JOSEPH M. FARLEY UNITS 1 AND 2
SAFETY-RELATED
MOV ΔP's FOR THE
AUXILIARY FEEDWATER SYSTEM

SEPTEMBER, 1986

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FARLEY AFW MOV ΔP

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I. INTRODUCTION

Provided herein is a detailed review and documentation of the design basis, differential pressures (ΔP) for the Farley Auxiliary Feedwater (AFW) motor-operated valves. The purpose of this review is to respond in part, to Action Item (a) of I&E Bulletin 85-03. Specifically, this report provides "the maximum differential pressure during both opening and closing the valve for both normal and abnormal events to the extent that these valve operations and events are included in the existing, approved design basis." This review generally follows the methodology developed as part of the Westinghouse Owners Group Safety Related MOV program, with exceptions/clarifications as noted.

There are two major sections in this report. Section II discusses the methodology used in selecting the AFW MOVs and in evaluating these MOVs to determine the maximum differential pressure. Section III is the application of this methodology to the Farley Nuclear Plant. Table 1 lists the AFW MOVs selected and Table 2 gives the maximum operating ΔPs.

II. METHODOLOGY

A. Auxiliary Feedwater System Definition

The Auxiliary Feedwater (AFW) System is an engineered safety feature designed to supply feedwater to the steam generators during plant startup, cooldown, and emergency conditions when the normal feedwater supply is not available. Under emergency conditions, the AFW System provides a redundant means of removing decay and sensible heat from the Reactor Coolant System via the steam generators.

The AFW system is a separate and independent system, and requires no special definition to establish the system boundaries. However, the following explanation is provided for clarity.

In addition to the normal feedwater source from the condensate storage tank, a redundant backup source is provided from the safety class 2B portion of the Service Water System. Under emergency conditions, AFW is defined as:

1. Those portions of the system required to supply steam to the turbine driven pump.

2. Those portions of the system taking suction from the Condensate Storage Tank and providing discharge, via the two motor driven or one steam turbine driven pumps, to individual lines feeding each steam generator.

3. Those portions of the system which, alternatively, take suction from the safety related portion of the Service Water System.

The AFW System is further described in FSAR Section 6.5.

B. General AFW System Valve Selection

All MOVs within the AFW system are included in the list of valves to be examined for maximum differential pressure. Under evaluated conditions, these valves function to:

B.1 Establish a flowpath(s) from the AFW safety grade water source (or its backup) to the steam generators, and to isolate AFW flow from the motor driven pumps to the faulted steam generator.

B.2 Establish an AFW flowpath(s) from the AFW sources to the steam generators and to prevent backflow to the AFW System.

B.3 Establish a steam delivery flowpath to the AFW turbine and to trip the turbine at turbine overspeed.

MOV valve selection for the AFW System is summarized in Table 1.

C. Fluid System Evaluation

The fluid system evaluation determined the maximum operating open/close Δps for the selected MOVs based on system configuration, equipment capability, and design operating modes. The assumptions applicable to these Δp determinations were based on the methodology provided in the Westinghouse Owners Group (WOG) Safety-Related MOV Program Final Report (March 1986; Reference 1) with exceptions as noted in Section III.B. The results of the evaluation based on this methodology are summarized in Table 2.

The AFW provides a reliable source of feedwater to the steam generators in the event main feedwater is either lost or isolated.

Two different sets of single failure criteria were used for the fluid system evaluation depending on whether short term operating modes or long term operating modes are being considered.

1. Short-Term Operation - Single active failures were considered. Passive failures were not assumed. This means that gross check valve backleakage was not assumed (requires a passive failure of the check valve).

2. Long-Term Operation - Both active and passive failures were considered credible. However, the analysis was based on a single failure which was found to be the worse of either the active or passive failures.

In general, the fluid system evaluation was the determination of a maximum operating ΔP for any system operating mode and design basis event. As noted in Section III.B, calculating the maximum operating ΔP by neglecting piping pressure losses or by basing it on the pump head at minimum flow does not necessarily represent realistic operating conditions.

