Enclosure 1

EMERGENCY FEEDWATER SYSTEM

UPGRADE TO SAFETY GRADE DESIGN

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1.0 DESIGN DESCRIPTION

1.1 Summary

The purpose of these modifications is to upgrade the Emergency Feedwater (EFW) System of Unit No. 1 of the Three Mile Island Nuclear Station (TMI-1) to a safety grade system in order to provide increased reliability in its capability to mitigate the effects of design basis accidents when the Main Feedwater (MFW) System is not available. Furthermore, these modifications to the EFW system must meet the following criteria:

1) Pressure in the reactor coolant and main steam systems should be maintained below 110% of the design pressures.

2) The potential for core damage is evaluated on the basis that it is acceptable if the core thermal power is less than 112% of rated power.

3) Any activity release must be such that the calculated doses at the site boundary are within 10 CFR Part 100 guidelines.

4) The emergency feedwater system must be safety grade and automatically initiated when required.

5) Prevent core uncovery during small break LOCA's.

6) Prevent overpressurization of the containment as a result of main steam line break accidents.

7) Prevent lifting of the PORV in response to design basis loss of MFW transients and prevention of safety valve lifting during the MFW line break accident.

8) Limit flow to any one OTSG so that tube cross flow vibration limits are not exceeded, i.e., 5ft./sec. cross flow velocity.

These modifications were made in accordance with the requirements of NUREG-0578 Sections 2.1.7. a and 2.1.7.b, NUREG-0680 Section 2.1.7a and 2.1.7 b of Short Term Action Order Item No.8, NUREG-0737 Sections II.E.1.1 and II.E.1.2, Atomic Safety and Licensing Board (ASLB) Partial Initial Decision Section II, Subsection Q, and using the acceptance criteria of Standard Review Plan Sections 9.2.6, 10.4.9 (associated Branch Technical position ASB 10-1), 15.2.6, 15.2.7 and 15.2.8 as principal guidance.

This system design description addresses the following modifications within the Emergency Feedwater Long Term Upgrade Modification Program:

A) Add cavitating venturis and vibration supports in the EFW injection line to each once through steam generator (OTSG).

B) Provide redundant safety grade EFW control and block valves.

C) Lock open the EFW recirculation valves EF-V8A/B/C to prevent damage to the EFW pumps.

D) Upgrade the EFW pumps recirculation line from recirculation control valves (EF-V8A/B/C) to the Condensate Storage Tank (CST) (CO-T1B) to Seismic Class I requirements.

E) Intermediate Building flood protection from a Main Feedwater Line Break (MFLB).

F) Modify the vent stacks for main steam safety valves, MS-V22A/B and atmospheric dump valves MS-V4A/B.

G) Provide a Class 1E power supply to valves CO-V111 A/B and upgrade the cable routing for the existing Class 1E power supply to valves CO-V14 A/B to meet Seismic Class I requirements.

H) Provide an overspeed trip alarm in the main control room for the turbine driven EFW pump (EF-P-1).

I) Provide an Intermediate Building flood detection alarm using Class 1E components.

J) Provide safety grade EFW initiation on high containment pressure isolation signal.

K) Provide safety grade OTSG level instrumentation and signals for MFW OTSG high water level isolation and OTSG low water level initiation of the EFW system.

L) Provide a safety grade automatic control system independent of the Integrated Control System (ICS) that permits the EFW system to control OTSG level without control interaction with the MFW system.

M) Upgrade the controls for the Main Steam Line Rupture Detection System (MSLRDS) to safety grade such that a single failure of the control system will not prevent MFW isolation when required, nor inadvertently isolate the MFW System.

N) Upgrade to safety grade the water level indication and low-low water level alarm in the control room for each CST.

O) In addition to the turbine driven EFW pump, both of the motor driven EFW pumps automatically start upon loss of both MFW pumps or loss of four (4) Reactor Coolant (RC) Pumps.

P) The motor driven EFW pumps are automatically loaded on the diesel generator during loss of offsite power with or without simultaneous existence of Engineered Safeguards (ES) actuation.

Q) Redundant indication is available in the control room of EFW flow to each steam generator.

R) Control room annunciation for all auto start conditions of the EFW system is available.

S) Delete the existing cross-connect between electrical busses that allows a control room operator to load both EFW pump motors onto a single diesel generator in order to ensure electrical separation of the busses.

T) Provide main steam overpressure protection to the turbine section of the turbine driven EFW pump. Change setpoints for main steam valves MS-V6 and MS-V22 A/B.

U) Evaluate the EFW and ES electrical power, control and instrumentation cables that are presently routed through the Alligator Pit and Tendon Access Gallery.

1.2 References

The codes and standards used for these modifications are in accordance with SDD 424A, 424B, 424D and 424E Division I Requirements. Drawings which show the modifications are given below:

1.2.1 GPU Nuclear (GPUN) Drawings

GPUN Drawing No.	Rev.	Title
IC-640-42-001	0	Instrument Loop Diagram OTSG A Pressure/Level Sheet 1
IC-640-42-002	0	Instrument Loop Diagram OTSG A Pressure/Level Sheet 2
IC-640-42-003	0	Instrument Loop Diagram OTSG A EF/FW
IC-640-42-004	0	Instrument Loop Diagram OTSG A Pressure/Level Sheet 1
IC-640-42-005	0	Instrument Loop Diagram OTSG A Pressure Level Sheet 2
IC-640-42-006	0	Instrument Loop Diagram OTSG A EF/FW

IC-640-42-007	0	Instrument Loop Diagram Condensate Storage Tank A&B Level
IC-640-41-001	0	Logic Diagram OTSG A FW Isolation
IC-640-41-002	0	Logic Diagram OTSG A FW Isolation on Hi Level
IC-640-41-003	0	Logic Diagram OTSG A EF Initiation on Low Level (Pumps)
IC-640-41-004	0	Logic Diagram OTSG Containment Pressure - RPS/ES and Feed-water Rupture Detection (FWRD)
IC-640-41-005	0	Logic Diagram OTSG A Main Steam Rupture Detection (MSRD)
IC-640-41-006	0	Logic Diagram OTSG A/EF Pumps EF Initiation
IC-640-41-007	0	Logic Diagram OTSG B FW Isolation
IC-640-41-008	0	Logic Diagram OTSG B FW Isolation on Hi Level
IC-640-41-009	0	Logic Diagram OTSG B EF Initiation on Low Level (Pumps)
IC-640-41-010	0.	Logic Diagram OTSG B Feedwater Rupture Delection (FWRD)
IC-640-41-011	0	Logic Diagram OTSG B Main Steam Rupture Detection (MSRD)
IC-640-41-012	0	Logic Diagram OTSG EF Initiation
IC-640-41-013	0	Logic Diagram OTSG A EF Initiation on Low Level Valves
IC-640-41-014	0	Logic Diagram OTSG B EF Initiation on Low Level Valves

