

OR

**Based on Weather Related LOOP Frequency:**

$1.1 \times 10^{-5}$/year (**Yellow**) $< \Delta CDF_{2B} < 4.8 \times 10^{-4}$/year (**Red**)

**Other Rain Intensities (CP=1):**

**8 inches/hour:**

$\Delta CDF = 2 \times 10^{-5}$ (**Yellow**)

**PMP 11.7 inches/hour**

$\Delta CDF = 2 \times 10^{-6}$ (White)

## NOAA PF Tabular

| PDS-based point precipitation frequency estimates with 90 percent confidence intervals (in inches)[1] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Duration | Average recurrence interval(years) | | | | | | | | | |
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.537** (0.432-0.664) | **0.620** (0.498-0.768) | **0.759** (0.608-0.942) | **0.877** (0.699-1.09) | **1.04** (0.805-1.34) | **1.18** (0.886-1.52) | **1.31** (0.955-1.73) | **1.45** (1.01-1.95) | **1.64** (1.10-2.25) | **1.78** (1.17-2.48) |
| 10-min | **0.786** (0.632-0.972) | **0.908** (0.729-1.12) | **1.11** (0.890-1.38) | **1.28** (1.02-1.60) | **1.53** (1.18-1.96) | **1.72** (1.30-2.22) | **1.92** (1.40-2.53) | **2.12** (1.49-2.86) | **2.40** (1.62-3.30) | **2.61** (1.71-3.63) |
| 15-min | **0.958** (0.771-1.19) | **1.11** (0.890-1.37) | **1.36** (1.09-1.68) | **1.57** (1.25-1.95) | **1.86** (1.44-2.38) | **2.10** (1.58-2.71) | **2.34** (1.71-3.08) | **2.59** (1.81-3.48) | **2.92** (1.97-4.02) | **3.18** (2.09-4.43) |
| 30-min | **1.44** (1.16-1.78) | **1.68** (1.35-2.08) | **2.08** (1.67-2.59) | **2.42** (1.93-3.01) | **2.89** (2.23-3.69) | **3.26** (2.46-4.21) | **3.63** (2.65-4.78) | **4.01** (2.81-5.40) | **4.52** (3.05-6.22) | **4.91** (3.23-6.85) |
| 60-min | **1.94** (1.56-2.40) | **2.26** (1.82-2.80) | **2.82** (2.26-3.50) | **3.32** (2.65-4.14) | **4.06** (3.16-5.25) | **4.67** (3.54-6.08) | **5.32** (3.89-7.06) | **6.01** (4.23-8.14) | **6.98** (4.72-9.66) | **7.75** (5.10-10.8) |
| 2-hr | **2.44** (1.98-2.99) | **2.84** (2.30-3.48) | **3.56** (2.88-4.38) | **4.23** (3.40-5.22) | **5.24** (4.12-6.74) | **6.09** (4.66-7.90) | **7.01** (5.19-9.26) | **8.01** (5.69-10.8) | **9.44** (6.45-13.0) | **10.6** (7.03-14.7) |
| 3-hr | **2.75** (2.24-3.36) | **3.19** (2.60-3.90) | **4.02** (3.27-4.92) | **4.81** (3.88-5.91) | **6.05** (4.80-7.80) | **7.12** (5.49-9.22) | **8.29** (6.18-10.9) | **9.59** (6.86-12.9) | **11.5** (7.89-15.8) | **13.0** (8.67-17.9) |
| 6-hr | **3.31** (2.72-4.00) | **3.84** (3.16-4.65) | **4.86** (3.98-5.90) | **5.85** (4.77-7.13) | **7.43** (5.97-9.54) | **8.82** (6.88-11.4) | **10.4** (7.80-13.6) | **12.1** (8.72-16.1) | **14.5** (10.1-19.9) | **16.6** (11.2-22.7) |
| 12-hr | **3.90** (3.24-4.68) | **4.56** (3.78-5.47) | **5.79** (4.79-6.96) | **6.95** (5.72-8.39) | **8.77** (7.09-11.1) | **10.3** (8.12-13.2) | **12.1** (9.15-15.7) | **14.0** (10.2-18.5) | **16.7** (11.7-22.6) | **19.0** (12.9-25.7) |
