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Chester Fugate
Licensing Manager
Waterford 3

10 CFR 50.73

W3F1-2013-0012

March 22, 2013

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Subject: Licensee Event Report (LER) 2013-002-00
Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

Dear Sir or Madam:

Entergy is hereby submitting Licensee Event Report (LER) 2013-002-00 for Waterford Steam Electric Station, Unit 3 (Waterford 3). This report provides details associated with an Emergency Feedwater system flow control valve failing to close due to valve positioner failure.

Based on plant evaluation, it was determined that this condition is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B), Operation or Condition Prohibited by Technical Specifications.

This correspondence contains no new commitments. Please contact the Licensing Manager, Chester Fugate, at (504) 739-6685 if you have questions regarding this information.

Sincerely,

CF/WH

Attachment: Licensee Event Report 2013-002-00

cc: Mr. Elmo E. Collins, Jr., Regional Administrator
U.S. NRC, Region IV
RidsRgn4MailCenter@nrc.gov

U.S. NRC Project Manager for Waterford 3
Kaly.Kalyanam@nrc.gov

U.S. NRC Senior Resident Inspector for Waterford 3
Marlone.Davis@nrc.gov

Attachment to

W3F1-2013-0012

Licensee Event Report 2013-002-00

NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 10/31/2013

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Waterford 3 Steam Electric Station	05000 382	1 OF 8

4. TITLE

Emergency Feedwater System Flow Control Valve Fails To Close Due To Valve Positioner Failure

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
01	21	2013	2013	- 002 -	00	03	22	2013	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE

1

10. POWER LEVEL

91

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A
☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (*Include Area Code*)
Waterford 3 Steam Electric Station Chester Fugate	(504) 739-6685

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
X	BA	FCV	M120	N					

14. SUPPLEMENTAL REPORT EXPECTED

☐ **YES (If yes, complete 15. EXPECTED SUBMISSION DATE)** ☒ **NO**

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

ABSTRACT (*Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines*)

On January 21, 2013 at 15:51 CST, Waterford Steam Electric Station, Unit 3 (Waterford 3) experienced a reactor trip from approximately 91% power due to lowering Steam Generator (SG) #1 level. Emergency Feedwater (EFW) Actuation Signals (EFAS-1 and EFAS-2) were received due to low SG levels, which is an anticipated response to the reactor trip with the plant at or near full power. EFW flow to SG 1 was identified to be oscillating from 0 to 800 GPM. While resetting EFAS, EFW flow to SG 1 was approximately 120 GPM without a demand signal. Valve EFW-223A (Emergency Feedwater to SG1 Backup Flow Control Valve) was declared inoperable. Subsequent evaluation determined that EFW-223A past operability was affected by the apparent cause. Plant response to the reactor trip was unaffected by the condition and all design safety function capabilities remained available. This condition did not compromise the health or safety of the general public.

The past inoperability of valve EFW-223A is reportable as a Licensee Event Report pursuant to 10CFR50.73(a)(2)(i)(B), Operation or Condition Prohibited by Technical Specifications.

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		YEAR	SEQUENTIAL NUMBER	REV NO.	
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NARRATIVE

REPORTABLE OCCURRENCE

On January 21, 2013 at 15:51 CST, Waterford Steam Electric Station, Unit 3 (Waterford 3) experienced a reactor trip from approximately 91% power due to lowering Steam Generator (SG) [SG] #1 level. Emergency Feedwater (EFW) [BA] Actuation Signals (EFAS-1 and EFAS-2) were received due to low SG levels, which is an anticipated response to the reactor trip with the plant at or near full power. EFW flow to SG 1 was identified to be oscillating from 0 to 800 GPM. While resetting EFAS, EFW flow to SG 1 was approximately 120 GPM without a demand signal. Valve EFW-223A (EFW to SG1 Backup Flow Control Valve) [FCV] was declared inoperable. Subsequent evaluation determined that EFW-223A past operability was affected by the apparent cause. The condition was entered into the site corrective action program as CR-WF3-2013-0451. The past inoperability of valve EFW-223A is reportable as a Licensee Event Report (LER) pursuant to 10CFR50.73(a)(2)(i)(B), Operation or Condition Prohibited by Technical Specifications.

Reporting for the reactor trip and the engineered safety feature system actuation was performed under separate Waterford 3 LER-2013-001-00 as those events are not related to the condition identified on EFW-223A.

