COMPONENT FUNCTIONS
Section 3.7

Component ID	Service
1/2MS-2019, 2020	Steam Supply (Admission) Valves to AFW Pump Turbines

Safety-Related Functions

1. These valves shall automatically open to provide main steam to the associated AFW Pump Turbine-Driver within the time constraints of the accident analyses.

2. These valves shall be capable of remote-manual closure to isolate the affected steam generator in the event of a tube rupture (SGTR) or steam line break event (MSLB) **[Refs 9.4.44, 9.2.57 - Sections 14.2.4, 14.2.5, 9.5.76]**. (Note that IEB 85-03 responses did not recognize this function as safety-related **[REF 9.4.13]**). These valves are assumed to fail-as-is within 10 minutes after an MSLB that occurs in the area of the valves **[REF 9.4.40]**.

3. The Steam Supply Valve associated with a faulted SG shall close on reverse flow from the pressurized SG to the depressurized SG.

4. These valves shall passively maintain the Main Steam System pressure boundary integrity.

Non-Safety-Related Functions

Augmented Quality Functions

1. During fires requiring Control Room evacuation, these valves shall be capable of local manual operation to ensure steam supply to the AFW Pump turbines from the "B" steam generator only. **[REF 9.2.59]**

Non-QA Functions

1. These valves shall remain closed during normal operation to prevent the inadvertent initiation of AFW to the associated unit.

COMPONENT PARAMETERS SUMMARY
Section 3.7 (continued)

Component ID	Service
1/2MS-2019, 2020	Steam Supply Valves to AFW Pump Turbines

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Stroke Time		3.7.1
Nominal	21 seconds	
Design Basis	See Worksheet	
2. Operating Differential Pressure		3.7.2
Specified Design D/P	1085 psid	
Design Basis Maximum D/P		
• Opening D/P	1159 psid	
• Closing D/P	1159 psid	
3. Valve Position		3.7.3
Normal Position	Closed	
Fail Position	As-Is	
4. Control Signals		3.7.4
Automatic	Per Worksheet	
Remote-Manual (Control Rm)	Open/Shut	
Local Handwheel	Open/Shut	
5. Power Requirements	Independent of AC Power 125 VDC (nominal)	3.7.5
OTHER DESIGN INFORMATION		
6. Size	3-inch	9.6.94
7. Material	Carbon Steel valves w/ Stellite Trim	9.6.94

COMPONENT PARAMETER WORKSHEET
Section 3.7.1

Component ID	Service
1/2MS-2019, 2020	Steam Supply Valves to AFW Pump Turbines

A. Parameter — Stroke Time

B. Value

Nominal	21 seconds
Design Basis Maximum	See below

C. Source

1. MOV Spec M-91 [REF 9.6.94]
2. MR 86-123, 87-25 [REF 9.5.114, 115]
3. SE 97-134 [REF 9.5.189]
4. MR 97-099 [REF 9.5.135]
5. MR 97-079 [REF 9.5.136]
6. MR 97-075 [REF 9.5.137]
7. CR 97-1918 [REF 9.5.150]
8. PBNP Final Safety Analysis Report (FSAR), as updated through June 1999 [REF 9.2.57]
9. PBNP Calculation 89-042, "Evaluation of the PBNP Containment Pressure Response to a Steam Line Break, Based on the Results of Westinghouse Analysis for a Reference 2-Loop PWR", Revision 3, dated 7/30/96. [REF 9.4.44]

D. Background/Reason

These valves were originally specified to have nominal 15-second stroke-time [Source 1]. The stroke-time of this valve is significant because it has an automatic, time-sensitive function to open and initiate AFW within the time assumed by analysis. See worksheet 2.2.2 for system response information.

Source 2 modified the MOV gearing and lengthened the stroke time from approximately 13 seconds to 21 seconds. This revision was evaluated for its delay in opening to start the AFWP turbine (increased from 2 seconds to 3 seconds) and for its delay in closing (minimal effects to CST water inventory). The additional 1 second startup time for the turbine does not significantly impact the overall response time of the AFW system. However, later evaluations noted that the increase in stroke time of the steam supply valves was found to have a significant effect on the system response to a seismic/tornado event [Source 7]. During a seismic/tornado event the supply to AFW pump suction is considered to be lost, which requires that the AFW pumps be protected from a loss of fluid suction. Currently the low suction pressure trip for the AFW pumps is set at 6.5 psig [Sources 3, 4], which is equivalent to a system water level approximately 1 foot below the actual bottom of the CST. The amount of available water in the AFW system piping to the suction of the respective AFW pump was shown to be inadequate without modification to the AFW system pump protection logic [Source 7]. Additionally, modifications were required to protect more piping from credible missile damage [Sources 5, 6]. Finally, a modification to the trip throttle valve [Source 4] for each TDAFW pump was required to assure that the available water in the suction piping of the AFW pumps was sufficient to protect the AFW pumps following a seismic or tornado induced loss of AFW suction supply from the CSTs. This modification took into account all credible worst case assumptions, applied single failure criteria, and addressed electrical separation issues.

COMPONENT PARAMETER WORKSHEET

Section 3.7.1 (continued)

Source 2 stated that the additional MOV stroke time results in the AFW pump coming up to speed in approximately 3 seconds (an additional second over the previous MOV gearing). Evaluation of AFW system response indicates that there is a large margin before the expected 60-second AFW startup response time is approached (See worksheet 2.2.2 for overall system response time). Given a 10-second pump acceleration allowance and no credit for steam flow through a partially-open steam supply MOV, the stroke-time could be up to 50 seconds and not affect the expected system startup response time of 60 seconds, and be well within the required 5 minute system response to provide 200 gpm.

However, mitigation of a loss of AFW suction supply from the CST (postulated in a seismic/tornado induced event), requires that the cutoff time for the steam supply to the respective TDAFW pump be minimized. The shutdown of the TDAFW pumps is the most restrictive situation for the closing stroke time design basis for the steam supply valves. Plant modifications **[Source 4]** eliminated close stroke time requirements by modifying the respective trip throttle valve and using it as the valve of choice to protect the pumps following a seismic or tornado induced LONF. This modification provided a low suction pressure trip signal directly to the trip throttle valve, which has a closure time on the order of 0.3 seconds, and has been measured at under 0.1 seconds **[Reference IWP 97-099*E02 (Unit 2), *F02 (Unit 1)]**. The trip throttle valve is in a common steam path to both steam admission valves and effectively eliminates the concern as to the open or close status of these valves.

The requirement for these MOVs to be manually closed to isolate a faulted steam generator still exists. These valves must be isolable to prevent loss of steam from an intact steam supply to a faulted steam header. Since the MSLB and SGTR analysis show isolation of the faulted system to occur at approximately 10 minutes to 30 minutes **[Sources 8 (Section 14.2.4, 14.2.5), 9]** the normal closure time for these MOVs under electric power is much shorter than the allowable isolation time frame. Therefore, acceptable closure time for these valves is based on the IST criteria used to determine acceptable valve mechanical operation rather than specific accident analysis closing time requirements.

COMPONENT PARAMETER WORKSHEET
Section 3.7.2

Component ID	Service
1/2MS-2019, 2020	Steam Supply Valves to AFW Pump Turbines

A. Parameter Operating Differential Pressure

B. Value

Specified Design D/P	1085 psid
Design Basis Maximum D/P	
• Opening D/P	1159 psid
• Closing D/P	1159 psid

C. Source
1. WE Response to IEB 85-03 [REF 9.2.72]
2. IEB 85-03 [REF 9.2.80]
3. WE Ltr VPNPD-87-187 dated 5/5/87 [REF 9.2.82]
4. WE Ltr VPNPD-86-284 dated 7/3/86 [REF 9.2.81]
5. MR 86-123, 87-25 [REF 9.5.114, 115]
6. WE Calculation N-86-019 [REF 9.4.13]
7. AFW DBD Validation Report [REF 9.3.32]
8. WE Calculation N-93-81 Rev. 0 [REF 9.4.15]

D. Background/Reason

This valve was originally specified with a differential pressure of 1085 psig, and was evaluated in IE Bulletin 85-03 **[Source 1]** using a "Design Delta P" of 1085 psid and a "Maximum Delta P" of 1085 psid. **Source 2** defines the "maximum differential pressure" as that d/p "expected 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....". **Source 3** further clarified that the maximum d/ps were determined based on worst case conditions, using maximum sources of pressure for one side of a valve (pump shutoff head, RCS relief valve setpoint, tank hydrostatic pressure, etc.) and minimum conditions on the other side." Consistent with these criteria the opening and closing d/ps were selected based on steam generator design pressure (1085 psig) on one side and atmospheric pressure (0 psig) on the downstream side. **Source 7** determined that the steam generator pressure could be higher than 1085 psig during a loss of offsite power. However, **Source 7** also found that the capability to open the valve would not be affected by this higher pressure since the valve design is such that the steam flow will act on the disc (which is free to float - the operator merely raises and lowers the valve stem) to open the valve.

Source 5 stated that the highest thrust loads are required during valve closure (system pressure aids in opening the valves). Similarly, **Source 6** states that the maximum d/p across the valve will not have any adverse affect for the opening (safety-related) function.

In response to NRC Generic Letter 89-10, **Source 8** performed a more rigorous review of the valve's operating and design bases, and considered the need for the valve to be functional throughout a "mispositioning" and the subsequent "recovery from a mispositioning". The resulting maximum operating d/p (1159 psid) was based on a maximum upstream pressure attributable to the main steam safety valve setpoint (1085 psig) plus relief valve accumulation (3%).

COMPONENT PARAMETER WORKSHEET

Section 3.7.3

Component ID	Service
1/2MS-2019, 2020	Steam Supply Valves to AFW Pump Turbines

A. Parameter Valve Position

B. Value

Normal Position	Closed
Fail Position	As-Is

C. Source

1. AFW DBD Validation Report [REF 9.3.32]
2. Accident Analysis DBD Module #11, LONF [REF 9.3.26]
3. Accident Analysis DBD Module #15, SBLOCA [REF 9.3.48]
4. Accident Analysis DBD Module #12, MSLB [REF 9.3.49]

D. Background/Reason

Normal Position. This valve must be normally closed to prevent inadvertent startup of the AFW Pump turbine.

Fail Position. Although no documented basis has been found for the selection of a motor-operator in this application (as opposed to air-operator), several facts can support the design requirement to have an operator which fails "as-is". Since this valve has a safety function to open and other important functions which require it to remain closed, it is most reliable therefore to have the valve (upon loss of power) to fail to its existing state as opposed to changing states and creating an abnormal new condition when its power fails.

As noted in **Source 1**, the internal valve design is not exactly "fail-as-is" because of its floating disk design. If the valve is opened by the motor operator, either of the following events will close the valve: (1) a subsequent steam flow reversal (such as might be caused by an upstream break) or (2) steam flow with insufficient momentum to raise the valve disc (i.e. the stem will be raised by the motor but the disc stays on the seat) will close the valve.

Accident analyses **[Sources 2, 3, 4]** do not allow the blowdown of both steam generators following an accident. Provision must therefore be made to prevent the backfeed of steam from an intact steam generator to the faulted SG. The stop check design allows automatic valve closure on reverse flow that will prevent the intact SG from backfeeding to the faulted SG or steam line. The MOV design for these valves provides for positive closure of the valve via remote/manual action which is used to isolate a SG during a tube rupture event.

COMPONENT PARAMETER WORKSHEET
Section 3.7.4

Component ID	Service
1/2MS-2019, 2020	Steam Supply Valves to AFW Pump Turbines

A. Parameter Control Signals

B. Value

Automatic	Open (see below)
Remote-Manual (Control Rm)	Open/Shut
Local Handwheel	Open/Shut

C. Source 1. FPER Safe Shutdown Analysis (Section 6.8.4.6.1) [REF 9.2.59]

D. Background/Reason

Automatic Open Signal
Refer to TDAFWP controls described in Section 3.1.6.

Remote-Manual Control in the Control Room
To accommodate the capability for remote-manual action to initiate auxiliary feedwater or isolate a faulted steam generator, these valves must have remote-manual controls from the Control Room.

Local Handwheel
According to the Safe Shutdown Analysis **[Source 1]**, DC power must be removed from "the steam inlet and discharge valves ... to prevent spurious operation of these valves" during fires requiring Control Room evacuation. Subsequent operation of these valves in such fires requires manual, local operation to open 1/2MS-2019 and close 1/2MS-2020 to initiate steam flow from the "B" steam generator only.

These valves are listed (in **Source 1**) as components with a "potential spurious malfunction that could affect safe shutdown". Spurious closure of 1/2MS-2019 could isolate the steam supply to the TDAFWP, and spurious opening of 1/2MS-2020 could cause depletion of "A" Steam Generator water inventory.

COMPONENT PARAMETER WORKSHEET
Section 3.7.5

Component ID	Service
1/2MS-2019, 2020	Steam Supply Valves to AFW Pump Turbines

A. Parameter Power Requirements

B. Value Independent of AC Power
125 VDC (Nominal)

C. Source 1. MOV Spec M-91 [REF 9.6.94]
2. Condition Report 97-2664
3. MR 97-099 [REF 9.5.135]

D. Background/Reason

To be capable of performing during a station blackout and demonstrating the diversity of the turbine-driven AFW pump system, these valves must operate independently of the AC power supplies. Accordingly, the DC power supply was selected. The power supplies to redundant steam admission valves must be from redundant, safety-related DC power supplies so that the single failure of a power supply will not prevent both valves associated with a turbine drive from operating. However, per **Source 2** certain DC power supply train failures can cause one of the two steam admission valves to fail-as-is, which will result in the respective TDAFW pump to continue to operate even when the required action is to shut down the pump. Partly to address this DC power failure issue, **Source 3** modified the trip throttle valve to automatically shutdown the TDAFW pump when required.

Source 1 specified a nominal requirement that the motor operator be suitable for 125 volt DC supply voltage.

COMPONENT FUNCTIONS
Section 3.8

Component ID	Service
AF-4007,4014 1/2AF-4002	AFW Pump Recirc Flow Control Valves (AOV)

Safety-Related Functions

1. These valves shall close automatically to prevent the unnecessary diversion of AFW pump discharge during high-flow conditions where sufficient pump discharge flow is providing for inlet flow stability and removal of pump heat.

2. These valves shall passively maintain the AFW system pressure boundary integrity.

3. These valves shall open to provide a redundant flow path to ensure minimum AFP flow is maintained for pump protection [REF 9.2.17]. Note that, per the reference, this flow path was considered an enhancement and redundant to the still-credited manual operator action to ensure adequate flow is maintained through the pump to prevent damage. However, subsequent internal discussion determined that it is prudent and appropriate to require an available recirculation flow path as a requirement for pump operability. At the time of Revision 3 of this DBD, formal documentation of this decision was still pending, and was expected to be included in the Technical Specification Bases.

Non-Safety-Related Functions

Augmented Quality Functions

1. 1/2 AF-4002 shall be capable of being manually "gagged" in the open position to ensure minimum pump recirculation flow to Turbine-Driven AFW Pumps during plant fires. **[REF 9.2.59, Section 6.8.4.6.1]**

Non-QA Functions

1. These valves shall close automatically after the AFW pump is secured (and remain closed) to prevent a flowpath of MFW backleakage to the CST. This function is required only if the 1st off, 2nd off, and discharge check valves are leaking when backseated. **[REF 9.5.118]**

COMPONENT PARAMETERS SUMMARY
Section 3.8 (continued)

Component ID	Service
AF-4007,4014 1/2AF-4002	AFW Pump Recirc Flow Control Valves (AOV)

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Controls		3.8.1
Automatic	Open/Shut	
Manual Handwheel	Open/Shut	
2. Stroke Time	See Worksheet	3.8.2
3. Design Pressure, Temperature	1410 psig 100° F minimum specification	9.6.95
OTHER DESIGN INFORMATION		
4. Position		
Normal Position	Closed	
Failure Position		
- Loss of Instrument Air	Automatic control using backup air accumulators or nitrogen bottles	
- Loss of Backup Supplies or power	Closed	
5. Operational Requirements	Gagged Open during Plant Fires	3.8.6
6. Material	Stainless Steel	2.2.14
7. Valve Type	Globe	9.6.95
8. Operator Air Loading Pressure	45 psig	9.6.95

COMPONENT PARAMETER WORKSHEET
Section 3.8.1

Component ID	Service
AF-4007,4014 1/2AF-4002	AFW Pump Recirc Flow Control Valves (AOV)

A. Parameter Controls

B. Value Automatic

• Open	Pump On, Discharge Flow < Reqd Mini-Flow[1]
• Close	Pump On, Discharge Flow > Reqd Mini-Flow, delayed 45 sec[1]
Manual Handwheel	Open/Shut

C. Source
1. MR 88-99 [REF 9.5.117]
2. WE Internal Memo response to IEN 84-06 [REF 9.5.5]
3. MR IC-274 [REF 9.5.118]
4. MSSM 84-28 [REF 9.5.8]
5. PBNP Setpoint Document STPT 14.11 [REF 9.5.28]
6. W LONF Licensing Basis Accident Analysis Evaluation [REF 9.3. 102]
7. SE 97-201, RE: Changing time delay relay setpoint [REF 9.5.190]

D. Background/Reason

As stated in **Source 1** for MDAFW pump recirculation flow: "To ensure this minimum flow [50 gpm] is met, the setpoints for the valve's [AF-4007, -4014] controlling instrumentation will be adjusted so that the mini-recirc valve is open when flow in the discharge line is less than 80 gpm". This resulted in changing the automatic operating setpoints of AF-4007, -4014 based on flow past dPIS-4007, -4014 respectively:

AF-4007, -4014	95 gpm (increasing)	Valve Close, with 45 second delay
	75 gpm (decreasing)	Valve Open

Also, for the TDAFW pump recirculation flow, **Source 1** adjusted the automatic operating setpoints of 1/2AF-4002 (based on flow past 1/2dPIS-4002) accordingly:

1/2AF-4002	145 gpm (increasing)	Valve Close, with 45 second delay
	110 gpm (decreasing)	Valve Open

[1] These automatic controls are required to function only when the associated pump is running (as indicated by a closed MDAFW Pump breaker or open steam-admission valve to the TDAFW Pump). Without this feature, these valves would be open when the AFW system was in its normal standby lineup. The automatic control signals to close these valves are delayed 45 seconds per **Sources 5 and 7**.

COMPONENT PARAMETER WORKSHEET
Section 3.8.1 (continued)

Source 1 states that, "after each AFW pump is up to rated speed and flow [as sensed by the discharge flow instrument], a closure signal is sent to its associated mini-recirc valve which shuts after a 3 minute delay". The 3 minute time delay was later decreased to 45 seconds [**Sources 5 and 7**] to reduce the amount of time the AFW system is diverting water back to the CST. The time delay is activated whenever a signal is generated to close the valve. **Source 1** suggests two design bases for this time delay function associated specifically with the TDAFW pumps:

(1) the delay prevents the system from "hunting" for its operating point (applies to TDAFW pump), and
(2) the delay allows pump heat removal during pump coastdown associated with the TDAFW pumps.

In addition, the time delay performs the following functions for both the TDAFW and MDAFW pumps:

(3) the time delay duration satisfies the requirements discussed in W evaluations [**Source 6**] which assume a maximum time delay of under 1 minute, including valve stroke time to close (as seen in the 60 second time frame between the 100 gpm flow and the 200 gpm flow – which includes the delay time and the valve closure time).

(4) the time delay allows the mini-recirc line to be available as an additional flow path to help preclude running the pumps in a dead headed condition, since the mini-recirc valves are open for the initial 45 seconds after pump start. The discharge flow path for the MDAFW pumps has two valves that have to open in order to provide a flow path. The discharge path is the primary flow path to prevent a dead head condition when AFW is automatically initiated. A failure of either valve in the discharge path of a MDAFW pump would constitute a single failure since these valves have a safety related function to open (the valves would open enough to preclude dead head conditions when no valve failure occurs).

Design bases items (1) and (2) above compete with the performance objectives of IEN 84-06 to prevent water hammer in AFW discharge piping. **Sources 2 and 3** suggested that the coastdown control feature described above did not provide an "abrupt change" in differential pressure to ensure good seating of the discharge check valves. **Source 4** would have allowed operators to defeat this time delay function (to allow better valve seating), but it was canceled in lieu of improvements to the check valve design.

Another detriment of the time delay is its effect on pump runout analyses. The time delay maintains an additional discharge path for the AFW pumps upon startup and increases pump output. This effect has been evaluated in Source 1.

COMPONENT PARAMETER WORKSHEET

Section 3.8.2

Component ID	Service
AF-4007,4014 1/2AF-4002	AFW Pump Recirc Flow Control Valves (AOV)

A. Parameter Stroke Time

B. Value See Worksheet

C. Source
1. Section 2.2.2, System Response Time
2. Worksheet 3.8.1, AFW Pump Recirc Flow Control Valves (AOV) Controls
3. NMC Correspondence NRC 2002-0068 [REF 9.2.17]

D. Background/Reason

There is no required valve open or closed stroke time limit. However, based on the response time information supplied in Section 2.2.2 of this DBD **[Source 1]**, and Worksheet 3.8.1 **[Source 2]**, nominal valve stroke times can be determined.

As stated in Source 1, the capability to start and provide full system flow within one minute (60 seconds) will demonstrate that the actions needed to provide the required flows within 5 minutes can be completed.

Valve Closure:

Given the 45 second time delay for closing these valves **[Source 2]**, this allows a nominal close stroke of 15 seconds for the recirculation valves to meet the 60 second (1 minute) response. By closing the valves within 1 minute, this allows for full flow to the steam generators at essentially one minute.

Valve Open:

The recirculation path is the preferred path for the minimum flow required to protect the AFW pumps from damage due to too little flow. As discussed in **Source 3**, this path was considered redundant to the feed forward flow path. This position was established because manual operator intervention is required to reduce the automatic forward feed flow to the point that it could jeopardize the pump if the recirculation path was not available. Logically therefore, manual action should be credited to ensure that either adequate recirculation flow is available or to secure the pump if it is not.

Subsequent internal discussions during the development of **Source 4**, it was decided that it is prudent to consider a supporting safety function of the common recirculation line is to provide a minimum recirculation flow path, and that isolation of this flowpath would necessarily render all four AFW pumps inoperable. As of the issuance of revision 3 of this DBD, this is the station position on the issue, although formal documentation is still pending. It is expected that the resolution will be documented in the Technical Specification Bases by **Source 4**.

The minimum recirculation flow control valves should nominally open within the same time frame as the close stroke time (15 seconds). This will demonstrate proper mechanical operation of the valves, and changes in the stroke time will indicate degradation of the equipment.

COMPONENT PARAMETER WORKSHEET

Section 3.8.3

Component ID	Service
AF-4007,4014 1/2AF-4002	AFW Pump Recirc Flow Control Valves (AOV)

A. Parameter Position

B. Value

Normal Position	Closed
Failure Position	
- Loss of Instrument Air	Automatic control using backup air accumulators or nitrogen bottles
- Loss of Backup Supplies	Closed
- Loss of control power	Closed

C. Source

1. WE Calculation N-87-041 [REF 9.4.3]
2. MR 88-99 [REF 9.5.117]
3. MR IC-274 [REF 9.5.118]
4. MR 01-144 [REF 9.5.2]
5. MR 02-001 [REF 9.5.3]
6. NMC Internal Correspondence dated 4/25/02 [REF 9.3.23]
7. NMC Correspondence NRC 2002-0068 [REF 9.2.17]

D. Background/Reason

Failure Position

This valve has a safety function to close to maintain the system pressure boundary, as well as a safety related function to open, providing a redundant flow path for minimum cooling flow in the event that the feed forward path is isolated. This ensures adequate flow is maintained through an operating pump to prevent pump damage **[Source 7]**.

Interestingly, **Source 1** concludes that "adequate minimum pump flow will exist for all auxiliary feed pumps under all design basis conditions with an assumed failure of the pneumatic recirculation control valves". This evaluation, however, did not consider the potential for instrument air loss (causing recirc valve closure) in combination with the single active failure (i.e., the associated discharge MOV fails shut). The "worst case" recirculation flow would occur if the air-operated recirc valve(s) and the air-operated discharge valve(s) failed in the closed position.

COMPONENT PARAMETER WORKSHEET

Section 3.8.3 (continued)

Failure of one of these valves in the open position would cause a reduction in AFW System flow to the steam generators during an accident; however, the value of flow-reduction is bounded by the single failure condition created if the TDAFW Pump fails to start **[Source 2]**.

Due to the discovery of a potential common mode failure of all four AFW pumps in a scenario where instrument air has been lost, backup pneumatic sources were installed **[Source 4, 5]**. These systems were installed safety-related **[Sources 6, 7]**. **Source 4** tapped into the MDAFP discharge valve nitrogen backup system for use to stroke the AF-4007 and AF-4014 valves. **Source 5** installed instrument air accumulator tanks to supply the 1/2AF-4002 valves.

Normal Position

When the AFW System is in a standby lineup, these valves are normally closed to limit backleakage (from MFW) to the CST. As discussed in **Source 3**, allowing such leakage would mask the failure of AFW discharge check valves by allowing flow and keeping AFW piping temperatures and pump suction pressures below levels that would otherwise be indicative of a problem.

COMPONENT PARAMETER WORKSHEET
Section 3.8.4

Component ID	Service
AF-4007,4014 1/2AF-4002	AFW Pump Recirc Flow Control Valves (AOV)

A. Parameter Operational Requirements

B. Value Gagged Open during Plant Fires

C. Source
1. Fire Protection Evaluation Report [REF 9.2.59]
2. AOP-10A, "Safe Shutdown - Local Control" [REF 9.5.123]
3. PBNP Calculation N-93-117 [REF 9.4.46]

D. Background/Reason

According to the text of the Safe Shutdown Analysis of the PBNP Fire Protection Evaluation Report **[Source 1]**, valves 1/2 AF-4002 shall be manually "gagged" in the open position to ensure minimum pump recirculation flow to Turbine-Driven AFW Pumps during fires requiring Control Room evacuation. Spurious closure caused by control circuit damage could lead to pump damage if the AFW pump is started with its discharge valve closed. Refer to **Sources 2 and 3** for implementation of these requirements.

COMPONENT FUNCTIONS
Section 3.9

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

Safety-Related Functions

1. These valves shall automatically control (throttle) the discharge pressure of the motor-driven AFW Pumps to achieve their design flowrate regardless of downstream conditions. **[REF 9.2.45]**

2. These valves shall remain open (i.e., shall not close) to allow AFW flow from the motor-driven AFW Pumps to the associated steam generators **[REF 9.6.21]**.

3. These valves shall passively maintain the AFW system pressure boundary integrity.

4. These valves shall remain open and be capable of automatic control in the event of a loss of instrument air. **[REF 9.5.134, 9.5.182]**

Non-Safety-Related Functions

Augmented Quality Functions

None

Non-QA Functions

None

COMPONENT PARAMETERS SUMMARY

Section 3.9 (continued)

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Operating Differential Pressure		3.9.1
Specified "Available D/P"	46.7 psid	
Specified "Maximum D/P"	1410 psid	
2. Design Flow at "Available D/P"	200 gpm	3.9.1
3. Position		3.9.2
Normal Position	Open as necessary to maintain 1200 psig at pump discharge	
Fail Position		
• Loss of Air	Automatic Control using Backup Nitrogen (N_2) accumulators Local gagging of valve if flow requirements < 75 gpm	
• Loss of Nitrogen and Air	Full Open	
4. Valve response time	See worksheet	3.9.3
5. Range of Control Air Signals	3-15 psig	9.6.95
6. Design Pressure/Temperature	1410 psig/100°F(max of 220°F)	9.6.95
OTHER DESIGN INFORMATION		
7. Valve Type	Throttling Globe	9.6.95
8. Material	Carbon Steel	9.6.95
9. Operator Air Loading Pressure	20 psig (AF-4012) 45 psig (AF-4019)	9.6.95 9.5.196

COMPONENT PARAMETER WORKSHEET
Section 3.9.1

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

A. Parameter Operating Differential Pressure

B. Value Specified "Available D/P" 46.7 psid
Specified "Maximum D/P" 1410 psid

C. Source 1. AOV Spec M-181 [REF 9.6.95]

D. Background/Reason

This valve was originally specified with an "available" differential pressure of 46.7 psid, which was used in the vendor's design to achieve the design flowrate of 200 gpm specified on the original valve specification [Source 1]. The derivation of this d/p value is UNKNOWN.

This valve was originally specified with a "maximum" differential pressure of 1410 psid. These values are probably derived from the values of shutoff head on each Motor-Driven AFW Pump (1305 psig) plus a maximum suction pressure of 100 psig attributable to the maximum operating pressure of the Service Water System.

COMPONENT PARAMETER WORKSHEET
Section 3.9.2

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

A. Parameter: Position

B. Value

Normal Position	Throttled Open (pressure control set to 1200 psig)
Fail Position	
• Loss of Air	Automatic Control using Backup Nitrogen accumulators
• Loss of Nitrogen and Air	Full Open

C. Source

1. WE Internal Memo NEM-89-36 dated 1/17/89 [REF 9.5.25]
2. WE Ltr VPNPD-89-417 response to IEB 80-04 [REF 9.2.46]
3. WE Calculation P-87-001 [REF 9.4.1]
4. WE Calculation P-87-003 [REF 9.4.2]
5. NRC Ltr to WE dated 2/14/92 [REF 9.2.79]
6. WE Modification, MR 97-038*A [REF 9.5.134]
7. AOP-5B [REF 9.5.182]
8. CR 97-0930 [REF 9.5.192]
9. LER 97-014-00 [REF 9.2.108]
10. PBNP Inservice Test IT-10, Test of Electrically-Driven Auxiliary Feed Pumps and Valves (Quarterly) - Units 1 and 2, Revision 35, 01/08/99. [Ref. 9.5.91]
11. WE Letter 2002-0002 [REF 9.4.49]
12. WE Modification MR 01-144 [REF 9.5.2]

D. Background/Reason

Although no documented basis has been found for the selection of an air-operator in this application (as opposed to motor-operator), several facts can support the design requirement to have an operator which fails to the open position (with the exception that it is a detriment in the MSLB case). Since this valve has a safety function to open, and no significant closing function, it is most reliable (from a flow delivery standpoint) to have the valve fail (upon loss of power or instrument air) to the open position. Although failure to the full open position will cause a significant and deleterious increase in MDAFW pump flowrate, **Source 3** concluded that the CSTs would provide sufficient NPSH (and flow restrictions would be adequate) to prevent MDAFW pump runout with these valves. More recent evaluations concluded that modifications were required to prevent MDAFW pump runout when Instrument Air (IA) was lost **[Sources 8 and 9]**. **Source 6** modified the air supply to the discharge pressure control valves to be throttled with a safety-related backup nitrogen source when IA is lost (or when IA pressure was below minimum required to operate these valves). **Source 4** calculated the necessary valve "gag" positions to achieve a 200 gpm pump flowrate at various steam generator pressures which were incorporated in **Source 6** for automatic flow control on loss of IA.

COMPONENT PARAMETER WORKSHEET
Section 3.9.2 (continued)

Much analysis went into the failure position of this valve as a result of NRC Generic Letter 88-14 regarding Instrument Air Systems. **Source 1** determined that a motor-driven AFW pump could provide a depressurized steam generator as much as 616 gpm as a result of this failure (**FOR ILLUSTRATIVE PURPOSES** - this flow rate would trip the electrical breaker within 250 seconds based on generic breaker performance curves). This flow value exceeded that used in existing core and containment response analyses to the MSLB. However, a qualitative evaluation (**Source 2**) supported no further action to correct the existing failure mode. This evaluation was based on a low probability of occurrence, conservatism in existing analyses, the relatively small offsite dose consequences of a MSLB, and the risk associated with any modification that would tend to limit AFW System flow. Another consequence of the fail-open position of these valves is the potential for Emergency Diesel Generator overloading as the MDAFW pump demands more horsepower when the pump operates at these maximum flow conditions. This condition is addressed in **Source 5** and was recently re-evaluated. Because the Instrument Air System is non-safety related, these valves were modified per **Source 6**, which added a safety-related source of backup nitrogen, via nitrogen bottles, to support continued operation after a loss of Instrument Air. With the implementation of the safety related backup nitrogen bottle modification per **Source 6**, the runout potential, previously discussed, is precluded.

Testing of the nitrogen backup pressure supply performed as part of the installing modification [**Source 6**] verified that delivery of nitrogen from the accumulator to the discharge control valves provides adequate pressure to maintain control valve function. Testing performed in the inservice test program periodically verifies that the nitrogen supply provides adequate gas flow and pressure to operate the discharge control valves [**Source 10**].

The backup nitrogen system for the AF-4012 / 4019 valves has been tapped to also provide nitrogen for the MDAFP mini-recirc valves [**Source 12**]. **Source 11** confirmed that based on the changeout pressure given in **Source 10**, there will always be 1.5 hours (this assumes 6 full strokes of the valve per hour) of nitrogen available to operate the AF-4012 / 4019 discharge valves and the AF-4007 / 4014 mini-recirc valves following a loss of instrument air. **Source 7** has been updated to reflect this limit.

COMPONENT PARAMETER WORKSHEET

Section 3.9.3

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

A. Parameter Valve Stroke Time

B. Value See discussion below.

C. Source
1. CR 97-3366, IST Program requirements for motor driven AFW Pump flow control valves.
2. CR 99-0504,
3. IST Background document.
4. PBNP Inservice Test IT-10, Test of Electrically-Driven Auxiliary Feed Pumps and Valves (Quarterly) - Units 1 and 2, Revision 35, 01/08/99. [Ref. 9.5.91]

D. Background/Reason

No specific response time has been identified for operation of these valves. Two Condition Reports (CR 97-3366 and 99-0504) have been written that requested stroke time information for these valves. The responses to these CRs provide the basis for stroke time for the valve. Ultimately, the valve is only required to stroke to meet the response time identified in section 2.2.2, which is 5 minutes. Since the AFW system was originally set up to accommodate a 60 second time response for full flow, the maximum stroke time value is built around support for this system response.

