Progress Energy

Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

August 11, 2011
3F0811-02

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Crystal River Unit 3 – Response to Request for Additional Information to Support NRC Balance of Plant Branch Acceptance Review of the CR-3 Extended Power Uprate LAR (TAC No. ME6527)

References:
1. CR-3 to NRC letter dated June 15, 2011, "Crystal River Unit 3 – License Amendment Request #309, Revision 0, Extended Power Uprate" (Accession No. ML112070659)
2. Email from S. Lingam (NRC) to D. Westcott (CR-3) dated, July 25, 2011, "Crystal River, unit 3 - EPU LAR (ME6527)"

Dear Sir:

By letter dated June 15, 2011, Florida Power Corporation (FPC), doing business as Progress Energy Florida, Inc., requested a license amendment to increase the rated thermal power level of Crystal River Unit 3 (CR-3) from 2609 megawatts (MWt) to 3014 MWt. The proposed license amendment is considered an Extended Power Uprate (EPU). On July 25, 2011, via electronic mail, the NRC provided a request for additional information (RAI) related to turbine generator missile generation, Spent Fuel Pool Cooling and Cleanup System, and modification of the emergency feedwater pump recirculation valves needed to support the Balance of Plant Branch acceptance review of the CR-3 EPU License Amendment Request (LAR).

Attachment A to this submittal, "Response to Request for Additional Information to Support NRC Balance of Plant Branch Acceptance Review of the CR-3 EPU LAR," provides the CR-3 formal response to the RAI.

In support of the CR-3 EPU acceptance review RAI responses, four enclosures are provided. Enclosure 1, "Siemens Technical Report CT-27438, "Missile Probability Analysis Report Progress Energy Crystal River 3," Revision 1 (Confidential), provides the CR-3 specific turbine missile generation probability analysis performed for EPU conditions. Enclosure 2, "Siemens Technical Report CT-27438, "Missile Probability Analysis Report Progress Energy Crystal River 3," Revision 1A (For Public Record), provides a redacted version of the CR-3 specific turbine missile generation probability analysis. Enclosure 3, "EFW Pump Recirculation Valve Simplified Diagrams (Figures 1 and 2)," provides simplified diagrams of the proposed addition of emergency feedwater (EFW) pump recirculation valves. Enclosure 4, "Summary of Emergency Feedwater Pump Recirculation Valve Modification Failure Modes and Effects Analysis," provides a summary of the Failure Modes and Effects Analysis prepared for the new EFW pump recirculation valves.

A001
NRR

Progress Energy Florida, Inc.
Crystal River Nuclear Plant
15760 W. Powerline Street
Crystal River, FL 34428

Enclosure 1 contains Siemens Technical Report CT-27438 which includes information that Siemens considers confidential. Siemens Energy, Inc., as the owner of that confidential information, has executed the affidavit provided in Attachment B and states that the identified proprietary information has been classified as confidential, is customarily held in confidence, and not made available to the public. Siemens requests that the identified confidential information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390(a)(4). Enclosure 2 is a for public record copy of Siemens Technical Report CT-27438 with the confidential information redacted.

This correspondence contains no new regulatory commitments.

If you have any questions regarding this submittal, please contact Mr. Dan Westcott, Superintendent, Licensing and Regulatory Programs at (352) 563-4796.

Sincerely,

Jon A. Franke
Vice President
Crystal River Nuclear Plant

JAF/gwe

Attachments:

A. Response to Request for Additional Information to Support NRC Balance of Plant Branch Acceptance Review of the CR-3 EPU LAR

B. Siemens Affidavit for Withholding Proprietary Information from Public Disclosure

Enclosures:

1. Siemens Technical Report CT-27438, "Missile Probability Analysis Report Progress Energy Crystal River 3," Revision 1 (Confidential)

2. Siemens Technical Report CT-27438, "Missile Probability Analysis Report Progress Energy Crystal River 3," Revision 1A (For Public Record)

3. EFW Pump Recirculation Valve Simplified Diagrams (Figures 1 and 2)

4. Summary of Emergency Feedwater Pump Recirculation Valve Modification Failure Modes and Effects Analysis

xc: NRR Project Manager
Regional Administrator, Region II
Senior Resident Inspector
State Contact

STATE OF FLORIDA

COUNTY OF CITRUS

Jon A. Franke states that he is the Vice President, Crystal River Nuclear Plant for Florida Power Corporation, doing business as Progress Energy Florida, Inc.; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

Jon A. Franke
Vice President
Crystal River Nuclear Plant

The foregoing document was acknowledged before me this 11 day of August, 2011, by Jon A. Franke.

Signature of Notary Public
State of Florida

CAROLYN E. PORTMANN
Commission # DD 937553
Expires March 1, 2014
Bonded Thru Troy Fain Insurance 800-385-7019

(Print, type, or stamp Commissioned Name of Notary Public)

Personally Known ✓ -OR- Produced Identification ______

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 /LICENSE NUMBER DPR-72

ATTACHMENT A

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION TO SUPPORT NRC BALANCE OF PLANT BRANCH ACCEPTANCE REVIEW OF THE CR-3 EPU LAR

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION TO SUPPORT NRC BALANCE OF PLANT BRANCH ACCEPTANCE REVIEW OF THE CR-3 EPU LAR

By letter dated June 15, 2011, Florida Power Corporation (FPC), doing business as Progress Energy Florida, Inc., requested a license amendment to increase the rated thermal power level of Crystal River Unit 3 (CR-3) from 2609 megawatts (MWt) to 3014 MWt. The proposed license amendment is considered an Extended Power Uprate (EPU). On July 25, 2011, via electronic mail, the NRC provided a request for additional information (RAI) related to turbine generator missile generation, Spent Fuel Pool Cooling and Cleanup System, and modification of the emergency feedwater pump recirculation valves needed to support Balance of Plant Branch acceptance review of the CR-3 EPU License Amendment Request (LAR).

NRC Request for Additional Information

Our Balance-of-Plant Branch completed an acceptance review of the Crystal River 3 EPU LAR. We found the application unacceptable with opportunity to supplement consistent with the guidelines of LIC-109. This conclusion is based on the following 3 information insufficiencies in the Technical Report associated with the LAR:

1. Section 2.5.1.2.2 of the TR describes that the replacement turbine will have a missile generation probability of 3.5 E-05 based on a 100000 hour inspection interval, which the licensee described as satisfying NRG Guidelines from SRP Section 3.5.1.3. However, the licensee provided no description of the analysis used to determine the missile generation probability. At a minimum, the licensee must include a description of the methodology, the basis for acceptance of the methodology, and assumptions used in the analysis.

2. Section 2.5.4.1 of the TR describes how acceptable pool temperatures of less than 160°F can be achieved at EPU conditions by extending the time after shutdown. However, the licensee does not describe how these analysis results would be translated into procedures for refueling, consistent with the requirements of Criterion 5 of 10 CFR Part 50, Appendix B. The applicant must describe the effect of the analysis results on plant operating procedures subject to quality assurance program requirements, such as refueling procedures.

3. In several locations in the LAR, the licensee briefly describes a modification to the minimum flow recirculation control for the emergency feedwater pumps. Improper operation of the modification could cause failure of the pump, and the modification could be configured such that it introduces cross-train dependencies. The licensee must provide details of the modification necessary to establish that the modification would not adversely affect the independence of the emergency feedwater trains, such as a failure modes and effects analysis, and that the modification would not substantially reduce the reliability of the individual pumps (TMI Action Plan Item II.E.1.1), consistent with the guidelines of SRP Section 10.4.9.

CR-3 Responses:

1. **Section 2.5.1.2.2 of the TR describes that the replacement turbine will have a missile generation probability of 3.5 E-05 based on a 100000 hour inspection interval, which the licensee described as satisfying NRG Guidelines from SRP Section 3.5.1.3. However, the licensee provided no description of the analysis used to determine the missile generation probability. At a minimum, the licensee must include a description of the methodology, the basis for acceptance of the methodology, and assumptions used in the analysis.**

An analysis to determine the turbine missile generation probability was performed for EPU conditions. A description of the methodology used and the analysis results are documented in Siemens Technical Report CT-27438, "Missile Probability Analysis Report Progress Energy Crystal River 3" (Enclosures 1 and 2) for the Siemens BB281-18m^2 low pressure (LP) turbine design. This CR-3 turbine missile probability analysis used the missile analysis methodology provided in Siemens Technical Report CT-27332, "Missile Probability Analysis for the Siemens 13.9 M^2 Retrofit Design of Low-Pressure Turbine by Siemens AG" (Reference 2). This methodology has been previously approved by the NRC for the BB281-13.9m^2 LP turbine design, which is an advancement over the Westinghouse BB281 model originally used at CR-3, as documented in a letter from Herbert Berkow (NRC) to Stan Dembkoski (SWPC), dated March 30, 2004 (Reference 3). In the associated NRC Safety Evaluation, the NRC staff concluded that the technical report could be applied generically to other designs that are dimensionally different but follow the same missile analysis methodology.

Assumptions used in the CR-3 turbine missile generation probability analysis documented in the CR-3 specific Technical Report CT-27438 are equivalent to those documented in the NRC approved Technical Report CT-27332.

A confidential version of the Siemens Technical Report CT-27438 is provided in Enclosure 1 and a for public record copy of the report is provided in Enclosure 2.

Maintenance, inspection and testing associated with the turbine rotors and the turbine overspeed control system, including frequencies of these activities, will not change as a result of EPU. CR-3 utilizes a quarterly test frequency for the main turbine governor and throttle valves and an inspection interval on the turbine rotors and blades of every five refueling outages (approximately 10 year interval or < 87,600 operating hours), which is conservative to the manufacturer recommended inspection frequency of 100,000 operating hours. These current testing and inspection frequencies ensure a reasonably low probability of generating turbine missiles.