INITIAL CONDITIONS

Waterford 3 had recently completed refueling outage RF-18 and was in the process of raising plant power to 100%. Plant operation was being conducted using normal plant operating procedures. There were no Technical Specification Limiting Conditions of Operation specific to this condition in effect. During the power escalation, plant personnel had noted that Main Feedwater (MFW) [SJ] system vibrations were higher than had been previously experienced and had put a plan in place to measure and evaluate the condition. An automatic reactor trip with subsequent actuation of the EFW system occurred due to low SG #1 level.

EVENT DESCRIPTION

Following the reactor trip, actuation EFAS-1 was received due to SG 1 level decreasing below setpoint. At this time the EFW pumps started, both SG 1 EFW isolation valves opened, and both SG 1 EFW flow control valves received a permissive to open (see Figure 1). EFW flow to SG 1 varied by several hundred gallons per minute (Point ID C26229). Control Room operators noted that EFW-223A (EFW to SG1 Backup Flow Control Valve) level controller output on panel CP-8 was oscillating rapidly from 10% to 50% and EFW flow to SG 1 was oscillating rapidly from 500 GPM to maximum flow. In addition, controller output for EFW-224A (EFW to SG1 Primary Flow Control Valve) [FCV] was noted to be stable.

Due to the rising SG 1 level, EFW-223A controller output was driven to the close position. At this time EFW flow was stable at approximately 280 GPM (approximately 200 GPM from EFW-224A and 80 GPM leaking by EFW-223A). Also due to the rising SG 1 level, EFW-224A was driven to the closed position. With a zero EFW flow demand signal, SG 1 level continued to rise (Point ID's A11106 / A11120) due to a 120 GPM EFW flow rate.

While Operations was resetting the EFAS actuation, EFW-228A (EFW to SG 1 Primary Isolation Valve) [FCV] was closed and EFW Flow to SG 1 did not change. However, when EFW-229A (EFW to SG 1 Backup Isolation Valve) [FCV] was closed, EFW Flow to Steam Generator 1 went to zero GPM. This

demonstrated that valve EFW-223A was not fully closed with an active close demand.

SYSTEM DESIGN

EFW System Description (see Figure 1):

The Emergency Feedwater (EFW) System provides a sufficient supply of cooling water to the SGs for the removal of decay heat from the reactor during emergency situations when the Main Feedwater System is not available. The system can also be used during emergency situations to cooldown the Reactor Coolant System (RCS) [AB] to the temperature and pressure required for Shutdown Cooling System (SDC) [BP] operation.

The EFW system supplies this demand via three EFW pumps through two supply paths. Both supply paths are supplied with redundant flow control valves and isolation valves, all of which fail open on loss of air. The control and isolation valves are arranged with "A" and "B" powered valves in series. This ensures that, in the event of a single failure, water can be supplied and controlled to either one or both SGs by the operable valves since the valves fail open. Water could also be prevented from entering the ruptured SG during a postulated Feedwater or Main Steam Line Break Accident by the operable EFW control and isolation valves. The valves can be operated locally using the manual handwheel.

EFW-223A Description:

EFW-223A is a 4-inch, Masoneilan Air Operated Valve (AOV) model number 47-40512 Sigma-F consisting of a globe valve and a diaphragm actuator. EFW-223A is air-to-close, spring-to-open (fail open) and is provided with a backup nitrogen accumulator, if needed, to perform its safety related function. The actuator accessories include a Fisher 67FR filter regulator, a Masoneilan 8012-3C I/P transducer, and a Moore 61H volume booster. EFW-223A is not equipped with a valve positioner as the EFW Control System within Process Analog Control (PAC) controls the valve in the open and closed direction. The air supply for EFW-223A is supplied either by the Instrument Air System or Nitrogen Accumulator V/IX.

