



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
REGION II
245 PEACHTREE CENTER AVENUE N.E., SUITE 1200
ATLANTA, GEORGIA 30303-1200

April 23, 2021

Mr. Steven M. Snider
Site Vice President
Duke Energy Carolinas, LLC
7800 Rochester Highway
Seneca, SC 29672-0752

**SUBJECT: OCONEE NUCLEAR STATION – INTEGRATED INSPECTION REPORT
05000269/2021001 AND 05000270/2021001 AND 05000287/2021001**

Dear Mr. Snider:

On March 31, 2021, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Oconee Nuclear Station. On April 20, 2021, the NRC inspectors discussed the results of this inspection with you and other members of your staff. The results of this inspection are documented in the enclosed report.

One finding of very low safety significance (Green) is documented in this report. This finding involved a violation of NRC requirements. We are treating this violation as a non-cited violation (NCV) consistent with Section 2.3.2 of the Enforcement Policy.

If you contest the violation or the significance or severity of the violation documented in this inspection report, 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 II; the Director, Office of Enforcement; and the NRC Resident Inspector at Oconee Nuclear Station.

If you disagree with a cross-cutting aspect assignment 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 U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region II; and the NRC Resident Inspector at Oconee Nuclear Station.

This letter, its enclosure, and your response (if any) will be made available for public inspection and copying at <http://www.nrc.gov/reading-rm/adams.html> and at the NRC Public Document Room in accordance with Title 10 of the *Code of Federal Regulations* 2.390, "Public Inspections, Exemptions, Requests for Withholding."

Sincerely,

/RA/

Jared H. Nadel, Acting Chief
Reactor Projects Branch 1
Division of Reactor Projects

Docket Nos. 05000269 and 05000270 and 05000287
License Nos. DPR-38 and DPR-47 and DPR-55

Enclosure:
As stated

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SUBJECT: OCONEE NUCLEAR STATION – INTEGRATED INSPECTION REPORT
 05000269/2021001 AND 05000270/2021001 AND 05000287/2021001 DATED
 April 23, 2021

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**U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report**

Docket Numbers: 05000269, 05000270 and 05000287

License Numbers: DPR-38, DPR-47 and DPR-55

Report Numbers: 05000269/2021001, 05000270/2021001 and 05000287/2021001

Enterprise Identifier: I-2021-001-0071

Licensee: Duke Energy Carolinas, LLC

Facility: Oconee Nuclear Station

Location: Seneca, South Carolina

Inspection Dates: January 01, 2021 to March 31, 2021

Inspectors: B. Griman, Resident Inspector
D. Lanyi, Senior Operations Engineer
M. Meeks, Senior Operations Engineer
J. Nadel, Senior Resident Inspector
J. Parent, Resident Inspector
N. Peterka, Fuel Facility Inspector
A. Ruh, Senior Resident Inspector

Approved By: Jared H. Nadel, Acting Chief
Reactor Projects Branch 1
Division of Reactor Projects

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting an integrated inspection at Oconee Nuclear Station, in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to <https://www.nrc.gov/reactors/operating/oversight.html> for more information.

List of Findings and Violations

Inadequate Design Control of Low-Pressure Injection System Modification			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green NCV 05000269,05000270/2021001-01 Open/Closed	[P.2] - Evaluation	71152
The inspectors identified a Green finding and associated Non-cited Violation (NCV) of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," when the licensee's design control measures failed to translate low pressure injection (LPI) system suction relief valves' design bases into station procedures and drawings, such that design outlet pressures would be maintained in service. The licensee's design control measures also failed to select suitable parts for a safety-related pressure boundary function of the relief valves.			

Additional Tracking Items

None.

PLANT STATUS

Unit 1 operated at or near 100 percent rated thermal power (RTP) for the entire inspection period.

Unit 2 operated at or near 100 percent RTP for the entire inspection period.

Unit 3 operated at or near 100 percent RTP for the entire inspection period.

INSPECTION SCOPES

Inspections were conducted using the appropriate portions of the inspection procedures (IPs) in effect at the beginning of the inspection unless otherwise noted. Currently approved IPs with their attached revision histories are located on the public website at <http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/index.html>. Samples were declared complete when the IP requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, "Light-Water Reactor Inspection Program - Operations Phase." The inspectors performed plant status activities described in IMC 2515, Appendix D, "Plant Status," and conducted routine reviews using IP 71152, "Problem Identification and Resolution." The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards.

Starting on March 20, 2020, in response to the National Emergency declared by the President of the United States on the public health risks of the Coronavirus Disease 2019 (COVID-19), resident inspectors were directed to begin telework and to remotely access licensee information using available technology. During this time, the resident inspectors performed periodic site visits each week; conducted plant status activities as described in IMC 2515, Appendix D, "Plant Status"; observed risk-significant activities; and completed on-site portions of IPs. In addition, resident and regional baseline inspections were evaluated to determine if all or portions of the objectives and requirements stated in the IP could be performed remotely. If the inspections could be performed remotely, they were conducted per the applicable IP. In some cases, portions of an IP were completed remotely and on-site. The inspections documented below met the objectives and requirements for completion of the IP.

REACTOR SAFETY

71111.01 - Adverse Weather Protection

Seasonal Extreme Weather Sample (IP Section 03.01) (1 Sample)

- (1) The inspectors evaluated readiness for seasonal extreme weather conditions prior to the onset of seasonal cold temperatures for the following structures and systems: standby shutdown facility, auxiliary building, turbine building, essential siphon and vacuum on January 7, 2021.