Valve Stroke Time using the 60 second system response time (discussion from CR 99-0504 #7 response).

The portion of time available for operation of the discharge control valves can be determined utilizing 60 seconds from initiation of pump operation to full flow delivery. This time frame can be divided into two portions, pump start and ramp to full speed, and discharge control valve operation from full closed to full open.

Calculation 97-0215 assumes a three second time for pump ramp up to full speed from a pump start signal. Without further characterizing pump flow response, a 10 second allowance which includes a sensor time delay of 2 seconds and starting the pump and reaching the full flow condition will be assumed. This leaves 50 seconds for valve response time to meet the 60 second system response time. Time response to account for EDG startup and sequencer delay is not considered here. In the limiting analysis for a loss of all AC, the EDGs would be started at the initiating event (time 0), and the AFW pump start signal would be initiated by a low steam generator water level trip at 41. 3 seconds. Therefore the diesels would be up to speed (10 seconds) and through sequencing (10 seconds) before the AFW pump start signal would be initiated.

COMPONENT PARAMETER WORKSHEET
Section 3.9.3 (continued)

Valve opening.
The discharge control valves open in response to AFW pump discharge pressure, which will increase as the pump comes up to speed. Therefore, the control valve time response from full closed to full open should occur in 50 seconds or less, including any inherent time delays in the control circuitry as well as the valve response time.

Valve closure.
Valve closure time should be equivalent to valve opening time, full open to full closed in 50 seconds or less, including any inherent time delays in the control circuitry as well as the valve response time.

Slow valve closure could possibly allow the motor-driven AFW pump to trip due to a time delayed over current condition. Evaluation of pump operating curve information and electrical breaker time-current characteristics curve data (see CR response written for **Source 2**) shows that a trip of the breaker at 50 seconds would require a minimum current of more than 500 amps. Pump operating curve data (for P-38A/B) shows pump flow out to 500 gpm using 330 to 340 BHP. Overestimating and using 400 BHP to evaluate current from the BHP used gives a value of nearly 360 amps to operate the pumps at the 400 BHP level. This current draw is well under the 500 amps shown on the breaker time-current characteristics curve that would return a trip at 50 seconds. Therefore, by setting the closing time for the valve at 50 seconds, high flow conditions can be controlled by the valve response without reaching the overcurrent trip setting on the breakers.

Response to CR 97-3366 #2 (**Source 1**) to provide IST input information provided a response time of 20 seconds for the valves. This response was based on applying all identified time delays to the 60 second response time with a 20 second valve response time to determine a 16 second pump acceleration. The 20 second valve response time was picked using engineering judgement as a reasonable valve response time, and supported by the remaining system response time inputs. As such, a 20 second time response is an acceptable time frame for use in the IST testing program.

The current IST documents (**Source 3**) have been verified to use the 20 seconds as the maximum for valve stroke time. However, IST testing methods (**Source 4**) verify the stroke using a method that bypasses the I&C controller for the valves and sends an air pressure signal directly to the valve for opening. This method does not consider the instrumentation response to AFW flow conditions. When considering the I&C setup for the valves, the 50 second stroke time identified above should be used as the maximum stroke time for the overall response of the valve.

COMPONENT FUNCTIONS
Section 3.9

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

Safety-Related Functions

1. These valves shall automatically control (throttle) the discharge pressure of the motor-driven AFW Pumps to achieve their design flowrate regardless of downstream conditions. **[REF 9.2.45]**

2. These valves shall remain open (i.e., shall not close) to allow AFW flow from the motor-driven AFW Pumps to the associated steam generators **[REF 9.6.21]**.

3. These valves shall passively maintain the AFW system pressure boundary integrity.

4. These valves shall remain open and be capable of automatic control in the event of a loss of instrument air. **[REF 9.5.134, 9.5.182]**

Non-Safety-Related Functions

Augmented Quality Functions

None

Non-QA Functions

None

COMPONENT PARAMETERS SUMMARY
Section 3.9 (continued)

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Operating Differential Pressure		3.9.1
Specified "Available D/P"	46.7 psid	
Specified "Maximum D/P"	1410 psid	
2. Design Flow at "Available D/P"	200 gpm	3.9.1
3. Position		3.9.2
Normal Position	Open as necessary to maintain 1200 psig at pump discharge	
Fail Position		
• Loss of Air	Automatic Control using Backup Nitrogen (N_2) accumulators Local gagging of valve if flow requirements < 75 gpm	
• Loss of Nitrogen and Air	Full Open	
4. Valve response time	See worksheet	3.9.3
5. Range of Control Air Signals	3-15 psig	9.6.95
6. Design Pressure/Temperature	1410 psig/100°F(max of 220°F)	9.6.95
OTHER DESIGN INFORMATION		
7. Valve Type	Throttling Globe	9.6.95
8. Material	Carbon Steel	9.6.95
9. Operator Air Loading Pressure	20 psig (AF-4012) 45 psig (AF-4019)	9.6.95 9.5.196

COMPONENT PARAMETER WORKSHEET
Section 3.9.1

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

A. Parameter Operating Differential Pressure

B. Value Specified "Available D/P" 46.7 psid
Specified "Maximum D/P" 1410 psid

C. Source 1. AOV Spec M-181 [REF 9.6.95]

D. Background/Reason

This valve was originally specified with an "available" differential pressure of 46.7 psid, which was used in the vendor's design to achieve the design flowrate of 200 gpm specified on the original valve specification [**Source 1**]. The derivation of this d/p value is UNKNOWN.

This valve was originally specified with a "maximum" differential pressure of 1410 psid. These values are probably derived from the values of shutoff head on each Motor-Driven AFW Pump (1305 psig) plus a maximum suction pressure of 100 psig attributable to the maximum operating pressure of the Service Water System.

COMPONENT PARAMETER WORKSHEET
Section 3.9.2

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

A. Parameter Position

B. Value

Normal Position	Throttled Open (pressure control set to 1200 psig)
Fail Position	
• Loss of Air	Automatic Control using Backup Nitrogen accumulators
• Loss of Nitrogen and Air	Full Open

C. Source

1. WE Internal Memo NEM-89-36 dated 1/17/89 [REF 9.5.25]
2. WE Ltr VPNPD-89-417 response to IEB 80-04 [REF 9.2.46]
3. WE Calculation P-87-001 [REF 9.4.1]
4. WE Calculation P-87-003 [REF 9.4.2]
5. NRC Ltr to WE dated 2/14/92 [REF 9.2.79]
6. WE Modification, MR 97-038*A [REF 9.5.134]
7. AOP-5B [REF 9.5.182]
8. CR 97-0930 [REF 9.5.192]
9. LER 97-014-00 [REF 9.2.108]
10. PBNP Inservice Test IT-10, Test of Electrically-Driven Auxiliary Feed Pumps and Valves (Quarterly) - Units 1 and 2, Revision 35, 01/08/99. [Ref. 9.5.91]
11. WE Letter 2002-0002 [REF 9.4.49]
12. WE Modification MR 01-144 [REF 9.5.2]

D. Background/Reason

Although no documented basis has been found for the selection of an air-operator in this application (as opposed to motor-operator), several facts can support the design requirement to have an operator which fails to the open position (with the exception that it is a detriment in the MSLB case). Since this valve has a safety function to open, and no significant closing function, it is most reliable (from a flow delivery standpoint) to have the valve fail (upon loss of power or instrument air) to the open position. Although failure to the full open position will cause a significant and deleterious increase in MDAFW pump flowrate, **Source 3** concluded that the CSTs would provide sufficient NPSH (and flow restrictions would be adequate) to prevent MDAFW pump runout with these valves. More recent evaluations concluded that modifications were required to prevent MDAFW pump runout when Instrument Air (IA) was lost [**Sources 8 and 9**]. **Source 6** modified the air supply to the discharge pressure control valves to be throttled with a safety-related backup nitrogen source when IA is lost (or when IA pressure was below minimum required to operate these valves). **Source 4** calculated the necessary valve "gag" positions to achieve a 200 gpm pump flowrate at various steam generator pressures which were incorporated in **Source 6** for automatic flow control on loss of IA.

COMPONENT PARAMETER WORKSHEET
Section 3.9.2 (continued)

Much analysis went into the failure position of this valve as a result of NRC Generic Letter 88-14 regarding Instrument Air Systems. **Source 1** determined that a motor-driven AFW pump could provide a depressurized steam generator as much as 616 gpm as a result of this failure (**FOR ILLUSTRATIVE PURPOSES** - this flow rate would trip the electrical breaker within 250 seconds based on generic breaker performance curves). This flow value exceeded that used in existing core and containment response analyses to the MSLB. However, a qualitative evaluation (**Source 2**) supported no further action to correct the existing failure mode. This evaluation was based on a low probability of occurrence, conservatism in existing analyses, the relatively small offsite dose consequences of a MSLB, and the risk associated with any modification that would tend to limit AFW System flow. Another consequence of the fail-open position of these valves is the potential for Emergency Diesel Generator overloading as the MDAFW pump demands more horsepower when the pump operates at these maximum flow conditions. This condition is addressed in **Source 5** and was recently re-evaluated. Because the Instrument Air System is non-safety related, these valves were modified per **Source 6**, which added a safety-related source of backup nitrogen, via nitrogen bottles, to support continued operation after a loss of Instrument Air. With the implementation of the safety related backup nitrogen bottle modification per **Source 6**, the runout potential, previously discussed, is precluded.

Testing of the nitrogen backup pressure supply performed as part of the installing modification [**Source 6**] verified that delivery of nitrogen from the accumulator to the discharge control valves provides adequate pressure to maintain control valve function. Testing performed in the inservice test program periodically verifies that the nitrogen supply provides adequate gas flow and pressure to operate the discharge control valves [**Source 10**].

The backup nitrogen system for the AF-4012 / 4019 valves has been tapped to also provide nitrogen for the MDAFP mini-recirc valves [**Source 12**]. **Source 11** confirmed that based on the changeout pressure given in **Source 10**, there will always be 1.5 hours (this assumes 6 full strokes of the valve per hour) of nitrogen available to operate the AF-4012 / 4019 discharge valves and the AF-4007 / 4014 mini-recirc valves following a loss of instrument air. **Source 7** has been updated to reflect this limit.

COMPONENT PARAMETER WORKSHEET

Section 3.9.3

Component ID	Service
AF-4012, 4019	MDAFW Pump Discharge Pressure Control Valves (AOVs)

A. Parameter Valve Stroke Time

B. Value See discussion below.

C. Source
1. CR 97-3366, IST Program requirements for motor driven AFW Pump flow control valves.
2. CR 99-0504,
3. IST Background document.
4. PBNP Inservice Test IT-10, Test of Electrically-Driven Auxiliary Feed Pumps and Valves (Quarterly) - Units 1 and 2, Revision 35, 01/08/99. [Ref. 9.5.91]

D. Background/Reason

No specific response time has been identified for operation of these valves. Two Condition Reports (CR 97-3366 and 99-0504) have been written that requested stroke time information for these valves. The responses to these CRs provide the basis for stroke time for the valve. Ultimately, the valve is only required to stroke to meet the response time identified in section 2.2.2, which is 5 minutes. Since the AFW system was originally set up to accommodate a 60 second time response for full flow, the maximum stroke time value is built around support for this system response.

Valve Stroke Time using the 60 second system response time (discussion from CR 99-0504 #7 response).

The portion of time available for operation of the discharge control valves can be determined utilizing 60 seconds from initiation of pump operation to full flow delivery. This time frame can be divided into two portions, pump start and ramp to full speed, and discharge control valve operation from full closed to full open.

Calculation 97-0215 assumes a three second time for pump ramp up to full speed from a pump start signal. Without further characterizing pump flow response, a 10 second allowance which includes a sensor time delay of 2 seconds and starting the pump and reaching the full flow condition will be assumed. This leaves 50 seconds for valve response time to meet the 60 second system response time. Time response to account for EDG startup and sequencer delay is not considered here. In the limiting analysis for a loss of all AC, the EDGs would be started at the initiating event (time 0), and the AFW pump start signal would be initiated by a low steam generator water level trip at 41. 3 seconds. Therefore the diesels would be up to speed (10 seconds) and through sequencing (10 seconds) before the AFW pump start signal would be initiated.

COMPONENT PARAMETER WORKSHEET

Section 3.9.3 (continued)

Valve opening.
The discharge control valves open in response to AFW pump discharge pressure, which will increase as the pump comes up to speed. Therefore, the control valve time response from full closed to full open should occur in 50 seconds or less, including any inherent time delays in the control circuitry as well as the valve response time.

Valve closure.
Valve closure time should be equivalent to valve opening time, full open to full closed in 50 seconds or less, including any inherent time delays in the control circuitry as well as the valve response time.

Slow valve closure could possibly allow the motor-driven AFW pump to trip due to a time delayed over current condition. Evaluation of pump operating curve information and electrical breaker time-current characteristics curve data (see CR response written for **Source 2**) shows that a trip of the breaker at 50 seconds would require a minimum current of more than 500 amps. Pump operating curve data (for P-38A/B) shows pump flow out to 500 gpm using 330 to 340 BHP. Overestimating and using 400 BHP to evaluate current from the BHP used gives a value of nearly 360 amps to operate the pumps at the 400 BHP level. This current draw is well under the 500 amps shown on the breaker time-current characteristics curve that would return a trip at 50 seconds. Therefore, by setting the closing time for the valve at 50 seconds, high flow conditions can be controlled by the valve response without reaching the overcurrent trip setting on the breakers.

Response to CR 97-3366 #2 (**Source 1**) to provide IST input information provided a response time of 20 seconds for the valves. This response was based on applying all identified time delays to the 60 second response time with a 20 second valve response time to determine a 16 second pump acceleration. The 20 second valve response time was picked using engineering judgement as a reasonable valve response time, and supported by the remaining system response time inputs. As such, a 20 second time response is an acceptable time frame for use in the IST testing program.

The current IST documents (**Source 3**) have been verified to use the 20 seconds as the maximum for valve stroke time. However, IST testing methods (**Source 4**) verify the stroke using a method that bypasses the I&C controller for the valves and sends an air pressure signal directly to the valve for opening. This method does not consider the instrumentation response to AFW flow conditions. When considering the I&C setup for the valves, the 50 second stroke time identified above should be used as the maximum stroke time for the overall response of the valve.

COMPONENT FUNCTIONS
Section 3.10

Component ID	Service
AF-112, 113 1/2AF-111	AFW Pump Suction Check Valves

Safety-Related Functions

1. These valves shall automatically open to provide a flowpath for auxiliary feedwater from the condensate storage tanks (CSTs) to each of the AFW pumps when AFW is initiated **[REF 9.6.21]**.
2. These valves shall automatically close when the Service Water System is aligned to the AFW pump suctions to prevent the diversion of service water back to the CST **[REF 9.6.21]**.
3. These valves shall passively maintain the AFW system pressure boundary integrity.

Non-Safety-Related Functions

Augmented Quality Functions

None.

Non-QA Functions

None

COMPONENT FUNCTIONS
Section 3.11

Component ID	Service
AF-109, 110 1/2AF-108	AFW Pump Discharge Check Valves

Safety-Related Functions

1. These valves shall automatically open to provide a flowpath for auxiliary feedwater from the AFW pump discharge to the associated steam generators, when AFW is initiated [REF 9.6.21].

2. These valves shall passively maintain the AFW system pressure boundary integrity.

Non Safety-Related Functions

Augmented Quality Functions

These valves shall remain closed during normal AFW-standby operation to prevent backflow of high-pressure MFW discharge (or steam generator water) to the AFW lines. Such backflow may potentially disable AFW pumps through "steam binding", and may also cause AFW System temperatures in excess of nominal design temperatures [REF 9.2.69 and 9.2.70].

It is important to note that this function is redundant to backleakage prevention provided by the first-off and second-off check valves. Additionally, the discharge isolation MOVs, AF-4021/4022/4023/4024 and the discharge pressure control valves, AF-4012/4019, provide backleakage prevention for the MDAFW pumps.

Non-QA Functions

None

THERE IS NO COMPONENT PARAMETER SUMMARY SHEET FOR THESE VALVES.

COMPONENT FUNCTIONS
Section 3.12

Component ID	Service
1AF-102,104,106,107 2AF-103,105,106,107	Second-Off AFW Check Valves

Safety-Related Functions

1. These valves shall automatically open to provide a flowpath for auxiliary feedwater from the AFW pump discharge to the associated steam generators, when AFW is initiated **[REF 9.6.21]**.

2. These valves shall automatically close whenever its respective line has achieved no-flow conditions. Backleakage through these valves into connected AFW piping that is at a lower pressure could result in reduced flow in the line which is at a higher pressure. In effect, this could be a flow diversion path for the functioning AFW line. **[REF 9.5.119]**

3. These valves shall passively maintain the AFW system pressure boundary integrity.

Non-Safety-Related Functions

Augmented Quality Functions

1. These valves shall remain closed during normal AFW-standby operation to prevent backflow of high-pressure MFW discharge (or steam generator water) to the AFW lines. Such backflow may potentially disable AFW pumps through "steam binding", and may also cause AFW System temperatures in excess of design temperatures **[REF 9.2.69 and 9.2.70]**.

   This condition is further mitigated by the first-off check valves and the capability to close AFW Pump discharge MOVs in the unlikely event that all the discharge check valves leak excessively. **[REF 9.5.119]**

2. These valves shall be closed to prevent air or steam pockets from forming in the AFW lines thus precluding water hammer **[REF 9.2.94, 9.3.57, 9.3.58, 9.3.59]**.

Non-QA Functions

None

THERE IS NO COMPONENT PARAMETER SUMMARY SHEET FOR THESE VALVES.

COMPONENT FUNCTIONS
Section 3.13

Component ID	Service
1/2AF-100, 1/2AF-101	AFW 1st Off Check Valves

Safety-Related Functions

1. These valves shall automatically open to provide a flowpath for auxiliary feedwater from the AFW pump discharge to the associated steam generators, when AFW is initiated **[REF 9.6.21]**.

2. These valves shall close in order to protect an intact steam generator[1] from a loss of inventory from a fault condition in the opposite steam generator or the opposite steam generator's AFW or MFW line. **[REFs 9.3.56, 9.3.97]**.

3. These valves shall passively maintain the AFW system pressure boundary integrity.

Non-Safety-Related Functions

Augmented Quality Functions

1. These valves shall remain closed during normal AFW-standby operation to prevent backflow of high-pressure MFW discharge (or steam generator water) to the AFW lines. Such backflow may potentially disable AFW pumps through "steam binding", and may also cause AFW System temperatures in excess of nominal design temperatures **[REF 9.2.69, 9.2.70]**.

   It is important to note that this function is redundant to backleakage prevention provided by the second-off check valves and pump discharge check valves.

2. These valves shall be closed to prevent air or steam pockets from forming in the AFW lines thus precluding water hammer **[REF 9.2.94, 9.3.57, 9.3.58, 9.3.59]**.

Non-QA Functions

1. These valves must close and remain closed to prevent cross leakage to the other S/G on the same unit for the TDAFW pumps **[REF 9.6.21]**.

THERE IS NO COMPONENT PARAMETER SUMMARY SHEET FOR THESE VALVES.

[1] The first off check valve for the intact steam generator will remain open as long as AFW is continued on that steam generator. Should AFW flow be shut off to control level, the first off check valve will then close, providing the first isolation point to prevent inventory from the intact steam generator blowing down the TDAFW supply line back to the faulted steam generator. The second off check valve will close to prevent loss of flow through the TDAFW supply line while AFW flow is being supplied (see SR function #2 on worksheet 3.12)

COMPONENT FUNCTIONS
Section 3.14

Component ID	Service
AF-4027,4028 1/2AF-4026	AFW Pump Suction Relief Valves

Safetv-Related Functions

1. These valves shall automatically open and discharge sufficient fluid to prevent overpressurization of the AFW pump suction piping and associated components in the event of a malfunction in the pump or pump discharge lines that could cause a high pressure in the pump suction line through the pump to the suction piping. **[REF 9.5.119]**.

2. These valves shall remain closed below the relief setpoint to maintain the pressure boundary integrity of the AFW System.

Non-Safetv-Related Functions

Augmented Quality Functions

None

Non-QA Functions

None

COMPONENT PARAMETERS SUMMARY
Section 3.14 (continued)

Component ID	Service
AF-4027,4028 1/2AF-4026	AFW Pump Suction Relief Valves

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Set Pressure	100 psig	3.14.1
2. Capacity	Minimal	3.14.2
3. Seismic Requirements	Class I	9.6.96
OTHER DESIGN INFORMATION		
4. Size - Inlet	1 inch	9.6.96
5. Materials	bronze valves bronze trim	9.6.96

COMPONENT PARAMETER WORKSHEET
Section 3.14.1

Component ID	Service
AF-4027,4028 1/2AF-4026	AFW Pump Suction Relief Valves

A. Parameter Set Pressure

B. Value 100 psig (tolerance unknown)

C. Source
1. Relief Valve Spec M-180 [REF 9.6.96]
2. NCR N-90-233 [REF 9.3.28]
3. NQAD Audit Report A-P-90-12 [REF 9.5.101]

D. Background/Reason

The original valve specification **[Source 1]** specified a set pressure value of 50 psig. However, the set pressure was reevaluated in 1990 to accommodate expected service water conditions (60-70 psig) **[Source 2]**.

This set pressure must be low enough to protect the suction line pipe and components from pressures exceeding their expected design pressures (120 psig per **Source 2**], and must be high enough to prevent spurious relief valve lifting when AFW suction is aligned to Service Water. The acceptability of raising the original setpoint to 100 psig was based on an (IEB 79-14) analyzed pressure of 120 psig for the suction piping **[Source 2]**.

The acceptable setpoint tolerance is unknown.

The AFW pump suction relief valves' set pressure of 100 psig was evaluated by **Sources 2 and 3**.

COMPONENT PARAMETER WORKSHEET
Section 3.14.2

Component ID	Service
AF-4027,4028 1/2AF-4026	AFW Pump Suction Relief Valves

A. Parameter Capacity

B. Value 35 gpm or minimal

C. Source
1. Relief Valve Spec M-180 [REF 9.6.96]
2. SPEED 91-002 [REF 9.5.125]
3. AFW DBD Validation Report [REF 9.3.32]

D. Background/Reason

Source 1 specified the original relief capacity of this valve as "minimal", but failed to define the term or provide the supporting rationale for not selecting a higher value.

As verified by **Source 3**, the original valves were replaced using the SPEED evaluation of **Source 2**. **Source 2** evaluated the replacement of the existing Ashton-Crosby Relief Valves (Model GC-32) with a Lonergan Relief Valve (Model TBB3). The replacement valves have an indicated set pressure of 100 psi and a nominal capacity of 35 gpm stamped on the label plate. **[Source 3]**

COMPONENT FUNCTIONS
Section 3.15

Component ID	Service
AF-4035	AFW Pump Recirculation Line Relief Valve

Safety-Related Functions

1. This valve shall automatically open and discharge sufficient fluid to prevent overpressurization of the AFW pump recirculation line in the event that the line is isolated from the CST [**REF 9.5.119**].

2. This valve shall remain closed below the relief setpoint to maintain the pressure boundary integrity of the AFW System.

Non-Safety-Related Functions

Augmented Quality Functions

None

Non-QA Functions

None

Note that the purpose of the relief valve may not be a Code requirement; protection of the recirculation line against over pressure is not needed to assure the function of the line, and a rupture of the line would not compromise the line's function to provide a flow path. While this valve was apparently installed as a "good practice", isolation of the recirculation line from the CSTs would be contrary to the line's design function. There are no identified Code requirements that would have required the relief valves installation.

COMPONENT PARAMETERS SUMMARY
Section 3.15 (continued)

Component ID	Service
AF-4035	AFW Pump Recirculation Line Relief Valve

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Set Pressure	50 psig	3.15.1
2. Capacity		3.15.2
Design Capacity	200 gpm	
Required Capacity	Minimal, See Worksheet	
3. Seismic Requirements	Non-Seismic	9.6.96
OTHER DESIGN INFORMATION		
4. Size	3 inch	9.5.117
5. Materials	Carbon Steel Valve Stainless Steel Trim	9.6.96

COMPONENT PARAMETER WORKSHEET
Section 3.15.1

Component ID	Service
AF-4035	AFW Pump Recirculation Line Relief Valve

A. Parameter Set Pressure

B. Value 50 psig (tolerance unknown)

C. Source 1. Relief Valve Spec M-180 [REF 9.6.96]
2. MR 88-99 [REF 9.5.117]

D. Background/Reason

This set pressure must be low enough to protect the recirculation line pipe and components from pressures exceeding their design pressures, and must be high enough to prevent spurious relief valve lifting during normal (AFW Pump recirculation) operation.

The original valve specification **[Source 1]** established a set pressure value of 150 psig. Subsequently, **Source 2** revised the required set pressure to 50 psig; superseding the original value.

The acceptable setpoint tolerance has not been specified.

COMPONENT PARAMETER WORKSHEET
Section 3.15.2

Component ID	Service
AF-4035	AFW Pump Recirculation Line Relief Valve

A. Parameter Capacity

B. Value

Design Capacity		268 gpm
Required Capacity		Minimal, See Below

C. Source
1. Relief Valve Spec M-180 [REF 9.6.96]
2. MR 88-99 [REF 9.5.117]
3. AFW DBD Validation Report [REF 9.3.32]
4. WE Letter NRC 2002-0068 [REF 9.2.17]
5. Modification MR 02-029 [REF 9.5.6]
6. Calculation 2002-0026 [REF 9.4.52]

D. Background/Reason

The original valve installed in this application was designed with a 30 gpm flow capacity **[Source 1]**. Although no rationale was provided for the selection of this value, it appears to have been derived from the original design recirculation flow of one AFW pump (30 gpm). Therefore, the original designers might have assumed only one AFW pump running at shutoff pressure (i.e. as might be caused during brief testing periods or inadvertent pump-start) when the recirculation line to the CST was isolated. The original designers therefore, did not foresee single failure scenarios or operating conditions which would allow more than one AFW pump to be running at shutoff pressures on the recirculation line common to all four (4) AFW pumps. Accordingly, the 30 gpm design capacity was established.

Subsequently, the minimum recirculation flow for each pump was increased to improve heat removal ability and preclude flow instabilities **[Source 2]**. Section 3.1.3 of this DBD describes the design minimum recirculation flowrates that one pump will contribute. To accommodate the increase in recirculation flowrates, **Source 2** installed a new recirculation line relief valve with a design capacity of 268 gpm. No basis for this value was provided; however, it does provide substantial improvement over the flow capacity of the original valve. **Source 6** evaluated the capacity of the installed relief valve and found it to be adequate to provide all four AFW pumps with minimum recirculation flow in the event that the downstream path to the CSTs was isolated. Since the valve is not Safety Related, this functioning may not be credited for normal operation. However, under special circumstances (such as interim configurations for maintenance), it may be possible to credit the functioning of this valve if appropriate additional precautions are enacted.

COMPONENT PARAMETER WORKSHEET
Section 3.15.2 (continued)

In **Source 4**, a licensing commitment was made to re-classify the minimum recirculation flow control valves to have a Safety Related function to open while retaining the Non-Safety Related classification of the common recirculation line **[Source 4]**. None the less, internal discussions determined that in the future, availability of the line would be considered a necessary pre-requisite for AFW pump operability. At the time of issuing of Revision 3 of this DBD the formal documentation of this position had not occurred. It is expected that **Source 5** will cause this position to be documented in the plant Technical Specification Bases.

To implement the new commitment, one action was to remove the internals from AF-117, a swing check valve located in the common recirculation line **[Source 5]**. A single failure of this check valve to open could have caused a common mode failure of all operating AFW pumps since the non-Safety Related relief valve could not be counted on to function. This action was taken as being preferable to upgrading and maintaining the relief valve to Safety Related. All manual valves in the line are administratively controlled to be open at all times that the AFW pumps are required to be Operable.

COMPONENT FUNCTIONS
Section 3.16

Component ID	Service
RO-4008,4015 1/2 RO-4003	AFW Pump Recirculation Line Orifice

Safety-Related Functions

1. These orifices shall provide passive flow resistance in the recirculation line of each AFW pump; thereby establishing the required mini-recirc flow and the pressure drop from AFW pump discharge pressure to CST pressure. These orifices must provide sufficient flow to prevent low-flow instabilities and excessive fluid temperature rise in the AFW pumps **[REF 9.5.117]**.

2. These orifices shall limit the recirculation flow in the event that the recirculation control valve fails to close during the AFW operation response to an accident **[REF 9.5.117]**.

3. These orifices shall passively maintain the AFW system pressure boundary integrity.

Non-Safety-Related Functions

Augmented Quality Functions

None

Non-QA Functions

None

COMPONENT PARAMETERS SUMMARY
Section 3.16 (continued)

Component ID	Service
RO-4008,4015 1/2RO-4003	AFW Pump Recirculation Line Orifice

PARAMETER	VALUE		REFER TO
SUPPORTING DESIGN REQUIREMENTS			
1. Design Flow			3.16.1
	Min Flow	Max. Flow	
TDAFWP Orifice	75 gpm	126 gpm	
MDAFWP Orifice	50 gpm	89 gpm	

COMPONENT PARAMETER WORKSHEET
Section 3.16.1

Component ID	Service
RO-4008,4015 1/2RO-4003	AFW Pump Recirculation Line Orifice

A. Parameter: Design Flow

B. Value

	Min	Max
TDAFWP	75 gpm	126 gpm
MDAFWP	50 gpm	89 gpm

See Section 3.1 for nominal flows

C. Source

1. IEB 88-04 and WE Responses [REF 9.2.61, 9.2.62, 9.2.63]
2. MR 88-99 [REF 9.5.117]
3. Byron Jackson letter dated 8/7/89 [REF 9.3.20]
4. WE Calculation N-91-032 [REF 9.4.21]
5. WE Calculation N-91-069 [REF 9.4.22]
6. FlowServe Letter dated 3-2-01 [REF 9.3.16]
7. Modification MR 99-029 [REF 9.5.4]

D. Background/Reason

In response to the NRC IEB 88-04 concerns **[Source 1]**, WE committed to increase the miniflow capacity of the AFW pumps to the flow rates recommended by the pump manufacturer. **Source 2** upgraded the recirc orifice capacity to meet the AFW Pump minimum recirculation flow requirements stated in section 3.1.3.

Source 2 established the design minimum recirculation flow as 80 gpm for the Motor-Driven AFW Pumps and 125 for the Turbine-Driven AFW Pumps. These values provided margin above the original minimum required flow of 70 gpm for the MDAFP and 100 gpm for the TDAFP per **Source 3**. These minimum flows have been reduced to 50 for the MDAFP and 75 for the TDAFP, for an accumulated operational time of 60 hours by **Source 6,** and thus the margin has been increased.

Sources 4 and 5 estimated the effect of the increased recirculation line size on flow rates to the steam generators if the recirc valve stuck open. The calculation showed that minimum steam generator flow rate will still be achieved in these conditions. These calculations provide the basis for the maximum allowable flow through the recirculation lines during most design basis accidents that credit AFW.

Source 7 replaced the orifices. Post Modification testing verified the flows through the minimum recirculation lines are within the required range. The approximate values are 75 gpm for the MDAFW pumps, and 120 gpm for the TDAFW pumps.

COMPONENT FUNCTIONS
Section 3.17

Component ID	Service
1/2FT-4036, 4037	AFW System Flow to Steam Generators
FT-4007, -4014	MDAFW Pump Discharge Flow
1/2FT-4002	TDAFW Pump Discharge Flow
DPIS-4007, 4014	MDAFW Pump Discharge Differential Pressure Switch
1/2DPIS-4002	TDAFW Pump Flow Differential Pressure Switches

Safety-Related Functions

1. AFW System Flow Transmitters (1/2FT-4036, 4037) shall provide appropriate signals to permit the control room operator to take manual control of AFW flow to maintain the secondary heat sink during design basis accidents. This function is a backup to Steam Generator Narrow Range Water Level Indication. This flow signal is safety-related because it indicates a RG 1.97 Type A variable; meaning it provides a basis for a post-accident manually controlled action which has no automatic control. **[REF 9.2.106, DG-G06]**

Non-Safety-Related Functions

Augmented Quality Functions

1. AFW Pump Flow Transmitters (FT-4007, 4014, 1/2FT-4002) shall provide appropriate signals to monitor the operation of the AFW System during design basis accidents. These flow signals are augmented quality because they indicate a RG 1.97 Type D variable; meaning they provide information to indicate the operation of a safety system. **[REF 9.2.106, DG-G06]**

Non-QA Functions

1. AFW System Flow Transmitters (1/2FT-4036, 4037) shall indicate flow rates to individual steam generators to monitor normal AFW system operation during hot shutdown and cooldown conditions.

2. AFW Pump Flow Transmitters (FT-4007, 4014, 1/2FT-4002) shall indicate individual AFW pump flow rates to monitor normal pump operation during shutdown and cooldown conditions.

3. AFW Pump Flow Differential Pressure Switches (DPIS-4007, 4014, 1/2DPIS-4002) shall provide appropriate signals to control the recirculation flow control valve.

COMPONENT PARAMETERS SUMMARY

Section 3.17 (continued)

Component ID	Service
1/2FT-4036, 4037	AFW System Flow to Steam Generators
FT-4007, 4014	MDAFW Pump Discharge Flow
1/2FT-4002	TDAFW Pump Discharge Flow
DPIS-4007, 4014	MDAFW Pump Discharge Differential Pressure Switch
1/2DPIS-4002	TDAFW Pump Flow Differential Pressure Switches

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Indicating Range[1]		DBD-T-44
1/2FT-4036, 4037	0 - 500 gpm	
FT-4007, 4014	0 - 300 gpm	
1/2FT-4002	0 - 400 gpm	
2. Setpoint		3.8.1
Open Recirc Control AOV		
DPIS-4007, 4014	75 gpm (decreasing)	
1/2 DPIS-4002	110 gpm (decreasing)	
Close Recirc Control AOV		
DPIS-4007, 4014	95 gpm (increasing)	
1/2 DPIS-4002	145 gpm (increasing)	
3. Environmental Qualification[1]		DBD-T-44
1/2FT-4036, 4037	Yes	
FT-4007, 4014, 1/2FT-4002	No	
4. Seismic Requirements[1]	Yes	DBD-T-44
5. Power Supply[1]		DBD-T-44
1/2FT-4036, 4037, 4002	1E	
FT-4007, 4014	1E	
6. Single Failure Criteria[1]		DBD-T-44
1/2FT-4036, 4037, 4002	No	
FT-4007, 4014	No	

[1] In general, these parameters reflect actual instrument performance characteristics rather than regulatory requirements. Refer to DBD-T-44 for discussion of these parameters.