IC-640-41-015	0	Logic Diagram OSTG A/B FW Isolation on Hi Level (2)
IC-640-41-016	0	Logic Diagram OTSG A/B Main Steam Rupture Detection (MSRD) (2)

1.2.2 Impell Corporation Drawings

Impell Drawing No.	Rev.	Description
0370-039-001	2	"Emergency Feedwater Bypass Line Modification - Plan"
0370-039-002	1	"Emergency Feedwater Bypass Line Modification - Sections"
0370-039-003	2	"Emergency Feedwater Recirculation Line Modification
0370-039-007	0	"Bypass and Recirculation Line Modification - Flow Diagram" (Mark-up Gilbert Dwg. C-302-081, Rev. 24)
0370-039-011	1	"Condensate - Flow Diagram" (Mark-up Gilbert Dwg. C-302-101, Rev. 24)
0370-064-001	1	HSPS Modification Electrical Block Diagram
0370-064-002	0	Main Steam and Feedwater Instrumentation Diagram
0370-064-003	0	HSPS Modification OTSG Level Instrument Cabinet Assignments
0370-064-004	0	HSPS Modification OTSG Level Instrument Cabinet Assignments
0370-064-005	0	Location of HSPS Modification Electronic Panels
0370-064-010	0	HSPS Modification - Main Control Panel "CC" Revisions
0370-064-011	0	HSPS Modification - Main Control Panel "CL" Revisions
0370-064-111	1	HSPS Modification-Electronic Cabinet Layout.

1.2.3 Gilbert Associates Inc. (GAI) Drawings

GAI DRAWING NO.	REV.	DESCRIPTION
208-505	1A-0	Electrical Elementary Diagram 480V Control Center
209-835	1F-0	Electrical Elementary Diagram Alarms
302-081	25	Feedwater Flow Diagram

1.3 Detailed System Description

The basic result of the modifications to the EFW System is that the system is capable of withstanding a design basis event and a single active failure and still perform its function of supplying a heat removal path to allow safe shutdown of the reactor. The modifications also ensure that a single active failure will not inadvertently initiate the EFW System nor isolate the MFW system.

1.3.1 The cavitating venturis and their supports are being installed to limit the flow of EFW to a ruptured OTSG in order to ensure sufficient EFW flow to the intact OTSG, to limit the mass and energy release within the Reactor Building for overpressure protection and to limit the flow to the OTSG in order to reduce excessive Reactor Coolant System (RCS) overcooling.

1.3.2 The installation of redundant safety grade EFW block valves and control valves is being implemented to preclude a single active failure from preventing the addition of EFW to the steam generators. The EFW block valves will also ensure the capability to isolate EFW flow to a ruptured OTSG.

1.3.3 The EFW recirculation line modification upgrades the EFW pumps recirculation line from the EFW recirculation control valves (EF-V-8A/B/C), to the condensate storage tank (CO-T1B), to Seismic Class I requirements. This modification ensures that this piping can withstand a design basis event and thus prevents depletion of the required CST inventory for the EFW function. The EFW recirculation valves EF-V8A/B/C are being blocked open to prevent possible EFW pump damage caused by an EFW pump running at shutoff head with the recirculation line closed.

1.3.4 The Intermediate Building flood protection modification mitigates the effects of flooding due to a postulated MFLB in the Intermediate Building by allowing water to flow into the Tendon Access Gallery (TAG) and portions of the Alligator Pit. By removing the upper half of the "stop walls", in the alligator pit and opening entrances "A" and "B" to the TAG, the time required for water from a MFLB to jeopardize the EFW pumps (EL 296'-7/8") in the Intermediate Building is increased from 5.5 minutes to approximately 25 minutes.

1.3.5 The vent stack modification upgrades the stacks for main steam safety relief valves MS-V22A/B and atmospheric dump valves MS-V-4A/B to Seismic Class I requirements. This modification ensures that the vent stacks are able to withstand a seismic event and therefore prevents the release of main steam to the Intermediate Building. Thus, this modification reduces the possibility of overpressurization in the Intermediate Building and protects the EFW System components from exposure to a harsh steam environment and gravity missiles, i.e., the Vent Stacks.

1.3.6 Safety grade power is being supplied to valves CO-V111 A/B to allow isolation at the main control room of a damaged CST from the EFW system. This modification ensures that the EFW System will perform its safety function by having sufficient inventory in the intact CST. The cable routing for the power supply to valves CO-V14A/B has been upgraded to meet Seismic I requirements. The ability to close CO-V14A/B from the main control room will allow isolation of non-EFW functions from the CST.

1.3.7 An overspeed trip alarm is being added in the main control room for the turbine driven EFW pump (EF-P-1). This alarm provides the operator with an otherwise non-detectable trip indication in the control room.

1.3.8 An intermediate Building flood detection alarm system utilizing Class 1E components is being added to alert the operator in the control room to flooding conditions in the Intermediate Building as a result of a MFLB. The transmitter will be located in the lower Tendon Access Gallery (Elev. 263' - 2 1/4" ± 3") and will provide the operator with sufficient time to take corrective action to prevent damage to the EFW pumps.

1.3.9 The EFW system is being designed to initiate on a high containment pressure isolation signal. This signal is an indication of a possible MFLB, MSLB or LOCA inside containment. This indication (along with low OTSG level) anticipates a possible failure of the secondary heat sink.

1.3.10 Safety grade level instruments for the OTSG's and safety grade controls are designed for MFW isolation and EFW initiation. MFW valves FW-V5A/B, FW-V16A/B, FW-V17A/B and FW-V92A/B receive a signal to isolate the affected OTSG if high water level exists in either of the OTSG's. The EFW System will be initiated if low water level exists in either of the OTSG's. The MFW isolation or EFW initiation signal will be capable of proper operation while sustaining a single active failure in any part of the safety grade instruments or controls.

1.3.11 A safety grade automatic control system, independent of the Integrated Control System (ICS), is designed to measure the OTSG water level, compare the reading to a preselected setpoint and modulate the EFW control valves EF-V30 A/B/C/D to control OTSG water level. The preselected setpoint will depend on plant conditions and RC pump availability.

1.3.12 The MSLRD System is upgraded to safety grade and designed to withstand a single failure in the control system. The main steam line pressure of each OTSG is monitored by four redundant channels. Two channels for each OTSG are located in the Reactor Building. Two channels for each OTSG are located in the Intermediate Building. The redundancy of monitoring and diversity of location ensure that no single failure will prevent isolation of MFW if such isolation is required.