| 24-hr | **4.55** (3.81-5.41) | **5.35** (4.48-6.36) | **6.79** (5.66-8.09) | **8.11** (6.73-9.70) | **10.1** (8.22-12.6) | **11.8** (9.35-14.9) | **13.7** (10.4-17.5) | **15.7** (11.5-20.5) | **18.5** (13.0-24.8) | **20.8** (14.2-28.0) |
| 2-day | **5.26** (4.45-6.19) | **6.19** (5.23-7.29) | **7.83** (6.59-9.25) | **9.33** (7.81-11.1) | **11.6** (9.47-14.3) | **13.5** (10.7-16.7) | **15.5** (11.9-19.6) | **17.6** (13.0-22.9) | **20.7** (14.7-27.5) | **23.2** (16.0-30.9) |
| 3-day | **5.70** (4.85-6.68) | **6.69** (5.68-7.84) | **8.45** (7.15-9.92) | **10.1** (8.46-11.8) | **12.5** (10.3-15.3) | **14.5** (11.6-18.0) | **16.7** (12.9-21.1) | **19.0** (14.2-24.6) | **22.4** (16.0-29.6) | **25.1** (17.4-33.3) |
| 4-day | **6.06** (5.17-7.07) | **7.08** (6.03-8.26) | **8.90** (7.57-10.4) | **10.6** (8.94-12.4) | **13.1** (10.8-16.1) | **15.3** (12.3-18.8) | **17.6** (13.7-22.1) | **20.1** (15.0-25.8) | **23.6** (17.0-31.1) | **26.5** (18.5-35.1) |
| 7-day | **6.99** (6.01-8.10) | **8.06** (6.92-9.34) | **9.99** (8.55-11.6) | **11.8** (10.0-13.7) | **14.5** (12.1-17.6) | **16.8** (13.6-20.6) | **19.3** (15.1-24.1) | **22.0** (16.5-28.1) | **25.8** (18.7-33.8) | **28.9** (20.3-38.1) |
| 10-day | **7.88** (6.81-9.08) | **9.00** (7.77-10.4) | **11.0** (9.48-12.7) | **12.9** (11.0-14.9) | **15.7** (13.1-19.0) | **18.0** (14.7-22.0) | **20.6** (16.2-25.6) | **23.3** (17.6-29.7) | **27.3** (19.8-35.5) | **30.5** (21.5-39.9) |
| 20-day | **10.6** (9.26-12.1) | **12.0** (10.4-13.7) | **14.3** (12.5-16.4) | **16.4** (14.2-18.9) | **19.4** (16.3-23.1) | **21.9** (18.0-26.3) | **24.5** (19.4-30.1) | **27.2** (20.7-34.2) | **31.1** (22.8-40.0) | **34.1** (24.3-44.3) |
| 30-day | **13.0** (11.4-14.7) | **14.6** (12.8-16.6) | **17.3** (15.1-19.7) | **19.6** (17.0-22.4) | **22.8** (19.2-26.8) | **25.4** (20.9-30.2) | **28.0** (22.3-34.1) | **30.8** (23.5-38.3) | **34.5** (25.4-44.0) | **37.4** (26.8-48.3) |
| 45-day | **16.0** (14.1-18.0) | **17.9** (15.8-20.3) | **21.1** (18.5-23.9) | **23.7** (20.7-27.0) | **27.3** (23.1-31.8) | **30.1** (24.8-35.5) | **32.8** (26.2-39.6) | **35.6** (27.3-43.9) | **39.2** (29.0-49.7) | **42.0** (30.2-54.0) |
| 60-day | **18.6** (16.4-20.9) | **20.8** (18.4-23.4) | **24.4** (21.5-27.5) | **27.3** (24.0-30.9) | **31.2** (26.5-36.2) | **34.2** (28.3-40.1) | **37.1** (29.7-44.5) | **39.9** (30.7-49.1) | **43.6** (32.3-54.9) | **46.3** (33.5-59.4) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90 percent confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5 percent. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.