For this evaluation, the following equipment and system configuration information was considered in the determination of the maximum operating ΔP provided in Table 2:

1.	Pumps	Operating/not operating, operation configuration (miniflow/no miniflow, maximum discharge head).
2.	Relief Valves	Setpoint limits system pressure.
3.	Piping changes	Line losses and elevation.
4.	Check Valves	No gross backleakage.

5. Tanks — Elevation head and design pressure.

6. Other MOVs — Position (open/close).

Outside the AFW system, steam generator pressure was considered for determination of ΔP.

Based on the above, maximum operating MOV differential pressures were developed for both open and close operations. For each maximum operating Δp, a justification is given based on system configuration and equipment constraints.

Finally, these maximum operating differential pressures were compared against the valve design specification Δp to verify adequate design.

D. <u>Farley EOP Survey</u>

The Farley EOP Survey determined when the selected AFW MOVs (See Table 1) are required to function for emergency operation. In addition, the survey identified other important characteristics of the system operation which impact the MOV's capability to function. (Details the EOP survey are provided in Appendix A.)

Many of the steps on this list were repetitive. Therefore, the list was consolidated to a few general cases for each valve. Each general case gives the EOP operation and the required MOV operation (open or close) during the EOP operation.

The EOP operation general cases were checked against the fluid system assumptions. If the EOPs and the fluid system assumptions were consistent, then a "yes" appears in the "EOP confirmation" column of Table 2.

E. <u>Normal Operation</u>

The AFW system generally functions during off-normal situations when auxiliary feedwater is needed (i.e., mainfeed is lost or tripped). A part of the system has normal operative functions during start-up, shutdown and hot stand by conditions. However, all of these normal AFW system operations are bounded by off-normal, accident scenarios.

III. APPLICATION TO FARLEY

A. AFW System Valve Selection Applied to Farley

Using the selection criteria defined in II.B., the AFW system valve list was generated for Farley, and is shown in Table 1. The table lists the MOVs by function and by Farley MOV number. In addition, valve position information and which functional selection criteria the valve meets to be included on the list (either B.1, B.2, B.3, as defined in the "General AFW System Valve Selection" Section II.B) is given.

B. Fluid System Evaluation Applied to Farley

The application of the fluid system evaluation to the AFW system is shown in Table 2. The table gives the following information:

1. Valve Description
2. Farley MOV Number
3. Design (Spec.) ΔP
4. Maximum Operating ΔP (Based upon the approach described in Section II)
5. Justification for Maximum Operating ΔP
6. EOP Confirmation of Operating Assumptions

Following Table 2 is a summary of the applicable justifications.

The maximum operating differential pressures for valves MOV-3764 A through F, MOV-3350 A through C, MOV-3209 A and B, MOV-3210 A and B, and MOV-3216 are not based completely on the assumptions used in Reference 1. The following discussion is provided as a justification for not determining the maximum operating ΔP for these valves based on pump miniflow discharge head as suggested in Reference 1.

Valves MOV-3764 A through F and MOV-3350 A through C are normally open and fail "as is". In the event of a feedwater line break, these valves will be remotely actuated to isolate flow from the motor-driven pump to the faulted steam generators. During emergency conditions (e.g., a line break in any one of the feedwater lines), the FSAR states that a minimum flow of 350 gpm following a reactor trip be maintained to the remaining two intact steam generators. The Emergency Operating Procedures incorporate this flow requirement. The MOV's in the broken line which are required to be closed for isolation will see a maximum differential pressure of 1270 psi, the pump discharge head at rated flow; line losses will actually reduce this pressure. The WOG report, Reference 1, suggests using the supply pump discharge head at mimimum flow which was assumed to be the pump head at a mimimum flow of 50 gpm and results in valve ΔP's of 1525 psid. However, the discharge head at rated flow (i.e., 1270 psid) is considered more appropriate.

Valves MOV-3209 A and B, MOV-3210 A and B, and MOV-3216 are located in the lines providing emergency, backup service water to the auxiliary feedwater pumps. The pump head corresponding to the flow required from the service water system is equivalent to about 100 psig. With the normal losses in the pipe and fittings, the differential pressure which these valves would see is not expected to exceed 100 psig. Reference 1 suggests using the pump maximum head at minimum flow which was assumed to be the pump head at 10% of rated flow and results in valve ΔP's of 145 psid. However, the pump discharge head, less line losses, at normal Service Water System flow (prior to LOCA injection (i.e., 100 psid)) is considered more appropriate.