1.3.13 The upgrade of the water level indication of the CST to safety grade is being implemented to display proper CST level for each tank in the Control Room. An alarm will annunciate when low-low water level is sensed in either CST.

1.3.14 All of the EFW pumps receive a safety grade auto-start signal on loss of both MFW pumps or loss of all four RC pumps. Detection of loss of both MFW pumps is accomplished by sensing the differential pressure across the MFW pumps. Loss of all four RC pumps is sensed by utilizing contacts from the RC pump power monitors.

The motor driven EFW pumps are powered by the diesel generators during all loss of off-site power conditions, with or without ESAS actuation. In order to limit voltage dip on the diesel generator during concurrent loss of off-site power and coincident ESAS actuation condition, the motor driven EFW pumps will be loaded on the diesel generator five seconds after block four loading. For a loss of off-site power only, the motor driven EFW pumps will be loaded on the diesel generator five seconds after the diesel generator has started.

1.3.15 Each of the EFW injection lines are provided with two redundant Class 1E flow indication loops. For each EFW injection line, one annubar shall serve as the source for two redundant differential pressure transmitters. The differential pressure transmitters provide flow signals, through Class 1E instrument loops to the main control room indicators.

1.3.16 Control room annunciation for all auto start conditions is being provided and alerts the operator to the fact that certain EFW initiating parameters have been reached.

1.3.17 The deletion of the MSLRDS signals from the EFW control valves EF-V30A/B prevents the MSLRDS from isolating EFW to the OTSG's in certain scenarios when it should not be blocked. The deletion of the MSLRDS signal will improve the availability of the OTSG's as a heat sink and will improve the reliability of EFW flow to the OTSG's during loss of MFW. Low OTSG pressure, which actuates the MSLRDS, can result from either a severe overcooling or a loss of heat sink event. The original design required operator action to bypass MSLRDS to prevent a loss of heat sink if a low OTSG pressure condition developed. Since the venturis limit EFW flow, the MSLRDS is no longer required for OTSG protection against severe overcooling. The addition of the cavitating venturis to the EFW System and removal of the MSLRDS from isolating the EFW control valves eliminates operator action to provide EFW to the intact OTSG.

1.3.18 The deletion of the cross connect feature between electrical busses prevents both motor driven EFW pumps from being loaded onto a single diesel generator. This design feature will ensure electrical separation and will prevent a common mode single failure from rendering both motor driven EFW pumps inoperable.

1.3.19 Main steam over pressure protection is being provided for the turbine section of the turbine driven EFW pump. Pressure control valve MS-V6 in the main steam supply to the EFW pump turbine section is being restricted to 65% of the full valve steam travel distance and the pressure setpoint for the pressure controller to valve MS-V6 has been changed from 200 psig to 175 psig. Furthermore, the pressure relief setpoints for main steam safety valves MS-V22A/B, for the EFW pump turbine section, are being changed from 495 psig and 505 psig, respectively, to 200 psig and 220 psig, respectively. These modifications to the turbine driven EFW pump will protect the turbine section from overpressurization in the event of a failure of pressure control valve MS-V6 with upstream valves MS-V10A/B open.

NOTE: The three (3) EFW pump turbine section nozzle hand valves are being locked open to ensure sufficient main steam flow to the turbine section.

1.3.20 The EFW and ES electrical power, control, and instrumentation cables were evaluated to determine their capability of performing their safety function after a MFLB incident and subsequent Intermediate Building flooding. The results of this evaluation is discussed in Technical Data Report (TDR) No. 542.

1.4 System Performance Characteristics

The cavitating venturis located in the EFW injection lines to the OTSG's limit the total EFW flow to 1250 gpm to both OTSG's.

System performance characteristics of the Heat Sink Protection System (HSPS) modifications remain essentially unchanged. Pipe sizing/routing and valve selection were chosen in order to attain minimal pressure drops consistent with the original configuration. Instrumentation and control modifications will ensure that the system will perform its intended function while sustaining a single active failure in the instrumentation and control system.

The modification to the EFW controls allows the "B" train of the EFW to be manually controlled from Remote Shutdown Panel "B". The operator has control of both the "B" train EFW Block Valves (EF-V-53, & V-54), and EFW Control Valves (EF-V-30B & V-30D) which are used to control EFW flow and OTSG level. Similarly, the operator has control of the "A" train EFW Control Valves (EF-V-30A & 30C)on Remote Shutdown Panel "A". The necessity of operator action to manually control the EFW will be required if a) the Control Room becomes uninhabitable and reactor shutdown is required from an alternate location or b) the unlikely event of a fire damaging three or more channels of the HSPS electronics.

The Appendix R modifications to the Remote Shutdown Panel (RSP) will be completed at the Cycle 6 Refueling Outage. Until such time as the modification to the RSP is made the EFW system will have an interim design to interface with the existing LM-38 Remote Shutdown Panel. The interim EFW design will allow for control of level control valves EF-V30A/B from their respective LM-38 RSP. The four EFW block valves (EF-V 52, 53, 54 and 55) and the two EFW control valves (EF-V-30C/D) will not be controlled from the LM-38 RSP. The interim design maintains the fire protection and remote shutdown capability that existed previous to the EFW modification.

The TMI-1 EFW is a stand-by plant system which is not used during normal plant start ups, shutdowns or operation. The system is maintained in stand-by during plant operations and is automatically actuated upon loss of both MFW, or loss of all four RC pumps; high containment isolation signal, and low OTSG water level. The following table gives actuation times for the EFW pumps:

EVENT	DRIVEN-PUMP TURBINE	MOTOR-DRIVEN PUMP
a)Loss of MFW, or Loss of four RC Pumps, low OTSG level, High Containment Pressure	Immediate	5 sec.
b)Above with loss of off-site power (LOOP)	Immediate	15 sec.
c)Above with ESAS but no LOOP	Immediate	20 sec.
d) Above with ESAS and LOOP	Immediate	30 sec.

Start up and test data indicates that the turbine driven EFW pump requires 18 seconds to reach full flow. The motor driven EFW pumps are capable of accelerating to full speed in less than 10 seconds. Therefore under worst case conditions EFW flow will be established within 40 seconds of initiation. Maximum deliverable EFW flow rates are sumarized in Table 1 for various pump combinations.

Control of EFW flow following initiation is designed to be accomplisned by the Heat Sink Protection System (HSPS). The HSPS controls the injection of EFW to maintain water level in each OTSG to one of two setpoints depending on whether the RC pumps are available. Under forced cooling conditions, the HSPS controls level to 30 inches on the start up range since this is sufficient to provide core cooling. However upon loss of forced RCS circulation the HSPS controls OTSG level to 240 inches on the operating range to promote natural circulation with the RC System.

NOTE: The control room manual EFW controls are available for the operator to take control of EFW flow to either OTSG, when needed, or in the event of HSPS malfunction.