71111.04 - Equipment Alignment

Partial Walkdown Sample (IP Section 03.01) (3 Samples)

The inspectors evaluated system configurations during partial walkdowns of the following systems/trains:

- (1) Unit 3 motor driven emergency feedwater trains on February 4, 2021 while turbine driven pump was out of service for testing
- (2) Emergency power system walkdown on February 26, 2021
- (3) Unit 3 protected service water (PSW) while 3B high pressure injection pump was inoperable from PSW power on March 30, 2021

Complete Walkdown Sample (IP Section 03.02) (1 Sample)

- (1) Unit 2 low pressure injection system alignment between March 2-4, 2021

71111.05 - Fire Protection

Fire Area Walkdown and Inspection Sample (IP Section 03.01) (5 Samples)

The inspectors evaluated the implementation of the fire protection program by conducting a walkdown and performing a review to verify program compliance, equipment functionality, material condition, and operational readiness of the following fire areas:

- (1) Fire zone 34: Unit 1 4160V switchgear on January 21, 2021
- (2) Fire zone 108: Unit 1 east penetration room on January 21, 2021
- (3) Fire zone 92: Unit 2 equipment room on February 10, 2021
- (4) Fire zone 101: Unit 3 cable room on February 10, 2021
- (5) Fire zone 90: Unit 2 auxiliary building 300 level hallway on March 2, 2021

Fire Brigade Drill Performance Sample (IP Section 03.02) (1 Sample)

- (1) The inspectors evaluated the onsite fire brigade training and performance during an unannounced fire drill on February 1, 2021.

71111.06 - Flood Protection Measures

Inspection Activities - Internal Flooding (IP Section 03.01) (1 Sample)

The inspectors evaluated internal flooding mitigation protections in the:

- (1) Unit 2 auxiliary building 'A' low pressure injection pump room

Cable Degradation (IP Section 03.02) (1 Sample)

The inspectors evaluated cable submergence protection in:

- (1) CT-5 cable trench, Work Order (WO) 20446401

71111.11B - Licensed Operator Requalification Program and Licensed Operator Performance

Licensed Operator Requalification Program (IP Section 03.04) (1 Sample)

The inspectors reviewed the facility operating history and associated documents in preparation for this inspection. During the week of March 15 - 19, 2021, the inspectors reviewed documentation, interviewed licensee personnel, and observed the administration of operating tests associated with the licensee's operator requalification program. Each of the activities performed by the inspectors was done to assess the effectiveness of the facility licensee in implementing requalification requirements identified in 10 CFR Part 55, "Operators' Licenses." The evaluations were also performed to determine if the licensee effectively implemented operator requalification guidelines established in NUREG-1021, "Operator Licensing Examination Standards for Power Reactors," and Inspection Procedure 71111.11, "Licensed Operator Requalification Program." The inspectors also evaluated the licensee's simulation facility for adequacy for use in operator licensing examinations using ANSI/ANS-3.5-2009, "American National Standard for Nuclear Power Plant Simulators for use in Operator Training and Examination." The inspectors observed three crews during the performance of the operating tests. Documentation reviewed included written examinations, Job Performance Measures (JPMs), simulator scenarios, licensee procedures, on-shift records, simulator modification request records, simulator performance test records, operator feedback records, licensed operator qualification records, remediation plans, watchstanding records, and medical records. The records were inspected using the criteria listed in Inspection Procedure 71111.11.

Biennial Requalification Written Examinations

The inspectors evaluated the quality of the licensed operator biennial requalification written examination administered on March 12, 2021.

Annual Requalification Operating Tests

The inspectors evaluated the adequacy of the facility licensee's annual requalification operating test.

Administration of an Annual Requalification Operating Test

The inspectors evaluated the effectiveness of the facility licensee in administering requalification operating tests required by 10 CFR 55.59(a)(2) and that the facility licensee is effectively evaluating their licensed operators for mastery of training objectives.

Requalification Examination Security

The inspectors evaluated the ability of the facility licensee to safeguard examination material, such that the examination is not compromised.

Remedial Training and Re-examinations

The inspectors evaluated the effectiveness of remedial training conducted by the licensee, and reviewed the adequacy of re-examinations for licensed operators who did not pass a required requalification examination.

Operator License Conditions

The inspectors evaluated the licensee's program for ensuring that licensed operators meet the conditions of their licenses.

Control Room Simulator

The inspectors evaluated the adequacy of the facility licensee's control room simulator in modeling the actual plant, and for meeting the requirements contained in 10 CFR 55.46.

Problem Identification and Resolution

The inspectors evaluated the licensee's ability to identify and resolve problems associated with licensed operator performance.

71111.11Q - Licensed Operator Regualification Program and Licensed Operator Performance

Licensed Operator Performance in the Actual Plant/Main Control Room (IP Section 03.01) (1 Sample)

- (1) The inspectors observed and evaluated licensed operator performance in the control room during testing of the protected service water system on February 26, 2021.

Licensed Operator Regualification Training/Examinations (IP Section 03.02) (1 Sample)

- (1) The inspectors observed and evaluated the annual exam of crew C-1 under Scenario ASE-3 on February 23, 2021.

71111.12 - Maintenance Effectiveness

Maintenance Effectiveness (IP Section 03.01) (2 Samples)

The inspectors evaluated the effectiveness of maintenance to ensure the following structures, systems, and components (SSCs) remain capable of performing their intended function:

- (1) Unit 3 essential siphon and vacuum (ESV) and failure of 3ESV-2
- (2) Keowee emergency power overhead path

Quality Control (IP Section 03.02) (1 Sample)

The inspectors evaluated the effectiveness of maintenance and quality control activities to ensure the following SSC remains capable of performing its intended function:

- (1) Commercially dedicated 2LP-195/196 suction relief valve bellows

71111.13 - Maintenance Risk Assessments and Emergent Work Control

Risk Assessment and Management Sample (IP Section 03.01) (5 Samples)

The inspectors evaluated the accuracy and completeness of risk assessments for the following planned and emergent work activities to ensure configuration changes and appropriate work controls were addressed:

- (1) Unit 1, 2, and 3 elevated green risk on January 12, 2021 due to planned maintenance that removed Keowee hydro Unit 1 from service
- (2) Unit 3 elevated green risk on February 4, 2021 due to emergent out of service of primary instrument air compressor and planned maintenance on turbine driven emergency feedwater train
- (3) Unit 1, 2, and 3 yellow risk on February 16, 2021 due to the planned annual standby shutdown facility (SSF) outage
- (4) Unit 2 elevated green risk on March 17, 2021 due to main feeder bus 2 normal feeder breaker racked out for maintenance
- (5) Unit 1 and 2 elevated green risk on March 29, 2021 due to planned maintenance on 'B' low pressure service water pump and 230kV switchyard red bus outage