COMPONENT FUNCTIONS
Section 3.18

Component ID	Service
PT-4012, 4019	MDAFW Pump Discharge Pressure
1/2PT-4005	TDAFW Pump Discharge Pressure
PT-4042, 4043	MDAFW Pump Suction Pressure
1/2PT-4044	TDAFW Pump Suction Pressure

Safety-Related Functions

1. MDAFW Pump Suction Pressure Transmitters (PT-4042, 4043) shall send an appropriate signal to trip the associated AFW pump when suction pressure is inadequate. This is a pump protection feature installed post-TMI as an alternative to installing an automatic system to control AFW suction switchover from the CST to Service Water. **[REF 9.2.87]**

2. TDAFW Pump Suction Pressure Transmitters (1/2PT-4044) shall send an appropriate signal to shut the trip throttle valves to the associated turbine-drivers when suction pressure is inadequate. This is a pump protection feature installed post-TMI as an alternative to installing an automatic system to control AFW suction switchover from the CST to Service Water. **[REF 9.2.87]**

Non-Safety-Related Functions

Augmented Quality Functions

1. AFW Pump Discharge Pressure Transmitters (PT-4012, 4019, 1/2PT-4005) shall provide appropriate signals to monitor the operation of the AFW System during design basis accidents. These pressure signals are augmented quality because they indicate a RG 1.97 Type D variable; meaning they provide information to indicate the operation of a safety system.**[REF 9.2.106]**

2. AFW Pump Suction Pressure Transmitters (PT-4042, 4043, 1/2PT-4044) shall provide appropriate signals to monitor the operation of the AFW System during design basis accidents. These pressure signals are augmented quality because they indicate a RG 1.97 Type D variable; meaning they provide information to indicate the operation of a safety system. **[REF 9.2.106]**

Non-QA Functions

1. AFW Pump Suction and Discharge Pressure Transmitters shall indicate the associated pressures of individual AFW pumps to monitor normal AFW system operation during power operation (AFW standby), hot shutdown, and cooldown conditions.

COMPONENT PARAMETERS SUMMARY
Section 3.18 (continued)

Component ID	Service
PT-4012, 4019	MDAFW Pump Discharge Pressure
1/2PT-4005	TDAFW Pump Discharge Pressure
PT-4042, 4043	MDAFW Pump Suction Pressure
1/2PT-4044	TDAFW Pump Suction Pressure

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Indicating Range[1]		DBD-T-44
PT-4012, 4019, 1/2PT-4005	0 - 1600 psig	
PT-4042, 4043, 1/2PT-4044	0 - 100 psig	
2. Setpoint		3.1.7
AFW Pump Low Suction Alarm		
PT-4042, 4043, 1/2PT-4044	7 psig (decreasing)	
AFW Pump Low Suction Pump Trip		
PT-4042, 4043, 1/2PT-4044	6.5 psig (decreasing)	
3. Environmental Qualification[1]	No	DBD-T-44
4. Seismic Requirements[1]		DBD-T-44
1/2PT-4005	No	
PT-4012, 4019, 4042, 4043, 1/2PT-4044	Yes	
5. Power Supply[1]	1E	DBD-T-44
6. Single Failure Criteria[1]	No	DBD-T-44

[1] In general, these parameters reflect actual instrument performance characteristics rather than regulatory requirements. Refer to DBD-T-44 for discussion of these parameters.

COMPONENT FUNCTIONS
Section 3.19

Component ID	Service
LT-4038, 4040	Condensate Storage Tank "A" Level
LT-4039, 4041	Condensate Storage Tank "B" Level

Safety-Related Functions

1. CST Level Transmitters shall provide appropriate signals to permit the control room operator to direct the manual switchover of AFW Pump suction to Service Water during design basis accidents. This level signal is safety-related because it indicates a RG 1.97 Type A variable; meaning it provides a basis for a post-accident manually controlled action which has no automatic control. **[REF 9.2.106]**

Non-Safety-Related Functions

Augmented Quality Functions

1. CST Level Transmitters shall provide appropriate signals to monitor the operation of the AFW System during design basis accidents. These signals are augmented quality because they indicate a RG 1.97 Type D variable; meaning they provide information to indicate operation of a safety system. **[REF 9.2.106]**

Non-QA Functions

1. CST Level Transmitters shall provide appropriate signals to monitor normal AFW system operation during power operation (AFW standby), hot shutdown, and cooldown conditions.

COMPONENT PARAMETERS SUMMARY
Section 3.19 (continued)

Component ID	Service
LT-4038, 4040	Condensate Storage Tank "A" Level
LT-4039, 4041	Condensate Storage Tank "B" Level

PARAMETER	VALUE	REFER TO
SUPPORTING DESIGN REQUIREMENTS		
1. Indicating Range[1]	0 - 21.5 feet	DBD-T-44
2. Environmental Qualification[1]	Yes	DBD-T-44
3. Seismic Requirements[1]	Yes	DBD-T-44
4. Power Supply[1]	1E	DBD-T-44
5. Single Failure Criteria[1]	Yes	DBD-T-44

[1] In general, these parameters reflect actual instrument performance characteristics rather than regulatory requirements. Refer to DBD-T-44 for discussion of these parameters.

COMPONENT FUNCTIONS
Section 3.20

Component ID	Service
AF-133, 153	First-Off MDAFP Backup Nitrogen Bottle Check Valves

Safety-Related Functions

1. These valves shall remain closed during a Loss of Instrument Air event to prevent backflow of nitrogen into the instrument air system. **[REFs 9.5.134; 9.5.2]**

2. These valves shall passively maintain the IA system pressure boundary integrity.

Non-Safety-Related Functions

Augmented Quality Functions

None

Non-QA Functions

None

All other components associated with these valves are within the boundary of the Instrument Air System and are addressed in DBD-06.

THERE IS NO COMPONENT PARAMETER SUMMARY SHEET FOR THESE VALVES.

COMPONENT FUNCTIONS
Section 3.21

Component ID	Service
1/2 MS-2082	TDAFW Pump Trip Throttle Valves

Safety-Related Functions

1. These valves shall automatically close and remain closed to secure the associated TDAFW pump upon receipt of a low suction pressure trip associated with a loss of AFW suction supply from the CSTs due to a seismic or tornado induced LONF event. The closure of these valves will secure steam from the turbine(s) thus allowing a safe shutdown of the turbine in order to protect the pump from damage. **[REF 9.5.135]**

Non Safety-Related Functions

Augmented Quality Functions

None

Non-QA Functions

1. These valves shall rapidly close and remain closed when the turbine reaches an overspeed condition (4500 rpm). This is required to secure steam from the turbine to allow a safe shutdown of the turbine in order to protect the turbine from damage. **[REF 9.7.1, 9.3.92]**

COMPONENT PARAMETERS SUMMARY
Section 3.21 (continued)

Component ID	Service
1/2 MS-2082	TDAFW Pump Trip Throttle Valves

PARAMETER	VALUE	REFER TO
PERFORMANCE REQUIREMENTS		
1. Stroke Time		3.21.1
Design Basis Maximum	2 seconds (based on IST group request to allow testing with manual stopwatch)	
SUPPORTING DESIGN REQUIREMENTS		
2. Reset Capability	Remote-Manual Motor Operator reset Local Handwheel Reset	3.21.2
3. Power Supply Requirements	Independent of AC Power 125 VDC (nominal)	3.21.3
OTHER DESIGN INFORMATION		
4. Stroke Time	Nominal (measured ~0.05 sec)	3.21.1 0.3 seconds

COMPONENT PARAMETER WORKSHEET

Section 3.21.1

Component ID	Service
1/2 MS-2082	TDAFW Trip Throttle Valves

A. Parameter Stroke Time

B. Value

Nominal Stroke Time	0.3 seconds
Maximum Stroke Time	2 seconds

C. Source

1. Terry Technical Manual [REF 9.7.1]
2. MR 97-099 [REF 9.5.135]
3. WE Calculation N-97-0215, "Water Volume Swept by All Four AFW Pumps Following a Seismic/Tornado Event Affecting Both Units", Revision 1, dated 1/11/98 [Ref. 9.4.29].

D. Background/Reason

Opening Stroke Time: The open stroke time is not essential to the safety related function to close to protect the pump. The valve is reset to the open position and remains mechanically latched in the open position until either a low suction pressure trip or mechanical overspeed trip is applied. The open stroke time is time insensitive.

Closing Stroke Time: Calculation N-97-0215 **[Source 3]** assumed that these valves will close in 2 seconds **[Source 3]**. This assumption is used to determine the amount of fluid pumped during a seismic/tornado induced loss of suction pressure. The calculation shows that the valves will respond in a manner that protects the pumps during this scenario. The 2 second requirement is based on an agreement with the IST group who decided that hand timing these valves for closure is an acceptable test methodology, but a time of 2 seconds was needed to allow for valve closure and human error in the timing.

These valves were installed by **Source 2**, which provided valves that are spring loaded to close in a rapid manner. According to **Source 1,** these valves nominally close in less than 0.3 seconds. Informal measurements place actual closure times at ~0.05 seconds.

COMPONENT PARAMETER WORKSHEET

Section 3.21.2

Component ID	Service
1/2 MS-2082	TDAFW Trip Throttle Valves

A. Parameter Reset Capability

B. Value Remote-Manual Motor Operator (MO) Reset
Local Handwheel Reset

C. Source
1. Terry Technical Manual [REF 9.7.1]
2. MR 97-099 [REF 9.5.135]
3. NUREG 0737 SER [REF 9.2.36]

D. Background/Reason

These valves are required to provide overspeed protection of the TDAFW pumps and have been modified per **Source 2** to include an additional requirement to provide an automatic closure of the trip throttle valves for the respective pump upon receipt of a low suction pressure trip signal. The function to automatically close on a low suction pressure trip signal is a safety-related function. This automatic closure of the trip throttle valves secures the respective TDAFW pump, thus protecting the pump from a loss of water to the suction of the pump. To recover from a low suction pressure pump trip, the capability to remotely reset the trip throttle valve is provided by a motor operator that can be remote-manually actuated from the control room, after the valve has been reset locally by the operators **[Source 2]**. Remote reset is necessary to enable operators to realign TDAFW pump suction from the CST to service water within a 5 minute time frame **[Source 3]**. Additionally, local handwheel reset capability is provided per original design **[Source 1]**.

COMPONENT PARAMETER WORKSHEET
Section 3.21.3

Component ID	Service
1/2 MS-2082	TDAFW Trip Throttle Valves

A. Parameter: Power Supply Requirements

B. Value: Independent of AC Power
125 VDC (nominal)

C. Source
1. Terry Technical Manual [REF 9.7.1]
2. MR 97-099 [REF 9.5.135]
3. Westinghouse Drawing 499B466, Sheet 743 & 744, Elementary Drawing Turb. Driven AFW Trip/Throttle Valve 1MS-2082 & 2MS-2082. [REF 9.6.106]

D. Background/Reason

To enable the turbine-driven AFW pumps to perform their function during a station blackout, the tripping solenoid and trip resetting motor operator for these valves must operate independently of the AC power supplies. Accordingly, power from the 125 VDC system was selected.

Source 1 describes general design requirements for the original trip-throttle valve. **Source 2** specifies a nominal requirement that the tripping solenoid and the valve reset motor operator be suitable for 125 volt DC supply voltage.

Turbine Driven AFW Valve 2MS-2082 is powered from DC Distribution Panel D14 Breaker 13 and Turbine Driven AFW Valve 1MS-2082 is powered from DC Distribution Panel D11 Breaker 25 per **Source 3.**

4.0 CODES, STANDARDS AND REGULATORY DOCUMENTS

This section summarizes PBNP General Design Criteria, codes and standards, and regulatory documents that apply to the AFW System design.

4.1 General Design Criteria

General Design Criteria (GDCs) **[REF 9.1.1]** provided the basis for the original PBNP design, including the design of the Auxiliary Feedwater System. Those GDCs to which PBNP is committed are described in the FSAR.

Although AFW is not classified as an Engineered Safety Feature (ESF) in FSAR Chapter 6, the following ESF-related GDCs are considered to reasonably apply to the overall AFW design. **[REFs 9.2.49, 9.3.67, 9.3.68, 9.3.69]**

4.1.1 Criterion 1, Quality Standards

Those systems and components of reactor facilities which are essential to the prevention, or mitigation of the consequences, of nuclear accidents which could cause undue risk to the health and safety of the public shall be identified and then designed, fabricated, and erected to quality standards that reflect the importance of the safety function to be performed. Where generally recognized codes and standards pertaining to design, materials, fabrication, and inspection are used, they shall be identified. Where adherence to such codes or standards does not suffice to assure a quality product in keeping with the safety function, they shall be supplemented or modified as necessary. Quality assurance programs, test procedures, and inspection acceptance criteria to be used shall be identified. An indication of the applicability of codes, standards, quality assurance programs, test procedures, and inspection acceptance criteria used is required **[REF 9.5.170]**. Where such items are not covered by applicable codes and standards, a showing of adequacy is required **[REF 9.2.57 (Table 1.3-1)]**.

Applicability of Criterion 1 to AFW System

The AFW System is designated a Class 1 system in FSAR Section 10.2. The NPBU Nuclear Quality Assurance (QA) Program **[REF 9.5.170]** has established a Q-List, contained in the CHAMPS database, which defines the quality requirements for the design, operation, maintenance, and testing of plant components. The Q-List designation of each AFW component is controlled by the Quality Assurance Program. **[REFs 9.5.27, 9.2.57 Section 10.2, 9.5.170, 9.5.173, 9.5.174]**

4.1.2 Criterion 2, Performance Standards

Those systems and components of reactor facilities which are essential to the prevention or to the mitigation of the consequences of nuclear accidents which could cause undue risk to the health and safety of the public shall be designed, fabricated, and erected to performance standards that enable such systems and components to withstand, without undue risk to the health and safety of the public, the forces that might reasonably be imposed by the occurrence of an extraordinary natural phenomenon such as earthquake, tornado, flooding condition, high wind, or heavy ice. The design bases so established shall reflect: (a) appropriate consideration of the most severe of these natural phenomena that have been officially recorded for the site and the surrounding area and (b) an appropriate margin for withstanding forces greater than those recorded to reflect uncertainties about the historical data and their suitability as a basis for design **[REF 9.2.57 (Table 1.3-1)].**

Applicability of Criterion 2 to AFW System

The AFW System is designated a Class 1 system in FSAR Section 10.2. As a Class 1 system, AFW System components are designed so that there is no loss of function in the event of the maximum hypothetical earthquake. Measures are also taken in the design to protect against high winds, flooding, and other phenomena, such as the effects of a tornado. **[REF 9.5.27 and 9.2.57 (Section 10.2)].**

4.1.3 Criterion 4, Sharing of Systems

Reactor facilities may share systems or components if it can be shown that such sharing will not result in undue risk to the health and safety of the public **[REF 9.2.57 (Table 1.3-1)].**

Applicability of Criterion 4 to AFW System

This criterion is applicable to portions of the AFW System which are shared between Unit 1 and Unit 2. Sharing of the motor-driven AFW pumps will not prevent the AFW System from performing the required safety functions under emergency conditions **[REF 9.2.57, Appendix A.6].**

4.1.4 Criterion 11, Control Room

The facility shall be provided with a control room from which actions to maintain safe operational status of the plant can be controlled. Adequate radiation protection shall be provided to permit continuous occupancy of the control room under any credible post accident condition or as an alternative, access to other areas of the facility as necessary to shut down and maintain safe control of the facility without excessive radiation exposures of personnel **[REF 9.2.57 (Table 1.3-1)].**

Applicability of Criterion 11 to AFW System

This criterion is applicable to the instrumentation and control systems provided to monitor and maintain within prescribed operating ranges the temperatures, pressures, flows and level in the reactor coolant systems, steam systems, containments, and other auxiliary systems **[REF 9.2.57 (Section 1.3.3)]**. AFW System instruments and controls are located in the control room.

4.1.5 Criterion 12, Instrumentation and Controls

Instrumentation and controls shall be provided as required to monitor and maintain within prescribed operating ranges essential reactor facility operating variables **[REF 9.2.57 (Table 1.3-1)]**.

Applicability of Criterion 12 to AFW System

This criterion is applicable to the instrumentation and control systems provided to monitor and maintain within prescribed operating ranges the temperatures, pressures, flows, and levels in the reactor coolant systems, steam systems, containments, and other auxiliary systems **[REF 9.2.57 (Section 1.3.3)]**.

4.1.6 Criterion 37, Engineered Safety Features Basis for Design

Engineered safety features shall be provided in the facility to back up the safety provided by the core design, the reactor coolant pressure boundary, and their protection systems. Such engineered safety features shall be designed to cope with any size reactor coolant piping break up to and including the equivalent of a circumferential rupture of any pipe in that boundary, assuming unobstructed discharge from both ends **[REF 9.2.57 Table 1.3- 1)]**.

Applicability of Criterion 37 to AFW System

Although the AFW System is not classified as an engineered safety feature, it is required to provide high pressure feedwater to the steam generators in the event of an accident. WE has stated that the AFW system is considered equivalent to an engineered safety system **[REF 9.2.49]**.

4.1.7 Criterion 38, Reliability and Testability of Engineered Safety Features

All engineered safety features shall be designed to provide such functional reliability and ready testability as is necessary to avoid undue risk to the health and safety of the public. **[REF 9.2.57 (Table 1.3-1)]**

Applicability of Criterion 38 to AFW System

As an ESF-equivalent system, the AFW System is designed for periodic testing. Specifically, major AFW System mechanical components and the AFW actuation circuitry are periodically tested to assure reliable performance, upon demand. In addition, the AFW System is capable of an integrated test, to assure system performance as designed and to prove proper operation of the actuation circuitry. **[REF 9.2.49 and REF 9.2.57 (Section 6.1.1)]**

4.1.8 Criterion 40, Missile Protection

Adequate protection for those engineered safety features, the failures of which could cause an undue risk to the health and safety of the public, shall be provided against dynamic effects and missiles that might result from plant equipment failures **[REF 9.2.57 (Table 1.3-1)].**

Applicability of Criterion 40 to AFW System

This criterion is applicable to the AFW System Class I components both inside and outside containment. The AFW System safety-related functions will not be impaired as a result of a missile.

4.1.9 Criterion 41, Engineered Safety Features Performance Capability

Engineered safety features, such as the emergency core cooling system and the containment heat removal system, shall provide sufficient performance capability to accommodate the failure of any single active component without resulting in undue risk to the health and safety of the public **[REF 9.2.57 (Table 1.3-1)].**

Applicability of Criterion 41 to AFW System

As an ESF-equivalent system, the AFW System is designed as a *safety-grade* system which meets single failure criteria. **[REF 9.2.49]** Specifically, the AFW System is designed with sufficient mechanical and electrical redundancy such that a single failure of an active component, either in the system or in a supporting system, can be accommodated without loss of the overall AFW System safety-related functions.

4.1.10 Criterion 42, Engineered Safety Feature Components Capability

Engineered safety features shall be designed so that the capability of these features to perform their required function is not impaired by the effects of a loss-of-coolant accident to the extent of causing undue risk to the health and safety of the public. **[REF 9.2.57 (Table 1.3-1)]**

Applicability of Criterion 42 to AFW System

As an ESF-equivalent system, the AFW System is designed to function following a loss-of-coolant accident. AFW System safety-related functions can be accomplished in the harsh environments resulting from the loss-of-coolant accident.

4.2 Codes and Standards

Listed below are some of the governing codes and standards used for the auxiliary feedwater system. The specific code or standard that applies to the components installed in the system can be found in the documentation that was supplied with the component by the vendor. For most components that are original plant equipment, this information is usually not readily available, but can be inferred from either the original specifications for the system and the design code of the system (USAS B31.1 – 1967, Power Piping). For newer components installed, the procurement (QAR) records, vendor documents, or modification packages should be reviewed.

- USAS B31.1 – 1967, Power Piping: This code was applied to the AFW system piping and components. Newer piping installations are seismically analyzed using some equations from ASME Section III – 1977 with 1978 Addenda. This is done because B31.1 does not provide any guidance on the application of seismic loading on piping system components. However, B31.1 is still the design code for all piping in the auxiliary feedwater system.

- ASME Section III, Rules for Construction of Nuclear Power Plant Components: Some of the replacement valves installed in the AFW system have been designed to Section III, but these valves have not been N-stamped, and are not considered Section III components. They meet all the requirements for installation in a B31.1 piping system.

- AWWA D100 – 1967, Standard for Steel Tanks for Water Storage: This standard applies to the design of the Condensate Storage Tanks **[REF 9.6.91]**.

- IEEE 279, Criteria for Protection Systems for Nuclear Power Generating Stations [REF 9.1.4]. This standard applies to the protective system and engineered safety feature instrumentation, including the automatic initiation requirements of NUREG-0737.

4.3 Regulatory Documentation

The regulatory documents associated with the Auxiliary Feedwater System are: Title 10 of the Code of Federal Regulations, **[REF 9.1.2]** Regulatory Guides, NUREGs, DOR guidelines, Generic Letters, I&E Bulletins and Notices, and NRC SERs. The following documents are directly applicable to the AFW System design.

4.3.1 10 CFR 50.48, Fire Protection

The AFW System is required to remove decay heat in the event of a fire. Refer to Section 2.2.16.

4.3.2 10 CFR 50.49, Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants

Some AFW System electrical equipment is required to be environmentally qualified. Refer to Section 2.2.11.

4.3.3 10 CFR 50.55a, Codes and Standards

The inservice inspection of the AFW System is governed by this regulation. Refer to Section 6.0.

4.3.4 10 CFR 50.63, Loss of All Alternating Current Power

The AFW System must be capable of providing feedwater to the steam generators in the event of the loss of all AC power (Station Blackout). Refer to Section 2.1.2.2.

4.3.5 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants

The safety-related portions of the AFW System are governed by this regulation because the AFW System is required to mitigate the consequences of postulated accidents.

4.3.6 10 CFR 50, Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1976, Section III.L, Alternative and Dedicated Shutdown Capability

The AFW System is required to remove decay heat in the event of a fire. Refer to section 2.2.16.

4.3.7 Regulatory Guide 1.97

Regulatory Guide 1.97, Revision 2, dated December 1980 with Errata through July 1981, Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident **[REF 9.1.5, 9.2.67, 9.5.103]**. These requirements are applicable to AFW System instrumentation used to monitor AFW flow and Condensate Storage Tank level.

4.3.8 NUREG-0578

NUREG-0578, dated July 1979, TMI-2 Lessons Learned Task Force: Status Report and Short Term Recommendations, Sections 2.1.7a and 2.1.7b **[REF 9.1.3 and 9.2.34]**. These requirements are applicable to AFW System upgrades to improve reliability as a result of TMI-2 lessons.

4.3.9 NUREG-0611

NUREG-0611, dated January 1980, Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant Accidents in Westinghouse-Designed Operating Plants . The evaluation has recommendations for upgrading the PBNP Auxiliary Feedwater System based on lessons learned from TMI-2 event. Many of the recommendations have been implemented in the plant **[REFs 9.1.4, 9.2.34, 9.2.35, 9.2.36, 9.2.39, and 9.2.87]**.

4.3.10 NUREG-0737

NUREG-0737, dated November 1980, Clarification of TMI Action Plan Requirements, Sections II.E.1.1 and II.E.1.2 **[REF 9.1.4, 9.2.34, 9.2.35, 9.2.36, 9.2.39, and 9.2.87]**. These requirements are applicable to AFW System upgrades to improve reliability as a result of TMI-2 lessons.

4.3.11 Generic Letter No. 81-14

Generic Letter No. 81-14, Seismic Qualification of Auxiliary Feedwater Systems, dated February 10, 1981 **[REFs 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.2.5, 9.2.6, 9.2.7, 9.2.8 and 9.2.46]**. This generic letter addresses concerns regarding the seismic qualification of AFW Systems.

4.3.12 Generic Letter No. 81-21

Generic Letter No. 81-21, Natural Circulation Cooldown, dated May 5, 1981 **[REFs 9.2.9, 9.2.10 and 9.2.11]**. This generic letter addresses the requirement that sufficient condensate grade AFW be available to perform a natural circulation cooldown.

4.3.13 Generic Letter No 87-02

GL 87-02 was issued requiring older operating plants to assess the capability of their equipment against seismic criteria not in use when the plants were originally licensed. [REF 9.2.16] PBNP carried out an extensive program of review for plant systems and their ability to meet the seismic requirements imposed by the GL. The AFW system was reviewed by PBNP as part of this process. The NRC Safety Evaluation [REF 9.2.109], documenting acceptance of PBNP response to the GL 87-02 issues, indicated that the AFW system is capable of providing its required functions given a seismic event. NRC response to the PBNP submittals indicated acceptance of the documentation presented by PBNP, noting that the system can be switched over to the Safety Related SW supply within 5 minutes of the incident, to establish emergency feedwater should the CST be lost in the seismic event. See DBD worksheets 2.2.1, 2.2.2, and 2.2.3 for additional details regarding the switchover.

4.3.14 Generic Letter No. 88-03

Generic Letter No. 88-03, Resolution of Generic Safety Issue 93, Steam Binding of Auxiliary Feedwater Pumps, dated February 17, 1988 **[REF 9.2.12, 9.2.13 and 9.2.14]** (Refer to IE Bulletin 85-01). This generic letter addresses the affects of steam binding on the AFW System Operability. This issue should be considered as the system is modified.

4.3.15 Generic Letter No. 89-10

Generic Letter No. 89-10, Safety-Related Motor Operated Valve Testing and Surveillance, dated June 28, 1989 **[REF 9.2.73]**; Supplement 1, dated June 13, 1990 **[REF 9.2.74]**; Supplement 2, dated August 3, 1990 **[REF 9.2.75]**; Supplement 3, dated October 25, 1990 **[REF 9.2.76]**. This generic letter addresses the operability of safety-related motor-operated valves under design basis conditions and requests that licensees establish programs to ensure operability. As a result, WE has initiated a program to meet the five-year schedule identified in the generic letter **[REF 9.2.77 and 9.2.78]**. In response to this GL, the design basis operating differential pressures and other parameters were calculated [Refer to Sections 3 and 8 for description of the results].

4.3.16 IE Notice No. 80-23

IE Notice No. 80-23, Loss of Suction to Emergency Feedwater Pumps, dated 5/29/80 **[REF 9.2.15]**. This information notice addresses AFW pump suction loss caused by pumping hot water. The PBNP AFW pumps are currently aligned to cold water sources. This restriction should be considered in design modifications.

4.3.17 IE Notice No. 84-06

IE Notice No. 84-06, Steam Binding of Auxiliary Feedwater Pumps, dated 1/25/84 **[REF 9.2.18, 9.5.5 and 9.5.8]**. This information notice addresses steam binding of AFW pumps due to backleakage of feedwater through check valves. As a result of this issue, Modification Requests 83-55, 83-56, and 83-57 **[REFs 9.5.46, 9.5.47, 9.5.48]** were initiated. Refer to Table 7-1.

4.3.18 IE Notice No. 86-14

IE Notice No. 86-14, PWR Auxiliary Feedwater Pump Turbine Control Problems, dated 3/10/86 **[REFs 9.2.22, 9.5.12, 9.5.99 and 9.5.13]**. This information notice addresses turbine driven AFW pump trips due to turbine control problems. As a result of this issue, cold, fast start testing of the AFW pumps was initiated. Refer to section 6.0.

4.3.19 IE Notice No. 90-45

IE Notice No. 90-45, Overspeed of the Turbine-Driven Auxiliary Feedwater Pumps and Overpressurization of the Associated Piping System, dated 7/6/90 **[REFs 9.2.30 and 9.5.22]**. This information notice addresses AFW System overpressurization due to overspeed of a turbine driven AFW pump. Refer to section 3.1.10.

4.3.20 IE Bulletin No. 80-04

IE Bulletin No. 80-04, Analysis of a PWR Main Steam Line Break with Continued Feedwater Addition, dated 2/8/80 **[REFs 9.2.71, 9.2.40, 9.2.41, 9.2.42, 9.2.43, 9.2.44, 9.2.45, 9.5.23, 9.2.46, 9.2.47, 9.2.48, 9.5.25 and 9.4.4]**. This bulletin addresses the effects of feedwater being added to a depressurized steam generator after a steam line break.

4.3.21 IE Bulletin No. 85-01

IE Bulletin No. 85-01, Steam Binding of Auxiliary Feedwater Pumps, dated 10/29/85 **[REFs 9.2.12, 9.2.13, 9.2.14, 9.2.69 and 9.2.70]**. This bulletin addresses the steam binding of AFW pumps due to backleakage of feedwater through check valves. As a result of this issue, Modification Requests 84-270 and 84-271 were initiated to remove AFW System insulation inside containment. In addition, WE committed to check the AFW System piping temperature once per shift (accomplished by touch to detect if pipe temperature is above ambient).

4.3.22 IE Bulletin No. 88-04

IE Bulletin No. 88-04, Potential Safety Related Pump Loss, Dated 5/5/88 [REFs 9.2.62, 9.2.2, 9.2.63]. This bulletin addresses the potential dead-heading of one or more pumps in safety-related systems that have a miniflow line common to two or more pumps or other piping configurations that do not preclude pump-to-pump interaction during minflow operation, and a second concern for whether or not the installed miniflow capacity is adequate for even a single pump in operation. As a result of this issue, WE implemented MR 88-99 to improve AFW pump minimum recirculation line characteristics. The MR added flow instrumentation to the recirculation lines and increased the capacity of recirculation lines for each of the AFW pumps. The original capacity was inadequate because it was based only on pumped fluid temperature rise. The enhanced capacity accommodates flow instability considerations as well. For additional information, see the MR description in section 7.0 of this document.

4.3.23 IE Bulletin No. 85-03

IE Bulletin No. 85-03, Motor-Operated Valve Switch Settings [REF 9.2.72]. This bulletin addresses the operability of motor-operated valves with improper switch settings. Due to this bulletin, WE has developed a motor-operated valve stem thrust measurement system. Based on these measurements, WE concluded that all motor-operated valves will perform their required automatic safety function under design basis conditions.

4.3.24 NRC SER Dated 7/15/70

Safety Evaluation by the Division of Reactor Licensing U.S. Atomic Energy Commission in the Matter of Wisconsin Electric Power Company and Wisconsin Michigan Power Company Point Beach Nuclear Plant Unit Nos. 1 and 2, dated July 15, 1970 [REF 9.2.31]. This is the original safety evaluation for PBNP Units 1 and 2. This SER is broad approval of the PBNP plant design described in the safety analysis report and provides no detailed design evaluation of the AFW System.

4.3.25 NRC SER Dated 9/9/77

Safety Evaluation by the Office of Nuclear Reactor Regulation Supporting Amendment Nos. 26 and 31 to Facility Licenses DPR-24 and DPR-27, dated September 1, 1977 [REF 9.2.32]. This safety evaluation addresses Technical Specification changes regarding the operability of AFW pumps.

4.3.26 NRC SER Dated 9/13/79

Safety Evaluation Report Steam - Generator Water Hammer - Kewaunee, Point Beach Units 1 and 2, Prairie Island Units 1 and 2, September 13, 1979 [REF 9.2.33]. This safety evaluation concludes that water hammer events are not likely to occur at PBNP due to the Main Feedwater and AFW System design.

4.3.27 NRC SER Dated 1/27/81

Safety Evaluation Report - Point Beach Nuclear Plant, Units 1 and 2 - Implementation of Recommendations for Auxiliary Feedwater Systems, dated January 27, 1981 **[REFs 9.2.34 and 9.2.35]**. This safety evaluation addresses the implementation of recommendations resulting from TMI-2 at PBNP.

4.3.28 NRC SER Dated 4/21/82

Supplement to Safety Evaluation Report - Point Beach Nuclear Plant, Units 1 and 2 - Implementation of Recommendations for Auxiliary Feedwater Systems (NUREG 0737, Item II.E.1.1), dated April 21, 1982 **[REFs 9.2.36, 9.2.37, 9.2.38, 9.5.135, and 9.5.150]**. This safety evaluation addresses the implementation of recommendations resulting from TMI-2 at PBNP.

4.3.29 NRC SER Dated 5/3/82

Safety Evaluation by the Office of Nuclear Reactor Regulation Point Beach Units 1 and 2 - Auxiliary Feedwater Automatic Initiation and Flow Indication TMI Action Plan Item II.E.1.2, dated May 3, 1982 **[REFs 9.2.39 and 9.2.54]**. This safety evaluation addresses the implementation of recommendations resulting from TMI-2 at PBNP.

4.3.30 NRC SER Dated 10/8/82

Safety Evaluation by the Office of Nuclear Reactor Regulation - Main Steam Line Break with Continued Feedwater Addition Point Beach Nuclear Plant Units 1 and 2, dated October 8, 1982 **[REF 9.2.40, 9.2.71]**. This safety evaluation concludes that the WE response to IE Bulletin 80-04 is acceptable.

4.3.31 NRC SER Dated 5/4/83

Safety Evaluation by the Office of Nuclear Reactor Regulation Supporting Amendment No. 73 to Facility Operating License No. DPR-24 and Amendment No. 78 to Facility Operating License No. 27 Wisconsin Electric Power Company Point Beach Nuclear Plant, Unit Nos. 1 and 2, dated May 4, 1983 **[REFs 9.2.50, 9.2.51, 9.2.52 and 9.2.53]**. This safety evaluation addresses Technical Specification changes regarding the operability of AFW pumps.

