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March 5, 1993

Docket No. STN 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: **Submittal Supporting Accelerated ABWR Review Schedule - I & C Diversity**

Dear Chet:

Enclosed are replacement pages for the text provided in my February 26, 1993 letter. The modifications are indicated by a vertical bar on the right hand column. These modifications are a result of a phone call between George Thomas and Frank Paradiso.

Sincerely,

Jack Fox

Jack Fox
Advanced Reactor Programs

cc: Norman Fletcher (DOE)
Monty Ross (GE)

JF93-50

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3/5/93

## EVENT: FEEDWATER LINE BREAK INSIDE CONTAINMENT

This event is postulated to be a break of a feedwater line coincident with a undiscovered common mode failure of the Essential Multiplex System (EMUX) in such a manner that all valid and correct EMUX control and monitoring data transmissions are lost.

### AUTOMATIC ACTIONS

After a feedwater line break inside containment, the reactor would be expected to automatically scram on High Drywell Pressure or RPV water Level 3. Because of the assumed EMUX common mode failure, these scram functions are postulated to fail. In addition, all ECCS systems are assumed not be available because of the postulated common mode failure. For the postulated line break, the RPV pressure will drop rapidly, resulting in closure of the turbine control valves by the pressure regulator and automatic scram signals (hardwired) from the subsequent turbine trip. Also, when RPV water level drops to Level 2, the ATWS scram functions are automatically activated (independent of EMUX) and initiate an automatic scram.

### EOP ENTRY CONDITIONS:

The following alarms are provided by equipment independent of the EMUX. These are the entry conditions for emergency operating procedures expected for a LOCA inside the primary containment from instruments that are hardwired.

| | SAR Appendix 18F Reference |
|---|---|
| 1. RPV WATER LEVEL LOW [FIXED POSITION], | Column 8, 18F-14 |
| 2. DRYWELL PRESSURE HIGH [FIXED POSITION], | Column 8, 18F-121 |

### OPERATOR ACTIONS PER EOPS

The expected principal operator actions are given herein. All control functions and process parameters are provided by equipment independent of EMUX.

Upon entering the EOPs developed from the RPV Control Guideline on High Drywell Pressure or RPV Water Level Low as an entry condition, and concurrently entering EOPs developed from the Primary Containment Control Guideline on Drywell Pressure High alarm as an entry condition, the following sets of actions are executed concurrently:

I. RPV Control

1. Initiate a manual scram if a scram has not been initiated .
2. Initiate reactor isolation if it should have been isolated automatically but did not.
3. Restore and maintain RPV water level (water level signal is hardwired) above Level 3 using the CRD system, maximizing flow into the RPV.
4. If RPV water level cannot be maintained above Level 3, maintain RPV water level above top of the active fuel.
5. When RPV water level cannot be maintained above top of the active fuel, depressurize the reactor (this action is not necessary as the reactor is depressurized through the break).

**OPERATOR ACTIONS PER EOPS (continued)**

II. Primary Containment Control:

1. Initiate wetwell sprays using the fire protection system and the firewater addition mode of RHR(C) for primary containment pressure control.
2. If necessary, initiate drywell spray using the fire protection system and the firewater addition mode of RHR(C ) for primary containment pressure control (drywell pressure signal is hardwired).

**CONTAINMENT RESPONSE**

The increase in suppression pool temperature due to vessel blowdown energy and decay heat is calculated to be approximately 70 °F over a time period of one hour. From this calculation, it is concluded that initiation of suppression pool cooling using RHR will not be required for the first hour of this postulated scenario in which all operator actions are limited to those performed in the main control room. The RHR suppression pool cooling function is assumed to be not available because of the EMUX common mode failure. Subsequent operator actions at the Remote Shutdown System will include initiation of the RHR suppression pool cooling function.

**COMPARISION TO CHAPTER 6 LOCA ANALYSIS**

The analysis in Chapter 6 assumed the operability of 1 HPCF, 2 loops of LPFL and 8 ADS valves. In addition, the automatic reactor isolation on Low Water Level 1.5 is assumed to be functional. The calculated peak clad temperature is 1008 °F as given in Table 6.3-4.

**LOCA ANALYSIS**

The complete circumferential break of a feedwater injection line was analyzed. For this case, both CRDs were assumed to be available for RPV makeup. The CRD takes suction from the condensate system. The hotwell holds enough water to provide 4 minutes of rated feedwater flow.

After scram one CRD pump continues to inject water into the RPV. The operator is assumed to start the other CRD pump but CRD injection flow is not enough to overcome the break flow. The water level continues to drop and the core is uncovered. Furthermore, it is assumed that the operator isolates the reactor 30 seconds after Low Water Level 1.5 is reached. The reactor is depressurized through the break and hence an emergency depressurization is not required. Refer to Figures 1 through 3 for analysis results. The peak cladding temperature is 1852 °F which is well below the 2200 °F limit.