71111.15 - Operability Determinations and Functionality Assessments

Operability Determination or Functionality Assessment (IP Section 03.01) (5 Samples)

The inspectors evaluated the licensee's justifications and actions associated with the following operability determinations and functionality assessments:

- (1) Nuclear Condition Report (NCR) 2352558, 3ESV-2 suspected not opening, Work Request (WR) 20185800
- (2) NCR 2366042, Questions about the capability of 1,2LP-195/196
- (3) NCR 2368082, Unit 2 pressurizer heater bank 1 not functioning due to ground faults and as-left condition with only 3 functional heater elements in group 'A'
- (4) NCR 2375753, Non-conservative inservice test and motor operated valve stroke times for 1,2,3HP-24 & 25
- (5) NCR 2370894, Fuel transfer tube structural support saddle weld not satisfying code stress criteria following system modification

71111.18 - Plant Modifications

Temporary Modifications and/or Permanent Modifications (IP Section 03.01 and/or 03.02) (2 Samples)

The inspectors evaluated the following temporary or permanent modifications:

- (1) Engineering Change (EC) 418511, Evaluate increasing the in-line fuse size for 1XSF-F03B from 150A to 200A
- (2) ON-13106 and ON-23106, Reactor building emergency sump return line modification

71111.19 - Post-Maintenance Testing

Post-Maintenance Test Sample (IP Section 03.01) (8 Samples)

The inspectors evaluated the following post-maintenance test activities to verify system operability and functionality:

- (1) OP/0/A/1106/019, Keowee Operability Check, on January 13, 2021 following maintenance performed on Keowee hydro Unit 1
- (2) IP/0/B/0200/049, Auxiliary Control System Reactor Coolant System Flow Instrument Calibration, following splice repair of U3 wide range T-hot resistance temperature detector cable, WO 20443005
- (3) Testing of new 51XYZ relay following failure of 2B motor driven emergency feedwater pump during surveillance testing, WO 20449429
- (4) PT/0A/0600/021, Standby Shutdown Facility Diesel Generator Operation, on February 17, 2021, following EC 114998 to modify lockout relays on breaker OTS1-4
- (5) PT/2/A/0203/006 A, Low Pressure Injection Pump Test - Recirculation and system operation per OP/2/A/1104/004 on March 3 and 4, 2021 following suction relief valve replacements
- (6) PT/2/A/0261/010, Essential Siphon Vacuum System Test, on March 10, 2021, following replacement of 2C ESV pump.
- (7) PT/0/A/0610/017, Operability Test of 4160 V Breakers after replacement of refurbished B2T-3 breaker, WO 20303358
- (8) PT/3/A/0150/070 - Leak Test of SFP Cooling Purification System Isolation From BWST following repairs to 3SF-51 and 3SF-54, WO 20440264

71111.22 - Surveillance Testing

The inspectors evaluated the following surveillance tests:

Surveillance Tests (other) (IP Section 03.01) (4 Samples)

- (1) PT/0/A/0620/009, Keowee Monthly Operational Check, on January 14, 2021
- (2) PT/1/A/0203/006 A, Low Pressure Injection Pump Test - Recirculation, on January 28, 2021
- (3) PT/3/A/0600/012, Turbine Driven Emergency Feedwater Pump Test, on February 4, 2021
- (4) PT/0/A/0400/005, SSF Auxiliary Service Water Pump Test, on March 18, 2021

Inservice Testing (IP Section 03.01) (2 Samples)

- (1) PT/3/A/0261/010, Essential Siphon Vacuum System Test, on January 23, 2021
- (2) PT/2/A/0202/011, 2A High Pressure Injection Pump Test, on February 9, 2021

OTHER ACTIVITIES – BASELINE

71151 - Performance Indicator Verification

The inspectors verified licensee performance indicators submittals listed below:

IE01: Unplanned Scrams per 7000 Critical Hours Sample (IP Section 03.01) (3 Samples)

- (1) Unit 1 (January 1, 2020 - December 31, 2020)
- (2) Unit 2 (January 1, 2020 - December 31, 2020)
- (3) Unit 3 (January 1, 2020 - December 31, 2020)

IE03: Unplanned Power Changes per 7000 Critical Hours Sample (IP Section 03.02) (3 Samples)

- (1) Unit 1 (January 1, 2020 - December 31, 2020)
- (2) Unit 2 (January 1, 2020 - December 31, 2020)
- (3) Unit 3 (January 1, 2020 - December 31, 2020)

IE04: Unplanned Scrams with Complications (USwC) Sample (IP Section 03.03) (3 Samples)

- (1) Unit 1 (January 1, 2020 - December 31, 2020)
- (2) Unit 2 (January 1, 2020 - December 31, 2020)
- (3) Unit 3 (January 1, 2020 - December 31, 2020)

MS07: High Pressure Injection Systems (IP Section 03.06) (3 Samples)

- (1) Unit 1 (January 1, 2020 - December 31, 2020)
- (2) Unit 2 (January 1, 2020 - December 31, 2020)
- (3) Unit 3 (January 1, 2020 - December 31, 2020)

71152 - Problem Identification and Resolution

Semiannual Trend Review (IP Section 02.02) (1 Sample)

- (1) The inspectors reviewed the licensee's corrective action program for potential adverse trends in quality control of component parts that might be indicative of a more significant safety issue.

Annual Follow-up of Selected Issues (IP Section 02.03) (2 Samples)

The inspectors reviewed the licensee's implementation of its corrective action program related to the following issues:

- (1) NCR 2347996, Keowee out of tolerance relay preventive maintenance being revised beyond TS surveillance frequency
- (2) NCRs 2366042 and 2364796, Low pressure injection system cross-train pressurization effects on suction side relief valves

71153 - Followup of Events and Notices of Enforcement Discretion

Personnel Performance (IP Section 03.03) (1 Sample)

- (1) The inspectors evaluated an inadvertent start of the Unit 1 turbine driven emergency feedwater pump and licensee's performance on March 15, 2021.