The Intermediate Building flood detection alarm system will alert the operator in the control room of a possible MFLB. The alarm will annunciate in a timely manner such that the operator will have a minimum of 20 minutes to take action to mitigate the consequences of flood damage to the EFW pumps. The alarm will be initiated by the Sens-Pak relay located in the Containment Water Level Cabinet "C". This alarm will correspond to a detected level of 2ft. + 3 inches tolerance in the Tendon Access Gallery.

1.5 System Arrangement

The redundant safety grade EFW control and block valves added to the system by means of a by-pass line around each of the existing EFW control valves as shown on Impell Drawings 0370-039-001, 002, 004 and 007.

EFW pumps recirculation control valves EF-V8A/B/C are shown as locked open on flow diagram C-302-081.

The motor driven EFW pumps auto start circuits and the diesel block loading sequence ensures that a single active failure shall not result in less than the minimum required pump capacity being available under all conditions including loss of off-site power.

The TMI-1 EFW design provides an emergency feed line with control provisions to each OTSG. The design is such that the required quantity of water can be provided to at least one OTSG during all single failure conditions involving a design basis event or loss of MFW. Under MSLB or MFLB conditions, when both MFW and EFW are isolated to the affected steam generator, a single failure must be assumed for the unaffected EFW feed line control valve. To provide further assurance that EFW can be delivered: 1) a back up instrument air system is provided, 2) manual control stations are provided in the control room, and 3) flow monitoring devices installed in the EFW lines provides information to the operator for regulating flow.

The EFW System is designed to have redundant fail close level control valves controlling EFW flow to each OTSG. The valves are designed to be installed in parallel with one valve controlled from each of the safety grade control systems. In conjunction with the EFW Block Valves, this design will ensure that no single active failure will prevent loss of decay heat removal capabilities or an inadvertent over-filling or over-cooling condition.

The level instruments which monitor the normal operating range and start up range of each of the two OTSG'S is increased to four separate channels per range and also upgraded to safety grade requirements. Similarly, the pressure instruments which monitor the steam pressure in each of the OTSG's is increased to four separate channels and upgraded to safety grade requirements. These pressure transmitters are located so a failure of a main steam line will not prevent the steam line failure from being detected. The level instruments monitoring both the CST levels are upgraded to two seismically qualified Class 1E channels for each tank.

The EFW control is designed to be from the Control Room. The EFW System will be capable of operation from outside the Control Room at the Remote Shutdown Panel. Control of the EFW Control Valves EF-V30B and EF-V30D and EFW Block Valves EF-V53 and EF-V54 is available at the Remote Shutdown Panel "B." Control of EF-V30A and EF-V30C is available at the Remote Shutdown Panel "A." Both Remote Shutdown Panels are located in the Control Building at elevation 322'.

1.5 The above Remote Shutdown Panel arrangement represents the final design after the Appendix R Modification to the Remote Shutdown Panel. The Appendix R Modification is scheduled to be completed during Cycle 6 Refueling Outage., In the interim, control of EFW Control Valve EF-V30A will be available from Remote Shutdown Panel "A" and control of EFW Control Valve EF-V30B will be available from Remote Shutdown Panel "B". Operator actions relative to the interim design is described in Section 4.

1.6 Instrumentation and Control

EFW flow indication is provided for operator information in the Control Room and on the Remote Shutdown Panel.

The EFW System is initiated through a safety grade 2 out-of-4 (2/4) combination control logic. Once initiated, the EFW is controlled by redundant level controllers which modulate the EFW flow from a demand signal based on OTSG level. The EFW is terminated by the operator.

The EFW System is designed to initiate on any of the following signals:

a) Low level in either OTSG.
b) High containment pressure (4psig)
c) Both feedwater pumps tripped (not part of 2/4 logic).
d) All Reactor Coolant Pumps (RCP's) tripped (not part of 2/4 logic).

The MFW to the OTSG is designed to isolate on the following signals:

a) High-high OTSG level.
b) MSLBD which is detected by low Main Steam line pressure (600 psig).

The OTSG level is measured by ten level transmitters on each OTSG (see table 5). Four level transmitters measure level over the operating range. One transmitter is assigned to each of the four measurement channels. Four level transmitters measure level over the startup range. One transmitter is assigned to each of the four measurement channels. Two full range level transmitters, one for Channel A and one for Channel B, use the EFW electronics to develop a temperature and pressure compensation full range level signal to be displayed in the Main Control Room and on the Remote Shutdown Panel. The locations of the OTSG level transmitters are shown on Impell Drawings 0370-064-003 and 004.

The level sensing lines to each of the OTSG vent connections will have four temperature elements, one temperature element for each of the measurement channels. This temperature measurement will be used for compensation of the level measurement to give a more accurate reading of the OTSG level.

The MS line pressure is measured by two pressure transmitters on each of the MS Lines from the OTSG's. Two measurement channels are connected to one steam line from each OTSG and the remaining two measurement channels are connected to the other steam line from each OTSG. Four MS line pressure transmitters (one for each steam line) will be located in the Containment outside of the D-Ring wall at the 308"-0 floor elevation. Four MS line pressure transmitters (one for each steam line) will be located in the Intermediate Building. The diversity in location will ensure that in the event of a MS break, the MSLRD system will function.

Four new containment pressure transmitters (see Table 5), one for each measurement channel, will monitor containment pressure and be used by the HSPS electronics to develop a feedwater isolation signal and an EFW pump initiation signal.

The level in both Condensate Storage tanks is measured by two channels of instrumentation. Level indication and off-normal annunciation is given in the Control Room.

The HSPS electronic instrumentation will accept input signals (see Table 5), compensate for temperature variation and density variations as required and use these signals as input to the logic for EFW actuation and control, MFW isolation, ICS inputs and Control Room indication and alarms. The instrument loops are shown on GPU drawings IC-640-42-001 through 007.

The logic for MFW isolation is shown on GPU Drawings IC-640-41-001, 002, 004, 005, 007, 009, 010, and 011. The conditions which will isolate the MFW system are:

a) level in either OTSG exceeds 370 inches
b) steam line pressure less than 600 psig, except if bypassed by the operator as is required during normal shutdown.

The Logic for EFW initiation is shown on GPUN Drawings IC-640-41-003, 004, 006, 009, 010, 012, 013, and 014. The EFW System is initiated on low OTSG water level in a two step process. The low level initiation signal will initiate EFW pumps if the OTSG water level goes below 20 inches above the lower level tap. The EFW control valves will not open until the low low OTSG water level setpoint (i.e. 18 inches above the lower level tap) is reached. This two step process is intended to prevent an inadvertant injection of EFW into a OTSG as a result of a single failure in the low level initiation circuitry. The high containment pressure signal described previously will also initiate EFW. A signal that both FW pumps have tripped or all RC pumps have tripped from existing logic cabinets will also initiate EFW. If the EFW System is initiated, a setpoint is automatically selected as input to the EFW level controller. The setpoint will be approximately 30 inches if at least one RC pump is running and approximately 240 inches if no RCP is running. Level is expressed as distance above the lower level tap which is 6 inches above the lower tube sheet. Table 2 lists the equipment actuation when the above plant conditions are sensed.