2. **Section 2.5.4.1 of the TR describes how acceptable pool temperatures of less than 160°F can be achieved at EPU conditions by extending the time after shutdown. However, the licensee does not describe how these analysis results would be translated into procedures for refueling, consistent with the requirements of Criterion 5 of 10 CFR Part 50, Appendix B. The applicant must describe the effect of the analysis results on plant operating procedures subject to quality assurance program requirements, such as refueling procedures.**

Consistent with 10 CFR 50, Appendix B, Criterion V requirements, the CR-3 spent fuel pool (SFP) steady state temperature of 160°F is currently quantitatively controlled via plant operating procedures by providing appropriate limitations and requirements. CR-3 procedure controls include;

- Operating Daily Surveillance Log provides a maximum SFP temperature acceptance criterion of 120°F;
- SFP high temperature alarm setpoint is 140°F;
- SFP cooling operation procedure provides steps to operate two SFP cooling pumps in parallel, during refueling and when defueled, to ensure the SFP temperature is maintained < 160°F;
- SFP cooling operation procedure provides a Note that precludes placing the purification demineralizer in service with SFP temperature ≥ 140°F;
- Refueling operation procedures require Reactor Coolant System (RCS) temperature to be ≤ 140°F during core offload, shuffles, and reload, which translates to the SFP when RCS is connected to the transfer canal; and
- Refueling operation procedures require the reactor to be subcritical for at least 150 hours prior to movement of irradiated fuel in the reactor vessel to ensure SFP thermal analysis assumptions are maintained. A Note in this procedure allows fuel to be transferred to the SFP before 150 hours if an engineering evaluation of the SFP thermal performance is made provided the reactor has been subcritical for 72 hours consistent with the fuel handling accident assumption.

A summary of the bounding analyses is presented in Section 2.5.4.1, "Spent Fuel Pool Cooling and Cleanup System," of the CR-3 EPU Technical Report (TR) (Reference 1, Attachment 7). The bounding analysis indicates that, with a full core offload after operating at EPU conditions for a full fuel cycle, both trains of SFP cooling capacity is greater than the core decay heat load at 11.24 days (270 hours).

Potentially affected calculations and associated procedures are identified for EPU implementation and are being tracked for revision via the CR-3 engineering change (EC) process. In accordance with the CR-3 EPU LAR Regulatory Commitment 2 (Reference 1, Attachment 10), procedures subject to quality assurance program requirements, such as refueling operation procedures, will be modified to reflect the analysis results presented in Section 2.5.4.1 of the CR-3 EPU TR prior to exceeding 2609 MWt. Specifically, the refueling operation procedure will be updated to require the reactor to be subcritical for at least 270 hours prior to movement of irradiated fuel in the reactor vessel. Additionally, the current allowance to perform an engineering evaluation which allows fuel to be

transferred to the SFP before the analysis delay time (270 hours) will be maintained for operation at EPU conditions provided the reactor has been subcritical for 72 hours.

3. **In several locations in the LAR, the licensee briefly describes a modification to the minimum flow recirculation control for the emergency feedwater pumps. Improper operation of the modification could cause failure of the pump, and the modification could be configured such that it introduces cross-train dependencies. The licensee must provide details of the modification necessary to establish that the modification would not adversely affect the independence of the emergency feedwater trains, such as a failure modes and effects analysis, and that the modification would not substantially reduce the reliability of the individual pumps (TMI Action Plan Item II.E.1.1), consistent with the guidelines of SRP Section 10.4.9.**

As stated in Appendix E, "Major Plant Modifications," of the CR 3 EPU TR (Reference 1, Attachment 7), Emergency Feedwater (EFW) System flow needs to be increased roughly in proportion to decay heat for EPU conditions. The required EFW pumps can supply the required flow, but are currently prevented from doing so by continuously in-service recirculation flow paths. An upgrade to the EFW pumps recirculation design is being developed in accordance with the CR 3 EC process to support the higher EFW flow requirements to the once-through steam generators (OTSGs) at EPU conditions. The EFW pump recirculation line modification design considers the probability of pump failure due to improper operation of the new components and ensures cross-train dependencies are not introduced as a result of the modification, thereby maintaining independence of the EFW trains.

<u>EFW Pump Recirculation Line Modification Overview</u>

As described in Section 2.8.5.2.3, "Loss of Normal Feedwater," and Appendix E of the CR 3 EPU TR (Reference 1, Attachment 7), the most limiting Design Basis Accident (DBA) for EFW System flow is the loss of feedwater (LOFW) event that requires a minimum EFW flow of 660 gallons per minute (gpm) (330 per SG) within 40 seconds. The current minimum required flow of EFW is 550 gpm (275 gpm per SG) within 60 seconds. Therefore, in order to meet the new flow requirements for EPU, the EFW System will be modified by installing new safety-related operated valves in the currently continuously open EFW pump recirculation lines. The recirculation valves will close when flow (as detected by differential pressure switches) to the OTSGs is sufficient to meet or exceed the pump manufacture's minimum recommended flow rates and reopen prior to EFW pump flow demand dropping below the minimum required pump flow rate. The differential pressure switches are provided with a dead band to prevent or minimize excessive cycling of the new recirculation valves. By installing valves in the recirculation lines that automatically close during times of high flow to the OTSGs, the current EFW pumps capacity and head can supply the OTSGs under EPU conditions.

The EFW System consists of two independent, 100% capacity, safety-related trains. The A EFW train consists of a diesel driven pump (EFP-3), flow limiting cavitating venturi, and flow control valves to each OTSG. The B EFW train consists of a turbine driven pump (EFP-2), flow limiting cavitating venturi, and flow control valves to each OTSG. Each of the new recirculation valves will be controlled by three safety-related differential pressure switches that sense flow across the associated cavitating venturi. A "2 out of 3 logic" will be required to open or close the associated safety-related EFW pump recirculation valve. EFW pump recirculation valve simplified piping diagrams are provided in Enclosure 3 showing the new valves in the EFW pump recirculation line and the sensing differential pressure instrumentation. The differential pressure switches, logic, control and motive power for each recirculation valve will be powered from the same safety-related electrical train as the associated EFW train.

A control switch will be added to the control room for each of the new EFW pump recirculation valves. Each switch will have "open" position to allow overriding the automatic operation forcing the valve to the open position. Control room alarms will also provide indication of the new valves "out of position" when the control switches are overriding the automatic function. As stated in the proposed CR-3 Improved Technical Specifications (ITS) Bases B 3.7.5, "Emergency Feedwater System" (Reference 1, Attachment 4), the EFW pump low flow instrumentation is required to be capable of closing the associated recirculation line isolation valve in sufficient time to ensure that EFW discharge flow to the OTSGs as assumed during transients and accidents is met. Thus, if an EFW pump recirculation valve control switch is placed in the open position, the associated EFW train would be rendered inoperable and ITS 3.7.5 Actions would apply.

<u>EFW Train Independence</u>

Enclosure 4 provides a summary of a failure mode and effects analysis (FMEA) conducted for the EFW pump recirculation valve modification. The FMEA was prepared in accordance with the general guidelines of ANSI/IEEE 352-1987, "IEEE Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Safety Systems." Note that the Number column in Enclosure 4 provides an arbitrary reference number for individual components or group of components and may be referenced by other failures in the matrix for cascading failures (e.g., Enclosure 4, Row 70.2). Note 1 to the Enclosure 4 table is also provided for failure sets which assume varied EFW flows through the cavitating venturi.

The FMEA indicates that there are no new potential EFW System failures that could result from human errors, common causes, single-point vulnerabilities, and test and maintenance outages as a result of the EFW pump recirculation valve modification which would prevent the EFW System from performing its intended safety function consistent with the position of NUREG-0737, "Clarification of TMI Action Plan Requirements,"

Item II.E.1.1. As indicated by the FMEA, postulated component failures are bounded by the current failure of a single EFW train and do not prevent the EFW System from performing its intended safety function.

Each EFW train is mechanically independent since each train has its own suction line from the emergency feedwater tank (EFT-2), pump, recirculation line back to EFT-2, cavitating venturi, and piping with flow control valves to each OTSG. Although piping cross connections are supplied at the suction piping from EFT-2 and at the discharge lines to the OTSG's, these cross connections are only used for defense in depth and are controlled via ITS Surveillance Requirements (i.e., SR 3.7.5.1) to maintain independence. ITS SR 3.7.5.1 requires, in part, that each EFW manual, power operated, and automatic valve in each water flow path that is not locked, sealed, or otherwise secured in position, is in the correct (i.e., accident) position. The addition of a safety-related recirculation valve on each independent EFW train recirculation line and utilizing the associated cavitating venturi for flow measurement will not impact this mechanical independence.

Each EFW train is electrically independent with all system instrumentation and controls (I&C) and electrical power supplied by independent safety related busses and batteries. The current electrical and I&C portions of the EFW System are designed and installed in accordance with IEEE 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations," which ensures independence with no cross-train dependence. The new EFW pump recirculation valves, including the control circuits, control room switches, and alarms are also being designed and procured using the same standard (i.e., IEEE 279-1971).

In addition to mechanical and electrical independence, the EFW trains are physically separated. The A EFW train (EFP-3) is located in its own safety-related building located on the west side of the plant. Also located in this building is all of the auxiliary equipment, including starting air, fire protection, HVAC, cavitating venturi, recirculation line, etc. The B EFW train (EFP-2) and all its auxiliary equipment is located in the Intermediate Building inside the plant. The new recirculation valves and associated differential pressure switches will be installed locally in the associated pump rooms. This ensures that the physical separation of the current EFW System is maintained following completion of the modification.