INSPECTION RESULTS

Inadequate Design Control of Low-Pressure Injection System Modification			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green NCV 05000269,05000270/2021001-01 Open/Closed	[P.2] - Evaluation	71152
<p>The inspectors identified a Green finding and associated Non-cited Violation (NCV) of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," when the licensee's design control measures failed to translate low pressure injection (LPI) system suction relief valves' design bases into station procedures and drawings, such that design outlet pressures would be maintained in service. The licensee's design control measures also failed to select suitable parts for a safety-related pressure boundary function of the relief valves.</p>			
<p><u>Description:</u> In 2005, station modifications ON-13106 and ON-23106, "ECCS – EOPI Reroute Lines in RB Emergency Sump," added new piping and relief valves to the suction side of the LPI system on Units 1 and 2. The design basis purpose of these suction header relief valves included limiting the pressurization of an idle train's suction header to approximately 150psi from cross-train pressurization caused by leakage past valves on the discharge of the opposite, operating train. These pressure reducing relief valves (LP-195 and LP-196) were designed to preserve ECCS inventory by relieving pressure back to the suction of the operating train. This design was implemented so that the pressure from an operating pump (up to 230psi) would not lift other suction-side safety relief valves (LP-26 and LP-27) that would result in release of highly contaminated water from the reactor building emergency sump, during an accident, into the auxiliary building.</p> <p>Since the new relief valves were designed to discharge back to the pressurized LPI system, a balanced bellows design was selected in order to prevent potentially variable system backpressures from affecting the valve's set point. Engineers specified the design pressure for the outlet of the valves as 200psi and the vendor supplied a valve design with a bellows having a catalog design pressure rating for 230psi. In addition to protecting the set point of the valve from system backpressure, and because of the unique way these valves were being used, the metallic bellows served a safety function as a pressure boundary seal for the LPI system. Failure of the bellows during an accident could result in uncontrolled leakage of reactor building emergency sump water from the LPI system into the auxiliary building through an intentionally open vent port in the bonnet of the valve. The licensee's engineers failed to recognize this safety function in 2005 and approved the vendor's valve design without procuring the bellows as a safety related part. As a result, critical characteristics of the commercial bellows, such as the bellows height, which establishes its level of beneficial pre-compression, were not controlled under a quality assurance process, as required by topical report DUKE-1A "Quality Assurance Program."</p> <p>The modification installed new piping and valves in the Unit 1 & 2 'A' train LPI pump rooms that contained the 'A' and 'C' LPI pumps and 'A' building spray (BS) pump. The piping was routed in such a manner that it created new high points that could trap air and other gasses. No vents were included in the design and system fill and vent procedure OP/2/A/1104/004 B, "LPI System Fill and Startup," was not updated in a manner that would prevent gas from accumulating in these pipes following refueling outage maintenance. These deficiencies were not identified by the licensee as part of their review and response to Generic Letter 2008-01</p>			

“Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems.” A primary concern of this review was that licensees ensure that gas accumulation is maintained less than the amount that challenges operability of certain systems, and that appropriate action is taken when conditions adverse to quality are identified. These lines were primarily evaluated for their potential to hold and transport gas to the suction of pumps and cause gas binding. Gas binding was ruled out because the volume of this piping was very small, however the potential for water hammer to affect the pressure boundary function of the relief valves was not recognized. As a result, the valve’s bellows remained vulnerable to being exposed to dynamic pressures that could exceed its design pressure.

On October 19, 2019, during a biennial check valve leakage test, unusual noises were heard when the 2B LPI pump was started. Operators investigated the pump rooms and found an approximate 2 gallons per minute leak through the bonnet vent port of 2LP-196. Later analysis of the valve showed there was a 1/4” long fatigue crack through one of the inner convolution welds of the bellows and that the bellows was angularly deformed by about 8 degrees with minor wear indications on the inside diameter of the convolutions nearest the crack. The test lineup that induced the fracture was representative of the conditions that would be created if the LPI system was activated by an engineered safeguards protective system signal during a small break loss of coolant accident (SBLOCA) once operators secured the ‘A’ train pump before the ‘B’ pump due to a 30 minute time restriction for the pumps to operate deadheaded on their minimum flow lines.

Following the failure, the valve was removed from service and a refurbished replacement was installed. Quality control personnel questioned, in action request 2304186, why the replacement bellows was not QA-1 and identified that the valve drawing didn’t clearly specify which parts were non-safety. Engineers conferred with the vendor and ultimately concluded it was satisfactory to use the bellows as an uncontrolled, non-safety part based on the ASME code. This decision represented a failed opportunity to identify the safety function of the bellows. Although the part was not prescriptively controlled by the ASME code, failure of the bellows could result in leakages that would exceed system leakage assumptions listed in UFSAR Section 6.1.3 used for demonstrating compliance with 10 CFR 50.67, “Accident Source Term.”

Because the repair was being accomplished as online maintenance and the normal refueling outage system fill and vent procedure wasn’t applicable, special instructions were created by operations to vacuum fill the piping by evacuating much of the air from the piping prior to opening the piping to the LPI system. This event represented a missed opportunity to identify the inadequacy of the existing fill and vent procedure for refueling outage maintenance.

In a January 2020 causal evaluation for the failure, engineers identified that acceptance of cross-train leakage since 2013 contributed to the failure by causing the relief valves to lift on potentially every pump start and excessive cycling of the bellows. In January 2021, inspectors identified that this causal determination was in error because the valve that failed was not actually being cycled during pump starts. Monitoring data showed that there was no significant cross-train leakage occurring on Unit 2 from the ‘A’ train discharge header to the ‘B’ train suction header that would cause 2LP-196 to lift. Instead, the failure occurred because of repeated pressurization, from the ‘B’ train discharge header, to the failed valve’s outlet, which is open to the ‘A’ train suction header.