**SUMMARY**

For the postulated event of a feedwater line break inside the containment, sufficient automatic control functions, information, and controls that are independent of EMUX are available in the main control room to mitigate the event and maintain the fuel clad temperature below its limit, assuming that all operator actions will be limited to the main control room for the first hour. Sufficient water inventory is available for decay heat removal during that one hour period. Subsequently, reactor cold shutdown conditions and post accident recovery operations can be initiated using the Remote Shutdown System.

## EVENT: STEAM LINE BREAK INSIDE CONTAINMENT

This event is postulated to occur coincident with a undiscovered common mode failure of the Essential Multiplex System (EMUX) in such a manner that all valid and correct EMUX control and monitoring data transmissions are lost.

### AUTOMATIC ACTIONS

After a steam line break inside containment, the main turbine and reactor feedpumps are tripped on a High Water Level 8 signal which is diverse from the SSLC. After the turbine is tripped, the reactor is scrammed from hardwired signals to the RPS from the turbine control system. It is postulated that because of EMUX common mode failure, the automatic isolation of the MSIVs is assumed to fail.

### EOP ENTRY CONDITIONS:

The following alarms are provided by equipment independent of the EMUX. These are the entry conditions for emergency operating procedures expected for a LOCA inside the primary containment from instruments that are hardwired.

| | SAR Appendix 18F Reference |
|---|---|
| 1. RPV WATER LEVEL LOW [FIXED POSITION]. | Column 8, 18F–14. |
| 2. DRYWELL PRESSURE HIGH [FIXED POSITION]. | Column 8, 18F–121 |

### OPERATOR ACTIONS PER EOPS

The expected principal operator actions are given herein. All control functions and process parameters are provided by equipment independent of EMUX.

Upon entering the EOPs developed from the RPV Control Guideline on High Drywell Pressure or RPV Water Level Low as an entry condition, and concurrently entering EOPs developed from the Primary Containment Control Guideline on Drywell Pressure High alarm as an entry condition, the following sets of actions are executed concurrently:

I. RPV Control

1. Initiate a manual scram if a scram has not been initiated .
2. Initiate reactor isolation if it should have been isolated automatically but did not. (MSIV control is hardwired)
3. Restore and maintain RPV water level (water level signal is hardwired) above Level 3 using the CRD pumps and the condensate pumps.
4. If RPV water level cannot be maintained above Level 3, maintain RPV water level above top of the active fuel.
5. When RPV water level cannot be maintained above top of the active fuel, depressurize the reactor (this action is not necessary as the reactor is depressurized through the break).

II. Primary Containment Control:

1. Initiate wetwell sprays using the fire protection system and the firewater addition mode of RHR(C) for primary containment pressure control.
2. If necessary, initiate drywell spray using the fire protection system and the firewater addition mode of RHR(C ) for primary containment pressure control (drywell pressure signal is hardwired).

## CONTAINMENT RESPONSE

The increase in suppression pool temperature due to vessel blowdown energy and decay heat is calculated to be approximately 70 °F over a time period of one hour. From this calculation, it is concluded that initiation of suppression pool cooling using RHR will not be required for the first hour of this postulated scenario in which all operator actions are limited to those performed in the main control room. The RHR suppression pool cooling function is assumed to be not available because of the EMUX common mode failure. Subsequent operator actions at the Remote Shutdown System will include initiation of the RHR suppression pool cooling function.

## COMPARISION TO CHAPTER 6 LOCA ANALYSIS

The analysis in Chapter 6 assumed the operability of 1 HPCF, RCIC, 2 loops of LPFL and 8 ADS valves. In addition, the automatic reactor isolation on Low Water Level 1.5 is assumed to be functional. The calculated peak clad temperature is 1025 °F as given in Table 6.3-4.

## LOCA ANALYSIS RESULTS

For main steamline break, scram was assumed to occur from tripping of the main turbine on a High Water Level 8 signal which is diverse from the SSLC. Also at the start of the LOCA, reactor feedpumps were tripped off by the Level 8 signal. It was also assumed that one CRD pump was running at the start of the LOCA and soon afterwards the operator placed the second CRD pump in operation to inject water into the RPV. In addition, reactor isolation was assumed to occur as a result of operator action upon entering the EOPs (assumed approximately 30 seconds after Low Water Level 1.5 is reached). Furthermore, it is assumed that the operator will place one condensate pump in operation to inject water into the RPV. This action is conservatively assumed to occur within 5 minutes after reaching Low Level 2. Thus RPV reflooding begins at this time since the reactor depressurizes through the break. Refer to Figures 1 through 3 for analysis results. These results of the analysis show that the peak clad temperature is 1578 °F, well below the limit of 2200 °F.