Based on the conceptual design of the new EFW pump recirculation valves and the results of the associated FMEA, CR 3 has determined that mechanical, electrical, and physical separation and independence of the EFW System will be maintained and that no new common mode failures are created by the modification.

EFW Pump Protection and Reliability

The EFW System modification installing new EFW pump recirculation valves is designed to maintain or enhance overall reliability by focusing on long term EFW pump protection. The current B train EFW pump (EFP-2) has a limitation on the time that it can be operated under normal conditions (approximately 3 hours) due to an undersized recirculation line (1 inch). Because of the undersized line, the minimum manufacture recommended flow rate of 250 gpm for continuous operation of the pump cannot be achieved with flow solely through the minimum flow line. In addition, the undersized line results in very high flow velocities which have resulted in past modification to change materials and increase pipe thickness to compensate for the wear from these high velocities. The EFW pump recirculation valve modification ensures the pump recirculation line is isolated when flow to the OTSGs is sufficient to meet minimum recommended flow rates and automatically un-isolates prior to EFW pump flow dropping below the minimum required pump flow rate. Adding the automatic recirculation valves will allow the recirculation line to be increased in size from the current 1 inch to a 2 inch line while still maintaining adequate pump margin. The increase in the recirculation line size will improve the recirculation flow rate to support continuous operation of the EFW pump and decrease the flow velocities to normally acceptable rates.

The new EFW pump recirculation valves and control logic are designed to ensure pump protection for long term reliability. Although the safety function position of the valve is closed to ensure the minimum 660 gpm for the LOFW event, the new valves are spring to open and will fail open on a loss of power. In addition the control logic was designed requiring 2 of 3 flow signals to close the valve and no ability to manually close the recirculation is provided in the main control room. This design was chosen to minimize the probability of operating the EFW pump with no flow resulting in possible pump damage. Designing the valves to fail in the open position is considered acceptable based on:

- The LOFW event analysis for EPU conditions indicates that a required EFW flow of 660 gpm. If an EFW pump recirculation valve fails in the closed position, the EFW pump can still supply the required EFW flow to the OTSGs. However, when flow demand to the OTSGs decreases, pump minimum flow requirements may not be met resulting in possible pump damage and loss of the EFW pump for long term accident mitigation.

- The current worst case single failure is a complete loss of an EFW train (e.g., pump fails to start, loss of both control valves, etc). The failure of a new EFW pump recirculation valve on one EFW train is considered a single failure. As a result of one EFW pump recirculation valve failing open, one EFW train could not supply the needed 660 gpm, however, the redundant EFW train would be

available to supply the required flow to the OTSGs, and the affected EFW pump would be available with a reduced flow to the OTSGs.

To ensure the reliability of the new components being installed under this modification, components (e.g., valves, pressure transmitters, etc.) are being designed, fabricated, and procured as safety-related. In addition to IEEE 279-1971 and IEEE 352-1987, the new components are also being seismically and environmentally qualified as applicable and are being designed to meet or exceed the codes and standards as required by CR-3 current licensing basis, including the following:

- IEEE 308-1969, "Criteria for Class 1E Electrical Systems,"
- IEEE 323-1974, "IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations," and
- IEEE 344-1971, "IEEE Guide for Seismic Qualification of Class I Electrical Equipment for Nuclear Power Generating Stations."

As described in Section 2.13, "Risk Evaluation," of the CR 3 EPU TR (Reference 1, Attachment 7), CR-3 uses a probabilistic safety assessment (PSA) model to determine the effect of the EPU modifications on core damage frequency (CDF) and large early release frequency (LERF). PSA analyses performed for the EPU indicate that the increased EFW flow assumed in the LOFW analysis is not required to prevent core damage. Therefore, the new EFW pump recirculation valves do not change the PSA success criteria of the EFW System and the new recirculation valves are not included in the PSA model for EPU.

CR-3 concludes that since; the new EFW System components are being designed to meet or exceed the current CR-3 codes and standards, the modification is designed with a high emphasis on pump protection and reliability for long term availability, and there is no affect to the CDF or LERF; the modification to the EFW System will not significantly reduce the reliability of the individual EFW pumps to perform their safety function.

References

1. CR-3 to NRC letter dated June 15, 2011, "Crystal River Unit 3 – License Amendment Request #309, Revision 0, Extended Power Uprate" (Accession No. ML112070659).

2. Siemens Technical Report CT-27332, "Missile Probability Analysis for the Siemens 13.9 M^2 Retrofit Design of Low-Pressure Turbine by Siemens AG" Revision 2.

3. Letter from Mr. Herbert N. Berkow, (NRC) to Mr. Stan Dembkoski (SWPC) dated March 30, 2004, Subject: Final Safety Evaluation Regarding Referencing the Siemens Technical Report No. CT-27332, Revision 2, "Missile Probability Analysis for the Siemens 13.9 M^2 Retrofit Design of Low-Pressure Turbine by Siemens AG" (TAC No. MB7964).

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 /LICENSE NUMBER DPR-72

ATTACHMENT B

SIEMENS AFFIDAVIT FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

AFFIDAVIT OF WITHHOLDING

I, John P. Musone hereby provide this Affidavit and state as follows:

1. I am Assistant Secretary for Siemens Energy, Inc., having its principle offices at 4400 Alafaya Trail, Orlando, Florida 32826 ("Siemens"), and Associate Chief Intellectual Property Counsel for its parent Siemens Corporation.

2. This statement is under 10 C.F.R. 2.390 and NRC Regulatory Issue Summary 2004-11.

3. 10 C.F.R. 2.390(a)(4) provides for nondisclosure of information provided to the Nuclear Regulatory Commission that constitutes "trade secrets and commercial or financial information obtained from a person and privileged or confidential."

4. 10 C.F.R. 2.390(b)(1)(ii) and (iii) provide for submission of an Affidavit as the mechanism by which such nondisclosure is affected, and specifies that the Affidavit --

   A. Identifies the document or part sought to be withheld;
   B. Identifies the official position of the person making the affidavit;
   C. Declares the basis for proposing the information be withheld, encompassing considerations set forth in Sec. 2.390(a);
   D. Includes a specific statement of the harm that would result if the information sought to be withheld is disclosed to the public; and
   E. Indicates the location(s) in the document of all information sought to be withheld;
   F. Contain a full statement of the reason for claiming the information should be withheld from public disclosure. Such statement shall address with specificity the consideration listed in paragraph (b)(4) of this section.

5. Following the Overview, this Affidavit tracks the affidavit organization and requirements of 10 C.F.R. 2.390.

Overview

6. Siemens contracted with Progress Energy Florida, (PEF) to design, fabricate, deliver and install BB281-18m^2 turbine improvements to PEF's Crystal River #3 Nuclear Power Plant in Crystal River Florida. In preparation of the design of the BB281-18m^2 turbine, Siemens performed a Missile Probability Analysis and documented this analysis in Missile Probability Analysis Report CT-27438 Revision 1 dated 8/25/2008 (the "MPAR").

7. PEF has requested Siemens permission to provide the MPAR to the NRC. Siemens is amenable to provide a redacted version of the MPAR titled Missile Probability Analysis Report CT-27438 Revision 1A dated 8/05/2011 (the "R-MPAR").

8. The MPAR contains highly sensitive and confidential design information which embodies Siemens' state-of-the-art design and analysis parameters for Siemens turbine rotors.

9. Public disclosure of the MPAR would (i) provide a windfall shortcut for Siemens competitors to obtain Siemens' rotor design and analysis parameters and thereby replicate Siemens components, and (ii) allow Siemens competitors to glean the capabilities and limits of Siemens' technology. This confidential information is invaluable when competing and akin to having the opposing team's playbook before and during the big game.

Document or Part Sought to be Withheld

10. Siemens specific confidential rotor design and parameters and calculation results contained within the MPAR prepared by Siemens pertaining to the BB281-18m^2 turbine improvements at PEF's Crystal River #3 Nuclear Power Plant.

Official Position of Person Making the Affidavit

11. The person making this Affidavit is John P. Musone, Assistant Secretary for Siemens Energy, Inc., having its principle offices at 4400 Alafaya Trail, Orlando, Florida 32826 ("Siemens"), and Associate Chief Intellectual Property Counsel for its parent Siemens Corporation.

Basis for the Information to be Withheld

12. The basis for the information to be withheld, is Section 2.390(a)(4) – "trade secrets and commercial or financial information obtained from a person and privileged and confidential." The person to provide the information is Siemens via PEF. The trade secret information is the specific rotor design parameters and calculation results contained within the MPAR prepared by Siemens pertaining to the BB281-18m^2 turbine improvements at PEF's Crystal River #3 Nuclear Power Plant that is confidential and proprietary to Siemens and only provided to PEF under strict terms of confidentiality.

Specific Statement of Harm Due to Public Disclosure

13. The general public has no defined interest in the specific confidential rotor design parameters and calculation results contained within the MPAR and would not undergo any harm due to its nondisclosure. The general public presumably is not interested in replicating Siemens components. The specific confidential rotor design parameters and calculation results contained within the MPAR provide no newsworthy or publicly-relevant information regarding the Crystal River Nuclear Plant. A false argument could be made that Siemens' competitors are "the public" and that they would be harmed because they would then not obtain a windfall shortcut to replicate Siemens components and glean Siemens capabilities.

Locations in the Document of Information to be Withheld

14. The portions of the R-MPAR identified in brackets that illustrate confidential rotor design parameters and calculation results (e.g. rotor disk temperatures, rotor disk stresses, fracture toughness and yield strength information, rotor disk crack initiation probability(s), simulation results) for the Crystal River #3 BB281-18m^2 turbine has been withheld.