As a result of inspector questions, the licensee obtained a third-party engineering evaluation

that suggested the bellows had been subjected to an excessive backpressure at the valve outlet. This excess pressure would have deformed the bellows and caused it to be susceptible to fatigue failure. The report also concluded that absent the existence of the excessive pressure, the bellows was adequately designed for the intended application if it was of nominal length and pre-compressed during assembly. It was also noted that the failed bellows was shorter than an unused bellows and was outside the tolerances of the manufacturer's commercial drawing. Engineers identified one credible source of excessive pressure as possibly resulting from expulsion of an air pocket through 2LP-195 and subsequent water slug impact with the valve's disk causing a pressure pulse that could propagate back to the discharge of 2LP-196. Air was expected to exist in the system as a result of inadequate filling and venting of these pipes following outage maintenance.

Corrective Actions: New, commercially dedicated, bellows were installed in 2LP-196 on March 3, 2021 and work orders were scheduled to replace bellows in other plant applications. The licensee also took steps to reduce Unit 2 cross-train leakage by tightening certain boundary valves and revised causal evaluations.

Corrective Action References: 2366042

Performance Assessment:

Performance Deficiency: The licensee's design control measures failure to 1) ensure gas accumulation was controlled such that component design pressures specified in station modifications ON-13106 and ON-23106 would be maintained in service and 2) ensure safety-related or commercially dedicated bellows were used in a safety-related application per DUKE-1A was a performance deficiency.

Screening: The inspectors determined the performance deficiency was more than minor because it was associated with the Equipment Performance attribute of the Initiating Events cornerstone and adversely affected the cornerstone objective to limit the likelihood of events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Specifically, the design deficiencies led to an equipment performance issue that increased the likelihood of an interfacing system loss of coolant accident (ISLOCA).

Significance: The inspectors assessed the significance of the finding using Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." Using Exhibit 1, "Initiating Events Screening Questions", a detailed risk evaluation was required because after a reasonable assessment of the degradation, the finding could have likely affected other systems used to mitigate a LOCA (e.g., Interfacing System LOCA). Specifically, leakage of post-LOCA emergency sump fluid into the LPI pump room as a result of a relief valve bellows failure induced by actuation of the LPI system in response to a SBLOCA could cause multiple adverse affects to mitigating equipment. Internal flooding of the room would affect the long-term availability of the 2A and 2C LPI pumps, and the 2A reactor building spray pump. Isolation of the leak during an accident could also render the 'A' LPI suction header unavailable. A regional SRA performed a detailed risk assessment using NRC IMC 0609 Appendix A, The Significance Determination Process (SDP) for Findings At-Power dated November 30, 2020 and IMC 0609 Appendix C Occupational Radiation Safety Significance Determination Process dated August 19, 2008. The SRA modelled the event using SAPHIRE 8 Version 8.2.1 and Oconee Units 1,2, and 3 SPAR model Version 8.60 dated May 13, 2019. Major assumptions were: 1) exposure time of 1 year, 2) leakage rate of 1 gallon per minute, and 3) the non-safety related sump pumps were not credited. The dominant accident sequence was a small break loss of coolant accident with a loss of offsite power, failure of the

2TD 4160V switchgear, and failure of the decay heat removal function after greater than 24 hours.

Appendix C: Due to the potential for LPI leakage rates into the auxiliary building to exceed design limits, control room habitability concerns were evaluated. Occupational dose concerns are addressed using IMC 0609 Appendix C. Since this issue was not an ALARA concern (step 1) and did not result in an actual overexposure (step 5), did not constitute a substantial potential for overexposure (step 11) and the licensee's ability to assess does was not affected (step 14), the concern would screen to green.

Appendix A : Since the Low Pressure Injection system (LPI) primary functions of injection, high pressure recirculation, and low pressure recirculation would not be directly impacted by the leak itself, the LPI pumps were assumed to remain operable until internal flood waters from the rupture would reach the pump motor. Therefore, functionality of the equipment in the room would not be affected until much greater than the 24-hour probabilistic risk assessment mission time, which allows multiple opportunities for recovery prior to the LPI pumps being adversely impacted. The SRA assigned a very low safety significance to the internal flooding concerns.

Conclusion: Based upon the above, the SRA characterize the performance deficiency as very low safety significance (Green).

Cross-Cutting Aspect: P.2 - Evaluation: The organization thoroughly evaluates issues to ensure that resolutions address causes and extent of conditions commensurate with their safety significance. Although the original design deficiencies occurred greater than the nominal three-year period associated with current licensee performance, there were present performance aspects relating to problem identification and resolution that allowed those deficiencies to persist associated with inaccurate evaluations following the October 19, 2019 failure.

Enforcement:

Violation: 10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that the design basis be correctly translated into specifications, drawings, procedures, and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components.

Contrary to the above, the licensee failed to translate the design bases for 1/2LP-195/196 relief valves into station procedures and drawings such that design outlet pressures would be maintained in service. Specifically, station modification ON-13106 and ON-23106 added relief valves at local high points, without providing vent valves or ensuring station fill and vent procedure OP/2/A/1104/004 B, "LPI System Fill and Startup," was adequate to maintain the piping adequately filled with water following refueling outage maintenance to avoid water hammer during system operation.

Contrary to above, the licensee failed to select and review parts for suitability of application that are essential to the safety-related functions of structures, systems and components. Specifically, the safety-related pressure boundary function of the relief valve bellows was not

recognized, and commercial parts were used in a safety-related application without verifying their critical characteristics and suitability for service.

Enforcement Action: This violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the Enforcement Policy.

EXIT MEETINGS AND DEBRIEFS

The inspectors verified no proprietary information was retained or documented in this report.