Table 4.1
**Qualitative Decision-Making Attributes for NRC Management Review**

| Decision Attribute | Applicable to Decision? | Basis for Input to Decision -= Provide qualitative and/or quantitative information for management review and decision making. |
|---|---|---|
| **Finding can be bounded using qualitative and/or quantitative information?** | Yes | The finding was bounded using quantitative techniques. The best estimate was Yellow and the range of potential outcomes was White to Red. |
| **Defense-in-Depth affected?** | Yes | Both emergency diesel generators could be affected by the finding. The temporary emergency diesels were not installed during the vast majority of the exposure period, so they were not available to help mitigate the significance. Unrecoverable failure of the diesels and the long-term loss of off-site power sequence would eventually degrade containment integrity as well. |
| **Performance Deficiency effect on Safety Margin maintained?** | Yes | Decrease in safety margin expected. |
| **The extent the performance deficiency affects other equipment?** | Yes | The holes in the vent lines were limited to the emergency diesel generator system. In response to NRC questions, the licensee inspected other potentially vulnerable areas and did not report any additional significant corrosion problems. |
| **Degree of degradation of failed or unavailable component(s)** | Yes | Partial degradation of the on-site emergency AC system. Water would not likely enter the vent line holes unless the rain intensity exceeded a certain threshold (3 to 4 inches/hour). Diesel failure was not postulated until a higher threshold was reached (5 inches/hour). This failure mechanism has not yet occurred. |
| **Exposure Time affect on the performance deficiency** | Yes | The duration of the degraded condition was unknown. Based on the cause (corrosion), it is reasonable to postulate that the degraded condition existed well over one-year. For the purpose of PRA analyses, this condition translated to two exposure periods. The first was a one week exposure period for a limited scope failure scenario, since the diesels are tested on a rotating two week basis (each diesel is tested once per month). The ΔCDF for this scenario was approximately $1 \times 10^{-6}$/year. The second scenario evaluated the existence of the performance deficiency for the maximum one year period. This scenario was dominant. |

| | | |
|---|---|---|
| | | Sensitivity studies range from White to Red in significance with the best estimate in the Yellow range. |
| **Likelihood that the licensee's recovery actions would successfully mitigate the performance deficiency** | Yes | If the diesels failed because of water intrusion into the fuel stream, the diesels are unlikely to be recovered within the 24 hour PRA mission time. Recover was most important within the first 6 hours. Off-site power recoveries were allowed to occur. However, historically, recovery from some weather related LOOPs has taken several days or longer. |
| **Additional qualitative circumstances associated with the finding that regional management should consider in the evaluation.** | Yes | The diesels can likely tolerate some water in the fuel stream. That amount is unknown.<br><br>The site experienced a LOOP during Hurricane Katrina in 2005. The West side of the storm hit the site, which did not produce as much rain. |

If you disagree with a cross-cutting aspect assignment or a finding not associated with a regulatory requirement in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region IV; and the NRC resident inspector at the Waterford Steam Electric Station, Unit 3.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC's Public Document Room or from the Publicly Available Records (PARS) component of the NRC's Agencywide Documents Access and Management 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/

Anton Vegel, Director
Division of Reactor Safety

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Enclosure:
Inspection Report 05000382/2014007
w/Attachments:
1. Supplemental Information
2. Detailed Risk Evaluation

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Letter to Michael R. Chisum from Anton Vegel dated January 22, 2015

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 – NRC COMPONENT DESIGN BASES INSPECTION REPORT 05000382/2014007 AND PRELIMINARY GREATER THAN GREEN FINDING

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