Full Statement of Reason for Claiming the Information Should be Withheld

15. Through its own innovation, substantial investment in research and development and by virtue of its long established experience as a world renowned going-concern in the power generation industry, Siemens successfully developed the turbine design embodied BB281-18m^2 turbine delivered to PEF. Siemens prepared the MPAR which in turn discloses the design parameters and calculation results (e.g. rotor disk temperatures, rotor disk stresses, fracture toughness and yield strength information, rotor disk crack initiation probability(s) and simulation results) from which Siemens' turbine is designed and manufactured. Public disclosure of the MPAR would (i) provide a windfall shortcut for Siemens competitors to obtain Siemens' rotor design parameters and thereby replicate Siemens components, and (ii) allow Siemens competitors to glean the capabilities and limits of Siemens' technology. This confidential information is invaluable when competing and akin to having the opposing team's playbook before and during the big game.

16. Siemens' specific turbine design information as embodied in the MPAR is valuable, confidential and proprietary business assets of Siemens and constitute trade secrets. They derive independent economic value from not being generally known and not being readily ascertainable by proper means by other persons who can obtain economic value from their disclosure or use. It is Siemens' understanding that the specific turbine design information as embodied in the MPAR is customarily held in confidence throughout the industry and is not made publicly available.

17. Siemens has adopted reasonable measures to maintain the secrecy of its trade secrets; to-wit: securing their business offices and facilities with private fences and borders restricting access via key pads requiring individual access codes, locking main building doors, locking file cabinets, password-protecting computer files, using automated e-mail encryption, and locking portable computers. Siemens also shreds confidential documents that are no longer in use.

18. In addition, Siemens requires its employees with access to Siemens trade secrets, to execute confidentiality agreements agreeing to maintain the confidentiality of the trade secrets. Further, Siemens employees are required to complete instruction modules covering, *inter alia,* protection of corporate confidential information and the importance of maintaining the secrecy of Siemens' trade secrets. Siemens' employees are also required to participate in routine security programs and checks directed by company security officers to ensure that the security measures are being followed.

19. Siemens further requires that, prior to any provision of Siemens confidential information to a third party, Siemens's management must authorize such disclosure and the third party must first execute a confidentiality agreement agreeing to maintain Siemens's confidential information in confidence. Siemens included a confidentiality provision in its contract with PEF.

20. For the foregoing reasons, Siemens' specific turbine design information as embodied in the MPAR comprise its confidential, proprietary and trade secret information. The general public has no defined interest in this design information and would not undergo any harm due to its nondisclosure. On the other hand, public disclosure of this design information would (i) provide a windfall shortcut for Siemens competitors to obtain Siemens' rotor design parameters and thereby replicate Siemens components, and (ii) allow Siemens competitors to glean the capabilities and limits of Siemens' technology. It is therefore respectfully requested that portions of Siemens MPAR remain in confidence.

SIGNED UNDER THE PAINS AND PENALTIES OF PERJURY THIS 10th DAY OF August, 2011.

John P. Musone
Assistant Secretary; Siemens Energy, Inc.
Associate Chief Intellectual Property Counsel; Siemens Corporation

FLORIDA POWER CORPORATION

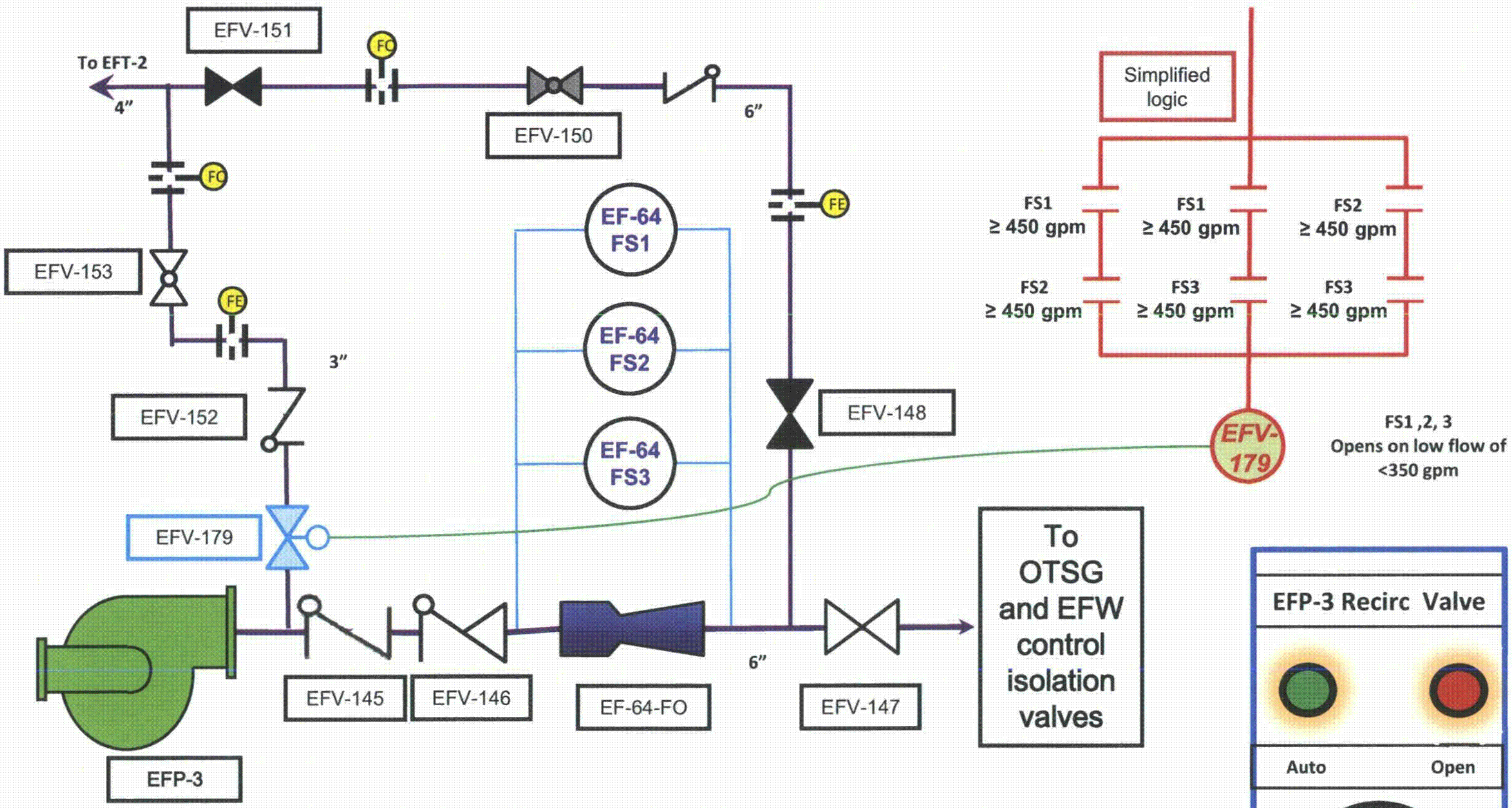
CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 /LICENSE NUMBER DPR-72

ENCLOSURE 3

EFW PUMP RECIRCULATION VALVE SIMPLIFIED DIAGRAMS (FIGURES 1 AND 2)

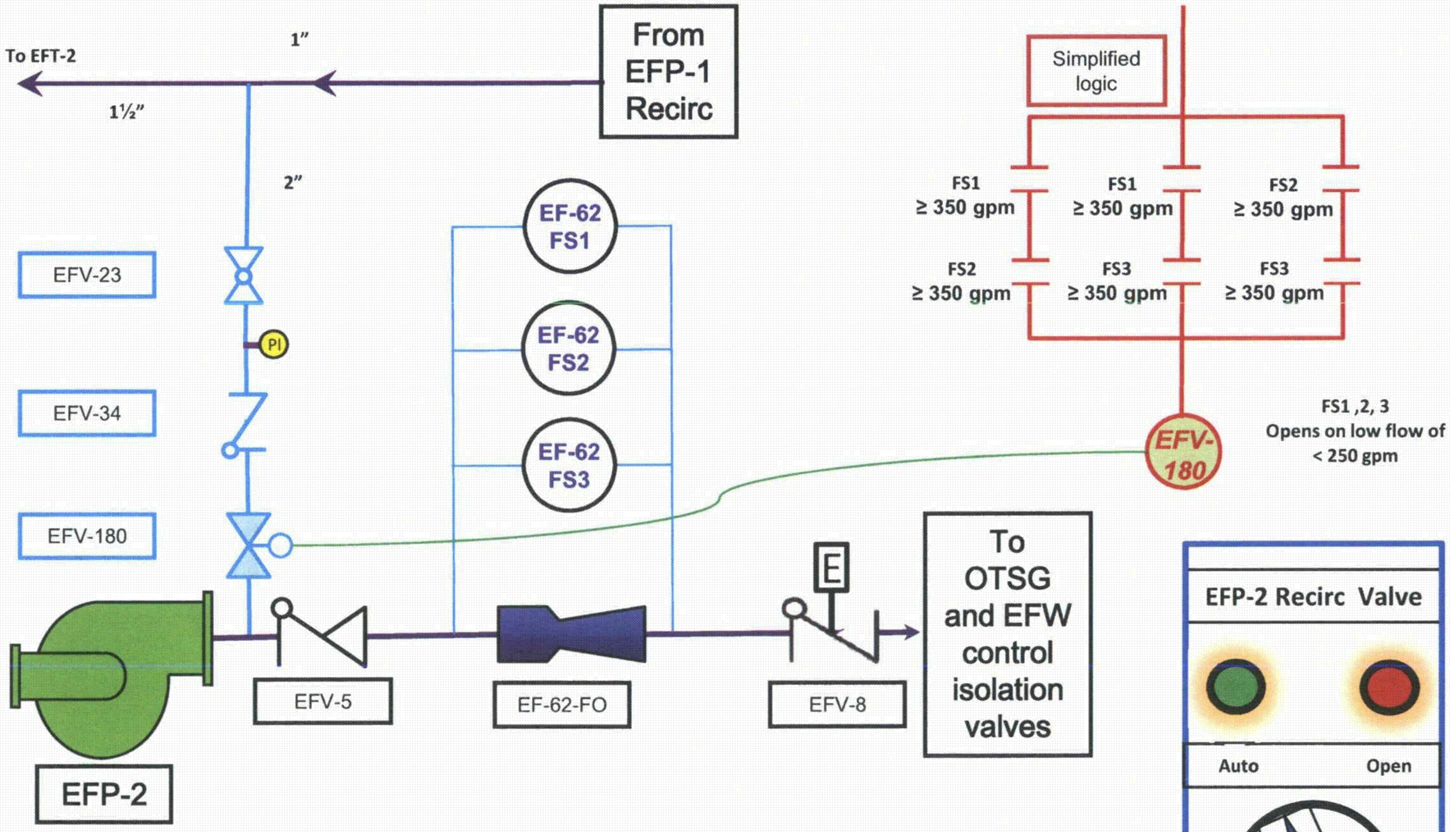
Figure 1
Simplified Diagram of EFP-3 Recirculation Valve