4.3.32 NRC SER Dated 11/8/83

Safety Evaluation by the Office of Nuclear Reactor Regulation - Generic Letter 81-21, Natural Circulation Cooldown Wisconsin Electric Point Beach Units 1 and 2, dated November 8, 1983 **[REF 9.2.10]**. This safety evaluation concludes that the WE response to Generic Letter 81-21 is acceptable.

4.3.33 NRC SER Dated 7/3/85

Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment Nos. 95 and 99 to Facility Operating License Nos. DPR-24 and DPR-27 -Wisconsin Electric Power Company Point Beach Nuclear Plant, Unit Nos. 1 and 2, dated July 26, 1985 **[REF 9.2.55]**. This safety evaluation addresses Technical Specification changes regarding a limiting condition for operation for the AFW System.

4.3.34 NRC SER Dated 9/16/85

Safety Evaluation by the Office of Nuclear Reactor Regulation - Seismic Qualification of the Auxiliary Feedwater System - Point Beach Nuclear Plant Units 1 and 2, dated September 16, 1986 **[REF 9.2.2]**. This safety evaluation addresses the WE response to Generic Letter 81-14.

4.3.35 NRC SER Dated 10/3/90

Safety Evaluation of the Point Beach Response to the Station Blackout Rule, dated October 3, 1990 **[REF 9.2.64]**. This safety evaluation addresses the WE response to the station blackout rule, 10 CFR 50.63, and recommends a Technical Specification revision to increase the minimum capacity of the Condensate Storage Tanks. Refer to Sections 2.1.2.2 and 3.2.1.

4.3.36 NRC SER Dated 10/28/93

Safety Evaluation of the Inservice Testing Program Relief Requests for Pumps and Valves **[REF 9.2.89]**. ASME Section XI requires one or more fixed sets of test reference values of differential pressure and flow. In typical testing applications, the flow is varied until either of the measured parameters (flow or d/p) equals a fixed reference value. This document justifies relief from this testing requirement based on the AFW pump recirculation configuration which uses a fixed flow-limiting orifice for testing. Without the capability to adjust (i.e., throttle) the recirculation flow to the fixed reference value, this SER approved the acceptability of a 2% tolerance around the reference value for testing.

4.3.37 IE Notice No. 93-12

IN 93-12, "Off-Gassing in Auxiliary Feedwater System Raw Water Sources" described a phenomenon whereby service water supplied to AFW pump suction "off-gassed". **REF 9.3.52** dismissed the applicability of this phenomenon to PBNP based on the plant's AFW/SW suction configuration. PBNP AFW pumps draw suction directly from the SW supply header as opposed to drawing suction from the discharge of a heat exchanger in the SW system. The IN was also dismissed because of good operating/test experience with the existing configuration. **[REF 9.3.52]**

5.0 SYSTEM OPERATION

This section identifies the precautions, limitations, and other operational requirements that have been imposed on the AFW System to ensure that system performance requirements are met. These operational requirements become evident when system equipment alone will not automatically achieve system performance requirements.

To the maximum practical extent, the implementing procedures for each operational requirement are identified herein. Reference is made to the procedure revision in effect at the time of DBD development and may change with time. These references are provided FOR INFORMATION ONLY, as a convenience to the reader. For more recent information on the implementation of these requirements, the reader must review current controlled procedures.

5.1 Actions to Prevent Pump Excessive Flow Rates

To prevent pump or pump-motor damage, the flowrate of each motor driven pump (P-38A and P-38B) should not exceed the maximum flowrate described in Section 3.1.4 (500 gpm). To prevent pump or pump-turbine damage, the flowrate of each turbine driven pump (1P-29 and 2P-29) should not exceed the maximum flowrate described in Section 3.1.4 (700 gpm). It should be noted that even though the motor driven pumps can operate at 500 gpm with no pump damage, there are limitations associated with overcurrent protection of the motor.

IMPLEMENTING PROCEDURES:
- OI-62A (describes a more limiting value of 240 gpm for MD) **[REF 9.5.69]**
- OI-62B **[REF 9.5.70]**
- IT-8A and IT-9A (describes a more limiting value of 450 gpm for TD) **[REFs 9.5.88, 9.5.90]**

5.2 Manual Gagging of AOV Recirc Flow Control Valves

The motor driven AFW pump AOV Recirc Flow Control Valves, AF-4007 and AF-4014, may have to be gagged to control AFW flow if instrument air is lost and flow to S/Gs is less than 75 gpm. Otherwise, the MD pumps are not to be run with flows less than 70 gpm. [Refer to Section 3.9.2].

IMPLEMENTING PROCEDURE(S):
- OI-62A **[REF 9.5.69]**
- AOP-5B **[REF 9.5.182]**

5.3 Actions to Reset Low Suction Pressure Trip

In the event of low suction pressure, the motor driven and turbine driven AFW pumps will trip. After an alternate source of AFW is established the trip must be reset (this can be done in the control room, remote-manually, or locally by hand-wheel) to restart the pump [Refer to Section 3.1.7].

IMPLEMENTING PROCEDURE(S):

- PBNP OI-62A **[REF 9.5.69]**
- PBNP OI-62B **[REF 9.5.70]**

5.4 Actions for Low Condensate Storage Tank Level

The current design basis for the AFW System requires switching the AFW pump suction to the Service Water System within five (5) minutes if the Condensate Storage Tank is not available **[REFs 9.2.4, 9.2.6]**. These actions include; (1) verification of low suction pressure and CST level, (2) tripping of AFW pumps, (3) obtaining operator concurrence, and (4) completing switchover actions **[REF 9.2.4]**. AFW Pump or suction check valve failures which might occur after switchover would provide off-normal indications and operator action could be taken within ten (10) minutes of the failure **[REF 9.2.4]**. Failure of a suction check valve would require local action to shut the manual isolation valve within the ten-minute period.

IMPLEMENTING PROCEDURE(S):

- Foldout Page for EOP-0 **[REF 9.5.72]**
- Foldout Page for EOP-1 **[REF 9.5.74]**
- Foldout Page for EOP-2 **[REF 9.5.76]**
- Foldout Page for EOP-3 **[REF 9.5.77]**

5.5 Manual Shut down of TD AFW Pumps Due to Harsh Environment

The steam supply valves to the AFW pump turbine drive, 1MS-2019, 1MS-2020, 2MS-2019, and 2MS-2020 could fail under accident conditions because they are only qualified for 10 minutes in harsh environments. Stopping the turbine driven AFW pump (1P-29 or 2P-29) may require manual action.

IMPLEMENTING PROCEDURE(S):

- PBNP OI-62B **[REF 9.5.70]**

5.6 Manual Actions to Relieve Overheated or Steambound AFW Pump

In the event that an AFW pump (P-38A, P-38B, 1P-29, or 2P-29) is overheated or steambound due to check valve backleakage, manual action, including venting and refilling the steambound pump, is required to restore pump operability. Immediate action includes shutting the associated discharge valves and opening pump vents to reflood the pump with CST water and cool it. Subsequent action includes shutting the discharge valve if the check valve does not shut. These manual actions to correct a backleakage problem are case-specific and are not suitable for formal written procedures **[REFs 9.5.5, 9.5.8]**.

IMPLEMENTING PROCEDURE(S):
- PBNP AOP-2C **[REF 9.5.71]**

5.7 Operational Requirements to Isolate AFW Flow During a MSLB

In the event of a Main Steam Line Break (MSLB), the operator must isolate the faulted steam generator **[Ref 9.3.27, 9.4.44]**. This action will limit the mass-energy release to the containment and conserve AFW System water inventory (i.e., CST volume). Note that the current PBNP calculation shows that AFW isolation is assumed to occur within 10 minutes (600 seconds) in MSLB containment integrity analyses (a comparison of the <u>typical</u> 2-loop Westinghouse PWR with PBNP parameters) **[REF 9.4.44]**.

Actions performed in isolating the AFW flow include closing the steam supply to the AFW pump turbine-drive (1P-29 or 2P-29), as well as isolating the appropriate discharge flow paths for the turbine driven and motor driven AFW pumps.

IMPLEMENTING PROCEDURE(S):
- PBNP EOP-2 **[REF 9.5.76]**

5.8 Operational Requirements to Isolate AFW Flow During a SGTR

In the event of a Steam Generator Tube Rupture (SGTR), the operator must isolate the faulted steam generator to limit the release of radioactivity and to control the subsequent cooldown. This action includes shutting the ruptured steam generator's steam supply valve to the AFW pump turbine-drive (1P-29 or 2P-29) and maintaining AFW flow to the ruptured steam generator until the desired level is reached.

FSAR (Section 14.2.4) states the operator's <u>capability</u> to secure auxiliary feedwater flow to the affected steam generator within about 10 minutes (when offsite power is available). In the event of a SGTR without offsite power available, the FSAR (14.2.4.) states that within 30 minutes the ruptured steam generator has been isolated and is no longer releasing steam to the atmosphere. This implies that the operators have provided AFW isolation to the affected steam generator within 30 minutes.

IMPLEMENTING PROCEDURE(S):
- PBNP EOP-3 **[REF 9.5.77]**

5.9 Station Blackout Actions

In the event of a Station Blackout (a prolonged loss of all AC power), operators must establish a total AFW flow of at least 200 gpm from the turbine driven AFW pump (1P-29 or 2P-29), and manually align a cooling water supply (Diesel-Driven Fire Pump) to the AFW pump bearings if required. AFW flow is required to maintain steam generator levels sufficient to remove reactor plant decay heat.

IMPLEMENTING PROCEDURE(S):
- PBNP ECA-0.0 [REF 9.5.81]

5.10 Steam Generator Leak Check Support

In the event that AFW is required to support steam generator leak checks, the operators must heat up the CSTs between 80 - 110°F in order to raise the steam generator metal temperature ≥70°F before pressurizing the steam generators. The maximum temperature for the CSTs is 120°F. The leak check for the steam generators places the highest temperature requirement of the AFW system water temperature to support an operating need.

IMPLEMENTING PROCEDURES(S):

- PBNP OI 1A [REF 9.5.143]
- PBNP OI 1B [REF 9.5.144]
- PBNP OI 2A [REF 9.5.145]
- PBNP OI 2B [REF 9.5.146]

6.0 INSPECTION AND TESTING

The AFW System must be periodically inspected and tested to ensure that it is capable of performing its safety function in the event of an accident. In accordance with 10 CFR 50.55a **[REF 9.1.2]** this inspection is performed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI **[REF 9.5.85]**. In addition, the Technical Specifications **[REF 9.2.58]** require periodic surveillance of the AFW System.

Technical Specification 3.3.2 requires that instrumentation directly related to safety limits and limiting conditions of operation be checked, tested, and calibrated at sufficiently frequent intervals to assure safe operation. The requirement includes several instrument channels required for AFW System operation **[REF 9.2.58, Table 3.3.2-1]**. Modification Requests 82-54 **[REF 9.5.44]** and 82-55 **[REF 9.5.45]** added test switches and lights to reactor protection racks to allow periodic testing of the AFW automatic initiation logic. These modifications were in response to NUREG-0737, Clarification of TMI Action Plan Requirements, Section II.E.1.2 **[REF 9.2.39]**. In addition, the AFW System flow indicators are periodically checked under inservice test procedures **[REFs 9.5.88 and 9.5.90]**.

The inservice inspection of safety class components is required by Technical Specification 5.5.7. Code classified components are tabulated showing each specific examination area and the examination requirements in an inspection interval long-term plan. This plan is completely revised for each ten-year inspection interval **[REF 9.2.58 (Section 5.5.7)]**.

The AFW pumps must be periodically tested to verify that the AFW System is able to respond properly when required. This testing is required by Technical Specification S.R. 3.7.5.2 (tests developed heat and low of each pump in accordance with the IST Program and with a frequency established by the IST Program), and S. R. 3.7.5.4 (tests automatic starting in response to a signal on an 18 month frequency) **[Ref. 9.2.58]**

The operability of the pumps is determined by comparing test data with the acceptance limits contained in the specific IT procedures. Pumps with data exceeding these limits will be declared inoperable. The AFW test parameters include pump flow, lube oil level, speed (1P-29 and 2P-29 only), inlet pressure, differential pressure, vibration, and bearing temperature **[REF 9.5.85]** The required pump tests are performed under inservice test procedures **[REFs 9.5.91, 9.5.95, 9.5.98, 9.5.151, and 9.5.152]**. In 1992, recirculation line modifications **[REF 9.5.117]** improved system capability to accurately measure pump flow for these tests.

In addition, a cold fast start test of the turbine driven AFW pumps, 1P-29 and 2P-29, is performed on a quarterly basis **[REFs 9.5.88 and 9.5.90]**. The cold fast start tests are performed in accordance with the recommendations of INPO SOER 86-01 **[REF 9.5.99]** to ensure operability of turbine driven AFW pumps. Until recirc-line modifications **[REF 9.5.117]** were completed in 1992, the AFW pump run-time using the recirculation flow path was limited to 40 minutes for all pump tests **[REF 9.5.100]**. These tests also perform verification/setting of the discharge MOVs (in order to maintain at least 260 gpm AFW flow at steam generator pressure of 1085 psig), see worksheet 3.5.3 for additional information.

Technical Specification S.R. 3.7.5.3 **[REF 9.2.58]** requires that the AFW pump discharge valves and the service water supply valves to the pump suctions be tested every 18 months. In addition, the PBNP Inservice Testing Program **[REF 9.5.85]** requires periodic testing of the applicable AFW System valves, including check valves. The operability of valves is determined by comparing test data with the acceptance limits contained in Operations Manual Procedure OM 4.2.2 **[REF 9.5.169]**. Valves with test data exceeding these limits will be declared inoperable. The required valve tests are performed under inservice test procedures **[REFs 9.5.88, 9.5.90, 9.5.91, 9.5.151, 9.5.152]**.

TABLE 7-1
AFW MODIFICATIONS

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
E-198	**Steam Driven AFW Pump Bearing Cooling Water Valve** Control circuit for valve 1MS-2090-S modified to allow operation of the turbine driven AFW pump, 1P-29, and the steam generator blowdown system at the same time without having to use the manual bypass valve.		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.29
E-199	**Steam Driven AFW Pump Bearing Cooling Water Valve** Similar to E-198 for Unit 2, control circuit for 2MS-2090-S on AFW pump 2P-29 was modified.		
	Unit: 2	**Design Basis Impact:** No	**REF:** 9.5.30
IC-201	**AFW Pump Flow Indication on Main Control Boards** Control room flow indication added to the AFW pump discharge flow elements, FE-4007, FE-4014, 1FE-4002, and 2FE-4002. Control room indication required to support system testing and post accident operation, safety-grade AFW flow indication is addressed by NUREG-0585, TMI-2 Lessons Learned Task Force Final Report [REF 9.2.34], Item 2.1.7.b.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 3.1, 3.17	**REF:** 9.5.31
IC-210	**AFW Supply Line Flow Indication** Flow elements 1FE-4036 and 1FE-4037 added to the AFW lines to steam generators 1HX-1A and 1HX-1B, flow element provides safety-related indication in the control room, effect on the piping was evaluated and found to be acceptable, initiated in response to NUREG-0585, TMI-2 Lessons Learned Task Force Final Report [REF 9.2.34], Item 2.1.7b, stating safety-grade indication of auxiliary feedwater flow to each steam generator shall be provided in the control room.		
	Unit: 1	**Design Basis Impact:** Yes - sect. 2.2.11, 3.1, 3.17	**REF:** 9.5.32
IC-211	**AFW Supply Line Flow Indication** Similar to MR IC-210.		
	Unit: 2	**Design Basis Impact:** Yes - sect. 2.2.11, 3.1, 3.17	**REF:** 9.5.33
IC-223	**AFW Pump Turbine Bearing Temperature Indication** Thermocouples installed on the turbine bearings, thermocouples provide a non-safety-related bearing temperature indication, calculation to verify the seismic adequacy of the installation is included.		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.34

TABLE 7-1
AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
IC-224	**AFW Pump Turbine Bearing Temperature Indication** Similar to MR IC-223.		
	Unit: 2	**Design Basis Impact:** No	**REF:** 9.5.35
IC-295	**AFW Pump 1P-29 Suction Header Pressure** Augmented Quality pressure transmitter (PT4042, PT4043) added to the suction header of AFW pump 1P-29, provides input to an annunciator and the AFW pump trip circuit added under IC-325, addresses the seismic qualification of the installation, initiated in response to NRC requirements to protect the AFW pump, 1P-29, if the normal AFW supply is lost due to a seismic event or tornado [REF 9.2.34 and 9.2.35], MR IC-325 [REF 9.5.39] was initiated to revise the AFW pump logic to include a trip function.		
	Unit: 1	**Design Basis Impact:** Yes - sect. 3.1.7, 3.18	**REF:** 9.5.36
IC-296	**AFW Pump 2P-29 Suction Header Pressure** Similar to MR IC-295, MR IC-326 [REF 9.5.40] added a trip function for AFW pump 2P-29.		
	Unit: 2	**Design Basis Impact:** Yes - sect. 3.1.7, 3.18	**REF:** 9.5.37
IC-316	**Condensate Storage Tank Environmentally Qualified Level Transmitters** Redundant, safety-related level transmitters, LT-4038, LT-4039, LT-4040, and LT-4041 added to the Condensate Storage Tanks to provide redundant level indication in the control room, initiated in response to NUREG-0737, Clarification of TMI Action Plan Requirements, Item II.E.1.1, requires redundant level indications and low level alarms for the Condensate Storage Tanks, T-24A and T-24B [REF 9.2.36].		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 3.19, 3.2.6	**REF:** 9.5.104
IC-324	**AFW Pumps P-38A and P-38B Suction Header Pressure** Similar to MR IC-295, MR IC-327 added a trip function for AFW Pumps P-38A and P-38B.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 3.1.7, 3.18	**REF:** 9.5.38

TABLE 7-1

AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
IC-325	**AFW Pump 1P-29 Low Suction Pressure Trip** Associated with MR IC-295 [REF 9.5.36] and WMTP 11.39 [REF 9.5.142], added a trip and alarm function to the pump on low suction pressure, alarm and trip setpoints were determined by test data and calculations included in the modification, initiated in response to NUREG-0737, Clarification of TMI Action Plan Requirements, Item II.E.1.1, requires automatic protection of the AFW pump, 1P-29 if normal AFW supply is lost due to a seismic event or tornado [REF 9.2.34 and 9.2.35].		
	Unit: 1	**Design Basis Impact:** Yes - sect. 3.1.7, 3.18	**REF:** 9.5.39
IC-326	**AFW Pump 2P-29 Low Suction Pressure Trip** Similar to MR IC-325, pressure transmitter added to the suction of AFW Pump 2P-29 by MR IC-296 [REF 9.5.37].		
	Unit: 2	**Design Basis Impact:** Yes - sect. 3.1.7, 3.18	**REF:** 9.5.40
IC-327	**AFW Pumps P-38A and P-38B Low Suction Pressure Trip** Similar to MR IC-325, pressure transmitters added to the suction of AFW pumps P38A and P38B by MR IC-324 [REF 9.5.38].		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 3.1.7, 3.18	**REF:** 9.5.41
M-55	**Change Feedwater Check Valves AF-100 and AF-101** Replaced first off check valves 1AF-100, 1AF-101, 2AF-100, and 2AF-101 for easier maintenance. Removed the second (redundant) check valve in-line with each of the first off check valves.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 2.2.10, 3.10.1, 3.13	**REF:** 9.5.113
M-105	**AFW Chemical Addition Pots, T-47A and T-47B** Chemical addition pots and associated piping added to the AFW system, fabricated from 10 inch pipe and pipe caps, have a capacity of approximately nine gallons each, includes a calculation to verify that one inch, schedule 80 carbon steel pipe can be threaded without violating the required minimum wall thickness of the pipe.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** 9.5.42

TABLE 7-1

AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
M-623	**TDAFW Pump Bearing Cooling (Independence from AC Power)** In response to an NRC evaluation of the AFW System, this MR modified the TDAFW Pump bearing cooling system to function without AC Power. The approved method was to tie into the Fire Water System and install a fail-open hydraulic valve (FP-3771, 3772) which would supply fire protection water to TDAFW Pump bearing and lube oil coolers independent of AC power, DC power, and Instrument Air. Also, a check valve was installed in the SW line to prevent backflow into the SW system. This design was considered passive because it required no operator action [when the blackout occurs]; however, it did rely on the operation of the Fire Water System diesel-powered pump. (The final design of this modification was complete in May of 1983). Tests were done in conjunction with the modification to determine the actual cooling requirements of the pumps and turbines. Although the hardware changes of this modification primarily affect equipment scoped in the SW DBD, the changes were made to accommodate design basis requirements of the AFW System, and are therefore discussed here.		
	Unit: 1	**Design Basis Impact:** Yes - sect. 3.1.9	**REF:** 9.5.126
M-624	**TDAFW Pump Bearing Cooling (Independence from AC Power)** Similar to MR M-623.		
	Unit: 2	**Design Basis Impact:** Yes - sect. 3.1.9	**REF:** 9.5.127
82-53	**AFW Inoperable Alarm** Alarm for each unit added to indicate whenever any portion of the auxiliary feedwater automatic initiation system is disabled, split annunciator was provided to indicate the status of Unit 1 and Unit 2 automatic initiation operability, indication is provided whenever both main feedwater pump control switches are in the pull-to-lock position either motor driven AFW pump, P-38A or P-38B, control switch is in the pull-to-lock position or the applicable turbine driven AFW pump, 1P-29 or 2P-29, trip valve, 1MS-2082 or 2MS-2082, is closed, design allows the AFW system status of the operating unit to be monitored when the other unit is in an outage condition, initiated in response to NUREG-0737, Clarification of TMI Action Plan Requirements, Section II.E.1.2, NRC Safety Evaluation [REF 9.2.39] states that the automatic indication should be provided in the control room to alert the operators to the inoperable status of the AFW System.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 2.2.4, Table 2-2	**REF:** 9.5.43

TABLE 7-1

AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
82-54	**AFW Logic Test Circuit** Test switches and lights added to Unit 1 reactor protection racks, allows periodic testing which verifies proper operation of the relay coil/contact combination used to initiate auxiliary feedwater on a steam generator low-low level signal, initiated in response to NUREG-0737, Clarification of TMI Action Plan Requirements, Section II.E.1.2, NRC Safety Evaluation of this item [REF 9.2.39] states that periodic testing of the AFW automatic initiation logic should be performed.		
	Unit: 1	**Design Basis Impact:** Yes - sect. 6.0	**REF:** 9.5.44
82-55	**AFW Logic Test Circuit** Similar to MR 82-54.		
	Unit: 2	**Design Basis Impact:** Yes - sect. 6.0	**REF:** 9.5.45
83-55	**Replace 1AF-108, 1P-29 Discharge Check Valve** Check valve 1AF-108 replaced with a piston lift check valve equipped with dual seat and equalizer piping, check valve was provided with a soft seat of ethylene propylene to ensure tight sealing, purchased per specification PB-156 [REF 9.5.60].		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.46
83-56	**Replace 2AF-108, 2P-29 Discharge Check Valve** Similar to MR 83-55, replaced AFW pump discharge check valve 2AF-108.		
	Unit: 2	**Design Basis Impact:** No	**REF:** 9.5.47
83-57	**Replace AF-109 and AF-110, P-38A and B Discharge Check Valves** Similar to MR 83-55 replaced Unit 1 and 2 common check valves.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** 9.5.48
83-73-2	**AFW Pump Suction Sample Lines to New Sample Panel** Sample connections added to existing vent connections on the AFW pump suction piping, includes seismic qualification of the sample line from the AFW header to the first anchor, flow analysis was performed to verify a sample line rupture would not adversely effect the AFW system.		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.49
83-74-2	**AFW Pump Suction Sample Lines to New Sample Panel** Similar to MR 83-73-02.		
	Unit: 2	**Design Basis Impact:** No	**REF:** 9.5.50

TABLE 7-1

AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
83-104	**AFW System Discharge MOV Controls** Control logic for the motor driven AFW pump discharge valves, AF-4020, AF-4021, AF-4022, and AF-4023 was modified, revised valve logic is similar to the automatic starting logic for the motor driven pumps, following a steam generator Low-Low level signal in one unit, the valves to the affected unit will automatically open while the valves to the unaffected unit will automatically close, dual automatic/manual switches were provided for each valve, operators can remotely open or close the valve in either automatic or manual mode, in manual mode (control switch pulled out), the operators can control the valves, except that an automatic shut signal will close the valve, in automatic mode, (control switch pushed in), an automatic open signal will override an automatic shut signal to ensure the valve opens, alarm is provided to annunciate whenever a control switch is in the manual position since automatic (open) actuation is restricted, design allows the valves to be in either an open or closed position during normal operation. This modification was initiated in response to NUREG-0737, Clarification of TMI Action Plan Requirements, Section II.E.1.2, NRC correspondence [REF 9.2.60, 9.3.109] discusses the requirement for automatic initiation of auxiliary feedwater means that auxiliary feedwater must be provided to the steam generators without operator action.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** 9.5.51
84-270	**Remove AFW Piping Insulation** Most of the insulation was removed from the AFW piping inside containment, exposed piping was painted and personnel protection was installed where required, results of a heat transfer analysis to determine the amount of insulation to be removed is included, seismic effects of this modification were evaluated and found to be acceptable, recommended response to NRC Information Notice 84-06, [REF 9.2.18] and INPO Significant Operating Event Report 84-03.		
	Unit: 1	**Design Basis Impact:** Yes - sect. 3.3.2	**REF:** 9.5.53
84-271	**Remove AFW Piping Insulation** Similar to MR 84-270.		
	Unit: 1	**Design Basis Impact:** Yes - sect. 3.3.2	**REF:** 9.5.54

TABLE 7-1
AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
85-213 85-214	**ATWS - AMSAC Installation** As required by 10CFR50.62 and as committed to in WE to NRC letters dated 4/23/87, 12/30/87, and 3/2/88; provides a diverse signal (i.e., diverse to S/G Low-Low RPS Signal) to trip the main turbine and start MDAFWP and TDAFWP when a loss of MFW is detected (both MFW Pump breakers open or both MFW Control Valves close). Augmented quality installation.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 2.1.2.3, 2.2.12	**REF:** 9.5.120
85-252	**Change "AFWS DISABLED" Annunciator Logic for AFW MOVs** Annunciator logic revised to provide a "AFWS DISABLED" alarm as soon as a switch is removed from the automatic position, the logic was revised to provide a "AFWS DISABLED" alarm whenever the turbine driven AFW pump, 1P-29, Steam supply valves, 1MS-2019 and 1MS-2020, are placed in the closed position, control switches for the motor driven AFW pump discharge valves were changed to dual automatic/manual switches by Modification Request 83-104 [REF 9.5.51].		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.55
85-252A	**Replace 1P-29 Steam Supply Valve's Control Switch** The control switches with new 3 position switches, MR 85-252 [REF 9.5.55] revised the "AFWS DISABLED" annunciator to alert the operators when these switches are in the closed position.		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.56
85-253	**Change "AFWS DISABLED" Annunciator Logic for AFW MOVs** Similar to MR 85-252 and 85-252A.		
	Unit: 2	**Design Basis Impact:** No	**REF:** 9.5.57
86-123	**Change the Operator's Gear Ratio for 2MS-2019 and 2MS-2020** Modified the gear ratios (and effectively lengthened the operator's stroke-time) on MOVs 2MS-2019 and 2MS-2020 to improve valve operation. The longer stroke-time (from 13 to 21 sec) which resulted from this modification was evaluated from two perspectives; (1) the AFWP start-up time was found to be delayed from 2 seconds to 3 seconds, and (2) the AFWP shutdown-time was found to be delayed an additional 9 seconds. The effect of (1) was found insignificant to the existing margin to provide AFW in 60 sec. The effect of (2) on the additional CST level consumption was evaluated and found to have measurable, but insignificant impact on the AFWP low suction pressure trip calculations. CR 97-1918 raised additional issues associated with this conclusion (MR 97-099 installed changes to improve design).		
	Unit: 2	**Design Basis Impact:** Yes - sect. 3.7.1	**REF:** 9.5.114

TABLE 7-1
AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
87-25	**Change the Operator's Gear Ratio for 2MS-2019 and 2MS-2020** Similar to MR 86-123.		
	Unit: 1	**Design Basis Impact:** Yes - sect. 3.7.1	**REF:** 9.5.115
87-97	**1P-29 Turbine Thrust Bearing and Coupling** Governor end thrust bearing was replaced by an improved bearing that includes a separate bi-directional ball bearing, the pump-to-turbine coupling was replaced by an improved coupling to reduce the axial force transmitted from the pump to the turbine.		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.58
87-98	**2P-29 Turbine Thrust Bearing and Coupling** Similar to MR 87-97.		
	Unit: 2	**Design Basis Impact:** No	**REF:** 9.5.59
88-99	**AFW Pump Mini-Recirculation Line Improvements** In response to NRC IE Bulletin 88-04 and Generic Letter 89-04, WE implemented MR 88-99 to improve AFW pump minimum recirculation line characteristics in the following way: **88-99*A** Added flow instrumentation to the recirculation lines and increased the capacity of recirculation lines for AFW pump 1P-29. Increased recirculation size from 1.5 to 2 inches to increase flow capacity from 30 gpm to approximately 116 gpm. The original capacity was inadequate because it was based only on pumped fluid temperature rise. The enhanced capacity accommodates flow instability considerations as well. Installed a new, higher capacity relief valve on the common recirculation header to accommodate higher recirculation flows (200 gpm at 50 psig). Increased the setpoints on 1DPIS-4002 (Close recirc valve at 145 gpm increasing, and open recirc valve at 110 gpm decreasing). **88-99*B** Similar to MR 88-99*A, MR 88-99*B increased recirculation line size (from 1.5 to 2 inches) for AFW Pumps P-38A and B to allow an increase in flow capacity from 30 gpm to approximately 80 gpm. Added flow transmitters. **88-99*C** Similar to MR 88-99*A, this segment made similar improvements to the Unit 2 TDAFW pump. **88-99*D** Installed conduit supports for P38A and P38B.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 3.1.3	**REF:** 9.5.117

TABLE 7-1
AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
89-127	**Provide separate power supplies for pressure controllers, PC-4012 and PC-4019 (CANCELED)** Used as reference for MR 97-038. Identified that a loss of one instrument bus could affect both electric AFW pumps (pressure controllers for each pump were supplied by 1Y03).		
	Unit: 1/2	**Design Basis Impact:** No	**REF:** 9.5.147
90-241	**Addition of SW Flush Connection at AFW Pump Suctions** Added flush connections to the service water supply headers at the suctions to the AFW pumps to alleviate silt/sludge buildup issues at the low point of the SW riser upstream of the SW supply MOVs for each AFW pump. The added flush connection can be used to provide a high-velocity/volume flush of the SW header, to remove silt accumulations in the header.		
	Unit: 1/2	**Design Basis Impact:** No	**REF:** 9.5.139
91-219	**1P-29 AFP Governor Sensing Line Removal** Removed and capped the 3/4-inch sensing line which sensed main steam pressure and transmitted it to the 1P-29 AFP governor. The engineering evaluation proved that its removal would not affect the operability of the TDAFWP. In the engineering evaluation, several fast start tests were performed on 1/2P-29 with the governor sensing line disabled and RPM traces made. These RPM traces were compared with those taken with the governor sensing line enabled. It was concluded that the governor sensing line does not impact the ability of the governor itself to prevent overspeed. The turbine manufacturer supported these changes.		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.132
91-220	**2P-29 Governor Sensing Line Removal** Similar to 91-219.		
	Unit: 2	**Design Basis Impact:** No	**REF:** 9.5.132

TABLE 7-1
AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
92-91	**IST Testability Of 1AF-4002 (1P-29 Mini Recirc)** Installed an air line (and accompanying Whitey valves) around the Mini-Recirc control solenoid to allow testing of Mini-Recirc Flow Control Valves. When these valves were added to the IST Program, fail-safe and full stroke (close) tests were required. Installation did not change the normal operation of AF-4002, while it allows the required testing to be performed. Its failure causes the AOV to go to its original design for fail safe position, is evident at the control boards or locally, and can be dealt with by use of the AOV gag and by the use of electric auxiliary feedwater pumps as appropriate.		
	Unit: 1	**Design Basis Impact:** No	**REF:** 9.5.130
92-92	**IST Testability Of 2AF-4002 (2P-29 Mini Recirc)** Similar to MR 92-091		
	Unit: 2	**Design Basis Impact:** No	**REF:** 9.5.130
92-93	**IST Testability Of AF-4007, 4014 (P-38A/B Mini Recirc)** Similar to MR 92-091		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** 9.5.131
93-025 *A (Unit 2), *B (Unit 1)	**Main Control Board Maintenance and Modification to Assure Proper Control Wire Separation for the AFWS** Modification included rerouting of control wires with new designation numbers as appropriate, color coding of control wires, siltemping the control wires with fire proof material as appropriate, removing existing manual operating breakers (MOBs) as necessary and replace with new MOBs, removing the existing wires to the existing MOBs being removed and rerouting them to the new replaced MOBs with new designation numbers as appropriate, removing the existing wires and replacing them with new wires if necessary, and performing corrective maintenance such as tightening screws, terminals, etc. as necessary. This modification implements a PBNP commitment to verify that physical separation of trip system trains is six inches of air or a barrier is in the control board and to ensure post maintenance testing of safety related components has been adequately addressed.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 2.2.13, DBD-P-50	**REF:** 9.5.156