The electronics cabinets will be located in the Control Building at elevation 338'-6. See Impell drawing 0370-064-111 for location of the HSPS electronics cabinets.

Table 3 lists the annunciator points and annunciator/alarm assignments from the HSPS electronics cabinets. Table 4 lists the computer inputs from the HSPS electronics cabinets.

1.7 System Interfaces

The mechanical and structural modifications addressed by this revision are contained solely within the EFW system. The system interface for the instrumentation and controls of the HSPS Modification is shown on the Electrical Block Diagram, Impell Drawing 0370-064-001. The HSPS electronics cabinets interface with the MFW System, the Annunciator System, plant computer, Main Control Room, Integrated Control System, Remote Shutdown Panel, and the 120 Volt Vital AC System. Interfaces with non-IE equipment or signals is through the Train A electronics cabinet and is electrically isolated with a Class IE isolation device to prevent faults in the non-IE system from affecting the IE System. Electrical separation between redundant channels and between redundant trains, as well as non-IE circuits is in accordance with "TMI-1 Nuclear Generating Station Electric Cable and Raceway Routing" SDD 772-A.

Existing Motor Control Center (MCC) Units 13A, 13B in 1D Turbine Plant MCC (size 1 reversing starters) will be spared. Motor operated valve CO-V111A will be fed from MCC 1A Engineered Safeguards Unit 12D. Motor operated valve CO-V-111B will be fed from MCC 1B Engineered Safeguard Unit 14D. Nuclear Safety Related (NSR) reversing starters will be installed in the above MCC cubicles.

New motor starters for EFW block valves are located in the ES MCC 1A and ES MCC 1B. The starter for EF-V-52 is located in ES MCC 1A Compartment 10A. The starter for EF-V-53 is located in ES MCC 1B Compartment 15A. The starter for EF-V-54 is located in ES MCC 1B Compartment 15B. The starter for EF-V-55 is located in ES MCC 1A Compartment 13D.

The motor starters for the MFW block valves are located in ESV MCC 1A and ESV MCC 1B. MFW block valve FW-V-92A is fed from ESV MCC 1A Compartment 2C. MFW block valve FW-V-92B is fed from ESV MCC 1B Compartment 2C. MFW block valve FW-V-5A motor starter will be moved from ESV MCC 1C Compartment 1D to ESV MCC 1A Compartment 10D. MFW block valve FW-V-5B motor starters will be moved from ESV MCC 1C Compartment 1C to ESV MCC 1B Compartment 12A & 12B.

2.0 SYSTEM LIMITATIONS SET POINTS AND PRECAUTIONS

The following are setpoints in process units for the HSPS electronics:

Parameter	Setpoint	Logic
OTSG High Level	337"*	IC-640-41-002, 008
OTSG High-High Level	370"*	IC-640-41-002, 008
OTSG Overfill Level	380"*	IC-640-41-002, 008
OTSG Low Level	23"*	IC-640-41-003, 009, 013, 014
OTSG Low-Low Level	18"*	IC-640-41-003, 009, 013, 014
Containment High Pressure	4 psig	IC-640-41-004, 010
MS Low Pressure	750 psi or less	IC-640-41-005, 011
MS Low-Low Pressure	600 psi or less	IC-640-41-005, 011

The following are setpoints for the EFW Level controllers. This information is from GPUN Instrument Loop Diagram IC-640-42-003, 006.

Condition	Setpoint	Tolerance
No RCP's running	240"*	± 6 inches
One or more RCP's running	30"*	± 8 inches
No EFW in operation	0"*	± 4 inches

* = Level is expressed as distance above the lower level tap which is 6 inches above the lower tube sheet

A list of annunciator points is given in Table 3.

3.0 OPERATIONS

During all phases of Operation where the EFW System is not required to operate, the HSPS electronics is used to generate compensated OTSG Level inputs to the Integrated Control system and monitor the level in Condensate Storage Tanks 1A and 1B.

3.1 Feedwater Isolation

The HSPS electronics will isolate the MFW supply to the affected OTSG in the event of a failure of the MFW controls resulting in hign level in either of the OTSG's. The HSPS electronics will also isolate the MFW to both OTSG's in the event of low pressure in the depressurized OTSG line unless the operator has bypassed this interlock during normal shutdown procedure. In both cases, the EFW pumps will not start immediately. However, due to the isolation of the MFW and the resultant loss of flow to the OTSG's, the EFW pumps can be expected to start once the secondary side inventory in either OTSG has boiled off enough coolant to lower the OTSG water level to the EFW low level initiation point (i.e. less than 20 inches) or if the MFW pumps trip as a result of a malfunction in the normal MFW control. If the level continues to drop to the EFW Low-Low level (i.e. less than 18 inches) the EFW level control valves will automatically receive a preset setpoint and the level control valves will automatically open to control EFW flow around this preset setpoint.

3.2 Emergency Feedwater System Actuation

The EFW System will actuate on any of the following conditions:

a. Low level in either OTSG
b. High Containment pressure (4PSIG)
c. Loss of both feedwater pumps.
d. Loss of all reactor coolant pumps.

Once initiated, the EFW System will supply water to both OTSGS. The sensing portion of the HSPS electronics is four (4) independent channels with the actuation logic of two out of four (2/4). Such an arrangement will withstand a single failure in any 2/4 channel even if one channel has been bypassed for maintenance, test or repair. The actuation portion of the HSPS electronics is two independent trains. A single failure of either train will not prevent at least one train of EFW from operating.

There is a Train A and Train B level controller which controls the EFW to each OTSG. Each controller will receive a setpoint from the HSPS electronics depending on the plant conditions. They are as follows:

a) Normal Conditions - setpoint is 0 inches
b) EFW initiation and at least one RCP running - setpoint is 30 inches
c) EFW initiation and no RCP are running - setpoint is 240 inches.

The operator may override the automatically selected setpoint by means of controls at each of the controller display stations located on the control consoles CC and CL in the Main Control Room. The operator may also switch to manual control by means of controls at these same controls display stations.