- On April 20, 2021, the inspectors presented the integrated inspection results to Steven M. Snider and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.01	Corrective Action Documents		02363517	
	Procedures	OP/0/A/1104/011	High Pressure Service Water	105
		OP/0/A/1104/037	Plant Heating	007
		OP/0/A/1104/041	Auxiliary Building Ventilation	045
		OP/0/A/1106/041	Turbine Building Ventilation	011
		OP/0/A/1600/002	Standby Shutdown Facility Heating, Ventilation, and Air Conditioning System Operation (HVAC)	038
		OP/0/B/1104/050	Weather Related Activities	005
		OP/1/A/1104/051	ESV System	028
		OP/2/A/1104/051	ESV System	040
		OP/3/A/1104/051	ESV System	028
PT/0/A/0110/017	Cold Weather Protection	016		
71111.04	Calculations	OSC-7480	LPI/HPI Hydraulic Analysis (EOP Basis)	5
	Corrective Action Documents		2261622, 2267791, 2277471, 2289470, 2332992, 2359235, 2376050, 2376228	
	Drawings	K-0700	One Line Diagram – Relays & Meters – 13.8 – 230KV	
		O-702-A	6900V & 4160V Auxiliary Sys.	39
		OFD-100A-2.1	Flow Diagram of Reactor Coolant System	49
		OFD-102A-2.1	Flow Diagram of Low Pressure Injection System (Borated Water Supply and LPI Pump Suction)	61
		OFD-102A-2.2	Flow Diagram of Low Pressure Injection System (LPI Pump Discharge)	52
		OFD-102A-2.3	Flow Diagram of Low Pressure Injection System (Core Flood)	24
	Miscellaneous		Clearance OPS-2-19-LP-2LP-196-1866	
			Clearance OPS-2-21-LP-195-0392	
Procedures	EP/2/A/1800/001	Unit 2 EOP Loss of Subcooling Margin	1	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		0D		
		EP/2/A/1800/001 0I	Unit 2 EOP LOCA Cooldown	0
		EP/2/A/1800/001 0M	Unit 2 EOP Enclosures 5.1-5.10	1
		EP/2/A/1800/001 0N	Unit 2 EOP Enclosures 5.11-5.20	0
		OP/0/A/1650/006	PSW DC Power	10
		OP/3/A/1106/006	Emergency FDW System	114
		PT/0/A/0500/020	PSW Power Path Test	012
		PT/0/A/0620/009	Keowee Hydro Operation	055
	Work Orders		20438260	
71111.05	Calculations	OSC-9375	ONS Fire PRA Summary Report	4
		OSC-9378	Oconee Fire PRA, Fire Scenario Report	7
	Corrective Action Documents		2049530	
	Drawings	O-0310-K-008	Auxiliary & Reactor Building – Unit 2 Fire Protection Plan & Fire Barrier, Flood & Pressure Boundaries Plan At El. 796+6 & El. 797+6	23
		O-0909	Aux Bldg. - Conduit & Equip. Layout Below El. 809 + 3	33
	Fire Plans	CSD-ONS-PFP-1AB-0809	Unit 1 Auxiliary Building Elevation 809'	0
		CSD-ONS-PFP-1TB-0796	Unit 1 Turbine Building Elevation 796'	0
		CSD-ONS-PFP-2AB-0796	Unit 2 Auxiliary Building Elevation 796'	1
		CSD-ONS-PFP-3AB-0796	Unit 3 Auxiliary Building Elevation 796'	0
		CSD-ONS-PFP-3TB-0796	Unit 3 Turbine Building Elevation 796'	0
	Miscellaneous		Completed fire drill objective evaluation and critique dated	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
			February 15 2021	
	Procedures	AD-EG-ALL-1520	Transient Combustible Control	13
		CSD-ONS-FS-001	Standard Operating Guide General Response Guidelines	1
		CSD-ONS-FS-003	Standard Operating Guide Electrical Fires	0
		MP/0/A/1705/019	Fire Protection – SLC – Related Fire Doors – HELB Doors – Annual and Bi-Monthly Inspections	027
		MP/0/A/1705/032	Fire Hose Stations – Common Areas – SLC Related – Inspections	044
		MP/0/A/1705/032A	Fire Extinguishers – Auxiliary Building – Monthly Inspections	002
		MP/0/A/1705/032B	Fire Extinguishers – Turbine Building – Monthly Inspections	003
		NSD-104	Materiel Condition/Housekeeping, and Seismic Concerns	40
71111.06	Calculations	OSC-8671	Auxiliary Building Flooding	8
	Drawings	CSD-ONS-PFP-2AB-0796	Unit 2, Auxiliary Building, Elevation 796	1
		O-18D	Spent Fuel Pool & Hot Machine Shop Sections	4
		O-438E	Piping Layout Plan and Sections Elevation 796'6"	37
		O-507A	Heating – Ventilation – Air Conditioning Spent Fuel Pool Hot Machine Shop Plan	5
		OFD-104A-1.3	Spent Fuel Cooling System Reverse Osmosis Portion	4
		OFD-106E-1.2	Demineralized Water System (Auxiliary Building Portion)	33
	Engineering Changes	111605	Provide Non-QA Air Conditioning for Operation of the Reverse Osmosis Unit	5
71111.11B	Miscellaneous	JPM	ADM-CO-011	Rev. 00
		JPM	ADM-SO-027	Rev. 00
		JPM	AO-802	Rev. 00
		JPM	AO-S409	Rev. 01
		JPM	CO-105A	Rev. 00
		JPM	CO-606A	Rev. 01
		JPM	ADM-CO-019	Rev. 00
		JPM	ADM-SO-031	Rev. 00