<table>
<tr><th colspan="4">TABLE 7-1
AFW MODIFICATIONS (continued)</th></tr>
<tr><th>MR</th><th colspan="3">DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT</th></tr>
<tr><td rowspan="2">96-071*A</td><td colspan="3">G01 EDG Governor and Speed Sensing Panel (SSP) Upgrade
*A - implemented six functional and hardware changes to the G01 EDG control system. These changes were:
1) Replacement of the UG-8 hydro-mechanical engine speed governor,
2) Addition of automatic idle speed start capability,
3) Upgrade of Speed Sensing Panel with readily available equivalents,
4) Upgrade of the existing tachometer,
5) Changing starting air motor control logic to allow both banks of starting air to engage during every start attempt, and
6) Changing field flash control logic to prevent field flash from occurring during an idle start precluding potential for regulator damage.
These changes corrected design deficiencies, improved overall system reliability, reduced equipment unavailability by replacing obsolete components, and improved maintainability of the G01 EDG control system. These changes corrected the 'droop' characteristics which caused the Auxiliary Feedwater Pump to operate at a higher speed drawing significantly more current than the feed breaker was intended to carry, which caused tripping of the pump.</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: Yes -see DBD-16</td><td>REF: 9.5.138</td></tr>
<tr><td rowspan="2">97-038*A, *B1, *B2</td><td colspan="3">AFW Motor Driven Pump, Pressure Discharge Control Valves AF-4012/4019 Backup Nitrogen
*A - provided a safety related pneumatic supply to the IA system supplying the MDAFW pump discharge valves by connecting a nitrogen supply to the existing IA system with a pressure regulating valve which will open when the IA system pressure drops below the regulator setting. The nitrogen back up system is provided with two check valves in series to prevent nitrogen from entering the IA system.
*B - provided the raceway and cable routing required to assure the physical separation of the redundant cables for the controls and instrumentation associated with the MDAFW pump discharge valves. The instrument power supplies are changed to assure that power for the valve controls is supplied from redundant instrument busses. The valves will be powered from 1Y02 and 2Y02 (used to by 1Y03 for both valves). The effects of this modification are also discussed in DBD-06, Instrument and Service Air DBD.</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: Yes - sect. 3.9, 3.20</td><td>REF: 9.5.134</td></tr>
</table>

TABLE 7-1

AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT		
97-075	**Missile protected AFW suction piping at 25'6"EL** Provided shielding to protect the AFW suction piping up to the 25'6" EL in the Unit 2 Turbine Building truck access bay. This resulted from Civil Engineering walkdowns of the AFW pump suction piping to determine the impact on the piping due to a seismic event or tornado. The shielding was needed to ensure sufficient water volume for AFW pump suction prior to low suction pressure trip.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 3.2.5	**REF:** 9.5.149
97-079 *A	**Valve AF-67 moved and pipe line changed** Provided additional available water volume for AFW pump suction when the AFW pumps are aligned to take suction from the CSTs, following a seismic event or tornado. The heating boiler supply line was isolated from the AFW pump suction header, because the station heating boiler was not seismic and can not be assumed to stay intact during a seismic event. The supply line was cut to the station heating boilers and an isolation valve with a blind flange was installed. The supply line for the heating boiler was rerouted to take suction from the condenser makeup line.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 3.2.5	**REF:** 9.5.136

TABLE 7-1

AFW MODIFICATIONS (continued)

MR	DESCRIPTION OF MODIFICATION AND DESIGN BASIS EFFECT
97-099 *A, *B, *C, *D, *E, *F	**AFW Valve and Instrument Loop Modification (Low Suction Pressure Trip)** This modification was issued to correct the conditions described in CRs 97-1918, 97-2664, and CR 97-3486. It was determined that there was inadequate volume in the suction piping to the AFW pumps, following a low suction pressure trip, to prevent pump damage. Also, a single electrical failure could disable the low suction pressure trip for three of the four AFW pumps. Changes include replacing the existing Gimpel overspeed trip/throttle valve on the TDAFW pumps with a similar valve that has a solenoid trip and a motor operator for reset (remote-manual reset capability in the control room). Cable separation and power supply changes were made to ensure that no common mode or single electrical failure could affect more than 2 of 4 AFW pumps. The low suction pressure signal that was originally used to close the steam admission valves (1/2 MS-2019/2020) has been removed from these valves. *A - Installed new trip/throttle valve and low suction pressure trip circuitry (in AFW pump room) on Unit 2. *B/*D - Included upgrades to the design configuration of 3 pipe supports and the installation of one new support on the steam supply lines since the new trip/throttle valves weigh more than the old ones. *C - Installed new trip/throttle valve and low suction pressure trip circuitry (in AFW pump room) on Unit 1. *E – Replaced the existing Gimpel overspeed trip/throttle valves with a similar valve that has a DC solenoid trip and a motor operator for reset for unit 1 valve 1MS-2082. The solenoid trip was incorporated into the existing low suction pressure trip circuit. *F – Replaced the existing Gimpel overspeed trip/throttle valves with a similar valve that has a DC solenoid trip and a motor operator for reset for Unit 2 valve 2MS-2082. The solenoid trip was incorporated into the existing low suction pressure trip circuit. This modification changed the arrangement of the trip/throttle valves (1/2 MS-2082) and low suction pressure trip for the TDAFW pumps described in the FPER. The installed circuits associated with the new low suction pressure trip to the trip/throttle valves has been routed to ensure continued compliance with the PBNP Fire Protection/App R safe shutdown design basis and NRC approved App R exemptions for the AFW Pump Room and Cable Spreading Room. **Unit:** 1,2 | **Design Basis Impact:** Yes - sect. 3.1.7, 3.21 | **REF:** 9.5.135
00-077	**Upgrade Trip for AF-4019.** The internal trim (cage, plug, stem, roll pin) for AF-4019 was replaced with a trim design capable of providing increased stability at low flows (~35 gpm). This also increased air/back-up nitrogen consumption rates **Unit:** 1, 2 | **Design Basis Impact:** Yes - Sect. 3.9 | **Ref:** N/A

TABLE 7-2
AFW SYSTEM SPEEDs
This table contains historical information from a period when SPEEDs frequently effected design functions.

SPEED	DESCRIPTION AND DESIGN BASIS EFFECT		
86-03	**Replacement Byron Jackson AFW Pump Thrust Bearing** AFW Pump Thrust Bearings replaced. Refer to MRs 87-97 and 87-98.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
87-20	**Hinge Pin for Anchor Darling Check Valve** AFW System check valve hinge pins replaced with new part number.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
89-71	**Replacement Pump Gasket Material** AFW Pump gasket material replaced with that of new manufacturer.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
89-106	**Spring Washers** Spring washers for check valves 1AF-107, 2AF-107 replaced with new part number.		
	Unit: 1,2	**Design Basis Impact:** No	
90-35	**Emergency Governor Ball and Emergency Tappet** Emergency governor ball and tappet for 1P-29-T, 2P-29-T replaced with new part number.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
90-39	**IN4005 Diode** Diode for AFW Pump P-38A, P-38B replaced with new part number.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
90-70	**Thrust Ball Bearing** Thrust ball bearing, steel retainer, flush ground bearing for AFW pumps replaced with new part number.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
91-002	**Ashton-Crosby Relief Valve Model GC-32** Replaced the original and obsolete Ashton-Crosby relief valves in the AFW pump suction line.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** 9.5.125

TABLE 7-2
AFW SYSTEM SPEEDs (continued)

SPEED	DESCRIPTION AND DESIGN BASIS EFFECT		
91-011	**ASCO Solenoid Valve LB 8210B35, 3/4" pipe, 3/4" orifice, 125 VDC coil, 16.8 volts, 125 psig and its spare part kit # 162-218** Replaced the original and obsolete ASCO solenoid valve with ASCO Red-Hat II's, Model # 8210G35, as designated replacement. For use in the service water supply for cooling water to P-38A and P-38B, valves AF 4007 A-S and AF 4014 A-S. THESE AFW DESIGNATED VALVES ARE DISCUSSED IN THE SERVICE WATER DBD, DBD-12.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
92-117	**Changing Material from Cobalt based to Nitronic 60 based in Valve Internals** The valve internals for the manual isolation valves in the mini-recirc lines for P-38A and P38-B, AF-27 and AF-40, were changed from Stellite to Nitronic 60 (discs and bonnets in the ConVal 2" globe valves).		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
93-062	**Woodward Governor Type PGD 1140-1297 rpm, Part 8552-018US** The governor for the AFW TD pump turbines, 1P-029-T and 2P-029-T, has been modified by the manufacturer to improve performance. The exact original governor is no longer manufactured. Replacement governor is Part # 9903-484 and 9903-302.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
94-026	**Powell 3/4" Glove Valve Body Material Change** The manufacturer changed the body material from ASTM A-351 Grade CF8M to ASTM A-351 Grade CF3M. This affects AF-35A/B, AF-48A/B, 1AF-22A/B, and 2AF-60A/B. The change is to enhance weldability.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
95-033	**Change Existing Globe Drain Valve for a Gate Style Valve** This Vogt (manufacturer) valve, Part # SW-12141 changed to SW-12111, is used for AF-38A and AF-51A to drain sand and silt from the Service Water line prior to operating the AFW pump. By using a gate valve, seat damage will not be as likely to occur due to difference in internal flow dynamics.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
95-034	**Use of SKF 7409 BGM Bearings as a Substitute for MRC 7409 PU** The original MRC bearing is no longer available and the OEM (Byron Jackson) recommended and evaluated this replacement bearing (SKF 7409 BGM). This change affects 1/2 P-029 and P-38A/B.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA

<table>
<tr><th colspan="4">TABLE 7-2
AFW SYSTEM SPEEDs (continued)</th></tr>
<tr><th>SPEED</th><th colspan="3">DESCRIPTION AND DESIGN BASIS EFFECT</th></tr>
<tr><td rowspan="2">95-050</td><td colspan="3">Replacement Coupling for the Governor Gear Box on the TDAFW pump
Original coupling, Lovejoy Part # 59749 is being replaced by Sierbath Part # 106643A17. The spring in the Lovejoy coupling is subject to fatigue cracking. This change affects 1/2 P-29-T.</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: No</td><td>REF: NA</td></tr>
<tr><td rowspan="2">95-051</td><td colspan="3">Replacing ASCO model LB8210B35 with model HC8210G35
The replacement valve has a higher temperature coil in it. This is the 'HC' descriptive change. This change affects AF-4007A-S and AF-4014A-S. THESE AFW DESIGNATED VALVES ARE DISCUSSED IN THE SERVICE WATER DBD, DBD-12.</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: No</td><td>REF: NA</td></tr>
<tr><td rowspan="2">95-080</td><td colspan="3">Change of Material for Copes-Vulcan Trim Assembly Cage and Plug for MDAFW pump discharge control AOVs
The original cages and plugs for these valves are Part # 93522/88172 for cages and Part # 134209 and 136336 for plugs. The new cages and plugs are manufactured with a material that is less susceptible to cracking. The original items were made of 440C hardened stainless steel. Replacement cages and plugs are made of ASTM A-276-87 Type 420 Cond A. 420 is more ductile than 440C. This affects AF-4012 and AF-4019.</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: No</td><td>REF: NA</td></tr>
<tr><td rowspan="2">96-006</td><td colspan="3">Lubricant Consolidation Project
The greases/oils for PBNP were evaluated to minimize the number of lubricants on site. The affected equipment for AFWS are 1/2-P29 and P38A/B. Lubricants for 1/2-P29 are: 1) Turbine and Governor (AMER IND OIL 68), 2) Pump (nonpareil), 3) Grease fittings (RYKON PREM GRS 2), and 4) Gear Drive Governor (PERMAGEAR EP 220). Lubricants for P-38A/B are: 1) Coupling (Coupling GRS), 2) Electric motor (RYKON PREM GRS 2), and 3) Pump (nonpareil).</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: No</td><td>REF: NA</td></tr>
<tr><td rowspan="2">96-020</td><td colspan="3">Replacement of Instrumentation Cable for EQ Transmitters
The original cable (Anaconda, Brand Rex, Boston Insulated Wire) was replaced by Rockbestos cable. Affected AFWS instruments - LT-4038/4039/4040/4041(CST level) and 1/2FT-4036/4037(Discharge flow to each steam generator).</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: No</td><td>REF: NA</td></tr>
</table>

TABLE 7-2
AFW SYSTEM SPEEDs (continued)

SPEED	DESCRIPTION AND DESIGN BASIS EFFECT		
96-036	**Guide Bushing Material Change for TDAFW Pump Governor Valve** Changing guide bushing on TDAFW pump governor valve from 4140 stainless steel material to Inconel 718 to prevent corrosion build-up in the packing area. This item only serves to guide the valve stem, internal to the packing gland. This change affects 1/2 P-29-T.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
96-037	**Washer Material Change for TDAFW Pump Governor Valve Packing Spacer** Changing washer on TDAFW pump governor valve from 4140 stainless steel to Inconel 718 to prevent corrosion build-up in the packing area. The washers are used as packing spacers between the carbon packing rings in the stuffing box and are not in contact with the governor valve stem. The washers are being reverse engineered to be manufactured by PBNP. This change affects 1/2 P-29-T.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
96-038	**Valve Stem Material Change for TDAFW Pump Governor Valve** Changing valve stem on TDAFW pump governor valve from 4140 stainless steel to Inconel 718 to prevent corrosion build-up in the packing area. The valve stems are used in the governor valves for 1/2 P-29-T. The valve stems are being reversed engineered to be manufactured by PBNP.		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA
96-062	**Change the Piping Class from HP-19 to HD-8 for the SW Cooling Supply and Return for the Auxiliary Feedwater Pumps** The original carbon steel piping (HP-19) was corroding and pipe blockage was occurring, replaced piping with stainless steel (HD-8) to prevent blockage due to corrosion. The new piping also has a higher allowable stress than original piping and meets Seismic Class 1, as well. This affects 1/2P-29 and P-38A/B. In response to questions concerning whether a modification is more appropriate for this piping material change, CR 98-0366 was generated. At this time 2P-29 piping has been changed to stainless steel (and 1-1/2" versus 1" original pipe diameter). 1P-29 and P-38A/B pump piping will be changed under MR 97-130.		
	Unit: 1,2	**Design Basis Impact:** Yes - sect. 2.2.14	**REF:** NA
97-002	**Replaced Local Discharge Pressure Indicators of all Four Auxiliary Feedwater Pumps (PI-4011, PI-4018, and 1/2PI-4004)** New gauges have higher accuracy which reduces the uncertainty associated with the original gauge. Original gauge, Perma-Cal (PI-4011)/Ashcroft (PI-4018/1/2PI-4004), were replaced with Perma-Cal Part # 101RTB12A23 (all four).		
	Unit: 1,2	**Design Basis Impact:** No	**REF:** NA

<table>
<tr><th colspan="4">TABLE 7-2
AFW SYSTEM SPEEDs (continued)</th></tr>
<tr><th>SPEED</th><th colspan="3">DESCRIPTION AND DESIGN BASIS EFFECT</th></tr>
<tr><td rowspan="2">97-065</td><td colspan="3">Auxiliary Feedwater Pump Suction Pressure Transmitter Replacement
Original transmitters were not accurate enough to justify dual unit operation per CR 97-1918. Original equipment was Foxboro, Model # N-E11GM-IIB1-BF, replaced with Rosemount, Model # 1152GP6N92PM or PB. This affects AFW components, 1/2PT-4044 and PT-4042/4043.</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: Yes - sect. 3.1.7, 3.18</td><td>REF: NA</td></tr>
<tr><td rowspan="2">98-075</td><td colspan="3">Replacement for the AF Turbine, 1/2P-29-T, Inboard Bearing Cooler.
The speed documented replacements for the inboard bearing coolers that were originally provided by Terry Turbine. The original copper tube finned coolers were replace by stainless steel tubed copper finned units with similar heat transfer characteristics. The original description from Dresser-Rand was that there was no change in the heat transfer between the old and new units. In further correspondence, the heat transfer was noted to be some different, necessitating the need to increase the fluid flow rate from a minimum of 1.5 GPM up to 2.0 GPM. Given the small increase in the minimum requirement and noting that typical SW supply is substantially above this minimum, the overall design impact is negligible. However, the change in flow value for the coolers will be noted in Section 3.1.9 to provide the updated design information. At the time of this writing, field replacement for the Unit 1 equipment was complete, with closeout documentation still outstanding. Unit 2 installation was not complete.</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: Yes, Section 3.1.9</td><td>REF: NA</td></tr>
<tr><td rowspan="2">99-073</td><td colspan="3">Replacement for the AF Turbine, 1/2P-29-T, Outboard Bearing Cooler.
The speed documented replacements for the inboard bearing coolers that were originally provided by Terry Turbine. The original copper tube finned coolers were replace by stainless steel tubed copper finned units with similar heat transfer characteristics.. The original description from Dresser-Rand was that there was no change in the heat transfer between the old and new units. In further correspondence, the heat transfer was noted to be some different, necessitating the need to increase the fluid flow rate from a minimum of 1.5 GPM up to 2.0 GPM. Given the small increase in the minimum requirement and noting that typical SW supply is substantially above this minimum, the overall design impact is negligible. However, the change in flow value for the coolers will be noted in Section 3.1.9 to provide the updated design information.</td></tr>
<tr><td>Unit: 1,2</td><td>Design Basis Impact: Yes, Section 3.1.9</td><td>REF: NA</td></tr>
</table>

TABLE 7-2

AFW SYSTEM SPEEDs (continued)

SPEED	DESCRIPTION AND DESIGN BASIS EFFECT
99-029*A/ *B/*C/*D	**Aux Feed Water Pump Minimum Flow Recirc Line Orifice** Due to cavitation and vibration problems with the original orifices that caused the cracking of some welds on the minimum flow recirculation piping, the orifices were replaced with new models that prevent cavitation and vibration. The flow through these orifices did not change significantly. The orifices installed on the TDAFP recirculation line have the capability of being adjusted. **Unit:** 1,2 | **Design Basis Impact:** No | **REF:** 9.5.4
01-144	**AFW Motor-Driven Pump Mini-Recirc Flow Control Valve Modification** A backup supply of safety-related nitrogen was added to supply the AF-4007 / 4014 minimum flow recirculation valves to address LER 266/2001-005. This LER was submitted when it was discovered that a common mode failure of all the auxiliary feedwater pumps existed if instrument air was lost and all of the minimum flow recirculation valves failed closed. The existing backup nitrogen supply installed by MR 97-038 for the MDAFP discharge AOVs was tapped to supply nitrogen to the mini-recirc AOVs. Calculation 2002-0002 [REF 9.4.51] verified that the existing bottles provided an adequate supply of nitrogen for both AOVs simultaneously. **Unit:** 1,2 | **Design Basis Impact:** Yes, Section 3.8 | **REF:** 9.5.2
02-001	**IA Accumulator Addition for TDAFP Mini-Recirc Flow Control Valves** A backup supply of safety-related air was added to supply the 1/2AF-4002 minimum flow recirculation valves to address LER 266/2001-005. This LER was submitted when it was discovered that a common mode failure of all the auxiliary feedwater pumps existed if instrument air was lost and all of the minimum flow recirculation valves failed closed. Accumulators were installed in the instrument air supply tubing to act as reservoirs for a safety-related supply of air for the valves. Calculation 2001-0056 [REF 9.4.50] verified that the tank size is adequate to provide 2 hours of air to the valves. **Unit:** 1,2 | **Design Basis Impact:** Yes, Section 3.8 | **REF:** 9.5.3
02-029	**Addition of SR Open Function for AFW Mini-Recirc Flow Control Valves** To provide for testing and maintenance of the open function of these valves, the function was upgraded to Safety Related. This did not result in any physical changes to the valves or their supporting systems, but did require the removal of the internals of AF-117. AF-117 is a check valve in the common recirculation flow path, and failure of this non-QA valve to reposition could have resulted in a common mode failure defeating the intent of this modification. **Unit:** 1,2 | **Design Basis Impact:** Yes, Section 3.8 | **REF:** 9.5.6

8.0 CALCULATION SUMMARIES

The following engineering calculations form part of the design basis of the AFW System or verify that the design configuration of the system meets the design basis:

8.1 Westinghouse Internal Calculation PDC-SSC-W-3, "Steam Turbine Aux FW Pump Sizing", dated 12/28/66 [REF 9.4.23]

This calculation is cited in **Section 2.1.1** as a basis for minimum AFW flow, and in Worksheet **3.1.1** as a source for design flow and head values for the Motor driven and Turbine driven AFW pumps.

Purpose: Verify the required flow capacity of the steam turbine driven auxiliary feedwater pump. The rate is calculated on the basis that minimum steam generator water level will not be less than 10 feet above the tube sheet.

Inputs and Assumptions:

(1) Limiting conditions are a plant trip following a "blackout".
(2) TDAFW Pump starts up within one minute after "blackout".
(3) Steam Generator Water Levels are normal at time of accident.
(4) Energy Sources immediately following the trip total "22 full power seconds".
(5) Reactor Rating of 1455 MWt.
(6) AFW Temperature of 80°F.

Results and Conclusions: A delivery rate slightly over 200 gpm would meet the minimum requirements for this particular plant (PBNP). However, the TDAFW pump capacity was not reduced below the 400 gpm estimate because the 400 gpm pump had already been ordered, the cost difference was insignificant to achieve a higher flow rating, potential schedule impact due to a pump reorder was a major concern **[REF 9.3.105]**, and the additional flow provided a beneficial margin to account for any conditions differing from those assumed (such as a delayed pump start and a very low initial water level in the steam generator). The additional water depth [provided by the additional pump flow] also reduces the thermal transient on the tubes and tubesheet.

8.2 Westinghouse Internal Calculation, "WEP Aux Motor Driven FWP Sizing", dated 2/5/68, [REF 9.4.24]

This Calculation is cited in Section 2.2.1 and Worksheet 3.1.1 for historical system flow information.

Purpose: Determines the auxiliary feedwater flow capacity required to remove residual heat and maintain a steam generator level sufficient to transfer residual heat. The event description (i.e. LONF/LOAC) of this calculation is not clear, however it is evident that only one steam generator is considered operable, and that one MDAFW Pump is being used to support removal of the entire reactor plant residual heat load.

This calculation uses the term "full power seconds (fps)" in describing the residual heat and heat removal capacity of auxiliary feedwater. The rate of heat transfer is described in terms of fps per second (fps/s).

Inputs and Assumptions:

(1) The Steam Generator (SG) water inventory (without considering AFW-provided inventory) at 540 sec (9 mins) is sufficient to remove residual heat at a rate of 0.02 fps/s, which is a fraction of the total residual heat load at that time (0.033 fps/s). This is a given value, the source of which is unknown, but is evidently characteristic of the 1520 MWt reactor described in this calculation. From this datum, the calculation considers that the inventory provided by the AFW pump must be sufficient to cover enough heat transfer area and remove the incremental increase in residual heat (beyond the baseline 0.02 fps/s which is accommodated by the baseline steam generator inventory).
(2) AFW temperature is 80°F
(3) SG conditions (1100 psia, 556°F)
(4) RCS temperature is 620°F

Results and Conclusions:
(1) 1 lb of feedwater will "absorb" 0.79 x 10^{-3} fps of residual heat [by transforming 80°F saturated liquid to 560°F saturated steam].
(2) 1 ft SG level difference corresponds to a heat transfer area of 1496 ft^2.
(3) 1 ft SG level difference corresponds to 2470 lb of feedwater.
(4) 1 ft SG level difference can transfer 0.0037 fps/s.
(5) 1 ft SG level can "absorb" 1.95 fps.
(6) Therefore, "1 fps feedwater" can transfer 0.0019 fps/s (0.0037/1.95).
(7) From a plotted curve of incremental residual heat over time, the calculation plotted a tangential curve to determine the corresponding heat removal requirements of AFW. Thus, a feedwater pump with capacity corresponding to 0.0194 fps/s (the slope of the line) was found to be enough to remove residual heat and maintain a level sufficient to transfer residual heat (even a slightly smaller pump may be sufficient).
(8) The slope of the curve (in fps/s) was converted to an auxiliary feedwater rate, and this was related as a minimum auxiliary feedwater flow rate of 176 gpm.

Concludes that a pump capacity of 176 gpm would be sufficient.

8.3 <u>Calculation Included in Modification Requests IC-325, IC-326, and IC-327, AFW Pump Low Suction Pressure Setpoints, [REF 9.5.39; 9.5.40 and 9.5.41], dated 1/17/86</u>

This Calculation is cited in Section 2.2.7 and Worksheets 3.1.4, 3.1.7, 3.2.2, and 3.2.7 as verification that AFW system NPSH is adequate.

Purpose: This calculation determines the required setpoints for the AFW pump low suction pressure alarm and pump trips. The pump trip function is required to protect the AFW pumps from damage due to low suction pressure.

Inputs and Assumptions: The elevation of the condensate storage tank outlet pipe and AFW pump suction pressure transmitters are used to determine the elevation head at the transmitters. The friction head loss and the time for the suction pressure to recover after a pump start are based on test data [REF 9.5.142] included in the modifications. This data is required to establish the required pressure trip time delay.

Results and Conclusions: This calculation determines that the low pressure alarms should be set at 7.0 psig and that the low pressure trips should be set at 6.5 psig with a time delay of 20 seconds on the trips. The calculation also verifies that sufficient NPSH is available for the AFW pumps when the water level in the Condensate Storage Tanks is at the bottom of the outlet pipes. These setpoints will prevent damage to the AFW pumps due to low suction pressure and ensure that the maximum volume of water is available from the Condensate Storage Tanks.

8.4 <u>WE Calculation 85-008, Environmental Conditions At Safety Related Equipment Due To A High Energy Line Break Outside Of Containment, [REF 9.4.40]</u>

This calculation cited in Section 2.2.11 and 3.7 identifying a 10 minute operability period for AFW valves in the vicinity of a steam line break.

Purpose: This calculation determines the environmental conditions at safety-related equipment outside containment due to failure of a high-energy line. AFW system equipment evaluated are the MOVs (identified as Calc # 1 in REF 9.4.40) that supply steam the AFW TD pumps and the CST level transmitters (identified as Calc # 4 in REF 9.4.40). Revision 1 of the calculation addresses replacement of steam generators in Unit 2 and implementation of a full power operating temperature range of 557° to 573.9°F.

Inputs and Assumptions:
(1) A steady state analysis at the worst conditions of the high energy line break transient is considered.
(2) Steam lines contain ideal steam only which is treated as an ideal gas.
(3) Diffusion, friction, turbulent energy and momentum exchange, and heat transfer effects are not considered.
(4) The equipment is treated as a lumped thermal capacitance.
(5) When jet flow is involved, perfect mixing occurs with the room atmosphere.

Results and Conclusions:
(1) The MOVs (1/2 MS-2019/2020) that supply steam to the AFW TD pumps are operable for 10 minutes in the worst case environment of a nearby HELB. The peak equipment temperature is 326°F and pressure of 30.5 psia.
(2) The worst case environment will be applied to the CST level transmitters for < 30 minutes at a peak equipment temperature of 339°F and pressure of 26.4 psia.
(3) Two major areas of uncertainty in the calculation of environmental conditions revolve around steam generator performance and treatment of a steam jet.
(4) The full power T_{avg} range affects the new unit 2 steam generators in that a slight change on environmental conditions has a small impact on results when saturated conditions are considered.
(5) The environmental conditions reported in this calculation bound the conditions expected at safety-related equipment outside containment due to a high energy line break.

8.5 Calculation N-87-041, Auxiliary Feedwater Minimum Flow Evaluation, [REF 9.4.3]

This calculation cited in Worksheet 3.8.5 to support use of AOVs for AFW Recirc Flow control valves.

Purpose: This calculation determines if the AFW pumps could be subjected to shutoff head conditions, and possible damage due to the pump recirculation control valves, AF-4007, AF-4014, 1AF-4002, and 2AF-4002, failing closed due to a loss of instrument air.

Inputs and Assumptions: The allowable minimum AFW pump flow is assumed to be 75 gpm, based on the setpoint to close the recirculation control valves. The performance of the AFW pumps is based on the manufacturer's pump curves. The piping losses are based on calculation P-87-001 [REF 9.4.1]. The steam generator pressure is assumed to be 1136.25 psig based on the setpoint of the highest main steam safety valve with 1% tolerance.

Results and Conclusions: This calculation determines that when the AFW pumps are operating in parallel the flow from the motor driven pumps, P-38A and P-38B, would be reduced due to the higher head of the turbine driven pumps, 1P-29 and 2P-29. However, the flow from the motor driven pumps would be sufficient to prevent damage.

8.6 Calculation P-87-001, Electric Auxiliary Feedwater Pump Runout Study, [REF 9.4.1]

Calculation used in Section 2.2.7 and Worksheet 3.9.2 to support NPSH values for MDAFW pumps and to address runout considerations for the system.

Purpose: This calculation determines the response of the motor driven AFW pumps, P-38A and P-38B, to operation with the discharge flow control valves, AF-4012 and AF-4019, fully open at various steam generator pressures. This condition could occur due to a loss of instrument air (REF 9.5.134 has modified the control of these valves to preclude this condition).

Inputs and Assumptions: The flow resistance of the AFW system is based on the piping isometric drawings and valve data. Frictional head losses in the Main Feedwater System and steam generators are neglected. The performance of the AFW pumps is based on the manufacturer pump curves. The flow path from the pump to the steam generator with the least resistance is considered for conservatism. The water temperature is assumed to be 60°F.

Results and Conclusions: The results of this calculation are presented as a curve of steam generator pressure vs. AFW flow rate. The curve also presents the maximum allowable ambient temperatures for continuous operation of the AFW pump motors. The calculation concludes that operation within the limits of the results curve is acceptable and that operation beyond these limits may result in reduction of motor life or a motor overload trip. In addition, the calculation concludes that sufficient NPSH is available to operate the motor driven AFW pumps up to the end of the manufacturer's pump curve.

8.7 Calculation P-87-003, Electric Auxiliary Feedwater Pump Study - AOV Gagging. [REF 9.4.2]

Calculation used in Section 2.2.7 to show that no pump runout concerns exist, and in section 3.9.2 to substantiate MDAFW pump discharge pressure control valve gag position.

Purpose: This calculation determines the response of the motor driven AFW pumps, P-38A and P-38B, to operation with the discharge flow control valves, AF-4012 and AF-4019, manually gagged to the maximum required opening at various steam generator pressures.

Inputs and Assumptions: This calculation is based on the results of calculation P-87-001 [REF 9.4.1]. The maximum steam generator pressure is assumed to be 1125 psig based on the setpoint of the highest main steam safety valve.

Results and Conclusions: The results of this calculation are presented as curves of steam generator pressure vs. AFW flow for various positions of the discharge flow control valves, AF-4012 and AF-4019.

Refer to MR 97-038 [REF 9.5.134] for significant changes to the pressure controllers for these discharge flow control valves.

8.8 PBNP Calculation 89-042, Evaluation of the PBNP Containment Pressure Response to a Steam Line Break, Based on the Results of Westinghouse Analysis for a Reference 2-Loop PWR, [REF 9.4.44]

This calculation is cited in Sections 2.1.1.3, 3.5 and 3.7 in support of the requirement to isolate a faulted SG from the AFW system to prevent continued FW addition and loss of steam from the unfaulted SG.

Purpose: This calculation evaluates the effects of additional AFW flow during a steam line break inside containment. Additional AFW flow was identified by NCR N-89-011. This revision accounts for Δ47 replacement steam generators in Unit 2 and a full power T_{avg} range for both units.

Inputs and Assumptions:
(1) Fig. 14.3.4-1 in the PBNP FSAR is for saturated steam, air mixture with a partial pressure of air of 14.7 psia.
(2) Steam generator temperature is slightly below hot shutdown average temperature.
(3) Hot zero power FW and AFW flow to each steam generator is 400 gpm (total flow).
(4) Maximum AFW flow rate occurs in 1 minute.
(5) For containment pressure evaluation, only hot zero power case is evaluated due to higher steam generator inventory. Also, small break sizes are less severe and are not evaluated.
(6) For Safety Injection flow $\rho = 60$ lbm/ft^3 1ft^3 = 7.48 gal thus, 1 gpm = 0.1337 lbm/s
(7) Where applicable, density of steam is saturated at 1100 psia.
(8) Where applicable, the unisolable feedline volume is neglected.
(9) Fan cooler heat removal is degraded 25%.
(10) See calculation for detail of inputs.

Results and Conclusions:

(1) 6 cases were evaluated and the results showed peak containment pressures ranged from 46.5 psig to 59.8 psig.

(2) This evaluation does not change when the SI system boron concentration changes to 2000 ppm.

(3) This evaluation does not change for a full power T_{avg} range of 557°F to 573.9°F.

(4) By comparing conservative and non-conservative parameters, it is shown that the main non-conservatism in the analyses are additional FW and AFW, higher initial containment pressure, longer fan cooler delay time and lower fan cooler heat removal rates. These parameters are counter balanced by the conservatism in containment structural heat removal.

(5) A peak pressure of 51.3 psig is calculated after applying the effects of conservative and non-conservative parameters, which is less than the containment design pressure of 60 psig.

8.9 Calculation N-89-001, Maximum Auxiliary Feedwater Flow Rate to One Steam Generator, [REF 9.4.4]

This calculation cited in Section 2.2.3, 2.2.7 and in Worksheet 3.1.4 to support NPSH and maximum flow qualifications for the AFW system.

Purpose: This calculation determines the maximum AFW flowrate to one steam generator when the steam generator pressure is less than 5 psig.

Inputs and Assumptions: All flow from AFW pumps P-38B and 1P-29 is assumed to go to steam generator 1HX-1B. This assumption was chosen because the flow resistance to 1HX-1B is the lowest. A normal Condensate Storage Tank level of 23 feet is assumed. The position of valve 1AF-4000 is assumed to be the normal 24% (open) plus 5% for uncertainty. The pressure of steam generator 1HX-1B is assumed to be less than 5 psig. The flow resistance coefficients are based on piping isometric drawings and calculation N-90-029 [REF 9.4.7]. The AFW pump performance is based on calculation N-90-028 [REF 9.4.6].

Results and Conclusions: This calculation determines that a maximum of 1039 gpm of AFW flow would be provided to the steam generator. This flow should be conservative because the position of valve 1AF-4000 is assumed to be 29% (open), and its normal position is 24%.

8.10 Calculation PB-89-031, Voltage Drop Across MOV's Power Lines, [REF 9.4.10]

This calculation provides input information for calculation P-90-017 (see 8.14).