Nitrogen Accumulator V/IX Description:

Nitrogen Accumulator V/IX [ACC] provides a safety-related, backup pneumatic supply to allow operation of valves EFW-223A, EFW-228A, and MS-116A (SG 1 Atmosphere Dump Valve) [PCV] during a loss of instrument air. Accumulators V and IX are connected in parallel to increase the capacity for their associated valve supply headers. The nitrogen header is connected to a valve supply header that is normally supplied by the Instrument Air System via a check valve. Nitrogen Accumulator V/IX is connected to an associated valve supply header by a normally closed, solenoid-operated isolation valve (SOV) and a pressure control valve (PCV). The SOV automatically opens when the associated valve supply header's instrument air pressure drops below 88 psig and automatically re-closes at 98 psig rising. When the SOV is open, the downstream PCV controls the valve supply header pressure at 83 psig. Nitrogen Accumulator V/IX is credited and tested to provide a minimum 10-hour supply of nitrogen gas. After 10 hours, the affected valves may be operated manually by Operations personnel as required.

CAUSAL FACTORS

An apparent cause evaluation was performed. EPRI Guide NP-7412 Revision 1, "Air Operated Valve Maintenance Guide" was used as input to the casual analysis for both the Failure Modes and Fault Tree Analysis. In addition, information gathered from the troubleshooting activities and interviews were also used as input to the causal analysis.

Following the event, maintenance was performed on EFW-223A under work order instructions. During the "as-found" Air Operated Valve Diagnostic Testing, EFW-223A was found out of calibration. During further inspection, the flapper screw within the Masoneilan 8012-3C positioner was found loose. Within the positioner, the flapper screw acts to stabilize the force balance beam interaction with the air nozzle. The screw was tightened (approximately 2 turns) and EFW-223A was calibrated and returned to service.

- Apparent Cause: Manufacturer fabrication/construction less that adequate

  The flapper set screw, based on the series of events, was not tightened (or became loose) during or after the manufacturing process. With the flapper screw loose, the positioner was unable to achieve equilibrium while controlling EFW flow and was unable to achieve full backpressure to close EFW-223A.

  The flapper screw is not required to be adjusted when calibrating or performing initial setup of the positioner. This was confirmed by a review of the technical documents TD-M120.0045 and TD-M120.0055 for the Masoneilan 8012 Series Electro-Pneumatic Positioners. Based on the design of the Masoneilan 8012 Series Electro-Pneumatic Positioners, the loose flapper screw caused EFW-223A to control erratically and remain open when provided with a full close signal.

  This failure mode, found only on this one positioner, may have occurred at the manufacturer, during shipping or storage, or during use at the plant. During the Extent of Condition review, the flapper screws on similar positioners were found adequately tight to ensure proper valve function.

- Possible Cause: Vibration Induced Failure of the Positioner

  Vibration induced failure of the Masoneilan 8012-3C Electro-Pneumatic Positioner is a postulated cause as the vibration was present during the event, but there is insufficient evidence to further confirm (or to eliminate) the failure was due to the vibration. This possible cause is based on the assumption that a vibration induced failure mechanism exists for this positioner model. Following RF-18, plant personnel had noted that MFW system vibrations were higher than had been previously experienced. The EFW system line containing EFW-223A is being impacted by the vibration due to a two inch keep-fill line that connects between MFW system piping and EFW system piping. Due to the uniqueness of Waterford 3's vibration concern, it is not possible to perform a specific operating experience search regarding this issue. However, the operating experience search performed for the Masoneilan 8012 series positioners and the fact that EFW-223A positioner was previously found out of calibration during maintenance (prior to the vibration issues) provides refuting evidence to this cause.

EXTENT OF CONDITION

Due to the uniqueness of the apparent cause evaluation, the extent of condition was limited to all valves equipped with the Safety-Related Masoneilan 8012 series Electro-Pneumatic Positioners.

The following components are susceptible to the apparent cause identified within this evaluation:

- EFW-223B (EFW to SG2 Backup Flow Control Valve),
- EFW-224A (EFW to SG1 Primary Flow Control Valve), and
- EFW-224B (EFW to SG2 Primary Flow Control Valve).

Based on the following items, no immediate actions are required for the extent of condition valves:

- Satisfactory In-Service Testing Surveillance performance,
- Satisfactory Air Operated Valve Diagnostic Testing,
- Satisfactory electro-pneumatic positioner calibration history,
- No industry related industry failures per vendor input (Masoneilan/Enertech),
- Independent manufacturing lots on all electropneumatic positioners,
- Not an impacted part during calibration based on the review of the vendor manual and site procedures
- No industry related industry failures per Operating Experience searches on Masoneilan 8012-3-C, and
- Satisfactory review of digital trends during and following the event.