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		JPM	AO-S406	Rev. 01
		JPM	CO-806A	Rev. 00
		JPM	CO-P400A	Rev. 02
		Records	License Reactivation Packages (12 Records Reviewed)	
		Records	LORP Training Attendance Records (16 Records Reviewed)	
		Records	Licensed Operator Medical Files (10 Records Reviewed)	
		Records	Remedial Training Records (11 Records Reviewed)	
		Records	Remedial Training Examinations (11 Records Reviewed)	
		Records	Open Simulator Deficiency Reports (6 Records Reviewed)	
		Records	Closed Simulator Deficiency Reports (75 Records Reviewed)	
		Scenario Evaluation	ASE-22	Rev. 02
		Scenario Evaluation	ASE-04B	Rev. 02
		Scenario Evaluation	ASE-03	Rev. 00A
		Scenario Evaluation	ASE-45	Rev. 01
		Scenario Evaluation	ASE-20	Rev. 01A
		Simulator Scenario Based Test	ILT-20-1 NRC Exam Scenario 2	06/08/2020
		Simulator Scenario Based Test	ASE-19	02/19/2020
		Simulator Test	PT-04 Trip of One Reactor Coolant Pump	12/19/2019
		Simulator Test	PT-15 Dropped Control Rod	11/29/2020
		Simulator Test	Shutdown From Full Power	11/06/2018
		Simulator Test	Unit Startup for Unit Startup	08/28/2018
		Written Examinations	2021 LOCT Biennial 'C' Shift RO Examination	approved 02/04/2021
		Written	2021 LOCT Biennial 'C' Shift SRO Examination	approved