Purpose: This calculation determines the line voltage drop for AC and DC motor operated valves based on full load and motor stall current.

Inputs and Assumptions: The voltage drop is calculated based on the resistance of the cable size used, the length of cable installed, and the full load current of the motor. The motor stall current is taken to be five times the full load current.

Results and Conclusions: The results of the calculation are presented as a table of full load and motor stall current for each valve. The results are intended for use in calculation P-88-020 [REF 9.4.11].

8.11 Calculation N-90-028, Auxiliary Feedwater Pump Flow-Head Characteristic Polynomials, [REF 9.4.6]

Results and data from this calculation are used as input/reference for Calculation N-89-001 (Ref 9.4.4) and N-90-0095 (Ref. 9.4.8)

Purpose: This calculation generates polynomials for the turbine and motor driven AFW pump flow-head curves. These curves are for use in other system calculations.

Inputs and Assumptions: The AFW pump performance is based on manufacturer information, attached to the calculation.

Results and Conclusions: The calculation generates polynomials for the turbine and motor driven AFW pumps, P-38A, P-38B, 1P-29, and 2P-29. The polynomials can be used in other calculations to approximate the flow-head characteristics of the pumps.

8.12 Calculation N-90-029, Determination of Branch Resistance Coefficients in the AFW System, [REF 9.4.7]

Results and data from this calculation are used as input/reference for Calculations N-89-001 (Ref 9.4.4), N-90-0095 (Ref. 9.4.8), N-95-158 (Ref. 9.4.33) and S&L calculation M-09334-212-AF.1.

Purpose: This calculation determines the branch resistance coefficients in the AFW system. These coefficients are for use in other system calculations.

Inputs and Assumptions: The resistance coefficients are calculated based on piping isometrics, valve drawings, and orifice data sheets.

Results and Conclusions: This calculation determines the resistance coefficients of each AFW system branch from the condensate storage tanks to the Main Feedwater System. These coefficients can be used in other calculations.

8.13 Calculation N-90-095, Minimum AFW Flow for Automatic Actuation to Both Units, [REF 9.4.8]

Finding in this calculation that manual flow balance may be needed is documented in Section 2.2.1.

Purpose: This calculation determines if AFW flow can be provided to both units in the event of a loss of offsite AC power, considering a single failure. Section 14.1.11 of the FSAR addresses the loss of power transient.

Inputs and Assumptions: Unit 1 turbine driven AFW pump, 1P-29, is assumed to fail. The Unit 2 turbine driven AFW pump, 2P-29, and the motor driven AFW pumps, P-38A and P-38B, are assumed to provide flow to the Unit 2 steam generators. No flow is assumed to go to Unit 1. Valves 2AF-4000 and 2AF-4001 are assumed to be throttled to their required positions. The pressure at the discharge of the Condensate Storage Tank is assumed to be 10 psig based on the normal tank level. The system resistance coefficients and AFW pump performance is based on calculations N-90-028 [REF 9.4.6] and N-90-029 [REF 9.4.7] as well as the piping isometric drawings.

Results and Conclusions: The calculation determines the AFW system pressures at the Main Feedwater System interface for each steam generator based on the assumed system flows. The calculation concludes that the AFW system may not provide flow to the unit with a failed turbine driven AFW pump.

8.14 Calculation P-90-017, MOV Undervoltage Stem Thrust and Torque, [REF 9.4.12]

This calculation used in Worksheet 3.4.5 to support minimum voltage requirements.

Purpose: This calculation determines the maximum available stem thrust or the maximum available operator torque for motor operated valves during worst case undervoltage conditions. This calculation supersedes calculation P-88-20 [REF 9.4.11].

Inputs and Assumptions: The valve stem thrust is calculated based on the motor starting torque, the operator efficiency, the operator application factor, the reduced voltage factor, the operator unit ratio, and the stem factor. The valve torque for butterfly valves is calculated using similar inputs. The line losses for the valves are taken from calculation PB-89-031 [REF 9.4.10].

Results and Conclusions: The results of the calculation are presented as a table including the stem thrust or motor torque for each valve. It was found during testing that eight AFW System, DC motor driven valves did not produce the expected stem thrust.

8.15 Calculation N-91-031, "1&2 P29 Mini-Recirc Line System Characteristics", Rev. 0 [REF 9.4.20]

Results and data from this calculation are used as input for calculation N-91-032 (Ref.9.4.21).

Purpose: Determines the system characteristics for the TDAFW pump mini-recirc system and determines the equivalent K (resistance coefficient) values for the recirc line to the CST.

Inputs and Assumptions:
(1) Assumes the longest run of system piping is from the 2P29 AFW pump.
(2) Assumes a mini-recirc line flow of 100 gpm.

Results and Conclusions: The new mini-recirc system for the 1&2 P29 AFW pumps will allow a flowrate of 117 gpm with the globe valve and control valves positioned wide open. This will provide acceptable mini-recirc flow for approximately 60 hours of mini-flow service per year.

8.16 Calculation N-91-032, "Comparison of Nominal Flow Rates from 2P-29 to 2HX-1A and 2HX-1B with the Recirc Line Open", Rev. 0 [REF 9.4.21]

Used in Worksheet 3.16.1 to support system flows with failed open recirc valve.

Purpose: This calculation provides a comparison of the AFW flow rates to the Unit 2 steam generators from the turbine driven auxiliary feedwater pump (2P-29) with the existing and proposed recirculation systems "failed" open. An evaluation of the significance of this change is also provided in the conclusion of this calculation.

Inputs and Assumptions:

(1) Assumes the nominal TDAFW pump flow of 200 gpm per steam generator. The flow rate to each steam generator is reduced (by 126 gpm) if the recirculation line is open.

(2) Assumes that TDAFW pump discharge valves (2AF-4000/4001) are set to the placard values, resulting in 240 gpm at a steam generator pressure at 990 psig.

(3) Uses the recirc line characteristics provided by WE Calc N-91-031.

Results and Conclusions: Demonstrates that the proposed recirculation line will cause an increase in the total flow from 2P-29 if it is open, but a lower flow rate would be available for the steam generators. Also, the higher flow rate is well below the runout flow of approximately 700 gpm for 2P-029. Even if the recirculation line valve fails, the TDAFW pump remains the highest capacity pump in the AFW system, therefore this pump would still be the limiting safety grade failure for AFW limited accidents.

8.17 Calculation N-91-069, "Impact of Higher Capacity Recirculation System for the Electric Motor Driven AFW Pumps", Rev. 0 [REF 9.4.22]

Purpose: This calculation provides an estimate of the impact of the proposed higher capacity recirculation systems for the MDAFW pumps.

Inputs and Assumptions:

(1) Assumes the nominal flow rate through one MDAFW pump is 200 gpm, and a recirculation line flow is about 80 gpm for the proposed system.

Results and Conclusions: Demonstrates that the proposed recirculation line will allow approximately 93 gpm flow when it is open. If the proposed recirculation line is open when the pump flow is being controlled to about 200 gpm, the recirculation line flow rate would be about 89 gpm. That would leave about 111 gpm to be supplied to the steam generators. The limiting safety grade failure for the AFW system is typically a TDAFW pump, because three pumps are the highest capacity. If AFW is actuated to one unit, then the MDAFW pumps should still be able to provide sufficient flow to a unit without running out, even if the recirculation line valve fails open. It has been previously judged that the AFW system flows may need to be corrected by operator action, but at least 5 minutes is allowable for these actions.

8.18 Calculation N-93-81, MS-2019, 2020 MOV D/P Calculation [REF 9.4.15]

Maximum d/p used as reference in Worksheet 3.7.2.

Purpose: Documents the design basis and determines the maximum operating differential pressures, maximum line pressures, fluid temperatures, and flowrates for MS-2019, 2020, during expected operating conditions as well as mispositioning scenarios per NRC GL 89-10. Supersedes WE Calculation 86-19 [REF 9.4.13]

Inputs and Assumptions:
(1) Maximum upstream pressure is based on main steam safety valve pressure plus accumulation.
(2) Minimum downstream pressure is 0 psig

Results and Conclusions:
(1) Maximum operating d/p is 1159 psid opening, 1159 psid closing.
(2) Maximum expected line pressure is 1159 psig.
(3) Expected flowrate is 25,140 lbm/hr steam.
(4) Maximum operating temperature is 521°F.

8.19 Calculation N-93-86, AF-4000, 4001 MOV D/P Calculation [REF 9.4.16]

Maximum d/p used as reference in Worksheet 3.5.2.

Purpose: Documents the design basis and determines the maximum operating differential pressures, maximum line pressures, fluid temperatures, and flowrates for AF-4000, 4001, during expected operating conditions as well as mispositioning scenarios per NRC GL 89-10. Supersedes WE Calculation 86-19 [REF 9.4.13]

Inputs and Assumptions:
(1) Maximum upstream pressure is based on TDAFWP shutoff head (1340 psig) plus a maximum SW Supply Header pressure (100 psig).
(2) Minimum downstream pressure can be as low as 0 psig.

Results and Conclusions:
(1) Maximum operating d/p is 1445 psid opening, 1294 psid closing.
(2) Maximum expected line pressure is 1445 psig.
(3) Expected flowrate through either valve is 400 gpm.
(4) Maximum operating temperature is 100°F.

8.20 Calculation N-93-87, AF-4006 MOV D/P Calculation [REF 9.4.17]

Maximum d/p used as reference in Worksheet 3.6.2.

Purpose: Documents the design basis and determines the maximum operating differential pressures, maximum line pressures, fluid temperatures, and flowrates for AF-4006, during expected operating conditions as well as mispositioning scenarios per NRC GL 89-10. Supersedes WE Calculation 86-19 [REF 9.4.13]

Inputs and Assumptions:
(1) Maximum upstream pressure is based on a maximum SW Supply Header pressure (100 psig).
(2) Minimum downstream pressure can be as low as 0 psig.

Results and Conclusions:
(1) Maximum operating d/p is 105 psid opening, 105 psid closing.
(2) Maximum expected line pressure is 105 psig.
(3) Expected flowrate through either valve is 400 gpm.
(4) Maximum operating temperature is 80°F.

8.21 Calculation N-93-88, AF-4009, 4016 MOV D/P Calculation [REF 9.4.18]

Maximum d/p used as reference in Worksheet 3.6.2.

Purpose: Documents the design basis and determines the maximum operating differential pressures, maximum line pressures, fluid temperatures, and flowrates for AF-4009, 4016, during expected operating conditions as well as mispositioning scenarios per NRC GL 89-10. Supersedes WE Calculation 86-19 [REF 9.4.13]

Inputs and Assumptions:
(1) Maximum upstream pressure is based on a maximum SW Supply Header pressure (100 psig).
(2) Minimum downstream pressure can be as low as 0 psig.

Results and Conclusions:
(1) Maximum operating d/p is 105 psid opening, 105 psid closing.
(2) Maximum expected line pressure is 105 psig.
(3) Expected flowrate through either valve is 200 gpm.
(4) Maximum operating temperature is 80°F.

8.22 Calculation N-93-89, AF-4020, 21, 22, 23 MOV D/P Calculation [REF 9.4.19]

Maximum d/p used as reference in Worksheet 3.4.2.

Purpose: Documents the design basis and determines the maximum operating differential pressures, maximum line pressures, fluid temperatures, and flowrates for AF-4020, -4021, -4022, & -4023 during expected operating conditions as well as mispositioning scenarios per NRC GL 89-10. Supersedes WE Calculation 86-19 [REF 9.4.13]

Inputs and Assumptions:

For expected operating conditions, the following assumptions were used:

(1) Maximum downstream pressure is based on atmospheric steam dump control setpoint pressure (1050 psig). Minimum downstream pressure is based on a depressurized steam generator.

(2) Minimum upstream pressure is based on a minimum CST level (can be as low as 0 psig. Maximum upstream pressure is based on MDAFWP shutoff head (1300 psi).

For miss-positioning scenarios, these additional assumptions were used:

(1) Maximum upstream pressure is increased by the maximum SW Supply Header Pressure (100 psig).

Results and Conclusions:

(1) Maximum operating d/p is 1116 psid opening, 1376 psid closing.
(2) Maximum expected line pressure is 1405 psig.
(3) Expected flowrate through either valve is 200 gpm.
(4) Maximum operating temperature is 100°F.

8.23 WE Calculation N-93-117, "Appendix R Thermal Hydraulics Analysis" [REF 9.4.46]

This calculation is cited in Worksheets 3.5.4 and 3.8.6 to support manual operation of various AFW valves during a fire.

Purpose: This calculation provides a thermal-hydraulic analysis of the control room inaccessibility procedures as described in the FPER and AOP 10A. In particular, verification of the timetables established in the FPER are conducted. This calculation also provides a basis for the isolation of the letdown lines.

Inputs and Assumptions:

(1) RETRAN-02 MOD4 transient analysis program used to evaluate the Point Beach scenarios is accurate as used (4 scenarios as described in the calculation are evaluated).

(2) The components of most interest in this calculation are the pressurizer and steam generator(s).

(3) See the calculation for other assumptions and inputs.

Results and Conclusions:

(1) With the AC power available and manual trip of the reactor, this is the most limiting scenario. Within 100 seconds of the spurious actuation of the main feedwater pumps and opening the regulating or bypass valves, both steam generators will be solid. Within 500 seconds, the pressurizer will be empty. Opening the breakers to the MFW pumps or closure of the valves may be required.

(2) The other scenarios show that the reactor responds acceptably if all equipment performs as expected. The reactor is in hot shutdown when the rods drop. The RCS approaches stability in the first hour. At this time the operators can focus on bringing the reactor into cold shutdown.

8.24 WE Calculation N-94-015, Determination Of Fluid Level For Onset Of Vortexing In The Condensate Storage Tank. [REF 9.4.41]

This calculation provides the basis for vortex height cited in Worksheet 3.2.7, and is used as an input source value in calculation P-94-002 (Ref. 9.4.39).

Purpose: This calculation estimates the level (immersion depth) at which the fluid leaving the Condensate Storage Tank (CST) could potentially experience vortexing.

Inputs and Assumptions:
(1) Maximum flow rate from CST = 1200 gpm
(2) Minimum flow rate from CST = 200 gpm
(3) Diameter of AFW supply pipe = 10"
(4) Water density @ 75°F = 62.26 lb/ft^3
(5) Air density @ 75°F = 0.0742 lb/ft^3
(6) Harleman's relationship based on Bernoulli's equation is accurate to define the vortex point immersion depth.

Results and Conclusions:
(1) Immersion depth for 1200 gpm = 7.342"
(2) Immersion depth for 200 gpm = 3.586"
(3) The immersion depths calculated are conservatively high because Harleman's relationship is based on a center bottom drain and the CST is a side which would result in a lower immersion depth.
(4) The calculated levels will provide more than sufficient height to prevent vortexing.
(5) Overall installation is acceptable.

8.25 Calculation N-97-0215 Revision 1, Water Volume Swept by all four AFW Pumps following a Seismic/Tornado Event affecting both units, [REF 9.4.29]

This calculation cited in Worksheets 3.1.7, 3.5.3 and 3.21.1 to provide support for post seismic event operations of AFW.
Purpose: This calculation determines the maximum water volume swept by all four AFW pumps following loss of their normal suction water source (from the CSTs) caused by a piping failure from a seismic/tornado event. The swept volume is calculated from the time the common suction piping fails to the time when the pumps automatically trip on low suction pressure. This calculation will also compare swept volume to the total water volume available to the pumps in the protected suction piping downstream of the break.

Inputs and Assumptions:
(1) Modification MR 97-099 is completed.
(2) Two scenarios are evaluated -
Scenario 1: A pipe failure occurs before the pumps start.
Scenario 2: A pipe failure occurs after the pumps are running.
(3) Both units are operating at 100% power and the AFW system is fully operable (no pumps out of service).
(4) The seismic/tornado event causes a reactor trip of both units, turbine trip is caused by the reactor trip, and AFW pumps start (see calculation for additional details).

(5) The seismic/tornado induced pipe failure occurs as a break/shear of the unprotected AFW suction piping between the CSTs and the pumps. Only pipe break failures are assumed, pipe blockage or 'pinching' are not assumed. The AFW piping is protected from 25'6" elevation down to the pumps.
(6) The suction volume available after the break is the piping volume below elevation 24'-2" which corresponds to a piping volume of 512 gallons available to all four AFW pumps.
(7) The nominal low suction pressure trip setpoint for EACH AFW pump is 6.5 psig decreasing, with a worst-case instrument uncertainty applied this trip reduces to 5.69 psig.
(8) Additional volume in the suction lines, unique to each pump, is available to each TD and MDAFW pump for coastdown without damage, which equates to 10 gallons and 5 gallons, respectively.
(9) Trip/Throttle valve for each TDAFW pump closes in 2 seconds.
(10) Worst-case single failure is a DC power failure of either panel D-03 or D-04, either of which will prevent 2 of 4 AFW pumps from tripping on low suction pressure.
(11) Maximum time delay for low suction pressure trip circuitry is 21.5 seconds.
(12) For Scenario 1 only (break before pump start), an additional 1 second is added to the time delay to shutdown the pump.
(13) The pumps reach full flow in 3 seconds after receipt of start signal.
(14) Pump flow rate during ramp up to full speed is one half of rated flow for the 3 second duration of pump acceleration (Assumption 13).
(15) Volume consumed during pump coastdown for the MD and TDAFW pumps is 8.9 gallons and 12.6 gallons, respectively.
(16) Flow uncertainty, ~2%, is considered negligible.
(17) The auto start signal to the AFW pumps is delayed 8 seconds (same time different basis for the two types of AFW pumps).
(18) MDAFW pump full flow = 200 gpm each, TDAFW pump full flow = 360 gpm each (total of 1120 gpm).

Results and Conclusions:

(1) Any AFW pump that trips on low suction pressure following a seismic/tornado event is not damaged by water starvation.
(2) With a worst-case random single failure that causes two pumps to pump to destruction and uses the most volume of common water to all four AFW pumps, the two unaffected pumps trip in sufficient time to be protected from water starvation damage.
(3) If no single failure were assumed, all four pumps would trip properly (consuming less water) and be protected from damage.

8.26 S&L Calculation M-09334-212-AF.1. TDAFWP Low Pressure Capability. [REF 9.4.42]

This calculation is cited in Section 2.2.16 and on Worksheet 3.1.5 to support operation of the TDAFW pumps during low SG pressure conditions.

Purpose: This calculation evaluates the ability of the auxiliary feedwater pump turbine to drive the Auxiliary Feedwater Pump at pressures below 500 psig (addressing DBDOI-01-002). This revision corrects the steam generator pressure used in the calculation of the available pressure at the turbine inlet and establishes a new RCS hot leg temperature for operability of the turbine driven AFW pumps. As set forth in FPER 6.6.4, the TDAFW pump must be able to remove decay heat from the RCS, under natural circulation flow, with one TDAFW pump operating and only one steam generator available.

Inputs and Assumptions:

(1) RCS conditions for this calculation are 350°F and 425 psig.
(2) RHR system is placed into operation at time equals 35 hours post reactor trip.
(3) Adequate natural circulation occurs in the RCS for decay heat removal.
(4) RHR is placed into operation when RCS temperature is reduced to 350°F.
(5) Decay heat rate is determined IAW ANSI/ANS-5.1-1979.
(6) Auxiliary Feed Pump characteristics are per Byron-Jackson pump curves.
(7) Auxiliary Feed Pump, water side, friction factors are transcribed from WE Calculation N-95-158 **[REF 9.4.33]** and N-90-029 **[REF 9.4.7]**.
(8) Turbine characteristics are per Dresser-Rand Performance Curves attached to the calculation.
(9) The steam generator secondary side water inventory is maintained at the temperature which corresponds to the saturation pressure.
(10) Initial RCS flow is based on the coastdown of the Reactor Coolant Pumps. Natural circulation will takeover and become stable.
(11) No primary side venting to control RCS temperature and pressure.
(12) No additional cooling of RCS occurs beyond the removal of decay heat after RHR entry conditions have been reached.
(13) Saturation temperature of the secondary side steam, in the steam generator, is equal to the primary side (RCS) cold leg temperature.
(14) The water supply to the Auxiliary Feedwater Pump is the CST, at the minimum tank level of 8 feet.
(15) Pressure loss in 30" Main Steam line is negligible.
(16) Elevation head for steam line is negligible.
(17) Recirculation line valve 1AF-4002 is closed.

Results and Conclusions:

(1) The calculated minimum line pressure of 100 psig exceeds the required minimum line pressure of 95 psig to generate a BHP of 7.7.
(2) The generated BHP of 7.7 is sufficient to provide an AFW Pump flow of 45 gpm, which is adequate to preclude pump damage. This is sufficient flow rate to remove the decay heat from the RCS system at a hot leg temperature of 375°F. This flow is not sufficient to remove any additional heat.
(3) The AFW Pump Turbine will operate to cooldown the RCS hot leg to 375°F.

(4) Via secondary side steam venting through the Atmospheric Steam Dump Valves, the RCS can be further cooled to RHR cut-in conditions of 350°F. A minimum cooldown rate of 20°F/hr is recommended.
(5) Differences between unit 1 and 2 steam generators has negligible impact on the conclusions of this calculation.

8.27 Proto-Power Calculation 97-114, "Development and Analysis of Point Beach Auxiliary Feed Water System PROTO-FLO™ Thermal Hydraulic Model" [REF 9.4.47]

This calculation has not been referenced in the text of this DBD. However, its use as a tool to document and help verify the design of the system is recognized as providing a significant aid to documentation of the AFW system.

Purpose: This calculation documents the Auxiliary Feed Water System thermal hydraulic model, PBAFW.DBD. This calculation also documents the analysis determining the worst case under a steam line break inside containment scenario.

Inputs and Assumptions:
(1) Developed computer model accurately represents AFW System.
(2) Drawing and component/equipment information is accurate as provided by WEPCo - see calculation for details.
(3) The water in the CSTs is 70°F for normal conditions and 120°F for accident conditions.
(4) The steam generators are at a pressure of 1085 psig for 0% power condition and 824 psia for 100% power condition.
(5) The feed ring in the faulted steam generator is uncovered (79.48 ft elevation for unit 1 steam generators, 79.38 ft elevation for unit 2 steam generators) for pressures less than 824 psia for a steam line break inside containment condition.
(6) The AFW system valves in the valve path are 100% open. Standard valve closure curves are assigned to all globe and gate valves, and a modified linear valve closure curve is assigned to all check valves.
(7) Some valves did not have necessary valve input information so flow coefficients calculated from generic valve information is accurately representative for the respective valve.
(8) The cross connect between the motor operated pump discharges is closed for all situations.
(9) All the pump recirculation lines are closed when determining 1/2AF-4000/4001 valves positions to deliver 200 gpm per valve to the steam generators at 1085 psig (1099.7 psia) and normal CST level.
(10) See calculation for other assumptions and inputs as they are presented in the modeling process.

Results and Conclusions:

(1) The Point Beach AFW model database, PBAFW.DBD, created using Proto-FLO™ Version 3.04 and the interactive schematic, PBAFW.VSD created using Visio 4.0 has been prepared, documented and independently verified. The model is complete and ready for use in QA calculations.

(2) The worst case for a steam line break inside containment scenario has a full CST and unit steam generators without the pump recalculation since faulted unit 2B steam generator receives the most flow when it is at 324 psia and the intact steam generator is at 824 psia. The flow rates to the unit 1 steam generators are 275.57 gpm (intact 1HX-1) and 775.57 gpm (faulted 1HS-1B) with the pump recirculation. The flow rates to the unit 2 steam generators are 271.52 gpm (intact 2HX-1A) and 773.03 gpm (faulted 2HX-1B) without the pump recirculation, and 120.96 gpm (intact 2HX-1A) and 705.04 gpm (faulted 2HX-1B) with the pump recirculation.

(3) Most of the flow from the turbine driven pump goes to the faulted steam generator and a motor pump becomes the only supplier for the intact steam generator as the pressure difference between the faulted and intact steam generator increases. The check valves 1AF-0107 and 2AF-0106 need to be closed to prevent the reverse flow when there is pump recalculation and the steam generator pressures are 324 psia for the faulted and 824 psia for the intact (500 psid).

(4) The detailed files for this model are on optical disk.

8.28 <u>WE Calculation 2002-0002, "Nitrogen Backup System for MDAFP Discharge Valves (AF-4012/4019) and Minimum Flow Recirculation Valves (AF-4007/4014)", Rev 0 dated 1/28/02 [REF 9.4.51]</u>

This calculation superceded S&L Calculation M-09334-266-IA **[REF 9.4.49]** which was originally done for MR 97-038 **[REF 9.5.134]** for installation of a backup nitrogen system for the MDAFP discharge valves (AF-4012/4019).

The new calculation was performed because it was desired to use the existing nitrogen backup system to provide backup gas to the MDAFP minimum flow recirculation valves (AF-4007/4014) per MR 01-144 **[REF 9.5.2]** to respond to a potential common mode failure of the auxiliary feedwater pumps on a loss of instrument air.

This calculation used conservative assumptions for leakage, and verified that a full bottle provides 2 hours of nitrogen for the discharge and mini-recirc valves, assuming a stroking rate of 6 cycles per hour. Based on the bottle changeout pressure, 90 minutes of nitrogen in always available, which is the limit stated in AOP 5B **[REF 9.5.182]**.

9.0 REFERENCES

9.1 Industry Codes, Standards, and Regulations

9.1.1 PBNP General Design Criteria, set forth in the PBNP FSAR [REF 9.2.57].

9.1.2 10CFR50, Domestic Licensing of Production and Utilization Facilities

9.1.3 NUREG - 0578, July 1979, TMI-2 Lessons Learned Task Force: Status Report and Short Term Recommendations.

9.1.4 NUREG - 0737, November 1980, Clarification of TMI Action Plan Requirements.

9.1.5 Regulatory Guide 1.97, Rev. 3, Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident.

9.1.6 American Water Works Association AWWA D100-67 (AWS D5.2-67)

9.2 Regulatory Correspondence and Documents

9.2.1 WE letter to NRC, "Seismic Qualification of AFW System", dated 12/4/84.

9.2.2 NRC letter to WE, "Seismic Qualification of AFW System", dated 9/16/86.

9.2.3 NRC letter to WE, "Seismic Qualification of AFW System", dated 1/16/85.

9.2.4 WE letter to NRC, "Seismic Qualification of AFW System", dated 4/26/85.

9.2.5 WE letter to NRC, "Seismic Qualification of AFW System", dated 10/31/86.

9.2.6 WE letter to NRC, "Seismic Qualification of AFW System", dated 7/16/81.

9.2.7 NRC Generic Letter 81-14, "Seismic Qualification of AFW System", dated 2/10/81.

9.2.8 WE letter to NRC, "Response to GL-81-14", dated 5/4/82.

9.2.9 NRC Generic Letter 81-21, "Natural Circulation Cooldown", dated 5/5/81.

9.2.10 NRC letter to WE, "Response to GL 81-21", dated 11/8/83.

9.2.11 WE letter to NRC, "Response to GL 81-21", dated 11/25/81.

9.2.12 NRC Generic Letter 88-03, "Steam Binding of AFW Pumps", dated 2/17/88.

9.2.13 WE letter to NRC, "Response to GL 88-03", dated 3/23/88.

9.2.14 NRC letter to WE, "Response to GL 88-03", dated 4/12/88.

9.2.15 NRC IEN 80-23, "Loss of Suction to Emergency Feedwater Pumps", dated 5/29/80.

9.2.16 NRC Generic Letter 87-02, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46. Dated (received) Feb 19,1987

9.2.17 WE Letter NRC 2002-0068, Mark Warner. "Reply to a Notice of Violation (EA-02-031) NRC Special Inspection Report No. 50-266/01-17 (DRS); 50-301/01-17 DRS.

9.2.18 NRC IEN 84-06, "Steam Binding of AFW Pumps", dated 1/25/84.

9.2.19 Deleted.

9.2.20 Deleted.

9.2.21 Deleted.

9.2.22 NRC IEN 86-14, "PWR AFW Pump Turbine Control Problems", dated 3/10/86.

9.2.23 Deleted.
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9.2.29 Deleted.

9.2.30 NRC IEN 90-45, "Overspeed of Turbine-Driven AFW Pumps and Overpressurization of the Associated Piping Systems", dated 7/6/90.

9.2.31 AEC letter to WE, "Re: Original Station SER", dated 7/15/70.

9.2.32 NRC letter to WE, "Re: SER Amendment No. 26(2) and 31(1)", dated 9/1/77.

9.2.33 NRC letter to WE, "Re: SER for SG Water Hammer", dated 9/13/79.

9.2.34 NRC letter to WE, "Re: SER Recommendations for AFW Systems", dated 1/27/81.

9.2.35 WE letter to NRC, "Re: SER AFW System Requirements", dated 4/9/81.

9.2.36 NRC letter to WE, "Re: SER on NUREG-0737, Item II. E.1.1", dated 4/21/82.

9.2.37 NRC letter to WE, "Re: SER on Amendment No. 62(1) and 67(2)", dated 7/27/82.

9.2.38 WE letter to NRC, "AFW Pumps Automatic Actuation", dated 11/11/83.

9.2.39 NRC letter to WE, "Re: SER on NUREG-0737 Item II.E.1.2", dated 5/3/82.

9.2.40 NRC letter to WE, "Re: SER on Main Steam Line Break with Continued Feedwater Addition", dated 10/8/82.

9.2.41 WE letter to NRC, "AFW Addition Following a Steam Line Break", dated 4/25/80.

9.2.42 NRC letter to WE, "Additional Information Request on IEB 80-04", dated 2/26/82.

9.2.43 WE letter to NRC, "Response to Request for Information on IEB 80-04", dated 4/14/82.

9.2.44 WE letter to NRC, "Additional Information on IEB 80-04", dated 5/4/82.

9.2.45 WE letter to NRC, VPNPD-87-097, "AFW Pump Run-Out Protection", dated 3/12/87.

9.2.46 WE letter to NRC, VPNPD-89-417, "Supplement Response to IEB 80-04 and GL-88-14", dated 7/27/89.

9.2.47 WE letter to NRC, VPNPD-88-459, "Supplement Response to IEB 80-04", dated 9/7/88.

9.2.48 WE letter to NRC, VPNPD-88-172, "Response to Supplement on IEB 80-04", dated 4/23/88.

9.2.49 WE letter to NRC, "AFW Automatic Initiation and Flow Indication", dated 9/16/81.

9.2.50 NRC letter to WE, "Re: SER on Amendment 73(1) and 78(2)", dated 5/4/83.

9.2.51 WE letter to NRC, "AFW System Operability", dated 6/20/83.

9.2.52 NRC letter to WE, "AFW Pump Isolation Valve Modification", dated 9/15/83.

9.2.53 WE letter to NRC, "AFW System Operability", dated 7/6/84.

9.2.54 NRC letter to WE, "Re: SER on Amendment 80(1) and 85(2)", dated 12/29/83.

9.2.55 NRC letter to WE, "Re: SER on Amendment 99(1) and 95(2)", dated 7/26/85.

9.2.56 PBNP Final Facility Description and Safety Analysis Report (FFDSAR)

9.2.57 PBNP Final Safety Analysis Report (FSAR), as updated through June 1999

9.2.58 PBNP Technical Specifications, Appendix A to Facility Operating License DPR-24 (Unit 1) and DPR-27 (Unit 2).

9.2.59 PBNP Fire Protection Evaluation Report (FPER), Including Updates Through August, 1998.

9.2.60 NRC internal memorandum, Hague to Streeter, dated 3/10/83.

9.2.61 NRC IEB 88-04, "Potential Safety-Related Pump Loss", dated 5/5/88.

9.2.62 WE letter to NRC, VPNPD-88-335, "Re: Response to IEB 88-04", dated 6/28/88.

9.2.63 NRC letter to WE, "Response to IEB 88-04", dated 5/26/89.

9.2.64 NRC letter to WE, "SER on Station Blackout", dated 10/3/90.

9.2.65 WE letter to NRC, VPNPD-90-459, "Loss of All AC Power [Station Blackout]", dated 11/8/90.

9.2.66 NRC letter to WE, "IST Program for Pumps and Valves", dated 1/16/87.

9.2.67 WE letter to NRC, "Implementation of RG 1.97 for Emergency Response Capability", dated 9/1/83.

9.2.68 NRC letter to WE, "Re: Emergency Response Capability", dated 1/4/85.

9.2.69 NRC IEB 85-01, "Steam Binding of AFW Pumps", dated 10/29/85.

9.2.70 WE letter to NRC, "Response to IEB 85-01", dated 2/25/86.

9.2.71 NRC IEB 80-04, "Main Steam Line Break With Continued Feedwater Addition", dated 2/8/80.

9.2.72 WE letter to NRC, "Response to IEB 85-03", dated 6/30/88.

9.2.73 NRC Generic Letter 89-10, "Safety-Related MOV Testing and Surveillance", dated 6/28/89.

9.2.74 NRC Generic Letter 89-10 Supplement 1, "Results of Public Workshops", dated 6/13/90.

9.2.75 NRC Generic Letter 89-10 Supplement 2, "Availability of Program Descriptions", dated 8/3/90.

9.2.76 NRC Generic Letter 89-10 Supplement 3, "Consideration of the Results of NRC-Sponsored Tests of MOVs", dated 10/25/90.

9.2.77 WE letter to NRC, VPNPD-89-661, "Response to GL-89-10", dated 12/15/89.

9.2.78 NRC letter to WE, "Response to GL 89-10", dated 1/11/90.

9.2.79 NRC letter to WE, "Re: Inspection Report of AFW VSA", dated 2/14/92.

9.2.80 NRC IEB 85-03, "MOV Common Mode Failures During Plant Transients Due to Improper Switch Settings", dated 11/15/85.

9.2.81 WE letter to NRC, VPNPD-86-284, "Additional Response to IEB 85-03", dated 7/3/86.

9.2.82 WE letter to NRC. VPNPD-87-187, "Response to Request for Additional Information, IEB 85-03", dated 5/5/87.

9.2.83 WE letter to NRC, VPNPD-87-124, "ATWS Mitigating System Actuation Circuitry (AMSAC) Final Design and Implementation Schedule", dated 4/23/87.