## SUMMARY

For the postulated event of main steam line break inside containment coincident with an EMUX common mode failure sufficient automatic control functions, information, and controls that are independent of EMUX are available in the main control room to mitigate the event, assuming that all operator actions will be limited to the main control room for the first hour. Sufficient water inventory is available for decay heat removal during that one hour period. Subsequently, reactor cold shutdown conditions and post accident recovery operations can be initiated using the Remote Shutdown System.

## EVENT: HPCF LINE BREAK INSIDE CONTAINMENT

This event is postulated to be a break of HPCF(C) injection line coincident with a undiscovered common mode failure of the Essential Multiplex System (EMUX) in such a manner that all valid and correct EMUX control and monitoring data transmissions are lost.

### AUTOMATIC ACTIONS

After a HPCF(C) line break inside containment, the reactor would be expected to automatically scram on High Drywell Pressure. Because of the assumed EMUX common mode failure, this scram is postulated to fail. In addition, all ECCS systems are assumed not be available because of the postulated common mode failure and the break postulated in HPCF(C). The reactor feedpumps are assumed to fail. For the postulated line break, reactor scram is assumed to occur on a Low Water Level 2 ATWS scram signal which is diversed from the SSLC. The MSIVs should close when RPV water level drops to Level 1.5 but because of the assumed common mode failure, the MSIVs will not close automatically.

### EOP ENTRY CONDITIONS:

The following alarms are provided by equipment independent of the EMUX. These are the entry conditions for emergency operating procedures expected for a LOCA inside the primary containment from instruments that are hardwired.

| | SAR Appendix 18F Reference |
|---|---|
| 1. DRYWELL PRESSURE HIGH [FIXED POSITION], | Column 8, 18F–121 |

### OPERATOR ACTIONS PER EOPS

The expected principal operator actions are given herein. All control functions and process parameters are provided by equipment independent of EMUX.

Upon entering the EOPs developed from the RPV Control Guideline on High Drywell Pressure as an entry condition, and concurrently entering EOPs developed from the Primary Containment Control Guideline on Drywell Pressure High alarm as an entry condition, the following sets of actions are executed concurrently:

I. RPV Control

1. Initiate a manual scram if a scram has not been initiated .

2. Initiate reactor isolation if it should have been isolated automatically but did not.

3. Maintain RPV water level (water level signal is hardwired) above Level 3 using the condensate pumps and the CRD pumps. Since the postulated break is located at the HPCF(C) injection line which is below Level 1 but above top of the active fuel, water will spill out the break and into the drywell.

4. If RPV water level cannot be maintained above Level 3, maintain RPV water level above top of the active fuel.

5. When RPV water level drops below top of the active fuel, perform an emergency depressurization.

**OPERATOR ACTIONS PER EOPS (continued)**

II. Primary Containment Control:

1. Initiate wetwell sprays using the fire protection system and the firewater addition mode of RHR(C) for primary containment pressure control.
2. If necessary, initiate drywell spray using the fire protection system and the firewater addition mode of RHR(C ) for primary containment pressure control (drywell pressure signal is hardwired).

## CONTAINMENT RESPONSE

The increase in suppression pool temperature due to vessel blowdown energy and decay heat is calculated to be approximately 70 °F over a time period of one hour. From this calculation, it is concluded that initiation of suppression pool cooling using RHR will not be required for the first hour of this postulated scenario in which all operator actions are limited to those performed in the main control room. The RHR suppression pool cooling function is assumed to be not available because of the EMUX common mode failure. Subsequent operator actions at the Remote Shutdown System will include initiation of the RHR suppression pool cooling function.

## COMPARISION TO CHAPTER 6 LOCA ANALYSIS

The analysis in Chapter 6 assumed the operability of RCIC, 2 loops of LPFL and 8 ADS valves. In addition, the automatic reactor isolation on Low Water Level 1.5 is assumed to be functional. The calculated peak clad temperature is 1008°F as given in Table 6.3-4.

## LOCA ANALYSIS

The complete circumferential break of the HPCF(C) injection line was analyzed. For this case only the control rod drive makeup system and one condensate pump were assumed to be available for RPV makeup. The CRD takes suction from the the condensate system (hotwell) or from the CST.