3.3 Normal Startup and Shutdown

During normal shutdown, the EFW System is not needed. When the reactor is operating at power levels below 15% of rated power it is possible to experience oscillations in the OTSG level measurements to the extent that the EFW system may be inadvertantly initiated. To prevent possible EFW initiation, the circuitry which initiates EFW on low OTSG water level should be bypassed. This is done by means of bypass switches, one for each train of initiation, located on the control console. When low OTSG water level initiation is bypass, this fact will be annunciated in the Control Room. This bypass must be removed, by operator action, when the reactor power is above 15% rated power.

In order to prevent isolation of the MFW System and subsequent initiation of the EFW System, the operator must perform the following action during shutdown:

When the main steam line pressure decreases below 750 psig, the operator should bypass the MSLRD logic by operating control switches located on console CL and CC. When this is done, an indicating light entitled "SLB Enabled" will turn off indicating the MSLRD has been bypassed. Both trains of MSLRD logic must be bypassed.

Once bypassed, the steam line pressure can drop below 600 psig without initiating MFW isolation. The bypass is automatically removed when the steamline pressure increases above 750 psig. The bypass can not be initiated whenever the steam line pressure is greater than 750 psig.

4.0 CASUALTY EVENTS AND RECOVERY PROCEDURES

4.1 Casualty Events

Casualties which can be experienced by the EFW are:

a) Loss of pressure integrity for OTSG A or B
b) Loss or malfunction of control signal
c) Rupture of a MFW line to OTSG A or B
d) Fire
e) Component Malfunction
f) Loss of Voltage
g) Rupture of an EFW line to one OTSG
h) Rupture of a steamline to the turbine driven EFW pump

4.2 Design Features to Mitigate Effects of Casualty Events

a) Loss of pressure integrity of one OTSG may render the failed OTSG ineffective in properly removing heat from the RC System in a controlled manner. This can be the result of a MSLB, MFLB or an OTSG blowdown line break. The operator should verify that water level is being maintained in each OTSG and the pressure of each OTSG is approximately equal (i.e. less than 200 psi difference). If this is not the case, the OTSG which can't maintain level or pressure may be breached. If the operator determines there is a breached OTSG, he can stop all EFW flow to that OTSG. Flow can be stopped by transfer of the EFW level controllers for that OTSG to manual and driving the controller outputs to zero. The system would still have the other OTSG which could be used as the path of heat removal from the RC System.

b) Loss or malfunction of a control signal will render one train inoperative. The result will be supplying too much water or not enough water to the OTSG's. If not enough water is being supplied to the OTSG, the backup level controls will open the other control valve to ensure a supply of water to the OTSG. If too much water is supplied, the operator can place the malfunctioning controls in manual and close the block valve if required to the affected control valve. The backup control loop will automatically take over and supply the correct amount of water to the steam generators.

c) Rupture of the MFW line to the OTSG B anywhere inside the Intermediate Building could result in flooding the EFW pump compartments. This scenario is a worst case design basis incident. The modifications to the EFW system give approximately 20 minutes from the time of receipt of an Intermediate Building flooding alarm until the time the water level reaches the 296'-7/8" elevation in the Intermediate Building to jeopardize the EFW pumps.

Upon receipt of this alarm, the operator should dispatch personnel to the Intermediate Building to verify the alarm. The operator should also monitor the level in OTSG B for sign of insufficient feedwater i.e. low OTSG B level or decaying level. If a feedwater rupture is confirmed, all MFW to OTSG B should be stopped and a shutdown initiated. The affected OTSG should be supplied with EFW flow unless the MFW line rupture results in loss of OTSG pressure integrity.

d) Protection against fire is being included in the design by ensuring proper separation distances are maintained between redundant channels and between redundant trains of the EFW System components.

As a backup to the entire HSPS electronics system, the EFW System can be controlled from the Remote Shutdown Panels. See Section 4.3d for required operator actions.

e) Protection against component malfunction is being included in the design by including sufficient redundancy in the system so that no single failure can prevent the EFW System from performing its design function. Four independent channels of sensing is combined in a two-out-of-four (2/4) logic so that no single channel failure will prevent the system from operating when required or cause the system to operate when it is not required. The initiating logic is separated into two independent trains so that no single failure will prevent the system from performing its function.

f) Each channel and train is supplied with power from the uninterruptable power supply related to that channel or division. A single failure of a power supply can disable only one of the four channels and only one of the two initiation trains.

g) Rupture of an EFW line to an OTSG would result in a loss of pressure to the affected OTSG. The cavitating venturi in the EFW line would limit EFW flow through the ruptured line and prevent complete loss of EFW system capabilities. Detection of this event is similar to Section 4.2a above. The operator could isolate the EFW line by use of the block valves or manually closing the EFW control valves by use of the EFW Control Valve M/A Station.

h) Rupture of a steam line to the turbine driven EFW pump would render this pump inoperable. Steam flow to this pump can be stopped by closing Main Steam valves MS-V13 A/B.

5.0 MAINTENANCE

5.1 In-Service Testing and Inspection

In-service testing and inspection shall comply with the requirements of ASME Section XI - 1980 Edition with Addenda through winter 1980 and TMI-1 Technical Specification, Section 4.2.2 and 4.9.

Testing of the electronics shall be done periodically to ensure that undetected failures will be minimized. Testing shall be performed per manufacturer's specifications, instructions and recommendations.

6.0 TESTING

Testing required to ensure proper installation of the various modifications is covered under installation specifications TIIS-412024-001, 003, 004, 005 and 006.

7.0 HUMAN FACTORS

The location and arrangement of the piping layouts including pipe supports have been designed to provide access for operation and maintenance functions. The control and block valves on the EFW By-Pass Lines were located to provide the capability to manually operate these valves at the Intermediate Building 295'El without the use of additional platforms.The controls and indication related to the EFW System are located on the Main Control Console sections CC and CL in the Control Room and on the Remote Shutdown Panels 'A' and 'B'. The controls and indications are laid out and labled in accordance with GPUN Standard ES-004 "Human Engineering Guide - TMI-1," Rev. 0. The operator will be able to override automatic control of the level controller from the Main Control Room. The operator will also be able to transfer control of the EFW control valves to their respective Remote Shutdown Panel and manually control flow to both OTSG's from Remote Shutdown Panel "B" with Remote Shutdown Panel "A" acting as a backup means of control.