9.2.84 WE letter to NRC, VPNPD-87-545, "Additional Information ATWS Mitigating System Actuation Circuits (AMSAC)", dated 12/30/87.

9.2.85 WE letter to NRC, VPNPD-88-133, "ATWS Mitigating System Actuation Circuits (AMSAC)", dated 3/2/88.

9.2.86 WE letter to NRC, "Flooding Resulting from Non-Category I Failure", dated 2/14/75.

9.2.87 WE letter to NRC, "Response to NUREG-0737", dated 9/14/81.

9.2.88 PBNP LER 91-001, 5/6/91.

9.2.89 NRC SER, "Safety Evaluation of the Inservice Testing Program Relief Requests For Pumps and Valves", dated 10/28/93.

9.2.90 WE letter to NRC, VPNPD-93-143, "Request for Additional Information Auxiliary Feedwater System Operation", dated 8/24/93.

9.2.91 WE letter to NRC, "Auxiliary Feedwater Automatic Initiation", dated 3/16/82.

9.2.92 WE letter to NRC, "Auxiliary Feedwater System Operability", dated 3/24/83.

9.2.93 NRC letter to WE (Clark to Burstein), regarding "Auxiliary Feedwater System Requirements", dated 5/16/80.

9.2.94 WE letter to NRC, "Steam Generator Water Hammer", dated 11/1/77.

9.2.95 WE letter to NRC, "Additional Information Auxiliary Feedwater System", dated 7/8/80.

9.2.96 WE letter to NRC, RE: Exemption from Appendix R for AFW Pump Room, dated 8/5/94.

9.2.97 WE letter to NRC, RE: Clarification of AFW pump room App. R exemption request, dated 9/9/94.

9.2.98 WE letter to NRC, RE: Clarification of AFW pump room App. R exemption request, dated 10/31/94.

9.2.99 WE letter to NRC, RE: Clarification of AFW pump room App. R exemption request, dated 2/28/95.

9.2.100 NRC letter to WE, RE: Issuance of App R Exemption in AFW Pump Room Fire Area, dated 7/18/95.

9.2.101 NRC SER, RE: Increasing the allowed outage times for one motor driven auxiliary feedwater pump and for the standby emergency power for the Unit 1 Train B 4160 Volt safeguards bus (A06) from 7 to 12 days, dated 9/23/94.

9.2.102 NRC SER, RE: Upgrade of PBNP TSs and implementation of automatic steam generator (SG) overfill protection, dated 12/8/94.

9.2.103 NRC SER, RE: Allowance of a one-time exception for one Train A service water pump, operating with power supplied by the alternate shutdown system B08/B09 480-volt buses, to be considered operable during the Unit 1 1995 refueling outage, and to remove or revise some one-time exceptions that are no longer necessary or appropriate, dated 3/6/95.

9.2.104 NRC SER, RE: Amendments to approve operation of the units at either 2250 psia or 2000 psia primary system pressure and the applicable setpoints for either operating condition and steam generator replacement changes, dated 7/1/97.

9.2.105 WE Ltr to NRC, VPNPD-97-009, RE: Supplement to Technical Specification Change Requests 188 and 189, dated 1/16/97.

9.2.106 WE Ltr to NRC, "Implementation of Regulatory Guide 1.97 for Emergency Response Capability", dated 9/1/83.

9.2.107 NRC SER, RE: Station Blackout Modification, dated 10/16/95.

9.2.108 PBNP LER 97-014-00, RE: Auxiliary Feedwater System Inoperability Due To Loss Of Instrument Air, dated 4/18/97.

9.2.109 NRC Safety Evaluation, Safety Evaluation on the Resolution of unresolved Safety Issue A-46 At Point Beach Nuclear Plant Units 1 and 2, Dated July 7, 1998 Document No's. NPC98-03663 and NPC98-02896

9.2.110 PBNP Technical Specification Bases

9.3 <u>Technical Correspondence, Analyses, and Reports</u>

9.3.1 Westinghouse letter to Bechtel, PBW-B-101, "Steam System Criteria", dated 1/10/67.

9.3.2 Westinghouse letter to Bechtel, PBW-B-1051, "Auxiliary Electrical System", dated 3/15/68.

9.3.3 Westinghouse letter to Bechtel, PBW-B-917, "Starting Logic for the AFW Pumps", dated 2/6/68.

9.3.4 WE letter to Westinghouse, PBM-WMP-1330, "Motor Driven AFW Pumps", dated 9/18/70.

9.3.5 Bechtel letter to Westinghouse, PBB-W-1478, "AFW Pump Lube Oil Cooling:, dated 11/19/68.

9.3.6 Bechtel letter to Westinghouse, PBB-W-2182, "AFW Pumps", dated 6/20/69.

9.3.7 Bechtel letter to Westinghouse, PBB-W-2364, "AFW Pumps", dated 8/21/69.

9.3.8 Westinghouse letter to Bechtel, PBW-B-2629, "AFW Pumps", dated 8/27/69.

9.3.9 WE letter to Westinghouse, PBM-WMP-1300, "Cooling Water to AFW Pumps", dated 7/17/70.

9.3.10 Bechtel letter to Westinghouse, PBB-W-407, "AFW Pumps", dated 8/4/67.

9.3.11 Terry letter to Bechtel, "AFW Pump Turbine Drivers", dated 5/29/68.

9.3.12 Bechtel letter to Byron Jackson, "AFW Pumps Turbine Driver", dated 6/18/68.

9.3.13 Westinghouse Internal Memo SSE-W-1258, Looft to Haller, "MOVs", 3/12/68.

9.3.14 WCAP-8113, "Westinghouse Steam Side Water Chemistry Control Specifications", Revision 1, dated January 1975.

9.3.15 Westinghouse letter to Bechtel, PBW-B-88, "AFW System", dated 12/27/66.

9.3.16 FlowServe Letter to PBNP "Aux Feed Water Pumps Minimum Flow Analysis", 3/2/01

9.3.17 Bechtel letter to Westinghouse, PBB-W-41, "Conference Notes - AFW System", dated 11/1/66.

9.3.18 SGT D-5.1.1-4468, "Westinghouse Guidelines for Secondary Water Chemistry", February 1985.

9.3.19 Bechtel letter to Westinghouse, PBB-W-3141, "Cooling Water Control Operation", dated 6/30/70.

9.3.20 Byron Jackson letter to WE, "Minimum Flow Analysis", dated 8/7/89. This is an attachment to MR 88-99*B.

9.3.21 Westinghouse letter to Bechtel, PBW-B-567, "Steam Systems Criteria", dated 10/10/67.

9.3.22 Borg Warner letter to WE, "AFW Pumps", dated 7/10/87 (an attachment to REF 9.4.6)

9.3.23 NMC Internal Correspondence, Fred Cayia, "Designation of Backup Pneumatics for AFW Mini-Recirculation Valves as Safety Related", 4/25/02.

9.3.24 WE Internal Memo, NPM-91-1447, Castell to All NPD Personnel, "Station Blackout Equipment Upgrade to Augmented Quality", dated 12/3/91.

9.3.25 WCAP 10858 Rev. 1, "Anticipated Transients Without Scram", July 1987.

9.3.26 PBNP Accident Analysis Basis Document (DBD-T-35), Module 11.0, Rev. 1, "Loss of Normal Feedwater and Loss of All AC Power to the Auxiliaries", September, 1993.

9.3.27 Westinghouse letter to WE, WEP-89-142, "Transmittal of Containment Response Information", dated 6/30/89.

9.3.28 NCR N-90-233 Evaluation dated 11/21/90.

9.3.29 Byron Jackson letter to WE (WMPC), "AFW Pumps", dated 5/2/68.

9.3.30 WE Internal Memo (Bell to Reed), "Waste Disposal System Steam Supply Trip Valves" (including calculation), dated 4/1/76.

9.3.31 WCAP-7306, "Reactor Protection System Diversity in Westinghouse Pressurized Water Reactors", dated April 1969.

9.3.32 AFW DBD Validation Report, (Sargent & Lundy) approved 8/20/93.

9.3.33 WE Internal Memo (Newton to Reed), "Re: Testing Cooling Water Flow to AFW Pumps", dated 8/7/79.

9.3.34 WCAP-7769 Rev. 1, "Topical Report - Overpressure Protection for Westinghouse PWRs", dated 6/72.

9.3.35 WCAP-12327, "Final Report for Increased Peaking Factors and Fuel Upgrade Analysis Phase II, 25 Percent Steam Generator Tube Plugging", dated 9/89.

9.3.36 PB-WMP-362, dated 10/2/67.

9.3.37 Westinghouse letter to WE (WMPC), PBW-WMP-493, "Emergency Boiler Feed System", dated 1/15/68.

9.3.38 PBNP Condition Reports CRs 91-534, 535.

9.3.39 WE Internal Memo, "Meeting in Pittsburgh on May 16, 1967", dated 5/18/67.

9.3.40 Westinghouse Internal Memo, SE-CPS-34, "Actuation of WEP Auxiliary Feedwater Pumps", dated 2/2/68.

9.3.41 CN-TA-88-070 Rev. 0, LONF for PBNP for Peaking Factor Increase, (W-Proprietary) [includes LOAC analysis].

9.3.42 WE Internal Memo, NEPB-85-213, "Response to INPO SER 50-84 and Supplement 1, Internal Flooding of Power Plant Buildings", dated 8/6/85.

9.3.43 WE Internal Memo, NEPB-87-250, "Evaluation of SOER 85-5, Internal Flooding of Power Plant Buildings", dated 4/16/87.

9.3.44 Appendix 5, WE/W Steam Generator Settlement

9.3.45 EPRI NP-2704-SR, "PWR Secondary Water Chemistry Guidelines", Rev. 1, June 1984.

9.3.46 EPRI NP-5056-SR, "PWR Secondary Water Chemistry Guidelines", Rev. 1, March 1987.

9.3.47 EPRI NP-6239, "PWR Secondary Water Chemistry Guidelines", Rev. 2, December, 1988.

9.3.48 PBNP Accident Analysis Basis Document (DBD-T-35), Module 15.0, Rev. 0, Small Break LOCA Core Response, dated March 1995.

9.3.49 PBNP Accident Analysis Basis Document (DBD-T-35), Module 12.0, Rev. 0, Rupture of a Steam Pipe, dated May 1995.

9.3.50 WE Internal Memo, NPM 92-1004, "Safety-Related Equipment Reliability Survey Item #52", dated 11/2/92.

9.3.51 WE E-Mail Memo (Adams to Pridgeon), "AFW Flow Requirements in the EOPs", dated 8/17/93 8:01 am.

9.3.52 NPD Evaluation Request IN 93-012, "Off-Gassing in Auxiliary Feedwater System Raw Water Sources", JLS evaluation dated 5/11/93.

9.3.53 Deleted

9.3.54 SOER 86-03, "Check Valve Failures or Degradation", dated 10/15/86 (REF MSSM 86-31, dated 12/16/86; MSSM 87-19, dated 9/9/87).

9.3.55 WCAP-7451, "Steam Systems Design Manual", Subsection 7, "Auxiliary Feedwater System", dated 2/70.

9.3.56 WE letter to Westinghouse, PB-WMP-257, "Condensate And Feedwater P&ID M-202 Revision C", dated 5/31/67.

9.3.57 WE letter to Westinghouse, PBP-WMP-1043, "Westinghouse RADAR Response of July 31, 1980, dated 8/14/80.

9.3.58 Westinghouse letter to WE, RADAR RESPONSE, WEP-80-63, "S/G Thermal Sleeve Deformation", dated 7/31/80.

9.3.59 WE letter to NUS Corporation, "Auxiliary Feedwater System" (relating to backleakage and water hammer), dated 9/17/81.

9.3.60 WE Internal Memo (Koehler to Porter), "Requirements for Auxiliary Feedwater System", dated 6/24/80.

9.3.61 NCR N-90-181 Evaluation dated 8/30/90 and 8/31/90, RE: AFW TD Pump Actuation on UV.

9.3.62 WE Internal Memo (Zach to Porter), "Auxiliary Feedwater Requirements", dated 5/11/81.

9.3.63 WE letter to Institute of Nuclear Power Operations, "Auxiliary Feedwater Systems", dated 4/27/84.

9.3.64 WE Internal Memo (Reed to Fay), "Burstein Memo Of 03/30/81 Concerning Placing Gate, Globe and Check Valves On Periodic Maintenance Call-Up", dated 4/3/81.

9.3.65 WE Internal Memo (Burstein to Fay and Reed), "Valve Maintenance", dated 4/21/81.

9.3.66 WE Internal Memo (Link to Porter), "Westinghouse Letter On Potential For Loss Of All Auxiliary Feedwater Flow Following A Small Steamline Rupture Dated 09/26/80", dated 10/8/80.

9.3.67 WE Internal Memo (Krause to Reed), "Auxiliary Feedwater Automatic Initiation", dated 2/9/82.

9.3.68 WE Internal Memo (Reisenbuechler to Porter), "Auxiliary Feedwater Automatic Initiation Items Of Discussion With The NRC On March 2, 1982", dated 3/5/82.

9.3.69 Westinghouse letter to WE, WEP-83-606/NS-PL-12150, "Safety Evaluation for Auxiliary Feedwater System", dated 1/4/84.

9.3.70 WE letter to Terry Corporation, "Terry Turbine Bearing Thermocouples", dated 7/30/86.

9.3.71 WE Internal Correspondence, NEPB-86-200, "Low Suction Pressure Protection For Turbine Driven Auxiliary Feedwater Pumps", dated 4/21/86.

9.3.72 Westinghouse Startup Meeting Minutes, dated 7/26/71.

9.3.73 WE E-Mail Memo (Flynn to Walther), "NPSH for AFW Pumps", dated 7/11/97 12:43 pm.

9.3.74 Westinghouse Technical Bulletin, NSD-TB-79-9, "Check Valve Slam In Steam Generator Feedwater Lines", dated 11/27/79.

9.3.75 Westinghouse Internal Comments (Looft to Hakata), SSE-W-1974, "Auxiliary Feedwater Requirements for WEP/WIS", dated 3/25/69.

9.3.76 WE letter to Westinghouse, PBP-WMP-151, "Feedwater Line Check Valves", dated 11/12/69.

9.3.77 WE letter to Westinghouse, PBP-WMP-570, "Feedwater Line Check Valves", dated 9/7/72.

9.3.78 WE Internal Memo (Rhodes to Reed), "Unit 2 Water Hammer Of December 9, 1978". dated 12/19/78.

9.3.79 Westinghouse Technical Bulletin, NSD-TB-79-8, "Water Hammer In Steam Generator Feedwater Lines", dated 11/26/79.

9.3.80 B&W Nuclear Technologies REPORT, BWNT Document No. 77-1228292-00, "Auxiliary Feedwater System Component Screening Application Report", dated 6/94.

9.3.81 Westinghouse letter to WE, PBW-B-88, "Auxiliary Feedwater System", dated 12/27/66.

9.3.82 Westinghouse letter to Bechtel, PBW-B-92, "Auxiliary Feedwater System Schematic", dated 12/29/66.

9.3.83 WE (WMPC) letter to Westinghouse, PB-WMP-129, "Auxiliary Feedwater System and Westinghouse to Bechtel Letter PBW--B-88", dated 1/4/67.

9.3.84 WE (WMPC) letter to Westinghouse, PB-WMP-205, "Condensate and Feedwater System and Emergency Feedwater System", dated 4/6/67.

9.3.85 Westinghouse letter to WE (WMPC), PBW-WMP-188, "Auxiliary Feedwater System", dated 5/1/67.

9.3.86 WE Internal Memo (Reed to Burstein), "The Emergency Boiler Feed Pump Dilemma Following The Pittsburgh Meeting Of May 3, 1967", dated 5/5/67.

9.3.87 WE (WMPC) letter to Westinghouse, PB-WMP-467, "Auxiliary Feedwater Pumps Bechtel Specification 6118-M-6", dated 12/11/67.

9.3.88 Byron Jackson letter to Bechtel Corporation, Subject: Bechtel Purchase Order #6118-M-6-AC, dated 7/31/68.

9.3.89 The Terry Steam Turbine Company letter to Bechtel, ""Turbine Driven Auxiliary Feed Pumps Terry File 22520", dated 11/7/68.

9.3.90 Bechtel letter to Westinghouse, PBB-W-1478, "Bechtel Job 6118 Feed Pump Lube Oil Cooling", dated 11/19/68.

9.3.91 Westinghouse letter to WE (WMPC), PBW-WMP-1020, "Feedpump Lube Oil Cooling Spec M5 and M6", dated 12/4/68.

9.3.92 Bechtel letter to Westinghouse, PBB-W-1778, "Auxiliary Steam Generator Feed Pumps", dated 3/19/69.

9.3.93 WE letter to Westinghouse, PBM-WMP-1310, "Pipe Restraints", dated 7/30/70.

9.3.94 WE Internal Memo (Burstein to Tate, Westinghouse), "Cooling Water To Auxiliary Feedwater Pump Bearings", dated 8/2/71.

9.3.95 WE Internal Memo (Bell to Reed), "Bearing Cooling Water Supply", dated 8/17/71.

9.3.96 Westinghouse Internal Memo (Marburger to Bantley), SSE-K-1032, "Auxiliary [Auxiliary] Feedwater Pumps", dated 11/20/67.

9.3.97 Westinghouse Internal Memo (Hollen to Rinald @ Point Beach), PWR-HVH-378, "Pipe Restraints Main And Auxiliary Feedwater Lines", dated 3/16/70.

9.3.98 Sargent & Lundy letter to WE, SL-WE-97-142, "White Paper On The Limiting Accident For Service Water Hydraulic Modeling", dated 6/20/97.

9.3.99 BW/IP International, Inc. letter to WE, "Two Turbine Driven Auxiliary Feedwater Pumps", dated 6/13/97.

9.3.100 Westinghouse letter to WE, WEP-97-536, "LONF/LOAC Licensing Basis Accident Analyses Evaluation - New AFW Flows", dated 9/29/97.

9.3.101 Westinghouse letter to WE, WEP-97-541, "Seismic Considerations in Licensing Basis Accident Analyses", dated 12/8/97.

9.3.102 Westinghouse letter to WE, WEP-97-542, "LONF Licensing Basis Accident Analysis Evaluation", dated 12/9/97.

9.3.103 Westinghouse letter to W @ Wisconsin Project, SSE-W-605, "Condensate Storage Capacity", dated 6/12/67.

9.3.104 BW/IP International Ltr to WE, RE: Pump Operation with Loss of Suction/ Auxiliary Feedwater Pump/ 3 x 4 x 9D DVMX 9 Stage, SN 691-S-1028/31, dated 12/5/97.

9.3.105 Bechtel letter to W, PBB-W-548, "Claims for Extra Engineering Work", dated 11/7/67.

9.3.106 W letter to WE, WEP-84-572, "Reduced Auxiliary Feedwater Flow Rate", dated 7/27/84.

9.3.107 W Nuclear Service Division, Technical Bulletin NSD-TB-84-06, "Reduced Auxiliary Feedwater Flow Rates", dated 7/19/84 (REF MSSM 84-26).

9.3.108 S&L Ltr to WE, SL-WE-97-144, "Auxiliary Feedwater System Potential Pump Air Injection", dated 6/27/97.

9.3.109 W Ltr to WE, WEP-87-173, "Customer Feedback on Auxiliary Feedwater System Auto-Start Circuit", dated 6/19/87.

9.3.110 PBNP Design Basis Document (DBD-12), Service Water System.

9.3.111 Internal W Ltr for PBNP, SE-CPS-527, "Auxiliary Feedwater Requirements", dated 1/16/69.

9.3.112 W WCAP-8404, "Anticipated Transient Without Trip Analysis for Westinghouse PWRs With 44 Series Steam Generators", September 1974.

9.4 Calculations

9.4.1 WE Calculation P-87-001, "Electric Auxiliary Feedwater Pump Runout Study", Original Calculation, dated 5/25/87.

9.4.2 WE Calculation P-87-003, "Electric Auxiliary Feedwater Pump Study - AOV Gagging", Original Calculation, dated 5/25/87.

9.4.3 WE Calculation N-87-041, "Auxiliary Feedwater Minimum Flow Evaluation", Original Calculation, dated 11/30/87.

9.4.4 WE Calculation N-89-001, "Maximum Auxiliary Feedwater Flow Rate to One Steam Generator", Revision 2, dated 5/31/90.

9.4.5 WE Calculation N-89-019, "Steam Generator Inventories During One Hour of Station Blackout", Revision 1, dated 10/30/90. This calculation is not referenced in the text or described in the calculation summary section.

9.4.6 WE Calculation N-90-028, "Auxiliary Feedwater Pump Flow-Head Characteristic Polynomials", Original Calculation, dated 5/7/90.

9.4.7 WE Calculation N-90-029, "Determination of Branch Resistance Coefficients in the AFW System", Original Calculation, dated 5/30/90.

9.4.8 WE Calculation N-90-095, "Minimum AFW Flow for Automatic Actuation to Both Units", Original Calculation, dated 12/17/90.

9.4.9 WE Calculation N-91-007, "Steam Generator Inventories 5 Minutes After An Earthquake", Revision 2, dated 11/7/91. This calculation is not referenced in the text or described in the calculation summary section.

9.4.10 WE Calculation PB-89-031, "Voltage Drop Across MOVs Power Lines", Revision 1, dated 3/28/90.

9.4.11 WE Calculation P-88-020, "MOV Maximum Undervoltage Stem Thrust", Original Calculation, dated 7/5/88. This calculation is superceded by calculation P-90-017.

9.4.12 WE Calculation P-90-017, "MOV Undervoltage Stem Thrust and Torque", Superseding Calculation, dated 9/18/90.

9.4.13 WE Calculation 86-19, "MOV Design Basis Operation and D/P (IEB 85-03)", Rev 0, dated 4/29/86. Note: this calculation is superceded by calculation N-93-89 and others. References to this calc are for historical purposes.

9.4.14 WE Calculation N-90-006, "Service Water Flow Balance", Rev. 1, dated 2/17/94.

9.4.15 WE Calculation N-93-81, "1(2) MS-2019, 2020 MOV Differential Pressure Calculation". Rev. 0, dated 2/17/94.

9.4.16 WE Calculation N-93-86, "1(2) AF-4000, 4001 MOV Differential Pressure Calculation", Rev. 0, dated 2/14/94.

9.4.17 WE Calculation N-93-87, "1(2) AF-4006 MOV Differential Pressure Calculation", Rev. 0, dated 2/3/94.

9.4.18 WE Calculation N-93-88, "1(2) AF-4009, 4016 MOV Differential Pressure Calculation", Rev. 0, dated 1/25/94.

9.4.19 WE Calculation N-93-89, "1(2) AF-4020, 4021, 4022, 4023 MOV Differential Pressure Calculation", Rev. 0, dated 1/24/94.

9.4.20 WE Calculation N-91-031, "1&2 P29 Mini-Recirc Line System Characteristics", Rev. 0, dated 3/19/91. This calculation is not referenced in the text or described in the calculation summary section.

9.4.21 WE Calculation N-91-032, "Comparison of Nominal Flow Rates From 2P-29 to 2HX-1A and 2HX-1B with the Recirc Line Open", Rev. 0, dated 3/19/91.

9.4.22 WE Calculation N-91-069, "Impact of Higher Capacity Recirculation System for the Electric Motor Driven AFW Pumps", Rev. 0, dated 7/9/91.

9.4.23 Westinghouse Internal Calculation PDC-SSC-W-3, "Steam Turbine Aux FW Pump Sizing", dated 12/28/66.

9.4.24 Westinghouse Internal Calculation "WEP Aux Motor Driven FWP Sizing", dated 2/5/68.

9.4.25 Bechtel Internal Calculations “Auxiliary Feed Pump System delta” and “Auxiliary Feedwater Discharge”, both dated 7/18/67.

9.4.26 DE&S Calculation PBNP-IC-42, “Condensate Storage Tank Water Level Instrument Loop Uncertainty/Setpoint Calculation”, Revision 0, dated 12/15/97. This calculation is not referenced in the text or described in the calculation summary section.

9.4.27 WE Calculation N-96-0244, “Minimum Allowable IST Acceptance Criteria for Turbine and Motor-Driven AFW Pump Performance”, dated 10/31/96. This calculation is not referenced in the text or described in the calculation summary section.

9.4.28 WE Calculation N-97-0155, "Auxiliary Feedwater Pump Low Suction Pressure Trip Instrument Loop Uncertainty/Setpoint Calculation (Unit 2 Operation)", Rev. 1, dated 10/28/97. This calculation is related to N-97-0231 (9.4.30) and N-97-0210 (9.4.48). This calculation is not referenced in the text or described in the calculation summary section.

9.4.29 WE Calculation N-97-0215, "Water Volume Swept by All Four AFW Pumps Following a Seismic/Tornado Event Affecting Both Units", Revision 2, dated 5/13/99.

9.4.30 WE Calculation N-97-0231, "AFW Pump Low Suction Pressure Trip Instrument Loop Uncertainty/Setpoint Calculation (Unit 1 and Unit 2 Operation)", Revision 0, dated 12/1/97. This calculation is related to N-97-0210 (9.4.48) and N-97-0155 (9.4.28). This calculation is not referenced in the text or described in the calculation summary section.

9.4.31 WE Calculation N-94-0157, "Condensate Storage Tank Water Level Instrument Loop Uncertainty/Setpoint Calculation", Rev. 0, dated 12/7/94, Rev. 1 SUPERCEDED by Reference 9.4.26.

9.4.32 WE Calculation N-93-113, "Service Water Flow Balance To Meet Emergency Loads For SMP 1143", Rev. 0, dated 12/13/93, SUPERCEDED WE Calculation N-96-0117.

9.4.33 WE Calculation N-94-158, "Verification Of Required AFW Pump Differential Head For Accident Flow Rate", Rev. 0, dated 11/15/94. This calculation is not described in the calculation summary section.

9.4.34 WE Calculation N-97-0172, "Available Water In Volume Of Piping To The Auxiliary Feedwater Pumps Following Pipe Break At Elevation 25'6"", Rev. 0, dated 8/1/97. This calculation is not referenced in the text or described in the calculation summary section.

9.4.35 WE Calculation N-93-104, "Minimum Service Water Flow Area Required To AFW Pumps", Rev. 0, dated 12/22/93. This calculation is not referenced in the text or described in the calculation summary section.

9.4.36 S&L Calculation M-09334-288-AF.1, "Pump Suction Line Pressure Drop", Rev. 1, dated 7/11/97. This calculation is not referenced in the text or described in the calculation summary section.

9.4.37 WE Calculation N-97-0147, "Volume Of Water In The Designated Seismically-Qualified Piping Upstream Of The Auxiliary Feedwater Pumps", Rev. 2, dated 7/11/97.

9.4.38 WE Calculation N-97-0157, "Aux. Feedwater Supply Missile Protection", Rev. 1, dated 7/15/97.

9.4.39 WE Calculation P-94-002, "Condensate Storage Tank (T-24 A/B) Level Alarm Heights", Rev. 0, dated 7/19/94.

9.4.40 WE Calculation 85-008, "Environmental Conditions At Safety Related Equipment Due To A High Energy Line Break Outside Of Containment", Rev. 1, dated 10/29/96.

9.4.41 WE Calculation N-94-015, "Determination Of Fluid Level For Onset Of Vortexing In The Condensate Storage Tank", Rev. 0, dated 2/10/94.

9.4.42 S&L Calculation M-09334-212-AF.1, "TDAFWP Low Pressure Capability", Rev. 1, dated 7/9/97.

9.4.43 Westinghouse Calculation CN-CRA-96-58, "Steam Generator Tube Rupture Analysis for the Point Beach Units 1 & 2 Power Uprating Program", Rev. 0, dated 7/17/96 and Rev. 1, dated 10/10/96.

9.4.44 PBNP Calculation 89-042, "Evaluation of the PBNP Containment Pressure Response to a Steam Line Break, Based on the Results of Westinghouse Analysis for a Reference 2-Loop PWR", Revision 3, dated 7/30/96.

9.4.45 WE Calculation 98-0008, "Horsepower Calculation for 1P-29 at 560 gpm", Rev. 0, dated 1/26/98. This calculation is not referenced in the text or described in the calculation summary section.

9.4.46 WE Calculation N-93-117, "Appendix R Thermal Hydraulics Analysis", Rev. 0, dated 1/11/94.

9.4.47 Proto-Power Calculation 97-114, "Development and Analysis of Point Beach Auxiliary Feed Water System PROTO-FLO™ Thermal Hydraulic Model", Revision A, dated 12/2/97. This calculation is not referenced in the text or described in the calculation summary section.

9.4.48 WE Calculation N-97-0210, "Auxiliary Feedwater Pump Low Suction Pressure Trip Instrument Loop Uncertainty/Setpoint Calculation (Unit 1 Operation)", Rev. 0, dated 10/28/97. This calculation is related to N-97-0231 (9.4.30) and N-97-0155 (9.4.28). This calculation is not referenced in the text or described in the calculation summary section.

9.4.49 S&L Calculation M-09334-266-IA.1-A, "AF Nitrogen Bottle Sizing", Rev. 0 dated 5/3/2001

9.4.50 NMC Calculation 2001-0056, "TDAFP Mini-Recirc Flow Control Valve (1/2AF-4002) Instrument Air Accumulator Sizing", Rev. 0 dated 3/20/2002.

9.4.51 NMC Calculation 2002-0002 "Nitrogen Backup System for MDAFP Discharge Valves (AF-4012/4014) and Minimum Recirculation Flow Control Valves (AF-4017/4014)" Rev. 0 dated 1/28/02.

9.4.52 NMC Calculation 2002-0026 "Evaluation of AFW Recirculation Line Relief Valve AF-4035" Rev. 0 dated 9/6/2002.

9.5 **WE Drawings, Specifications, Modifications, and Other Documents**

9.5.1 Master List of Electrical Equipment to be Environmentally Qualified (EQML), Including Updates Through February 1991.

9.5.2 PBNP Modification MR 01-144: AFW Motor Driven Pump Mini Recirc Control Valve Modifications

9.5.3 PBNP Modification MR 02-001: TDAFP Mini Recirc Valve (1/2-AF-4002) Inst. Air Accumulator Addition

9.5.4 PBNP Modification MR 99-029*A, *B, *C, *D Aux Feed Water Pump Minimum Flow Recirc Line Orifice.

9.5.5 WE Internal Memo (Nolan/Lipke to Zach), "IEN 84-06 Discussion", dated 10/1/84.

9.5.6 PBNP Modification MR 02-029: Aux Feed Mini Recirc Safety Upgrade / Remove AF-117 Internals

9.5.7 Deleted.

9.5.8 Manager's Supervisory Staff Meeting (MSSM) 84-28, "SOER 84-03 Discussion", dated 10/9/84

9.5.9 Deleted.

9.5.10 Deleted.

9.5.11 WE Internal Memo (LaPlante/Lipke to Zach), NEPB-85-583, "IEN 85-76 Discussion", dated 1/2/86.

9.5.12 Manager's Supervisory Staff Meeting (MSSM) 86-31, "IEN 86-14 Discussion", 12/16/86.

9.5.13 WE Internal Memo (Kohn/Reimer/Lipke to Zach), NEPB-86-745, "IEN 86-14 Discussion", 11/7/86.

9.5.14 thru 9.5.21 Deleted.

9.5.22 WE Internal Memo (Price/Johnson to Maxfield), NPM-91-0402, "IEN 90-45 Discussion", dated 2/27/91.

9.5.23 WE Internal Memo (Krause/Lipke to Newton), NENE-87-58, "IEN 88-04 Discussion", dated 4/2/87.

9.5.24 WE Internal Memo (Castell/Hanneman to Newton), NENE-88-101, "IEN 88-22 Discussion", dated 7/15/82.

9.5.25 WE Internal Memo (Castell/Hanneman/Newton to Zach), NEM-89-36, "IEB 80-04 Discussion", dated 1/17/89.

9.5.26 Deleted

9.5.27 PBNP CHAMPS Q-List database.

9.5.28 WE Point Beach Nuclear Plant Setpoint Document STPT 14.11, Auxiliary Feedwater, Revision 15, dated 10/06/98.

9.5.29 PBNP Modification Request E-198, Steam Driven AFW Pump Bearing Cooling Water Valve - Unit 1.

9.5.30 PBNP Modification Request E-199, Steam Driven AFW Pump Bearing Cooling Water Valve - Unit 2.

9.5.31 PBNP Modification Request IC-201, AFW Pump Flow Indication on Main Control Boards.

9.5.32 PBNP Modification Request IC-210, AFW Supply Line Flow Indication - Unit 1.

9.5.33 PBNP Modification Request IC-211, AFW Supply Line Flow Indication - Unit 2.

9.5.34 PBNP Modification Request IC-223, AFW Pump Turbine Bearing Temperature Indication - Unit 1.

9.5.35 PBNP Modification Request IC-224, AFW Pump Turbine Bearing Temperature Indication - Unit 2.

9.5.36 PBNP Modification Request IC-295, AFW Pump, 1P-29, Suction Header Pressure - Unit 1.

9.5.37 PBNP Modification Request IC-296, AFW Pump, 2P-29, Suction Header Pressure - Unit 2.

9.5.38 PBNP Modification Request IC-324, AFW Pumps, P-38A and P-38B, Suction Header Pressure.

9.5.39 PBNP Modification Request IC-325, AFW Pump, 1P-29, Low Suction Pressure Trip -Unit 1.

9.5.40 PBNP Modification Request IC-326, AFW Pump, 2P-29, Low Suction Pressure Trip -Unit 2.

9.5.41 PBNP Modification Request IC-327, AFW Pump, P-38A and P-38B, Low Suction Pressure Trip.

9.5.42 PBNP Modification Request M-105, AFW Chemical Addition Pots, T-47A and T-47B.

9.5.43 PBNP Modification Request 82-53, AFW Inoperable Alarm.

9.5.44 PBNP Modification Request 82-54, AFW Logic Test Circuit - Unit 1.

9.5.45 PBNP Modification Request 82-55, AFW Logic Test Circuit - Unit 2.

9.5.46 PBNP Modification Request 83-55, Replace 1AF-108, 1P-29 Discharge Check Valve-Unit 1.

9.5.47 PBNP Modification Request 83-56, Replace 2AF-108, 2P-29 Discharge Check Valve-Unit 2.

9.5.48 PBNP Modification Request 83-57, Replace AF-109 and AF-110, P-38A and B Discharge Check Valves.

9.5.49 PBNP Modification Request 83-73-02, AFW Pump Suction Sample Lines to New Sample Panel - Unit 1.

9.5.50 PBNP Modification Request 83-74-02, AFW Pump Suction Sample Lines to New Sample Panel - Unit 2.

9.5.51 PBNP Modification Request 83-104, AFW System Discharge MOV Controls.

9.5.52 Deleted.

9.5.53 PBNP Modification Request 84-270, Remove AFW Piping Insulation - Unit 1.

9.5.54 PBNP Modification Request 84-271, Remove AFW Piping Insulation - Unit 2.

9.5.55 PBNP Modification Request 85-252, Change "AFWS DISABLED" Annunciator Logic for AFW MOVs - Unit 1.

9.5.56 PBNP Modification Request 85-252-A, Replace 1P-29 Steam Supply Valve's Control Switch - Unit 1.

9.5.57 PBNP Modification Request 85-253, Change "AFWS DISABLED" Annunciator Logic for AFW MOVs - Unit 2.

9.5.58 PBNP Modification Request 87-97, 1P-29 Turbine Thrust Bearing and Coupling - Unit 1.

9.5.59 PBNP Modification Request 87-98, 2P-29 Turbine Thrust Bearing and Coupling - Unit 2.

9.5.60 WE Specification PB-156, Auxiliary Feedwater Check Valves, Revision 0, 7/22/83.

9.5.61 Audit Topic Sheet No. 77 for Audit A-P-90-12, Vertical Slice Audit of the AFW System at PBNP, 10/10/90.

9.5.62 thru 9.5.68 Deleted.