Note:
Drawing omits some valves, contacts, relays and instruments for simplicity and clarity. Differential pressure switches use nominal numbers subject to inst uncertainty.

Ref. FSAR Fig 10-03

Figure 2
Simplified Diagram of EFP-2 Recirculation Valve



Ref. FSAR Fig 10-03

Note:
Drawing omits some valves, contacts, relays and instruments for simplicity and clarity. Differential pressure switches use nominal numbers subject to inst uncertainty.

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ENCLOSURE 4

SUMMARY OF EMERGENCY FEEDWATER PUMP RECIRCULATION VALVE MODIFICATION FAILURE MODES AND EFFECTS ANALYSIS

Summary of Emergency Feedwater Pump Recirculation Valve Modification Failure Modes and Effects Analysis

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
1.1	EFV-179	Fail OPEN	Electrical or mechanical failure	Ability of one train of EFW to mitigate an accident would be reduced.	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position.	EFW Train B available in the event of complete failure of affected pump.	A single (1 of 2) train would no longer be able to perform its design functions. The affected trains flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	
1.2.1	EFV-179	Fail CLOSED	Electrical or mechanical failure.	Immediate damage to EFP-3 '<250 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position.	EFW Train B available and running during the event of complete failure of affected pump.	A single (1 of 2) train would no longer be able to perform its design functions.	During periods of low flow one train of EFW could be removed from service. EFV-179 being in the closed position will only be a detriment during periods of low to no demand. This occurs late or outside of accident conditions with exception to LOCA.
1.2.2	EFV-179	Fail CLOSED	Electrical or mechanical failure.	Accelerated wear / damage to EFP-2 '>250 GPM <300 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position.	EFW Train B available in the event of complete failure of affected pump.	The affected train would no longer be credited to perform its design functions.	
1.2.3	EFV-179	Fail CLOSED	Electrical or mechanical failure.	No damage to EFP-2 '>300 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position.	EFW Train B available.	n/a	

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
1.3.1	EFV-179	Fail Mid-Travel	Electrical or mechanical failure	Immediate damage to EFP-3 '<250 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position. (includes Mid position)	EFW Train B available and running during the event of complete failure of affected pump.	During periods of low flow one train of EFW could be removed from service. EFV-179 being in the closed position will only be a detriment during periods of low to no demand. This occurs late or outside of accident conditions.	
1.3.2	EFV-179	Fail Mid-Travel	Electrical or mechanical failure	Accelerated wear / damage to EFP-3 '>250 GPM <300 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position. (includes Mid position)	EFW Train B available in the event of complete failure of affected pump.	The affected train would no longer be credited to perform its design functions.	
1.3.3	EFV-179	Fail Mid-Travel	Electrical or mechanical failure	No damage to EFP-2 '>300 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position. (includes Mid position)	EFW Train B available.	n/a	
1.6	EFV-179	Loss of control Circuit power	Electrical failure	Loss of Automatic Close of EFV-179 EFV-179 Opens	Periodic Test	EFW Train B available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
1.7	EFV-179	Loss of Motive power	Electrical failure	Loss of Automatic Close of EFV-179 EFV-179 Opens	Periodic Test	EFW Train B available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
10.1	EFV-180	Fail OPEN	Electrical or mechanical failure	Ability of one train of EFW to mitigate an accident would be reduced.	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position.	EFW Train A available and running during the event of complete failure of affected pump.	One train (1 of 2) of EFW could be removed from service.	
10.2.1	EFV-180	Fail CLOSED	Electrical or mechanical failure.	Immediate damage to EFP-2 '<100 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position.	EFW Train A available in the event of complete failure of affected pump.	A single (1 of 2) train would no longer be able to perform its design functions.	
10.2.2	EFV-180	Fail CLOSED	Electrical or mechanical failure.	Accelerated wear / damage to EFP-2 '>100 GPM <250 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position.	EFW Train A available in the event of complete failure of affected pump.	The affected train would no longer be credited to perform its design functions after >3 hr.	
102.3	EFV-180	Fail CLOSED	Electrical or mechanical failure.	No damage to EFP-2 '>250 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position.	EFW Train A available.	n/a	
10.3.1	EFV-180	Fail Mid-Travel	Electrical or mechanical failure	Immediate damage to EFP-2 '<100 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position. (includes Mid position)	EFW Train A available and running during the event of complete failure of affected pump.	During periods of low flow one train of EFW could be removed from service. EFV-180 being in the closed position will only be a detriment during periods of low to no demand. This occurs late or outside of accident conditions.	

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
103.2	EFV-180	Fail Mid-Travel	Electrical or mechanical failure	Accelerated wear / damage to EFP-2 '>100 GPM <250 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position. (includes Mid position)	EFW Train A available in the event of complete failure of affected pump.	The affected train would no longer be credited to perform its design functions after >3 hr.	
10.3.3	EFV-180	Fail Mid-Travel	Electrical or mechanical failure	No damage to EFP-2 '>250 GPM through pump.'	Annunciator alarm triggered by valve out of position. Actual position vs. demanded position. (includes Mid position)	EFW Train A available	n/a	
10.6	EFV-180	Loss of control Circuit power	Electrical failure	Loss of Automatic Close of EFV-180 20XB energized EFV-180 Opens	Periodic Test	EFW Train A available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
10.7	EFV-180	Loss of Motive power	Electrical failure	Loss of Automatic Close of EFV-180 20XB energized EFV-180 Opens	Periodic Test	EFW Train A available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
20.1	EFV-23	Fail OPEN	Mechanical failure	N/A	Surveillance	Valve line up.	Valves normal position is open	Manual valve

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"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
20.2.1	EFV-23	Fail CLOSED	Mechanical failure	Immediate damage to EFP-2 '<100 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	One train of EFW could be removed from service prior to operators being able to take compensatory measures.	
20.2.2	EFV-23	Fail CLOSED	Mechanical failure	Accelerated wear / damage to EFP-2 '>100 GPM <250 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	One train of EFW could be removed from service if undiscovered for an indeterminate time greater than 3 hr. Time periods greater than 3 hr increase wear and pump degradation.	
20.2.3	EFV-23	Fail CLOSED	Mechanical failure	No damage to EFP-2 '>250 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	None.	
20.3.1	EFV-23	Fail Mid-Travel	Mechanical failure	Immediate damage to EFP-2 '<100 GPM through pump'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	One train of EFW could be removed from service prior to operators being able to take compensatory measures.	
20.3.2	EFV-23	Fail Mid-Travel	Mechanical failure	Accelerated wear / damage to EFP-2 '>100 GPM <250 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	One train of EFW could be removed from service if undiscovered for an indeterminate time greater than 3 hr. Time periods greater than 3 hr increase wear and pump degradation.	

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"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
20.3.3	EFV-23	Fail Mid-Travel	Mechanical failure	No damage to EFP-2 '>250 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	None.	
30.1	EFV-34	Fail OPEN	Mechanical failure	EF-6-PI indicates higher than normal pressure during the sole operation of EFP-1	Surveillance	EFV-5 prevents back flow through EFP-2	Insignificant to no pump performance margin degradation	Check valve
30.2.1	EFV-34	Fail CLOSED	Mechanical failure	Immediate damage to EFP-2 '<100 GPM through pump'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	One train of EFW could be removed from service prior to operators being able to take compensatory measures.	
30.2.2	EFV-34	Fail CLOSED	Mechanical failure	Accelerated wear / damage to EFP-2 '>100 GPM <250 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	One train of EFW could be removed from service if undiscovered for an indeterminate time greater than 3 hr. Time periods greater than 3 hr increase wear and pump degradation.	
30.2.3	EFV-34	Fail CLOSED	Mechanical failure	No damage to EFP-2 ' >250 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	None.	