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
	Procedures	Examinations		02/04/2021
		AD-OP-ALL-0107	Maintenance of RO and SRO Licenses	Rev. 03
		AD-TQ-ALL-0068	Licensed Operator Continuing Training Program	Rev. 11
		AD-TQ-ALL-0230	Licensed Operator Requalification Annual and Biennial Exam Development	Rev. 09
		AD-TQ-ALL-0320	Development of Simulator Training and Evaluation Guides	Rev. 07
		AD-TQ-ALL-0410	Remediation and Reevaluation	Rev. 05
		AD-TQ-ALL-0420	Conduct of Simulator Training and Evaluation	Rev. 17
		AD-TQ-ALL-0425	Simulator Scenario Based Testing	Rev. 03
		AD-TQ-ALL-0430	Development and Administration of Job Performance Measures	Rev. 03
		AD-TQ-ALL-0450	Conduct of On-The-Job Training and Task Performance Evaluation	Rev. 06
		AD-TQ-ALL-1000	Conduct of Training	Rev. 21
		CSD-TQ-ALL-0101-01	Systematic Approach to Training Process	Rev. 04
	OTP 2701.0	Oconee Training Center Simulator Configuration Mgmt Guide	Rev. 36	
	Self-Assessments	02362001-05	2021 NRC 71111.11 Simulator Performance Assessment	
		AR# 236200	2021 NRC 7111.11 Readiness Assessment	
71111.11Q	Procedures	AD-OP-ALL-1000	Conduct of Operations	17
		AD-OP-ONS-0004	Duties and Responsibilities of Keowee Personnel	000
		PT/0/A/0500/020	PSW Power Path Test	012
	Work Orders		20438260	
71111.12	Corrective Action Documents		2371339, 2372569, 2372333, 2369229, 2369324, 2361367	
	Drawings	KEE-0113-05-C	Elementary Diagram Turbine Miscellaneous Relaying	17
		KEE-0113-05-E	Elementary Diagram 2 of 3 Phases Out of Tolerance (Frequency and/or Voltage) Logic Circuitry	0
		KEE-0114	Elementary Diagram Generator Control ACB-1 Control Circuit	33
OEE-117-6A		Elementary Diagram 4160 V Switchgear No. B1T (SK1)	15	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
			Standby Fdr. Bkr. Unit No. 5	
		OEE-117-6B	Elementary Diagram 4160 V Switchgear No. B1T (SK1) Standby Fdr. Bkr. Unit No. 5	12
		OM 254-0385.001	Nozzle Type Relief Valve	0
	Engineering Changes		418937	
	Procedures	MP-0-A-1200-010 A	Relief Valve Set Pressure Testing and Adjustment	31
		OP/1/A/2000/101	KHU-1 Alarm Response Guide 1SA-1	11
		PT/0/A/0620/018	KHS Out of Tolerance Test	12/09/2020
	Work Orders		20447424, 20190756	
71111.13	Miscellaneous		ONS Unit 2 – WhatIf 6 Current Risk Summary Report	03/17/2021
			ONS Unit 2 Operator Log, Dayshift	03/17/2021
			Clearance PRT-0-21-B LPSWP OOS-0049	
			Clearance PRT-0-21-RED BUS OOS-0055	
			Phoenix model risk output for Unit 1 on March 29, 2021	
			Phoenix model risk output for Unit 3 on February 4, 2021	
	Procedures	CSD-WC-ONS-0240-00	ONS ERAT Guidance	0
71111.15	Calculations	OSC-11343	Evaluation of MOV Motors and ETAP Inputs	4
		OSC-11581	U1/2/3 Keowee EPS and 100kV APS Voltage Adequacy Analyses	1
		OSC-5881	Acceptable Stroke Time for HP-24 & 25	1
		OSC-5898	Evaluation of EPRI MOV Methodology for 1,2,3HP-24 & 25	5
		OSC-72	Piping Analysis for Problem 4-56-01 Spent Fuel Transfer Tube – Auxiliary Building and Reactor Building	4
		OSC-72	Piping Analysis for Problem 4-56-01 Spent Fuel Transfer Tube – Auxiliary Building and Reactor Building	5
		OSC-7608	U1/2/3, AC Power System ETAP Model Base File	15
	Corrective Action		2364796, 2297905, 2369695, 1881699, 1886192	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
	Documents			
	Drawings	O-2701-C	One Line Diagram Station Auxiliary Circuits 600/208V L/C 3X4 & MCC 3XH, 3XK, 3XR, 3XT	59
		O-2701-E	One Line Diagram Station Auxiliary Circuits 600/208V L/C 3X6 & MCC 3XJ, 3XN, 3XP	57
		OEE-249-14	E/D -Pressurizer Heater Bank No. 1 & 2	27
		OM-271-0235-004	Transfer Tube Assy Duke I, II, III Transfer System	0
		OM-271-0235-005	Transfer Tube Assy – West Side Duke I, II, III Transfer System	2
	Miscellaneous	MPR Report 0079-0237-LTR-001	Assessment of the Continued Operability of Low Pressure Injection System Relief Valve 2LP-196	0
	Procedures	IP/O/A/0200/037	Pressurizer Heater Test and Surveillance	12
Work Orders		20451706		
71111.18	Calculations	OSC-3144	Pressurizer Heat Losses	21
		OSC-4151	Penetration Overcurrent Protection Type III	17
		OSC-6205	Relief Valve Design Parameters for NSM ON-1/23106	0
	Corrective Action Documents		1883249, 1884392, 1821414, 2352911	
	Engineering Changes	106427	Replace 200A and 150A breakers upstream of SSF PZR heater breakers	3
Miscellaneous	OSS-0254.00-00-0004	ASME Section III and Duke Safety Related Class F Safety Valve and Safety Relief Valves	0	
71111.19	Corrective Action Documents		2372333, 2373462, 2372569, 2361715, 2362175, 2368586, 2369752, 2369755	
	Drawings	OEE-117-1	Elementary Diagram Breaker Internal Diagram	6
		OEE-117-17-0A	Elementary Diagram 4160 Volt Switchgear No. B2T Normal Breaker Unit No. 3	14
		OFD-104A-1.3	Flow Diagram of Spent Fuel Cooling System Reverse Osmosis Portion	4
	OFD-104A-3.1	Flow Diagram of Spent Fuel Cooling System	55	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		OFD-104A-3.2	Flow Diagram of Spent Fuel Cooling System Purification System	21
	Procedures	MP/0/A/1300/080	Pump – Vacuum – Siemens – Essential Siphon – Removal, Repair, and Installation	013
		OP/0/A/1107/011 B	Removal and Restoration of EPSL Breakers	10
		OP/2/A/1104/051	ESV System	040
		PT/2/A/0261/010	Essential Siphon Vacuum System Test	032
Work Orders		20297870, 20307361		
71111.22	Calculations	OSC-2515	Verification of Emergency Feedwater System Flow Utilizing MFW System Bypass	25
	Drawings	OFD-133A-2.1	FLOW DIAGRAM OF CONDENSER CIRCULATING WATER SYSTEM (CCW INTAKE PUMPS DISCHARGE)	36
		OFD-133A-2.5	FLOW DIAGRAM OF CONDENSER CIRCULATING WATER SYSTEM (SSF AUX. SERVICE)	061
	Miscellaneous	ONTC-2-133A-0004-001	TEST ACCEPTANCE CRITERIA SSF ASW SUCTION PIPE AIR INJECTOR TEST	04
		OSS-0254.00-00-1000	Design Basis Specification for the Emergency Feedwater System	56
		OSS-0254.00-00-1005	DESIGN BASIS SPECIFICATION FOR THE STANDBY SHUTDOWN FACILITY AUXILIARY SERVICE WATER SYSTEM	044
	Procedures	PT/0/A/0400/005	SSF Auxiliary Service Water Pump Test	070
		PT/0/A/0620/009	Keowee Hydro Operation	055
	Work Orders		20441384	
	71151	Miscellaneous		Unit 1 MSPI Margin Report, High Pressure Injection System, December 2020
			Unit 2 MSPI Margin Report, High Pressure Injection System, December 2020	
			Unit 3 MSPI Margin Report, High Pressure Injection System, December 2020	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
			Unit 2 MSPI Derivation Report, High Pressure Injection System, URI, December 2020	
			Unit 3 MSPI Derivation Report, High Pressure Injection System, UAI, December 2020	
71152	Calculations	OSC-10790	Oconee Nuclear Station Internal Flooding Analysis	3
		OSC-6667	Auxiliary Building and Turbine Building Loss of Cooling and Ventilation Analysis	23
		OSC-7734	Maximum Hypothetical Accident (MHA) Dose Analysis	16
		OSC-8671	Auxiliary Building Flood Design Values	8
		OSC-9610	Evaluation of LPI, CF, RBS, & HPI Systems for Generic Letter 2008-01	2
	Corrective Action Documents		2372489, 2371950, 2364796, 1843695, 1848567, 2131043, 2291857, 2297905, 2345473, 1765760, 1788959, 1817888, 1884392, 1883249, 1882428, 2341042, 2367757, 2359748, 2358012	
	Drawings	KEE-0213-05-D	Elementary Diagram 2 of 3 Phases Out of Tolerance (Frequency and/or Voltage Logic Circuitry)	0
	Miscellaneous		Selected Licensee Commitment 16.6.4, LPI System Leakage	November 15, 2012
			GL 08-01 Evaluation – 2LP-196 Isolation	October 20, 2019
	Procedures	AD-OP-ALL-0110	General Equipment Operating Standards	3
		AD-OP-ALL-0200	Clearance and Tagging	20
		EP/2/A/1800/001 0N	Unit 2 EOP Enclosures 5.11-5.20	0
		IP/0/A/4980/081 E	ABB Type 81 Relay Test	016
		OP/2/A/1104/004 B	LPI System Fill and Startup	35
PT/2/A/0150/067		2LP-40 & 2LP-41 Leak Test	10	
Work Orders		20303828, 20397564, 20417442		
71153	Corrective Action Documents		1764283, 2374210, 2373925	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
	Drawings	O-422M-48	Instrumental Detail FWPT Control Oil Pressure	12
		OEE-147-2	Elementary Diagram Emergency FWPT System Isolation Valve and Misc. (1MS-93)	28
		OEE-147-2B	Elementary Diagram Emergency FWPT System Isolation Valve and Misc. (1MS-93)	8
	Miscellaneous		Operations Supplemental Information Package 21-10	03/15/2021
	Procedures	AD-OP-ALL-0110	General Equipment Operating Standards	3
		AD-OP-ALL-0204	Plant Status Control	5
		AD-OP-ALL-1000	Conduct of Operations	17
		IP/1/A/0275/006 C	Unit 1 Safety Related Functional Test of the MDEWFP and TDEFWP Initiation Pressure Switches and Cooling Water Valves	7
		OP/1/A/1106/006	Emergency FDW System	133
	Work Orders		20376291	