9.5.69 PBNP Operating Instructions OI-62A, Motor Driven Auxiliary Feedwater System (P-38A & B), Revision 18, 06/11/99.

9.5.70 PBNP Operating Instructions OI-62B, Turbine Driven Auxiliary Feedwater System (P-29), Revision 7, 5/4/98.

9.5.71 PBNP Abnormal Operating Procedure AOP-2C (Unit 1 and Unit 2), Auxiliary Feed Pump Steam Binding or Overheating, Revision 4, 9/29/97.

9.5.72 PBNP Emergency Operating Procedure EOP-0, Reactor Trip or Safety Injection, Revision 28, 6/9/99.

9.5.73 PBNP Emergency Operating Procedure EOP-0.1, Reactor Trip Response, U1 - Revision 20, 6/9/99, U2 – Revision 19, 6/9/99.

9.5.74 PBNP Emergency Operating Procedure EOP-1, Loss of Reactor or Secondary Coolant, Revision 27, 6/9/99.

9.5.75 PBNP Emergency Operating Procedure EOP-1.2, Small Break LOCA Cooldown and Depressurization, Revision 18, 6/9/99.

9.5.76 PBNP Emergency Operating Procedure EOP-2, Faulted Steam Generator Isolation, Revision 13, 6/9/99.

9.5.77 PBNP Emergency Operating Procedure EOP-3, Steam Generator Tube Rupture, Revision 25, 6/9/99.

9.5.78 PBNP Emergency Operating Procedure EOP-3.1, Post-SGTR Cooldown Using Backfill, Revision 14, 6/91/99.

9.5.79 PBNP Emergency Operating Procedure EOP-3.2, Post-Steam Generator Tube Rupture Cooldown Using Blowdown, Revision 14, 6/9/99.

9.5.80 PBNP Emergency Operating Procedure EOP-3.3, Post-Steam Generator Tube Rupture Cooldown Using Steam Dump, Revision.16, 6/9/99.

9.5.81 PBNP Emergency Contingency Action ECA-0.0, Loss of All AC Power, Revision 23, 6/9/99.

9.5.82 PBNP Emergency Contingency Action ECA-0.1, Loss of All AC Power Recovery without SI Required, Revision 14, 6/9/99.

9.5.83 PBNP Emergency Contingency Action ECA-0.2, Loss of All AC Power Recovery with SI Required, Revision 16, 6/9/99.

9.5.84 PBNP Emergency Contingency Action ECA-2.1, Uncontrolled Depressurization of Both Steam Generators, Revision 25, 6/9/99.

9.5.85 PBNP Inservice Testing Program Third Ten-Year Interval, Revision 6, June 10, 1999

9.5.86 DELETED

9.5.87 DELETED

9.5.88 PBNP Inservice Test IT-08A, Cold Start Testing of Turbine-Driven Auxiliary Feed Pump and Valve Test (Quarterly) - Unit 1, Revision 17, 8/14/99.

9.5.89 DELETED.

9.5.90 PBNP Inservice Test IT-09A, Cold Start Testing of Turbine-Driven Auxiliary Feed Pump and Valve Test (Quarterly) - Unit 2, Revision 18, 8/14/99.

9.5.91 PBNP Inservice Test IT-10, Test of Electrically-Driven Auxiliary Feed Pumps and Valves (Quarterly) - Units 1 and 2, Revision 35, 01/8/99.

9.5.92 DELETED

9.5.93 DELETED

9.5.94 DELETED

9.5.95 PBNP Inservice Test IT-290B, Overspeed Test Turbine-Driven Auxiliary Feedwater Pump, Refueling Interval- Unit 1, Revision 8, 5/22/98.

9.5.96 DELETED.

9.5.97 DELETED

9.5.98 PBNP Inservice Test IT-295B, Overspeed Test Turbine Driven Auxiliary Feedwater Pump, Refueling Interval - Unit 2, Revision 10, 5/22/98.

9.5.99 WE Internal Memo, NEM-89-762, Moylan, Reimer and Lipke to Zach, Cold Fast Starting of AFW Pumps, dated 10/12/89.

9.5.100 PBNP Standing Order 88-03, Test Duration for Safety-Related Pumps, Revision 3, 4/15/91 (Revision 4, CANCELED 6/17/92).

9.5.101 NQAD Audit Report No. A-P-90-12, Vertical Slice Audit of the Auxiliary Feedwater System at PBNP, 11/21/90.

9.5.102 WE Internal Memo PBM-91-0010, Nickels and Maxfield to Hoynacki; dated 1/7/91.

9.5.103 Audit Topic Sheet No. 58 for Audit A-P-90-12, Vertical Slice Audit of the AFW System at PBNP.

9.5.104 PBNP Modification Request IC-316, Condensate Storage Tank Environmentally Qualified Level Transmitters.

9.5.105 Audit Topic Sheet No. 5 for Audit A-P-90-12, Vertical Slice Audit of the AFW System at PBNP.

9.5.106 Engineering Change Notice, WIS-70053, 10/13/70.

9.5.107 NPBU Design and Installation Guidelines Manual, Revision 59, 6/4/99.

9.5.108 Instrument & Controls Procedure ICP 13.8 (also REF 9.5.165), Auxiliary Feedwater System, Revision 2, 1/20/98.

9.5.109 Deleted (procedure canceled, REF 9.5.161, 9.5.162).

9.5.110 Deleted (procedure canceled, REF 9.5.166, 9.5.167, 9.5.168).

9.5.111 Deleted (procedure canceled, REF 9.5.170).

9.5.112 WE Internal Memo, NPM-91-0368, Hoynacki to Frieling, Krieser, Lipke, Maxfield, and Newton, dated 3/5/91.

9.5.113 PBNP Modification Request M-55, Change Feedwater Check Valve AF-100 and AF-101.

9.5.114 PBNP Modification Request 86-123, Change the Operator's Gear Ratio on 2MS-2019 and 2020.

9.5.115 PBNP Modification Request 87-25, Change the Operator's Gear Ratio on 1MS-2019 and 2020.

9.5.116 Deleted

9.5.117 PBNP Modification Request 88-99 (including MR 88-99*A, *B, *C, *D), AFW Pump Mini-Recirc Flow Enhancement.

9.5.118 PBNP Modification Request IC-274 (CANCELED), Modify the Control Scheme of AFW Pump Recirc Flow Control Valves to keep valves normally open.

9.5.119 PBNP Inservice Testing Program Background Document, Revision 3, 6/24/99.

9.5.120 PBNP Modification Requests 85-213 and 85-214, Anticipated Transient Without Scram Mitigating System Actuation Circuit (AMSAC)

9.5.121 MSSM 90-23

9.5.122 PBNP Background Document BG-EOP-3, Rev. 25, 6/18/99.

9.5.123 AOP-10A, "Safe Shutdown - Local Control", Revision 25, 07/12/99.

9.5.124 Deleted.

9.5.125 SPEED 91-002, "Ashton-Crosby Relief Valve, Model GC-32, 100 psig set pressure, Crosby Drawing G-31436-1".

9.5.126 PBNP Modification Request M-623, TDAFWP Cooling Water Modification for Independence from AC Power.

9.5.127 PBNP Modification Request M-624, TDAFWP Cooling Water Modification for Independence from AC Power.

9.5.128 Deleted (REF 9.5.107).

9.5.129 PBNP Operating Procedure OP-7A, Placing Residual Heat Removal System in Operation, Rev. 36 dated 6/1/99.

9.5.130 PBNP Modification Request 92-091, 92-092, IST Testability Of 1/2AF-4002 (1/2P-29 Mini Recirc).

9.5.131 PBNP Modification Request 92-093, IST Testability Of AF-4007, 4014 (P-38A/B Mini Recirc).

9.5.132 PBNP Modification Request 91-219, 91-220, 1/2P-29 AFW Pump Governor Sensing Line Removal.

9.5.133 MSSM 92-09...

9.5.134 PBNP Modification Request 97-038 (*A , *B1, and *B2), AFW Discharge Valves AF-4012/4019 Modification.

9.5.135 PBNP Modification Request 97-099 (*A, *B, *C, *D, *E, *F), Auxiliary Feedwater Valve and Instrument Loop Modification with SE 97-207.

9.5.136 PBNP Modification Request 97-079 (*A), AF-67 Moved (plus new valve added) and Piping Changed / Rerouted.

9.5.137 PBNP Procedure WMTP 11.21, "72 Hour Test Of Turbine-Driven Auxiliary Feed Pump", Revision 0, dated 12/5/79.

9.5.138 PBNP Modification Request 96-071(*A), G01 EDG Governor and Speed Sensing Panel (SSP) Upgrade.

9.5.139 PBNP Modification Request 90-241 (*A), Addition of SW Flush Connection at AFW Pump Suctions (SER # 95-039).

9.5.140 Audit Topic Sheet No. 77 for Audit A-P-90-12, Vertical Slice Audit of the AFW System at PBNP (see REF 9.2.79).

9.5.141 FAX from Dresser-Rand sent 3/24/97 14:14, "Expected Performance ZS-4 Turbine S/N 36181 and 36182", Turbine Curve # 59659-1, dated 3/21/97.

9.5.142 PBNP Procedure WMTP 11.39, "Auxiliary Feedwater Pump Suction Pressure Determination At Full Flow", Revision 0, 10/4/85.

9.5.143 PBNP Operating Instructions OI-1A, 1HX-1A, Steam Generator Leak Check Unit 1, Revision 7, 12/2/98.

9.5.144 PBNP Operating Instructions OI-1B, 1HX-1B, Steam Generator Leak Check Unit 1, Revision 7, 12/2/98.

9.5.145 PBNP Operating Instructions OI-2A, 2HX-1A, Steam Generator Leak Check Unit 2, Revision 13, 12/2/98.

9.5.146 PBNP Operating Instructions OI-2B, 2HX-1B, Steam Generator Leak Check Unit 2, Revision 12, 12/2/98.

9.5.147 PBNP Modification Request 89-127, Provide separate power supplies for pressure controllers PC-4012 and PC-4019, CANCELED, but incorporated into MR 97-038.

9.5.148 PBNP Procedure WMTP 11.22, "72 Hour Test Of Electrically-Driven Auxiliary Feed Pumps", Revision 0, 12/5/79.

9.5.149 PBNP Modification Request 97-075, RE: Provide missile protection to AFW pump suction piping.

9.5.150 Condition Report CR 97-1918, RE: Issues associated with insufficient volume in suction piping to allow safe shutdown of AFW pumps upon receipt of a low suction pressure trip signal induced by a seismic/tornado event.

9.5.151 PBNP Inservice Test IT-10A, Test of Electrically-Driven Auxiliary Feed Pumps and Valves with Flow To Unit 1 Steam Generators (Quarterly) - Unit 1, Revision 3, 1/8/99.

9.5.152 PBNP Inservice Test IT-10B, Test of Electrically-Driven Auxiliary Feed Pumps and Valves with Flow To Unit 2 Steam Generators (Quarterly) - Unit 2, Revision 2, 1/8/99.

9.5.153 PBNP Component Maintenance Program CMP 1.3, Auxiliary Feedwater Turbines, Revision 0, 8/24/95.

9.5.154 NPBU Procedures Manual, NP 3.2.3, Secondary Water Chemistry Monitoring Program, Revision 6, dated 3/17/99.

9.5.155 PBNP Procedure WMTP 11.37, "Determination of MOV-4000 & 4001 Full Flow Settings", Revision 1, 10/4/85.

9.5.156 PBNP Modification Request 93-025 [*A (Unit 2), *B (Unit 1)], Main control board maintenance and modification to assure proper control wire separation for the Auxiliary Feedwater System.

9.5.157 Instrumentation & Control Procedure 1ICP 04.003-5. Auxiliary Feedwater Flow Instruments Outage Calibration, Revision 3, 10/7/98.

9.5.158 Instrumentation & Control Procedure 2ICP 04.003-5. Auxiliary Feedwater Flow Instruments Outage Calibration, Revision 4, 10/7/98.

9.5.159 Instrumentation & Control Procedure 1ICP 04.006-3, Aux Feedwater Flow and Pressure Instrument Outage Calibrations, Revision 4, 5/19/98.

9.5.160 Instrumentation & Control Procedure 2ICP 04.006-3, Aux Feedwater Flow and Pressure Instrument Outage Calibrations, Revision 3, 5/19/98.

9.5.161 Instrumentation & Control Procedure 1ICP 04.032-1, Auxiliary Feedwater System and Charging Flow Electronic Outage Calibration, Revision 4, 5/19/98.

9.5.162 Instrumentation & Control Procedure 2ICP 04.032-1, Auxiliary Feedwater System and Charging Flow Electronic Outage Calibration, Revision 4, 5/19/98.

9.5.163 Instrumentation & Control Procedure 1ICP 05.068, Aux Feedwater Pump Discharge Pressure Transmitter and Indicator Outage Calibrations, Revision 0, 9/30/97.

9.5.164 Instrumentation & Control Procedure 2ICP 05.068, Aux Feedwater Pump Discharge Pressure Transmitter and Indicator Outage Calibrations, Revision 0, 9/30/97.

9.5.165 Instrumentation & Control Procedure ICP 13.8 APP. A, Auxiliary Feedwater System, Revision 9, 12/19/97.

9.5.166 Instrumentation & Control Procedure ICP 13.009, Condensate Storage Tank Level Instruments Yearly Calibration, Revision 0, 8/1/95.

9.5.167 Instrumentation & Control Procedure ICP 13.009-1, Condensate Storage Tanks Level Transmitters Yearly Calibration, Revision 3, 9/29/97.

9.5.168 Instrumentation & Control Procedure ICP 13.009-2, Condensate Storage Tank Loop Instrument Yearly Calibrations, Revision 3, 9/30/98.

9.5.169 Operations Manual Procedure OM 4.2.2, Inservice Tests (PBNP 4.5.8), Revision 4, 5/3/99.

9.5.170 NPBU Nuclear Quality Assurance Program , Revision 2, 3/17/99.

9.5.171 Deleted

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9.5.173 NPBU Procedures Manual, NP 7.7.12. Safety Related and QA Scope Classification Upgrade or Downgrade Process, Revision 1, 3/3/99.

9.5.174 NPBU Procedures Manual, NP 7.7.10, Safety-Related and QA Scope Classification, Revision 0, 10/14/98.

9.5.175 PBNP Emergency Contingency Action ECA-3.1, SGTR With Loss of Reactor Coolant - Subcooled Recovery Desired, Revision 24, 6/9/99.

9.5.176 PBNP Emergency Contingency Action ECA-3.2, SGTR With Loss of Reactor Coolant - Saturated Recovery Desired, Revision 21, 6/6/99.

9.5.177 PBNP Emergency Contingency Action ECA-3.3, SGTR Without Pressurizer Pressure Control, Revision 16, 6/6/99.

9.5.178 PBNP Operating Procedure OP-13A, Secondary Systems Startup, Revision 51, 7/19/99.

9.5.179 PBNP Abnormal Operating Procedure AOP-0.0, Vital DC System Malfunction, Revision 11, 2/3/99.

9.5.180 PBNP Abnormal Operating Procedure AOP-0.1, Declining Frequency on 345 kV Distribution System, Revision 3, 10/12/95.

9.5.181 PBNP Abnormal Operating Procedure AOP-1C (Unit 1 and Unit 2), Hot Shutdown to Cold Shutdown With Primary System Leakage, U1 - Revision 3, 6/25/98, U2 – 7/6/98.

9.5.182 PBNP Abnormal Operating Procedure AOP-5B (Attachment R), Loss of Instrument Air, Revision 13, 1/28/99.

9.5.183 PBNP Abnormal Operating Procedure AOP-9A, Service Water System Malfunction, Revision 11, 7/12/99.

9.5.184 PBNP Abnormal Operating Procedure AOP-10B (Unit 1 and Unit 2), Safe to Cold Shutdown in Local Control, Revision 0, 7/18/97.

9.5.185 PBNP Abnormal Operating Procedure AOP-18B (Unit 1 and Unit 2), Train "B" Equipment Operations, Revision 2, 8/8/97.

9.5.186 PBNP Operating Instructions OI-124, Draining Steam Generators, Revision 2, 12/2/98.

9.5.187 MSSM 91-09, Attachment E, Page 3, Item # 2, RE: Agastat Relays.

9.5.188 SE 97-092, "Revision to the Required Post Accident Operating Time for Turbine Driven Auxiliary Feed Water Pump Steam Isolation Motor Operated Valves", dated 6/12/97.

9.5.189 SE 97-134, "Revised Trip and Alarm Setpoints for Auxiliary Feedwater Pump Low Suction Pressure Trip for Unit 2 Single Unit Operation", dated 7/12/97.

9.5.190 SE 97-201, "Setpoint Change to the Auxiliary Feedwater By-pass Control Valves Time Delay Relay Setpoints (1/2-NC005, 62-P38A and 62-P38B)", Rev. 0, dated 12/4/97.

9.5.191 SE 97-208, "IT-08A/09A, Cold Start Testing of Turbine-Driven Auxiliary Feedwater Pump and Valve Test Unit 1/2 (Quarterly)", Rev. 2, dated 4/21/98.

9.5.192 Condition Report CR 97-0930, RE: Questions and concerns about the use of operator action to control AFW flow, closed 7/1/97.

9.5.193 SPEED 98-075, Replacement for the AF Turbine, V2P-29-T, Inboard Bearing Cooler, dated 07/22/98.

9.5.194 SPEED 99-073, Replacement for the AF Turbine, 1/2-P-T, Outboard Bearing Cooler, dated 04/07/00

9.5.195 Condition Report CR 00-2981 Re: Questions about Atmospheric Dump Capacity, closed 11/28/01

9.5.196 PBNP Modification Request MR 00-077: AF-4019 Valve Trim Upgrade

9.6 Vendor Reports, Specifications, and Drawings

9.6.1 Deleted.

9.6.2 Deleted.

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9.6.4 Westinghouse Drawing 499B466, Sheet 369, Elementary Drawing AFW Pump.

9.6.5 Westinghouse Drawing 499B466, Sheet 370, Elementary Drawing AFW Pump.

9.6.6 Westinghouse Drawing 499B466, Sheet 372, Elementary Drawing AFW Pump.

9.6.7 Westinghouse Drawing 499B466, Sheet 812, Elementary Drawing AFW MOVs.

9.6.8 Westinghouse Drawing 499B466, Sheet 813, Elementary Drawing Turb. AFW Pump. MOVs.

9.6.9 Westinghouse Drawing 499B466, Sheet 816, Elementary Drawing Turb. AFW Pump Bypass Valve.

9.6.10 Westinghouse Drawing 499B466, Sheet 818, Elementary Drawing Service Water to Turb. AFW Pump MOV.

9.6.11 Westinghouse Drawing 499B466, Sheet 863, Elementary Drawing Serv. Water to Turb. AFW Pump MOV.

9.6.12 Westinghouse Drawing 499B466, Sheet 867, Elementary Drawing Turb. AFW Pump Disch. MOVs.

9.6.13 Westinghouse Drawing 499B466, Sheet 868, Elementary Drawings Steam to Turb. AFW Pump MOVs.

9.6.14 Westinghouse Drawing 499B466, Sheet 899, Elementary Drawing Turb. AFW Pump Bypass Valve.

9.6.15 Westinghouse Drawing 499B466, Sheet 1523, Elementary Drawing AFW Pumps Control.

9.6.16 Westinghouse Drawing 499B466, Sheet 1532, Elementary Drawing AFW Pumps Control.

9.6.17 Westinghouse Drawing 500B728, Sheet 65, Schematic Drawing Valve Position Indicators.

9.6.18 Westinghouse Drawing 500B728, Sheet 215, Schematic Drawing Valve Position Indicators.

9.6.19 Bechtel Drawing 6118-E-2065, Sheet 5, Schematic Drawing Secondary Plant Foxboro Loops Unit 2.

9.6.20 Bechtel Drawing 6118-E-65, Sheet 5, Schematic Drawing Secondary Plant Foxboro Loops Unit 1.

9.6.21 Bechtel Drawing 6118-M-217, Sheets 1 and 2, Auxiliary Feedwater System P&ID.

9.6.22 Bechtel Drawing 6118-M-201, Sheet 1, Main and Reheat Steam P&ID - Unit 1.

9.6.23 Bechtel Drawing 6118-M-2201, Sheet 1, Main and Reheat Steam P&ID - Unit 2.

9.6.24 Deleted.
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9.6.31 Foxboro Drawing 10665-BD-20, Block Diagram AFW Flow - Unit 2.

9.6.32 Foxboro Drawing 10665-BD-21. Block Diagram AFW Flow - Unit 2.

9.6.33 Foxboro Drawing 10668-BD-20. Block Diagram AFW Flow - Unit 1.

9.6.34 Foxboro Drawing 10668-BD-21, Block Diagram AFW Flow - Unit 1.

9.6.35 Westinghouse Drawing 499B466, Sheet 814, Elementary Drawing Steam to Turb. AFW Pump MOVs.

9.6.36 Westinghouse Drawing 499B466, Sheet 812A, Elementary Drawing AFW MOVs.

9.6.37 Westinghouse Drawing 499B466, Sheet 812B, Elementary Drawing AFW MOVs.

9.6.38 Westinghouse Drawing 499B466, Sheet 814A, Elementary Drawing AFW Low Suction Pressure MOVs.

9.6.39 Westinghouse Drawing 499B466, Sheet 868A, Elementary Drawing AFW Low Suction Pressure MOVs.

9.6.40 Foxboro Drawing 62550-CD1-10, Connection Diagram Rack 1C171B-F.

9.6.41 Foxboro Drawing 62550-CD2-10, Connection Diagram Rack 2C171B-F.

9.6.42 Foxboro Drawing 62550-CD1-14, Connection Diagram Rack 1C171B-F.

9.6.43 Foxboro Drawing 62550-CD2-14, Connection Diagram Rack 2C173B-F.

9.6.44 Foxboro Drawing 62550-CD1-15, Connection Diagram Rack 1C171B-F.

9.6.45 Foxboro Drawing 62550-CD2-15, Connection Diagram Rack 2C171B-F.

9.6.46 Foxboro Drawing 62550-CD1-23, Connection Diagram Rack 1C173B-F.

9.6.47 Foxboro Drawing 62550-CD2-23, Connection Diagram Rack 2C173B-F.

9.6.48 Westinghouse Drawing 499B466, Sheet 944, Elementary Drawing Control Board C01 Annunciators.

9.6.49 Westinghouse Drawing 499B466, Sheet 975, Elementary Drawing AFWS Disabled Alarms.

9.6.50 Westinghouse Drawing 499B466, Sheet 975A, Elementary Drawing AFW Low Suction Press. Alarms.

9.6.51 Westinghouse Drawing 499B466, Sheet 1669, Elementary Drawing C01 Annunciators.

9.6.52 Westinghouse Drawing 499B466, Sheet 1670, Elementary Drawing C01 Annunciators.

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9.6.84 Bechtel Drawing 6118-E-91, Sheet 3, Connection Diagram 480V Load Center 1B03.

9.6.85 Bechtel Drawing 6118-E-2091, Sheet 6, Connection Diagram 480V Load Center 2B04.

9.6.86 Westinghouse Drawing 499B466, Sheet 373, AFWP P-38A (P-38B) Low Suction Pressure Ckt.

9.6.87 Deleted.

9.6.88 Westinghouse Drawing 883D195, Sheet 23, "Loss of Feedwater Turbine Trip"

9.6.89 Westinghouse Drawing 883D195, Sheet 20, "Auxiliary Feedwater Pumps Start-Up Logic".

9.6.90 Bechtel Specification for Auxiliary Feedwater Pumps, M-6, Rev. 3, 10/28/68.

9.6.91 Bechtel Specification for Storage Tanks, M-21, 10/24/67.

9.6.92 Graver Tank & Mfg. Co. Drawing S-28232, Details for T-24A and T-24B.

9.6.93 Bechtel Specification for Piping, M-78, 12/15/67.

9.6.94 Bechtel Specification for Motor-Operated Valves, M-91, 3/4/68.

9.6.95 Bechtel Specification for Air-Operated Control Valves, M-181, 5/13/70.

9.6.96 Bechtel Specification for Safety Relief Valves, M-180, 4/10/70.

9.6.97 Bechtel Specification for Piping, M-3320, Rev. 10, 6/29/71.

9.6.98 Bechtel Specification for Check Valves 2-1/2 inches and larger, M-82

9.6.99 Graver Tank & Mfg. Co. Drawing L-23944-4, Rev. 5 dated 4/26/85.

9.6.100 Westinghouse Drawing 883D195 Sh. 23, Rev. 1, 2/13/90

9.6.101 WE Drwg P-117, Auxiliary Feedwater Pump Suction From Condensate Storage Tanks JG-4.

9.6.102 WE Drawing P-118, Auxiliary Feedwater Pump Suction From Condensate Storage Tanks 1-T24A&B.

9.6.103 WE Drawing P-140, Emergency Feedwater From DB-3 Into Ctmt To Main Feedwater 3" EB-10.

9.6.104 WE Drawing P-141, Emergency Feedwater From DB-3 Into Ctmt Penetration P-5 EB-10 Outside (Ctmt).

9.6.105 WE Drawing P-142, Emergency Feedwater From Ctmt Penetration P-5 To Main Feedwater EB-9 EB-10 Inside (Ctmt).

9.6.106 Westinghouse Drawing 499B466, Sheet 743 & 744, Elementary Drawing Turb. Driven AFW Trip/Throttle Valve 1MS-2082 & 2MS-2082.

9.7 **Vendor Manuals**

9.7.1 Terry, "Auxiliary Feedwater Pump Turbine Drive", Rev. 23, 7/14/95, Control # 00004.

9.7.2 Byron Jackson, "Model DV Turbine-Driven Auxiliary Feed Pump", Rev. 20, 6/7/95, Control # 00265.

ATTACHMENT A
LIST OF OPEN ITEMS (OI)

OI	DBD Section	Description
1	Attachment B	This open item has been closed. See NUTRK #DBDOI-01-001 for resolution of this open item.
2	3.1.5	This open item has been closed. See NUTRK #DBDOI-01-002 for resolution of this open item.
3	3.9. 3.20	This open item has been closed. See NUTRK #DBDOI-01-003, for resolution of this open item.
4	3.21, 9.5.135	This open item has been closed. See NUTRK #DBDOI-01-004, for resolution of this open item
5	3.13	This open item has been closed. See NUTRK #DBDOI-01-005, for resolution of this open item
6	3.5.3	This open item has been closed. See NUTRK #DBDOI-01-006, for resolution of this open item
7	3.9.3	This open item has been closed. See NUTRK #DBDOI-01-007, for resolution of this open item
8	1.2.3	This open item has been closed. See NUTRK #DBDOI-01-008, for resolution of this open item
9	N/A	This open item has been closed. See NUTRK #DBDOI-01-009, for resolution of this open item
10	N/A	This open item has been closed. See NUTRK #DBDOI-01-0010, for resolution of this open item
11	N/A	This open item has been closed. See NUTRK #DBDOI-01-0011, for resolution of this open item
12	3.9, 9.5.196	This open item has been closed. See NUTRK #DBDOI-01-0012, for resolution of this open item

ATTACHMENT B
DESCRIPTIONS OF FSAR CHAPTER 14 EVENTS MITIGATED BY AFW

1. Loss of Normal Feedwater Events

A loss of normal feedwater event (from a pump failure or valve malfunction), affecting one unit, results in a reduction in capability of the secondary system to remove the heat generated in the reactor core. If an alternate supply of feedwater were not supplied to the plant, residual heat following reactor trip would heat the primary system water to the point where water relief from the pressurizer occurs, and significant loss of water from the reactor coolant system could conceivably lead to core damage.

The AFW System shall be capable of performing this function with a limiting single active failure [REF 9.1.1 (Criterion 41), 9.2.49, and 9.3.1]. The AFW initiation parameters, flow requirements, flow delivery time requirements, and equipment required to operate are discussed in Section 2.2.

2. Loss of External Load Events

During a loss of external load event affecting one or both units, the AFW System shall automatically provide feedwater to the affected unit(s) to remove decay heat from the Reactor Coolant System(s) [REF 9.1.1 (Criteria 4 and 37) and 9.2.57 (Section 14.1.9)].

The AFW System shall be capable of performing these functions with a limiting single active failure [REF 9.1.1 (Criterion 41), 9.2.49, 9.3.1]. The AFW initiation parameters, flow requirements, flow delivery time requirements, and equipment required to operate are discussed in Section 2.2.

3. Loss of All AC Power Events

During a loss of all AC power event affecting one or both units, the AFW System shall automatically provide feedwater to the affected unit(s). The capacity of the AFW System shall be such that the water level in the steam generators does not recede below the lowest level at which sufficient heat transfer area is available to dissipate core residual heat without water relief from the pressurizer relief or safety valves. [REF 9.1.1 (Criteria 4 and 37), 9.2.57 (Section 14.1.11), 9.3.1, 9.1.4 (Section II.E.1.2), 9.2.39, 9.2.60].

The AFW System shall be capable of performing these functions with a loss of offsite electrical power and a limiting single active failure [REF 9.1.1 (Criterion 41), 9.2.49, 9.3.1]. The AFW initiation parameters, flow requirements, flow delivery time requirements, and equipment required to operate are discussed in Section 2.2.

4. Steam Generator Tube Rupture Events

During a steam generator tube rupture event with or without offsite power, the AFW System shall initially provide sufficient flow to the unaffected steam generator to support Reactor Coolant System cooldown and depressurization, so that Reactor Coolant blowdown to the steam generator may be terminated within thirty minutes.

ATTACHMENT B (continued)

The AFW System shall be capable of performing this function with or without a loss of offsite electrical power and a limiting single active failure [REF 9.1.1 (Criterion 41), 9.2.49, 9.3.1]. The AFW initiation parameters, flow requirements, flow delivery time requirements, and equipment required to operate are discussed in Section 2.2.

No AFW flow requirements are identified for the SGTR analysis. Per conversations with Westinghouse and a review of the SGTR Accident Analysis Basis Document (AABD) DBD-T-35 Module 14, AFW flow is calculated as an output of the SGTR analysis. Therefore it is inappropriate to take the calculated value of AFW flow and reflect it as an AFW system flow performance requirement. This methodology is appropriate, as the SGTR is typically not considered a limiting transient with respect to AFW system flow requirements. [AABD Module 14]

Further reinforcing the position that AFW has no limiting design basis function during a SGTR event is the evaluation performed for CR 00-2981 [Ref. 9.5.195]. That CR questioned whether the atmospheric steam dump valves are adequately sized to support the radiological analysis assumptions of time to stop dumping steam from the ruptured steam generator, and time to reach RHR cut-in temperature while dumping steam from a single intact steam generator. The CR resolution determined that the radiological analysis assumptions were developed prior to and independent of any thermal-hydraulic analysis, and are therefore not tied to the actual cool down capabilities within either the design or licensing bases of the facility.

This apparent disconnect is acceptable given the large margins to 10 CFR 100 release limits demonstrated within the radiological analyses. For a more detailed history and evaluation, the reader is referred to the resolution of CR 00-2981 [Ref. 9.5.195].

5. <u>Main Steam Line Break Events</u>

During a main steam line break event with or without offsite power, the AFW System shall automatically provide feedwater to the unaffected steam generator to remove decay heat from the Reactor Coolant System [REF 9.1.1 (Criteria 4 and 37), 9.2.57 (Section 14.2.5), 9.1.4 (Section II.E.1.2), 9.2.39, 9.2.60].

In addition, the AFW System shall be designed to allow remote-manual isolation of flow to affected steam generator to limit containment pressure increase, prevent AFW pump runout, and increase feedwater flow to the unaffected steam generator [REF 9.5.76]. The AFW System shall be capable of performing this function with or without a loss of offsite electrical power and a limiting single active failure [REF 9.1.1 (Criterion 41), 9.2.49, 9.3.1]. The AFW initiation parameters, flow requirements, flow delivery time requirements and equipment required to operate are discussed in Section 2.2.