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"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
30.3.1	EFV-34	Fail Mid-Travel	Mechanical failure	Immediate damage to EFP-2 '<100 GPM through pump'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	One train of EFW could be removed from service prior to operators being able to take compensatory measures.	
30.3.2	EFV-34	Fail Mid-Travel	Mechanical failure	Accelerated wear / damage to EFP-2 '>100 GPM <250 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	One train of EFW could be removed from service if undiscovered for an indeterminate time greater than 3 hr. Time periods greater than 3 hr increase wear and pump degradation.	
30.3.3	EFV-34	Fail Mid-Travel	Mechanical failure	No damage to EFP-2 '>250 GPM through pump.'	High recirculation line pressure	EFW Train A available and running during the event of complete failure of affected pump.	None.	
40.0.a	EF-64-FS1(Hi) Contact 9-10	Open	Electrical failure	Degraded logic Loss of 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	
40.1.a	EF-64-FS1(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	
40.2.a	EF-64-FS1(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded	

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"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
40.3.a	EF-64-FS1(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in after Hi flow	Periodic Test	EFW Train A & B available	Train A Logic degraded	
40.0.b	EF-66-FS1(Hi) Contact 9-10	Open	Electrical failure	Degraded logic Loss of 3EF-66-FS1	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 2/2	
40.1.b	EF-66-FS1(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 1/2	
40.2.b	EF-66-FS1(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-66-FS1	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 2/2	
40.3.b	EF-66-FS1(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in place after Hi flow	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 2/2	
40.0.c	EF-64-FS1(Hi) Contact 9-10	Open	Electrical failure	Degraded logic Loss of 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	
40.1.c	EF-64-FS1(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place 3EF-64-FS1 energized	Periodic Test	EFW Train A & B available	Train A Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	

(1) "a" denotes flow through the cavitating venturi of >350 GPM
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"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
40.2.c	EF-64-FS1(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	
40.3.c	EF-64-FS1(LO) Contact 2-3	Close	Electrical failure	Degraded logic. 1 of 2 close signals in place w/250 gpm flow	Periodic Test	EFW Train A & B available	Train A Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	
41.0.a	EF-64-FS2(Hi) Contact 9-10	Open	Electrical failure	Degraded logic. Loss of 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	
41.1.a	EF-64-FS2(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	
41.2.a	EF-64-FS2(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded	
41.3.a	EF-64-FS2(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in after Hi flow	Periodic Test	EFW Train A & B available	Train A Logic degraded	
41.0.b	EF-66-FS2(Hi) Contact 9-10	Open	Electrical failure	Degraded logic. Loss of 3EF-66-FS1	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 2/2	
41.1.b	EF-66-FS2(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place al	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 1/2	

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"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
41.2.b	EF-66-FS2(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-66-FS1	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 2/2	
41.3.b	EF-66-FS2(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in place after Hi flow	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 1/2 for after HI flow	
41.0.c	EF-64-FS2(Hi) Contact 9-10	Open	Electrical failure	Degraded logic. Loss of 3EF-64-FS2	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	
41.1.c	EF-64-FS2(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place 3EF-64-FS2 energized	Periodic Test	EFW Train A & B available	Train A Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	
41.2.c	EF-64-FS2(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-64-FS2	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2 Logic degrade from 2/3 to 2/2	
41.3.c	EF-64-FS2(LO) Contact 2-3	Close	Electrical failure	Degraded logic. 1 of 2 close signals in place w/250 gpm flow	Periodic Test	EFW Train A & B available	Train A Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	
42.0.a	EF-64-FS3(Hi) Contact 9-10	Open	Electrical failure	Degrade logic. Loss of 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	
42.1.a	EF-64-FS3(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	