The Masoneilan 8012-3C Positioners are manufactured and sold on an as-requested basis. Therefore, multiple manufacturing lots exist. A review of all Masoneilan 8012-3C Positioners indicates that all positioners installed or in the warehouse are from different manufacturing lots. Therefore, with the apparent cause being related to a possible manufacturing issue, it is reasonable to assume that this condition has not affected other lots due to the uniqueness of the failure mechanism.

CORRECTIVE ACTIONS

- Tightened flapper screw on EFW-223A and performed AOV Diagnostic Testing and valve calibration (complete)
- Enhancement - Revise TD-M120.0045 and TD-M120.0055 with the supplemental letter provided by Masoneilan that allows for a paint drop to be applied to Masoneilan 8012 series positioners. (complete)
- Circle Back - Verify that EFW-223A positioner flapper assembly is still tight after being subjected to the line vibration. This action is required to confirm that loosening of the positioner flapper assembly screw was not vibration induced. If the positioner flapper assembly screw is found loose, then initiate a new condition report. (planned)

SAFETY SIGNIFICANCE

Nuclear and Radiological Safety

This evaluation determines the risk significance of the positioner failure of EFW-223A. The major assumptions in this risk assessment are as follows:

- The EFW-223A positioner failure will also affect EFW-228A and MS-116A since all three of these valves are operated using Nitrogen Accumulator V/IX.
- EFW-223A, EFW-228A and MS-116A can be operated manually with or without air.
- EFW-223A and EFW-228A fail open on loss of air and MS-116A fails closed on loss of air (instrument air and nitrogen backup).
- The time period to be assumed for the EFW-223A positioner failure is 341 days.
- For an additional 62 days, valve EFW-223B had a defective diaphragm which also would impact EFW-228B and MS-116B.
- Over the analyzed time period of 341 days, MS-116B (SG 2 Atmospheric Dump Valve) was out of service for a total duration of 11 hours and 35 minutes. This occurred over 5 planned surveillance activities. This amount of time, roughly half a day, will be added to the 62 days which MS-116B was assumed inoperable due to the defective diaphragm on EFW-223B.

The base risk (CDF or core damage frequency) for this evaluation is 4.398E-06/yr using the Waterford 3 baseline cutset file with truncation limit set at E-13. The base risk includes all of the average maintenance and failure probabilities.

The EFW valve function of concern is the closure for steam generator isolation to prevent feeding a faulted SG #1. There are redundant valves in the line (EFW-229A and EFW-224A) that perform the same function, which results in low risk significance. These valve failures (EFW-223A and EFW-228A transfer open) are below the E-13 truncation limit and, therefore, the change in CDF due to these valve failures is less than 1E-13/yr. Any maintenance on the redundant valves would involve manual closure of the valves and the maintenance evolution would reduce risk during a SG isolation event. Furthermore, the failure of EFW-223B and EFW-228B are not included in this cutset file since they are below the truncation limit as well.

MS-116A valve failure is evaluated for risk by setting its failure events to true in the cutset file. The resulting CDF is 4.482E-06/yr, and the delta-CDF is 8.4E-08/yr (4.482E-06/yr – 4.398E-06/yr).

If both MS-116A and MS-116B failures are considered by setting both failure events to true in the cutset file, the resulting CDF is 4.567E-06/yr, and the delta-CDF is 16.9E-08/yr (4.567E-06/yr - 4.398E-06/yr).

During the 341 days in which MS-116A was considered potentially inoperable, MS-116B was also inoperable for 62.5 days or 1500 hours. Therefore, for this calculation, the time in which only the MS-116A valve was inoperable amounts to 278.5 days (341-62.5) or 6684 hours.

The ICCDP (incremental conditional core damage probability) for time in which only the MS-116A valve was potentially inoperable comes to be (6684 hrs / 8760 hrs/yr) x 8.4E-08/yr = 6.41E-08. The ICCDP for time in which the MS-116A and MS-116B valves were potentially inoperable comes to be (1500 hrs/ 8760 hrs/yr) x 16.7E-08/yr = 2.86E-08. Therefore, the total ICCDP for the 341 days is 6.41E-08 +

2.86E-08 = 9.27E-08**.** This is the delta risk for the situation in question.

As this is already a considerably low value, the delta-LERF for this case will be even lower due the fact that the LERF value is lower than the CDF value by at least an order of magnitude. Specifically for this case, the LERF value would be lower since the release path through the ADVs will be unavailable due to the failure of MS-116A(B).