C. Licensing Bases for Farley

Chapters 6 and 15 of the Farley FSAR were reviewed to identify any licensing commitments pertinent to the MOV effort. Specifically, the objective of the FSAR review was to identify the actuation requirements for the MOV's included in the study to establish required flow paths for the auxiliary feedwater.

The normal positions for the AFW motor operated valves are summarized, and the appropriate section of the FSAR which governs the actuation of each valve is referenced in Table 1 of this report.

D. References

1. Westinghouse Owners Group Safety-Related MOV Program Final Report (March 1986).

2. Farley Units 1 and 2 FSAR.

TABLE 1
Farley Units 1 & 2
Design Bases for Operation of AFW System MOV's

MOV	VALVE NUMBER	POSITION OR REPOSITION	FUNCTION*
Motor-Driven Pump Discharge Isolation Valves	MOV-3764A MOV-3764B MOV-3764C MOV-3764D MOV-3764E MOV-3764F	Normally Open, Remotely Closed from Control Room - Ref. FSAR Section 6.5.3	B.1
AFW Discharge Isolation Stop Check Valves	MOV-3350A MOV-3350B MOV-3350C	Normally Open (with power racked out), Remotely closed from Control Room - Ref. FSAR Section 6.5.2 and Table 6.2-32	B.2
Suction from Essential Service Water	MOV-3209A MOV-3209B MOV-3210A MOV-3210B MOV-3216	Normally Closed, Remote manually Opened - Ref. FSAR Section 6.5.2	B.1
Mechanical Trip & Throttle Valve (Steam Supply to Turbine Driven Pump)	MOV-3406	Normally Open - Ref. FSAR Section 6.5.2	B.3

*See Section II.B (General AFW System Valve Selection) for an explanation of "function".

TABLE 2
FARLEY UNITS 1 & 2
AUXILIARY FEEDWATER SYSTEM
DATA SUMMARY

MOV	VALVE NUMBER	DESIGN (SPEC) ΔP (PSID) CLOSE	OPEN	MAXIMUM OPERATING ΔP (PSID) CLOSE	OPEN	JUSTIFICATION FOR MAX OPERATING ΔP (See Note 2)	EOP CONFIRMATION OF OPERATING ASSUMPTIONS
Motor-Driven Pump Discharge Isolation Valves	MOV-3764A MOV-3764B MOV-3764C MOV-3764D MOV-3764E MOV-3764F	1270	1270	1270	1270	Open (See Note 1) Close (See Note 1)	Yes
AFW Discharge Isolation Stop Check Valves	MOV-3350A MOV-3350B MOV-3350C	1600	1600	1270	1270	Open (See Note 1) Close (See Note 1)	Yes
Suction From Essential Service Water	MOV-3209A MOV-3209B MOV-3210A MOV-3210B MOV-3216	100	100	100	100	Open (See Note 3) Close (See Note 3)	Yes
Mech. Trip & Throttle Valve (Steam Supply to Turbine-driven Pump)	MOV-3406	1250	1250	1110	1110	Open (See Note 4) Close (See Note 4)	Yes

JUSTIFICATION FOR TABLE 2

NOTES:

1. Maximum operating ΔP was calculated based on emergency operating flow requirements rather than AFW pump miniflow discharge head - See Section III.B for justification.

2. Atmospheric pressure is postulated for down stream condition.

3. Maximum operating ΔP was calculated based on emergency operating flow requirements rather than service water pump miniflow discharge head - See Section III.B for justification.

4. This valve must be able to open and close against steam pressure equal to the lowest safety valve setpoint plus 3% accumulation. A heavy spring in the yoke closes the valve when tripped.