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"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
42.2.a	EF-64-FS4(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded	
42.3.a	EF-64-FS3(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in after Hi flow	Periodic Test	EFW Train A & B available	Train A Logic degraded	
42.0.b	EF-66-FS3(Hi) Contact 9-10	Open	Electrical failure	Degrade logic. Loss of 3EF-66-FS1	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 2/2	
42.1.b	EF-66-FS3(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place al	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 1/2	
42.2.b	EF-66-FS4(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-66-FS1	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 1/2 after HI flow	
42.3.b	EF-66-FS3(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in place after Hi flow	Periodic Test	EFW Train A & B available	Train A Logic degrade from 2/3 to 1/2 for after HI flow	
42.0.c	EF-64-FS3(Hi) Contact 9-10	Open	Electrical failure	Degrade logic. Loss of 3EF-64-FS3	Periodic Test	EFW Train A & B available	EF-64-FS3(Hi) Contact 9-10	
42.1.c	EF-64-FS3(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place 3EF-64-FS3 energized	Periodic Test	EFW Train A & B available	Train A Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
42.2.c	EF-64-FS3(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-64-FS3	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	
42.3.c	EF-64-FS3(LO) Contact 2-3	Close	Electrical failure	Degraded logic. 1 of 2 close signals in place w/250 gpm flow	Periodic Test	EFW Train A & B available	Train A Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	
43.0	SS/ EFV-179-SV Contact 3-4	Open	Electrical Failure	Loss of Remote Manual Open capability	Periodic Test	EFW Train A & B available	Train A No Manual Open capability from Control Room	For all flows through cavitating venturi
43.1	SS/ EFV-179-SV Contact 3-4	Close	Electrical Failure	Loss of Automatic Close of EFV-179 20XB energized EFV-179 Opens	Periodic Test	EFW Train B available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
44.0	33o/EFV-179 Contact c-d	Open	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
44.1	33o/EFV-179 Contact c-d	Close	Electrical Failure	Nuisances Alarm 2EFV-179 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
44.2	33o/EFV-179 Contact a-b	Open	Electrical Failure	False indication for valve position.	Periodic Test; Operator Validation	EFW Train A & B available	Degraded valve position Indication	For all flows through cavitating venturi
44.3	33o/EFV-179 Contact a-b	Close	Electrical Failure	False indication for valve position.	Periodic Test; Operator Validation	EFW Train A & B available	Degraded valve position Indication	For all flows through cavitating venturi
45.0	33c/EFV-179 Contact a-b	Open	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
45.1	33c/EFV-179 Contact a-b	Close	Electrical Failure	False Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
45.2	33c/EFV-179 Contact a-b	Open	Electrical Failure	False indication for valve position.	Periodic Test; Operator Validation	EFW Train A & B available	Degraded valve position Indication	For all flows through cavitating venturi
45.3	33c/EFV-179 Contact a-b	Close	Electrical Failure	False indication for valve position.	Periodic Test; Operator Validation	EFW Train A & B available	Degraded valve position Indication	For all flows through cavitating venturi
50.0	3EF-64-FS1	Fails to Energize	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
50.1	3EF-64-FS1	Fails to Deenergize Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
50.2	3EF-64-FS1 Contact 1-2	Open	Electrical Failure	Degraded logic. Loss of Seal-in of 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded	For all flows through cavitating venturi
50.3	3EF-64-FS1 Contact 1-2	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
50.4	3EF-64-FS1 Contact 7-8	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
50.5	3EF-64-FS1 Contact 7-8	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
50.6	3EF-64-FS1 Contact 9-10	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
50.7	3EF-64-FS1 Contact 9-10	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
50.8	3EF-64-FS1 Contact 3-4	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
50.9	3EF-64-FS1 Contact 3-4	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
50.10	3EF-64-FS1 Contact 5-6	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
50.11	3EF-64-FS1 Contact 5-6	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
51.0	3EF-64-FS2	Fails to Energize	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
51.1	3EF-64-FS2	Fails to Deenergize	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
51.2	3EF-64-FS2 Contact 1-2	Open	Electrical Failure	Degraded logic. Loss of Seal-in of 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded	For all flows through cavitating venturi
51.3	3EF-64-FS2 Contact 1-2	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
51.4	3EF-64-FS2 Contact 7-8	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
51.5	3EF-64-FS2 Contact 7-8	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
51.6	3EF-64-FS2 Contact 9-10	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
51.7	3EF-64-FS2 Contact 9-10	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
51.8	3EF-64-FS2 Contact 3-4	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
51.9	3EF-64-FS2 Contact 3-4	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
51.10	3EF-64-FS2 Contact 5-6	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
51.11	3EF-64-FS2 Contact 5-6	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
52.0	3EF-64-FS2	Fails to Energize	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
52.1	3EF-64-FS2	Fails to Deenergize	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
52.2	3EF-64-FS3 Contact 1-2	Open	Electrical Failure	Degraded logic. Loss of Seal-in of 3EF-64-FS1	Periodic Test	EFW Train A & B available	Train A Logic degraded	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
52.3	3EF-64-FS3 Contact 1-2	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
52.4	3EF-64-FS3 Contact 7-8	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
52.5	3EF-64-FS3 Contact 7-8	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
52.6	3EF-64-FS3 Contact 9-10	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
52.7	3EF-64-FS3 Contact 9-10	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train A Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
52.8	3EF-64-FS3 Contact 3-4	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
52.9	3EF-64-FS3 Contact 3-4	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
52-10	3EF-64-FS3 Contact 5-6	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
52-11	3EF-64-FS3 Contact 5-6	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
53.0	20XB	Fails to Energize	Electrical Failure	Loss of Remote Manual Open capability	Periodic Test	EFW Train A & B available	Train A No Manual Open capability from Control Room	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
53.1	20XB	Fails to Deenergize	Electrical Failure	Loss of Automatic Close of EFV-179 20XB energized EFV-179 Opens	Periodic Test	EFW Train B available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
53.2	20XB Contact 5-6	Open	Electrical Failure	Loss of Automatic Close of EFV-179 EFV-179 Opens	Periodic Test	EFW Train B available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
53.4	20XB Contact 5-6	Close	Electrical Failure	Loss of Remote Manual Open capability	Periodic Test	EFW Train A & B available	Train A No Manual Open capability from Control Room	For all flows through cavitating venturi
53.5	20XB Contact 1-2	Open	Electrical Failure	Loss of Alarm Initiation signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
53.6	20XB Contact 1-2	Close	Electrical Failure	Nuisances Alarm 2EFV-179 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
54.0	20XA	Fails to Energize	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
54.1	20XA	Fails to Deenergize	Electrical Failure	Nuisances Alarm when valve closes 2EFV-179 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
54.2	20XA Contact 5-6	Open	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
54.3	20XA Contact 5-6	Close	Electrical Failure	Nuisances Alarm when valve closes 2EFV-179 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
54.4	20XA Contact 9-10	Open	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
54.6	20XA Contact 9-10	Close	Electrical Failure	Nuisances Alarm 2EFV-179 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
55.0	2EFV-179	Fails to Energize	Electrical Failure	Loss of Alarm	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
55.1	2EFV-179	Fails to Deenergize	Electrical Failure	Nuisances Alarm 2EFV-179 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
55.2	2EFV-179 Contact 1-5	Open	Electrical Failure	Loss of Alarm	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
55.3	2EFV-179 Contact 1-5	Close	Electrical Failure	Nuisances Alarm 2EFV-179 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
56.0.	EFV-179-SV	Fails to Energize	Electrical Failure	Valve remains in Open position	Periodic Test	EFW Train B available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
56.1	EFV-179-SV	Fails to Deenergize	Electrical Failure	Valve remains in Closed Position	Periodic Test	EFW Train B available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
57.0	DPDP-1D	Blown Fuse	Electrical Failure	Loss of control/motive power for EFV-179	Periodic Test	EFW Train B available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
58.0	2EFV-179/A	Fails to Energize	Electrical Failure	Nuisance Alarm	Annunciator Alarm	EFW Train A & B available	EFW Alarms degraded	For all flows through cavitating venturi
58.1	2EFV-179/A	Fails to Deenergize	Electrical Failure	Loss of Alarm	Periodic Test	EFW Train A & B available	EFW Alarms degraded	For all flows through cavitating venturi
58.2	2EFV-179/A Contact 1-5	Open	Electrical Failure	Loss of Alarm	Periodic Test	EFW Train A & B available	EFW Alarms degraded	For all flows through cavitating venturi
58.3	2EFV-179/A Contact 1-5	Close	Electrical Failure	Nuisances Alarm	Annunciator Alarm	EFW Train A & B available	EFW Alarms degraded	For all flows through cavitating venturi
60.1	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Fails High	Electrical or mechanical failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to open EFV-180	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
60.2	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Fails Low	Electrical or mechanical failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 1/2 to open EFV-180	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)
60.3	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Fails Constant	Electrical or mechanical failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to open EFV-180	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)
61.1	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Fails High	Electrical or mechanical failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 1/2 to close EFV-180	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
61.2	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Fails Low	Electrical or mechanical failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to close EFV-180	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
61.3	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Fails Constant	Electrical or mechanical failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to close EFV-180	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
62.1	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Leakage at pressure boundary – Low Side (Fails High)	Mechanical Failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to open EFV-180	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)
62.2	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Leakage at pressure boundary – High Side (Fails Low)	Mechanical Failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 1/2 to open EFV-180	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
63.1	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Leakage at pressure boundary – Low Side (Fails High)	Mechanical Failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 1/2 to close EFV-180	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
63.2	EF-62-FS1, FS2, FS3 (Any 1 of 3)	Leakage at pressure boundary – High Side (Fails Low)	Mechanical Failure	Affects either EF-62-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to close EFV-180	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
64.1	EF-64-FS1, FS2, FS3 (Any 1 of 3)	Fails High	Electrical or mechanical failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to open EFV-179	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)
64.2	EF-64-FS1, FS2, FS3 (Any 1 of 3)	Fails Low	Electrical or mechanical failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 1/2 to open EFV-179	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)
64.3	EF-64-FS1, FS2, FS3 (Any 1 of 3)	Fails Constant	Electrical or mechanical failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to open EFV-179	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)
65.1	EF-64-FS1, FS2, FS3 (Any 1 out of 3)	Fails High	Electrical or mechanical failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 1/2 to close EFV-179	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)
65.2	EF-64-FS1, FS2, FS3 (Any 1 out of 3)	Fails Low	Electrical or mechanical failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to close EFV-179	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
65.3	EF-64-FS1, FS2, FS3 (Any 1 out of 3)	Fails Constant	Electrical or mechanical failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to close EFV-179	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)
66.1	EF-64-FS1, FS2, FS3 (Any 1 of 3)	Leakage at pressure boundary – Low Side (Fails High)	Mechanical Failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to open EFV-179	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)
66.2	EF-64-FS1, FS2, FS3 (Any 1 of 3)	Leakage at pressure boundary – High Side (Fails Low)	Mechanical Failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 1/2 to open EFV-179	Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 open)
67.1	EF-64-FS1, FS2, FS3 (Any 1 of 3)	Leakage at pressure boundary – Low Side (Fails High)	Mechanical Failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 1/2 to close EFV-179	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)
67.2	EF-64-FS1, FS2, FS3 (Any 1 of 3)	Leakage at pressure boundary – High Side (Fails Low)	Mechanical Failure	Affects either EF-64-FS1, FS2, or FS3	Periodic Test	Redundant component	Logic degraded from 2/3 to 2/2 to close EFV-179	Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)
70.1	EFV-139	Fail Open	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	None	High Side root valve of EF-62-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
70.2	EFV-139	Fail Closed	Operational Mis-position or Mechanical Failure	EFV-180 opens. Affects EF-62-FS1, FS2,& FS3.	Periodic Test Red Light Indication for EFV-180	EFW Train A available	Will not auto-close EFV-180 Cascades into 10.2	High Side root valve of EF-62-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)
70.3	EFV-139	Fail Mid-Travel	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	None	High Side root valve of EF-62-FO.Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)
71.1	EFV-139	Fail Open	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	None	High Side root valve of EF-62-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
71.2	EFV-139	Fail Closed	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	Will not auto-close EFV-180 Cascades into 10.1	High Side root valve of EF-62-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
71.3	EFV-139	Fail Mid-Travel	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	None	High Side root valve of EF-62-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
72.1	EFV-140	Fail Open	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	None	Low Side root valve of EF-62-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
72.2	EFV-140	Fail Closed	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	Will not auto-open EFV-180 Cascades into 10.2	Low Side root valve of EF-62-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)
72.3	EFV-140	Fail Mid-Travel	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	None	Low Side root valve of EF-62-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-180 closed)
73.1	EFV-140	Fail Open	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	None	Low Side root valve of EF-62-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
73.2	EFV-140	Fail Closed	Operational Mis-position or Mechanical Failure	EFV-180 closes. Affects EF-62-FS1, FS2,& FS3.	Periodic Test Green Light Indication for EFV-180	EFW Train A available	Will not auto-open EFV-180 Cascades into 10.2	Low Side root valve of EF-62-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
73.3	EFV-140	Fail Mid-Travel	Operational Mis-position or Mechanical Failure	Affects EF-62-FS1, FS2,& FS3.	Periodic Test	EFW Train A available	None	Low Side root valve of EF-62-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-180 open)
74.1	EFV-181	Fail Open	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	None	High Side root valve of EF-64-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
74.2	EFV-181	Fail Closed	Operational Mis-position or Mechanical Failure	EFV-179 opens. Affects EF-64-FS1, FS2,& FS3.	Periodic Test Red Light Indication for EFV-179	EFW Train B available	Will not auto-close EFV-180 Cascades into 10.1	High Side root valve of EF-64-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)
74.3	EFV-181	Fail Mid-Travel	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	None	High Side root valve of EF-64-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)
75.1	EFV-181	Fail Open	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	None	High Side root valve of EF-64-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)
75.2	EFV-181	Fail Closed	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	Will not auto-close EFV-179 Cascades into 1.1	High Side root valve of EF-64-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset.(EFV-179 open)
75.3	EFV-181	Fail Mid-Travel	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	None	High Side root valve of EF-64-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset.(EFV-179 open)
76.1	EFV-182	Fail Open	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	None	Low Side root valve of EF-64-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
76.2	EFV-182	Fail Closed	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	Will not auto-open EFV-179 Cascades into 1.2	Low Side root valve of EF-64-FO.Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)
76.3	EFV-182	Fail Mid-Travel	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	None	Low Side root valve of EF-64-FO. Mode: High Flow Setpoint actuated with Low Flow Setpoint reset. (EFV-179 closed)
77.1	EFV-182	Fail Open	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	None	Low Side root valve of EF-64-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)
77.2	EFV-182	Fail Closed	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	Will not auto-open EFV-179 Cascades into 1.2	Low Side root valve of EF-64-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)
77.3	EFV-182	Fail Mid-Travel	Operational Mis-position or Mechanical Failure	Affects EF-64-FS1, FS2,& FS3.	Periodic Test	EFW Train B available	None	Low Side root valve of EF-64-FO. Mode: Low Flow Setpoint actuated with High Flow Setpoint reset. (EFV-179 open)
140.0a	EF-62-FS1(Hi) Contact 9-10	Open	Electrical failure	Degraded logic Loss of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
140.1a	EF-62-FS1(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
140.2a	EF-62-FS1(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded	
140.3a	EF-62-FS1(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in after Hi flow	Periodic Test	EFW Train A & B available	Train B Logic degraded	
140.0b	EF-62-FS1(Hi) Contact 9-10	Open	Electrical failure	Degraded logic Loss of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
140.1b	EF-62-FS1(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded	
140.2b	EF-62-FS1(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	
140.3b	EF-62-FS1(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in after Hi flow	Periodic Test	EFW Train A & B available	Train B Logic degraded	
140.0c	EF-62-FS1(Hi) Contact 9-10	Open	Electrical failure	Degraded logic Loss of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
140.1c	EF-62-FS1(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place 3EF-62-FS1 energized	Periodic Test	EFW Train A & B available	Train B Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
140.2c	EF-62-FS1(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
140.3c	EF-62-FS1(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
141.0a	EF-62-FS2(Hi) Contact 9-10	Open	Electrical failure	Degraded logic. Loss of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
141.1a	EF-62-FS2(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	
141.2a	EF-62-FS2(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded	
141.3a	EF-62-FS2(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in after Hi flow	Periodic Test	EFW Train A & B available	Train B Logic degraded	
141.0b	EF-62-FS2(Hi) Contact 9-10	Open	Electrical failure	Degraded logic. Loss of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
141.1b	EF-62-FS2(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded	