TABLE 1

EMERGENCY FEEDWATER FLOWS WITH RECIRCULATION CONTROL VALVES EF-V8 A/B/C OPEN

No. Pumps		Steam Pressure		Total Flow	Bearing Flow	Recirc Flow	Flow to OTSG		
Turb. Drive	Motor Drive	"A" SIG	"B" OTSG	gpm	gpm	gpm	"A" gpm	"B" gpm	Remarks
0	1	1050	1050	440	10	75	220	220	
1	0	1050	1050	660	15	155	330	330	
0	2	1050	1050	730	20	150	365	365	
1	1	1050	1050	800	25	225	400	400	
1	2	1050	1050	860	35	300	430	430	
0	1	1050	1050	360	10	75	0	360	"A" OTSG Isolated
1	0	1050	1050	400	15	160	0	400	"A" OTSG Isolated
0	2	1050	1050	475	20	150	0	475	"A" OTSG Isolated
1	1	1050	1050	440	25	230	0	440	"A" OTSG Isolated
1	2	1050	1050	475	35	300	0	475	"A" OTSG Isolated
0	1	1050	600	520	10	70	0	520	"B" OTSG Isolated
1	0	1050	600	800	15	150	240	560	"B" OTSG Isolated
0	2	1050	600	835	20	140	270	565	"B" OTSG Isolated
1	1	1050	600	950	25	220	360	590	"B" OTSG Isolated
1	2	1050	600	1000	35	300	410	590	"B" OTSG Isolated

TABLE 2

PLANT CONDITIONS NECESSARY FOR AUTOMATIC ACTION OF EQUIPMENT RELATED TO EFW MODIFICATION

Equipment Action	Plant Condition*
Close MFW Isolation Valves FW-V5A/B	1 or 4
Close MFW Isolation Valves MFW-V92A/B	1 or 4
Close MFW Control Valves MFW-V16A/B	1 or 4
Close MFW Control Valves MFW-V17A/B	1 or 4
Start EFW Motor Driven Pumps	2, 5, 6 or 7
Start EFW Turbine Driven Pump	2, 5, 6, or 7
Open EFW Block Valves EF-V52/53/54/55	2, 5, 6 or 7
Open EFW OTSG level control valves	3, 5, 6 or 7
i) Control OTSG level at 30 inches	3, 5, 6
ii) Control OTSG level at 240 inches	7

* Condition Code

1 - Low MS Line Pressure (less than 600 psi)
2 - Low OTSG Water Level (less than 20 inches)
3 - Low-Low OTSG Water Level (less than 18 inches)
4 - High OTSG Water Level (greater than 370 inches)
5 - High Containment Pressure (greater than 4 psig)
6 - Low MFW Pump Differential Pressure
7 - All RC Pumps Tripped

TABLE 3
EFW MODIFICATION LIST OF ANNUNCIATORS
POINTS AND ALARM ASSIGNMENTS

ALARM DESCRIPTION	LIGHT BOX	ROW	COLUMN	WINDOW LEGEND
Condensate Storage Tank A High Level	J	1	4	Cond STG TK A HI/LO Level
Condensate Storage Tank A Low Level	J	1	4	Cond STG TK A HI/LO Level
Condensate Storage Tank A Low-Low Level	PRF1	1	5	Cond STG TK A LO-LO Level
Condensate Storage Tank B High Level	J	2	4	Cond STG TK B HI/LO Level
Condensate Storage Tank B Low Level	J	2	4	Cond STG TK B HI/LO Level
Condensate Storage Tank B Low-Low Level	PRF1	1	6	Cond STG TK B LO-LO Level
OTSG A High Level	H	1	1	OTSG 1A OP LVL HI
OTSG A Overfill	PRF	5	7	OTSG A/B Level HI-HI
MFW Isolation/OTSG B High-High Level	PRF	5	7	OTSG A/B Level HI-HI
OTSG B High Level	H	1	2	OTSG 1B OP LVL HI
OTSG B Overfill	PRF	5	7	OTSG A/B Level HI-HI/FW Isolation
OTSG B High-High Level/MFW Isolation	PRF	5	7	OTSG A/B Level HI-HI/FW Isolation
MFW Isolation High-High OTSG Level Defeated	E	3	2	OTSG 1A SLRD Defeated
			3	OTSG 1B SLRD Defeated
[illegible] G A Low Level	H	2	1	OTSG 1A LO LVL/EF Pumps Init.
[illegible] Pump Initiation on OTSG A Low-Low Level	H	2	1	OTSG 1A LO LVL/EF Pumps Init.
[illegible] Low Level	H	2	2	OTSG 1B LO LVL/EF Pumps Init.
[illegible] Initiation on OTSG B Low-Low Level	H	2	2	OTSG 1B LO LVL/EF Pumps Init.
[illegible]inment Pressure	D	1	6	RB Press 4
OTSG A [illegible] Steam Pressure	H	1	6	OTSG 1A LO PRESS/FW Isolation
OTSG A Low-Low Steam Pressure/FW Isolation	H	1	6	OTSG 1A LO PRESS/FW Isolation
OTSG B Low Steam Pressure	H	1	7	OTSG 1B LO PRESS/FW Isolation
OTSG B Low-Low Steam Pressure/FW Isolation	H	1	7	OTSG 1B LO PRESS/FW Isolation
OTSG A Low-Low Level/EF Initiation (Valves)	PRF	5	8	OTSG A/B LVL LO-LO EFW INIT
OTSG B Low-Low Level/EF Initiation (Valves)	PRF	5	8	OTSG A/B LVL LO-LO EFW INIT
EFW Pump A Initiation on Loss of MFW or Loss of all RC Pumps	J	1	3	EFW System A Autostart Actuated
EFW Pump B Initiation on Loss of MFW or Loss of all RC Pumps	J	2	3	EFW System B Autostart Actuated
EFW System A Autostart Defeated	PRF 1	2	1	EFW SYS A Autostart Defeated
EFW Initiation on Low-Low Level Defeated	PRF 1	2	1	EFW SYS A Autostart Defeated
EFW System B Autostart Defeated	PRF 1	2	2	EFW SYS B Autostart Defeated
EFW Initiation on Low-Low Level Defeated	PRF 1	2	2	EFW SYS B Autostart Defeated
Too many HSPS Channel in Test	PRF 1	3	3	Too many HSPS CHANS in test
Turbine Driven EFW Pump Overspeed TRIP	D	2	1	Turb Driven EFW Pump Overspeed Trip
Intermediate Building Flood Detection	PRF 1	3	5	Intermediate Building Flooding

TABLE 4

HSPS MODIFICATION LIST OF COMPUTER INPUTS

OTSG A High Level
OTSG A Overfill
MFW Isolation on OTSG 1A Hi-Hi Level
OTSG B High Level
OTSG B Overfill
MFW Isolation on OTSG 1B Hi-Hi Level

OTSG A Low Level
EFW Pump Initiation on OTSG a Low-Low Level
OTSG B Low Level
EFW Pump Initiation on OTSG B Low-Low Level

OTSG A Low Steam Pressure
MFW Isolation on OTSG 1A Low Pressure
OTSG B Low Steam Pressure
MFW Isolation on OTSG 1A Low Pressure

EFW Initiation on OTSG 1A Low Level
EFW Initiation on OTSG 1B Low Level

EFW Pump Initiation on Low OTSG Level Defeated
High-High Level Feedwater Isolation Defeated