JOSEPH M. FARLEY UNITS 1 AND 2

EMERGENCY OPERATING PROCEDURES

SURVEY

AUXILIARY FEEDWATER VALVES

APPENDIX A

Turbine Trip and Throttle Valve (MOV-3406)

Case 1: Establish a steam delivery flowpath - open valve

ECP - 0.0	Step 4.2
FRP - H.1	Step 3.1.1
FRP - H.5	Step 4.2.1

Case 1: Open valve against steam pressure equal to the lowest safety valve setpoint + 3% accumulation.

MDAFW Pump Discharge Isolation Valves (MOV-3764 A, B, C, D, E, and F)

Case 1: Establish AFW flowpath - Open valves

FRP - H.1	Step 3.2
FRP - H.1	Step 17
FRP - H.3	Step 4.3
FRP - H.5	Step 4.3
FRP - S.1	Step 6.3

Case 2: Isolate AFW flowpath - close valves

EEP - 2	Step 5.1
EEP - 3	Step 6.1
FRP - H.2	Step 6.1
FRP - H.3	Step 3.1
FRP - H.5	Step 3.1.1
FRP - P.1	Step 1.3
FRP - P.2	Step 1.3
FRP - S.1	Step 8.2
FRP - Z.1	Step 6.1

Case 1: Open valves with pumps running

Case 2: Close valves with pumps running

AFW Discharge Isolation Stop Valves (MOV-3350A, B and C)

Case 1: Establish AFW flowpath - open valves

FRP - H.1	Step 3.2
FRP - H.1	Step 17
FRP - H.3	Step 4.3
FRP - H.5	Step 4.3
FRP - S.1	Step 6.3

Case 1: Open valves with auxiliary feedwater pumps running

Suction from Essential Service Water (MOV-3209A and B; 3210A and B; and 3216)

Case 1: Establish AFW flowpath from backup water source - open valves

ESP - 0.2	Step 9
EEP - 0	Step 4.1, Foldout Page
EEP - 0	Step 19.2
EEP - 1	Step 4.2, Foldout Page
EEP - 1	Step 3
EEP - 2	Step 6
EEP - 3	Step 4.2, Foldout Page
EEP - 3	Step 7
ESP - 0.0	Step 4.1, Foldout Page
ESP - 0.1	Step 5.2
ESP - 0.1	Step 4.1, Foldout Page
ESP - 0.2	Step 4.1, Foldout Page
ESP - 0.4	Step 4.1, Foldout Page
ESP - 1.1	Step 14
ESP - 1.1	Step 4.2, Foldout Page
ESP - 1.2	Step 4
ESP - 1.2	Step 4.2, Foldout Page
ESP - 1.3	Step 4.2, Foldout Page
ESP - 1.4	Step 4.2, Foldout Page
ESP - 3.1	Step 4.2, Foldout Page
ESP - 3.1	Step 5
ESP - 3.2	Step 5
ESP - 3.2	Step 4.2, Foldout Page
ESP - 3.3	Step 5
ESP - 3.3	Step 4.2 Foldout Page
ECP - 0.0	Step 11.6
ECP - 0.1	Step 7
ECP - 0.2	Step 6
ECP - 2.1	Step 1.3
ECP - 2.1	Step 4.2, Foldout Page
ECP - 3.1	Step 6
ECP - 3.1	Step 4.2, Foldout Page
ECP - 3.2	Step 4
ECP - 3.2	Step 4.2, Foldout Page
ECP - 3.3	Step 6
ECP - 3.3	Step 4.2, Foldout Page
FRP - C.1	Step 7
FRP - C.2	Step 7
FRP - H.1	Step 3.1
FRP - H.5	Step 4.4.1

Case 1: Open valves against essential service water source

ATTACHMENT 4

k) Training on Special Low Power Testing - Each licensed Reactor operator (RO) or Senior Reactor operator (SRO) who performs RO or SRO duties shall participate in the initiation, maintenance and recovery from natural circulation on the plant simulator verifying the acceptance criteria used in the Power Ascension test to be run during the test program. All RO's and SRO's who perform license duties shall be scheduled for this event. These actions shall be completed prior to full power operations. In the event the Power Ascension test fails acceptance criteria a letter to all license holders shall be issued detailing the changes between simulator action and plant action (acceptance criteria differences). The simulator will be updated using plant data and the operators will be retrained on the simulator during normal requalification training.