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
141.2b	EF-62-FS2(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	
141.3b	EF-62-FS2(LO) Contact 2-3	Close	Electrical failure	Degrade logic. 1 of 2 close signals permanently in after Hi flow	Periodic Test	EFW Train A & B available	Train B Logic degraded	
141.0c	EF-62-FS1(Hi) Contact 9-10	Open	Electrical failure	Degraded logic Loss of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
141.1c	EF-62-FS2(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-62-FS2	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2 Logic degrade from 2/3 to 2/2	
141.2c	EF-62-FS1(Hi) Contact 9-10	Open	Electrical failure	Degraded logic Loss of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
141.3c	EF-62-FS2(LO) Contact 2-3	Close	Electrical failure	Degraded logic. 1 of 2 close signals in place w/250 gpm flow	Periodic Test	EFW Train A & B available	Train B Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	
142.0a	EF-62-FS3(Hi) Contact 9-10	Open	Electrical failure	Degrade logic. Loss of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
142.1a	EF-62-FS3(Hi) Contact 9-10	Close	Electrical failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
142.2a	EF-62-FS3(LO) Contact 2-3	Open	Electrical failure	Degraded logic Loss of seal to 3EF-62-FS3	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	
142.3a	EF-62-FS3(LO) Contact 2-3	Close	Electrical failure	Degraded logic. 1 of 2 close signals in place w/250 gpm flow	Periodic Test	EFW Train A & B available	Train B Close Logic degraded from 2/3 to 1/2; No change to 2/2 Open Logic	
143.0	SS/ EFV-180-SV Contact 3-4	Open	Electrical Failure	Loss of Remote Manual Open capability	Periodic Test	EFW Train A & B available	Train B No Manual Open capability from Control Room	For all flows through cavitating venturi
143.1	SS/ EFV-180-SV Contact 3-4	Close	Electrical Failure	Loss of Automatic Close of EFV-180 20XB energized EFV-180 Opens	Periodic Test	EFW Train A available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
144.0	33o/EFV-180 Contact c-d	Open	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
144.1	33o/EFV-180 Contact c-d	Close	Electrical Failure	Nuisances Alarm 2EFV-180 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
144.2	33o/EFV-180 Contact a-b	Open	Electrical Failure	False indication for valve position.	Periodic Test; Operator Validation	EFW Train A & B available	Degraded valve position Indication	For all flows through cavitating venturi
144.3a	33o/EFV-180 Contact a-b	Close	Electrical Failure	False indication for valve position.	Periodic Test; Operator Validation	EFW Train A & B available	Degraded valve position Indication	For all flows through cavitating venturi
145.0	33c/EFV-180 Contact a-b	Open	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
145.1	33c/EFV-180 Contact a-b	Close	Electrical Failure	False Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
145.2	33c/EFV-180 Contact a-b	Open	Electrical Failure	False indication for valve position.	Periodic Test; Operator Validation	EFW Train A & B available	Degraded valve position Indication	For all flows through cavitating venturi
145.3	33c/EFV-180 Contact a-b	Close	Electrical Failure	False indication for valve position.	Periodic Test; Operator Validation	EFW Train A & B available	Degraded valve position Indication	For all flows through cavitating venturi
150.0	3EF-62-FS1	Fails to Energize	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
150.1a	3EF-62-FS1	Fails to Deenergize Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
150.2	3EF-62-FS1 Contact 1-2	Open	Electrical Failure	Degraded logic. Loss of Seal-in of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded	For all flows through cavitating venturi
150.3	3EF-62-FS1 Contact 1-2	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
150.4	3EF-62-FS1 Contact 7-8	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
150.5	3EF-62-FS1 Contact 7-8	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
150.6	3EF-62-FS1 Contact 9-10	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
150.7	3EF-62-FS1 Contact 9-10	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
150.8	3EF-62-FS1 Contact 3-4	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
150.9	3EF-62-FS1 Contact 3-4	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
150.10	3EF-62-FS1 Contact 5-6	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
150.11	3EF-62-FS1 Contact 5-6	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
151.0	3EF-62-FS2	Fails to Energize	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
151.1	3EF-62-FS2	Fails to Deenergize	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
151.2	3EF-62-FS2 Contact 1-2	Open	Electrical Failure	Degraded logic. Loss of Seal-in of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded	For all flows through cavitating venturi
151.3	3EF-62-FS2 Contact 1-2	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
151.4	3EF-62-FS2 Contact 7-8	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
151.5	3EF-62-FS2 Contact 7-8	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
151.6	3EF-62-FS2 Contact 9-10	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
151.7	3EF-62-FS2 Contact 9-10	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
151.8	3EF-62-FS2 Contact 3-4	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
151.9	3EF-62-FS2 Contact 3-4	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train B & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
151.10	3EF-62-FS2 Contact 5-6	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
151.11	3EF-62-FS2 Contact 5-6	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
152.0	3EF-62-FS2	Fails to Energize	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
152.1	3EF-62-FS2	Fails to Deenergize	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
152.2	3EF-62-FS3 Contact 1-2	Open	Electrical Failure	Degraded logic. Loss of Seal-in of 3EF-62-FS1	Periodic Test	EFW Train A & B available	Train B Logic degraded	For all flows through cavitating venturi

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Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
152.3	3EF-62-FS3 Contact 1-2	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
152.4	3EF-62-FS3 Contact 7-8	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
152.5	3EF-62-FS3 Contact 7-8	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
152.6	3EF-62-FS3 Contact 9-10	Open	Electrical Failure	Degraded logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 2/2	For all flows through cavitating venturi
152.7	3EF-62-FS3 Contact 9-10	Close	Electrical Failure	Degraded logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	Train B Logic degraded from 2/3 to 1/2	For all flows through cavitating venturi
152.8	3EF-62-FS3 Contact 3-4	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
152.9	3EF-62-FS3 Contact 3-4	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
152-10	3EF-62-FS3 Contact 5-6	Open	Electrical Failure	Degraded alarm logic. Loss of 1 close signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
152-11	3EF-62-FS3 Contact 5-6	Close	Electrical Failure	Degraded alarm logic. 1 of 2 close signals permanently in place	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
153.0	20XB	Fails to Energize	Electrical Failure	Loss of Remote Manual Open capability	Periodic Test	EFW Train A & B available	Train B No Manual Open capability from Control Room	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
153.1	20XB	Fails to Deenergize	Electrical Failure	Loss of Automatic Close of EFV-180 20XB energized EFV-180 Opens	Periodic Test	EFW Train A available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
153.2	20XB Contact 5-6	Open	Electrical Failure	Loss of Automatic Close of EFV-180 EFV-180 Opens	Periodic Test	EFW Train A available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
153.4	20XB Contact 5-6	Close	Electrical Failure	Loss of Remote Manual Open capability	Periodic Test	EFW Train A & B available	Train B No Manual Open capability from Control Room	For all flows through cavitating venturi
153.5	20XB Contact 1-2	Open	Electrical Failure	Loss of Alarm Initiation signal	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
153.6	20XB Contact 1-2	Close	Electrical Failure	Nuisances Alarm 2EFV-180 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
154.0	20XA	Fails to Energize	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
154.1	20XA	Fails to Deenergize	Electrical Failure	Nuisances Alarm when valve closes 2EFV-180 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
154.2	20XA Contact 5-6	Open	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
154.3	20XA Contact 5-6	Close	Electrical Failure	Nuisances Alarm when valve closes 2EFV-180 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
154.4	20XA Contact 9-10	Open	Electrical Failure	Loss of Alarm for valve out of position.	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
154.6	20XA Contact 9-10	Close	Electrical Failure	Nuisances Alarm 2EFV-180 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
155.0	2EFV-180	Fails to Energize	Electrical Failure	Loss of Alarm	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
155.1	2EFV-180	Fails to Deenergize	Electrical Failure	Nuisances Alarm 2EFV-180 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
155.2	2EFV-180 Contact 1-5	Open	Electrical Failure	Loss of Alarm	Periodic Test	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
155.3	2EFV-180 Contact 1-5	Close	Electrical Failure	Nuisances Alarm 2EFV-180 energized	Annunciator Alarm	EFW Train A & B available	EFW Alarm Logic degraded	For all flows through cavitating venturi
156.0	EFV-180-SV	Fails to Energize	Electrical Failure	Valve remains in Open position	Annunciator Alarm	EFW Train A available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing

Number (1)	Name	Failure Mode	Cause	Symptoms and Local Effects Including Dependent Failures	Method of Detection	Inherent Compensating Provision	Effect on ECCS	Remarks and Other Effects
156.1	EFV-180-SV	Fails to Deenergize	Electrical Failure	Valve remains in Closed Position	Annunciator Alarm	EFW Train A available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi
157.0	DPDP-5B	Blown Fuse	Electrical Failure	Loss of Automatic Close of EFV-180 EFV-180 Opens	Periodic Test	EFW Train A available	A single (1 of 2) train would no longer be able to perform its design functions. The affected train's flow would be approximately 75% of design. 100% design flows are typically necessary only early in accidents. The train with the failure will regain the ability to fully mitigate later in the accident scenario.	For all flows through cavitating venturi

(1) "a" denotes flow through the cavitating venturi of >350 GPM
"b" denotes flow through the cavitating venturi of >250 GPM <350 GPM increasing
"c" denotes flow through the cavitating venturi of >250 GPM <350 GPM decreasing