TABLE 5
EFW MODIFICATION LIST OF ADDITIONAL INSTRUMENTS

PARAMETER MONITORED	CHANNEL I (RED)	CHANNEL II (GREEN)	CHANNEL III (YELLOW)	CHANNEL IV (BLUE)
OTSG A Operate Range Level	LT-1044	LT-1040	LT-1045	LT-1041
OTSG A Startup Range Level	LT-1046	LT-1042	LT-1047	LT-1043
OTSG A Full Range Level	LT-775	LT-789		
OTSG A Ref. Leg. Temp.	TE-1046	TE-1044	TE-1047	TE-1045
OTSG A Steam Line Pressure	PT-950	PT-1180	PT-1182	PT-1181
OTSG B Operate Range Level	LT-1052	LT-1048	LT-1053	LT-1049
OTSG B Startup Range Level	LT-1054	LT-1050	LT-1055	LT-1051
OTSG B Full Range Level	LT-788	LT-776		
OTSG B Ref. Leg. Temp.	TE-1050	TE-1048	TE-1051	TE-1049
OTSG B Steam Line Pressure	PT-1184	PT-951	PT-1185	PT-1183
Containment Pressure	PT-1186	PT-1187	PT-1188	PT-1189
CST A Level	LT-1060	LT-1061		
CST B Level	LT-1062	LT-1063		
EFW Pump A Flow	FT 779	FT-788		
EFW Pump B Flow	FT 791	FT-782		
MFW Pump 1A Diff Press.	DPS-829	DPS-542		
MFW Pump 1B Diff Press.	DPS-830	DPS-543		
RC Pump A Power Monitor (PM)	PM-1	PM-2		
RC Pump B Power Monitor (PM)	PM-1	PM-2		
RC Pump C Power Monitor (PM)	PM-1	PM-2		
RC Pump D Power Monitor (PM)	PM-1	PM-2		
I.B. Flood Detection Transmitters			LT 1039 (Sensor) LY 1039 (receiver)	
Turbine Driven Pump Limit Switch	ZS-10 (non-divisional)			

TABLE 6

EFW Modification list of Control Room Recorders and Indicators

PARAMETER	TAG NO.	CHANNEL	LOCATION
OTSG A EFW Flow	FI-779	I (RED)	CC
	FI-788	II (GREEN)	PLF
OTSG B EFW Flow	FI-791	I (RED)	CC
	FI-782	II (GREEN)	PLF
OTSG A LEVEL			
START UP RANGE	LR-1046/1054*	I (RED)	CC
	LI-1042	II (GREEN)	PLF
OPERATE RANGE	LR-1044/1052*	I (RED)	CC
	LR-1040/1048*	II (GREEN)	CC
	LI-1040	II (GREEN)	PLF
FULL RANGE	LI-775B	I (RED)	CC
	LI-789B	II (GREEN)	CL
OTSG B LEVEL			
START UP RANGE	LR-1046/1054*	I (RED)	CC
	LI-1050	II (GREEN)	PLF
OPERATE RANGE	LR-1044/1052*	I (RED)	CC
	LR-1040/1048*	II (GREEN)	CC
	LI-1048	II (GREEN)	PLF
FULL RANGE	LI-788B	I (RED)	CC
	LI-776B	II (GREEN)	CC
CST A LEVEL	LI-1060	I (RED)	PCL
	LI-1061	II (GREEN)	PCL
	LI-43	NON-DIVISIONAL	CC
CST B LEVEL	LI-1062	I (RED)	PCL
	LI-1063	II (GREEN)	PCL
	LI-44	NON-DIVISIONAL	CC

*-Instrument listed twice-instrument is a two pen recorder

EFW Long Term Modifications Drawing List

Drawing's Sent August 6, 1984

EFW Bypass Line (Seismic)	0370-039-001	Rev 3
EFW Recirc Line (Seismic)	0370-039-003	Rev 3
Flood Protection Mod.	0370-039-006	Rev 1
EFW Bypass and Recirc Line (Seismic)	0370-039-007	Rev 0
Main Steam Vent Stack (Seismic)	0370-039-009	Rev 3
Main Steam	0370-039-010	Rev 3
Condensate	0370-039-011	Rev 0
Main Steam Vent Stack (Seismic)	0370-39-017	Rev 0
EFW Bypass Line Valve List	0370-39-021	Rev 0 (SH1)
Flood Protection Mod.	0370-39-021	Rev 0
Emergency Feed Water	E-304-086	Rev IB0

Drawings Sent February 19, 1985

EFW Turbine Driven Pump Overspeed Alarm

202-092 Rev. IA-0 Ovrspd Trip Alarm for EFP-1
SS-201-204 Rev. IB-0 Light Box D
SS-209-635 Rev. IF-0 Alarms

Intermediate Building Flood Detection

202-093 Rev. IA-0 IB Sump & Flood Level Indicators
521-158 Rev. IA-0 Flood Detector Monitoring Detail
C-209-956 Rev. IS-0 PRF 1 Annunciator
C-604-009 Rev. IB-1 Cont. Water Level Cab. C

COV-14 A/B and COV-111 A/B Upgrades

SS-208-505 Rev. IA-1 Electrical 480V CC
SS-202-090 Rev. IA-0 EFW Block Diagrams
SS-202-090 Rev. IA-1 "

Heat Sink Protection System

0370-064-014 Rev. 0 EFW Block Valve EFV 52 (Typical)
0370-064-002 Rev. 0 MS&FW Instrumentation
0370-064-010 Rev. 0 Main Control Panel CC Revisions
0370-064-011 Rev. 0 Main Control Panal CC Revisions
0370-064-001 Rev. 1 SH1 HSPS Mod Elec. Blk Diagram
" " SH2 "
IC-640-41-001 Rev. 0 Logic Diagram FW Isolation OTSGA
" -002 " " Hi Lvl
" -003 " EFW Initiation on Lo Lvl
" -004 " Cont Press-RPS/ES/FWRD
" -005 " MSRD
" -006 " EF Initiation
" -007 " Logic Diagram FW Isolation OTSG B
" -008 " " Hi Level
" -009 " EFW Initiation on Lo Lvl
" -010 " FWRD
" -011 " MSRD
" -012 " EF Initiation
" -013 " EF Initiation on Lo Lvl (Valves) OTSG A
" -014 " " OTSG B
" -015 " FW Isolation on Hi Lvl OTSG A/B
" -016 " MSRD OTSG A/B
IC-640-41-001 " Instrument Loop Press/Lvl OTSG A
" -002 " "
" -003 " EF/FW OTSG A
" -004 " Press/Lvl OTSG B
" -005 " "
" -006 " EF/FW OTSG B
" -007 " CST A/B Level