Therefore, the risk significance of the positioner failure on EFW-223A is considered low as defined in RG 1.174.

SIMILAR EVENTS

A search was performed for other similar reported events at Waterford 3. No similar events were identified.

ADDITIONAL INFORMATION

Energy industry identification system (EIIS) codes are identified in the text with brackets [ ].

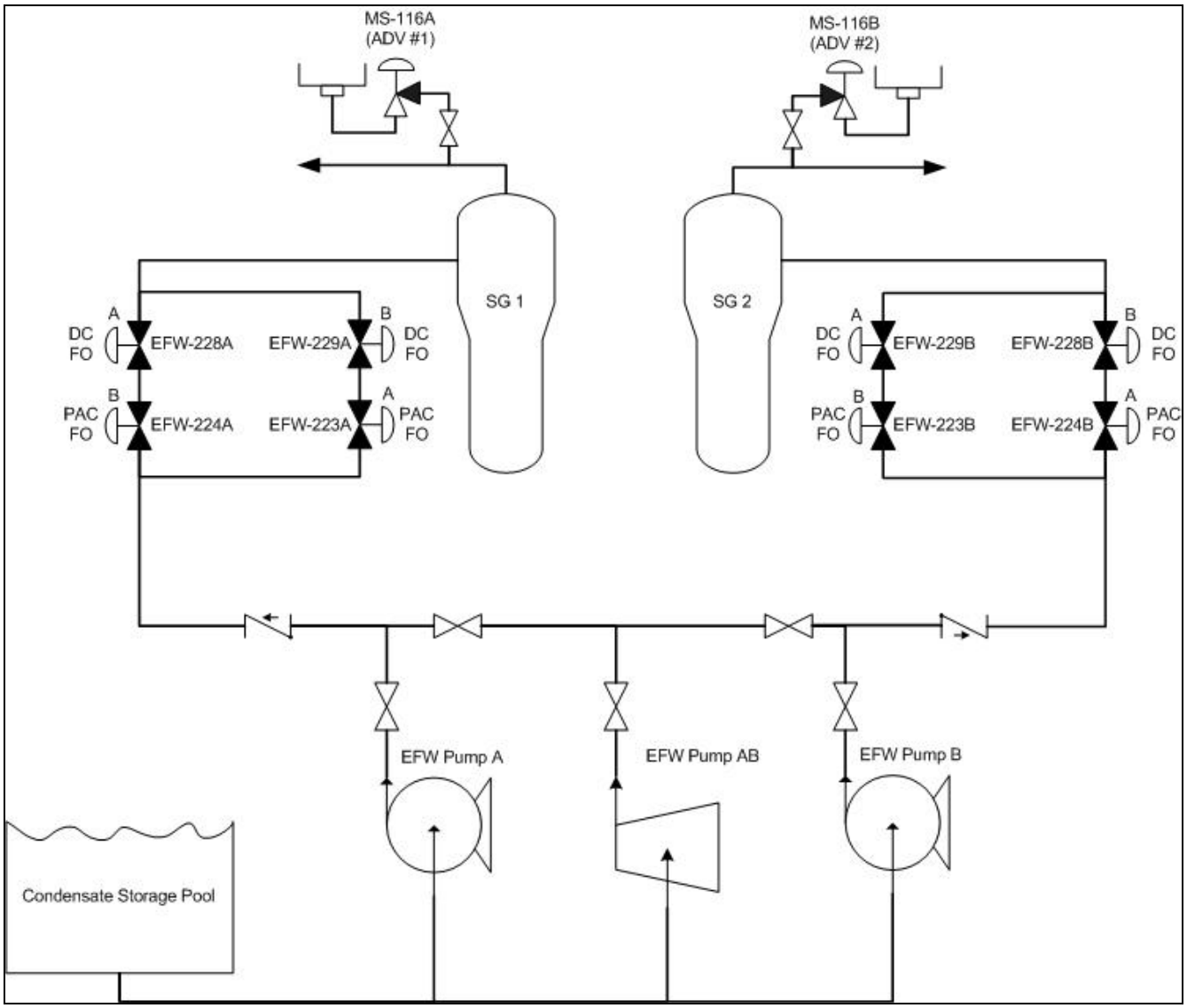

Figure 1: Emergency Feedwater System Basic Flow Diagram