After scram the CRD continues to inject water into the RPV but it is not enough to overcome the break flow. The water level continues to drop and the core is uncovered . Upon entry into the EOPs, the operator is assumed to isolate the reactor 30 seconds after reaching the automatic isolation setpoint of Level 1.5. It is further assumed that the operator will operate one condensate pump to inject water into the RPV. This action is assumed to occur at 5 minutes after RPV drops to Level 2 (operator is instructed to control water level above Level 3 with available injection systems). Refer to Figures 1, 2 and 3 for analysis results. The calculated peak cladding temperature is 1028 °F which is well below the 2200 °F limit.

## SUMMARY

For the postulated event of HPCF(C) line break inside the containment, sufficient automatic control functions, information, and controls that are independent of EMUX are available in the main control room to mitigate the event and maintain the fuel clad temperature below its limit, assuming that all operator actions will be limited to the main control room for the first hour. Sufficient water inventory is available for decay heat removal during that one hour period. Subsequently, reactor cold shutdown conditions and post accident recovery operations can be initiated using the Remote Shutdown System.

# EVENT: SHUTDOWN COOLING LINE BREAK INSIDE CONTAINMENT

This event is postulated to be a break of one shutdown cooling line of RHR coincident with a undiscovered common mode failure of the Essential Multiplex System (EMUX) in such a manner that all valid and correct EMUX control and monitoring data transmissions are lost.

## AUTOMATIC ACTIONS

After a shutdown cooling line break inside containment, the reactor would be expected to automatically scram on High Drywell Pressure. Because of the assumed EMUX common mode failure, this scram is postulated to fail. In addition, all ECCS systems are assumed not be available because of the postulated common mode failure . The reactor feedpumps are assumed to fail at the beginning of the event. For the postulated line break, reactor scram is assumed to occur on a Low Water Level 2 ATWS scram signal which is diversed from the SSLC. The MSIVs should close when RPV water level drops to Level 1.5 but because of the assumed common mode failure, the MSIVs will not close automatically.

## EOP ENTRY CONDITIONS:

The following alarms are provided by equipment independent of the EMUX. These are the entry conditions for emergency operating procedures expected for a LOCA inside the primary containment from instruments that are hardwired.

| | SAR Appendix 18F Reference |
|---|---|
| 1. DRYWELL PRESSURE HIGH [FIXED POSITION]. | Column 8, 18F–121 |

## OPERATOR ACTIONS PER EOPS

The expected principal operator actions are given herein. All control functions and process parameters are provided by equipment independent of EMUX.

Upon entering the EOPs developed from the RPV Control Guideline on High Drywell Pressure as an entry condition, and concurrently entering EOPs developed from the Primary Containment Control Guideline on Drywell Pressure High alarm as an entry condition, the following sets of actions are executed concurrently:

I. RPV Control

1. Initiate a manual scram if a scram has not been initiated .
2. Initiate reactor isolation if it should have been isolated automatically but did not.
3. Maintain RPV water level (water level signal is hardwired) above Level 3 using the condensate pumps and the CRD pumps.
4. If RPV water level cannot be maintained above Level 3, maintain RPV water level above top of the active fuel.
5. When RPV water level drops below top of the active fuel, perform an emergency depressurization.

## OPERATOR ACTIONS PER EOPS (continued)

II. Primary Containment Control:

1. Initiate wetwell sprays using the fire protection system and the firewater addition mode of RHR(C) for primary containment pressure control.
2. If necessary, initiate drywell spray using the fire protection system and the firewater addition mode of RHR(C ) for primary containment pressure control (drywell pressure signal is hardwired).

## CONTAINMENT RESPONSE

The increase in suppression pool temperature due to vessel blowdown energy and decay heat is calculated to be approximately 70 °F over a time period of one hour. From this calculation, it is concluded that initiation of suppression pool cooling using RHR will not be required for the first hour of this postulated scenario in which all operator actions are limited to those performed in the main control room. The RHR suppression pool cooling function is assumed to be not available because of the EMUX common mode failure. Subsequent operator actions at the Remote Shutdown System will include initiation of the RHR suppression pool cooling function.

## COMPARISION TO CHAPTER 6 LOCA ANALYSIS

The analysis in Chapter 6 assumed the operability of 1 HPCF, RCIC, 2 loops of LPFL and 8 ADS valves. In addition, the automatic reactor isolation on Low Water Level 1.5 is assumed to be functional. The calculated peak clad temperature is 1008 °F as given in Table 6.3-4.

## LOCA ANALYSIS

The complete circumferential break of a shutdown cooling suction line was analyzed. For this case only the control rod drive makeup system and one condensate pump were assumed to be available for RPV makeup. The CRD takes suction from the the condensate system (hotwell) or from the CST.

After scram the CRD continues to inject water into the RPV but the CRD flow is not enough to overcome the break flow. The water level continues to drop and the core is uncovered . Upon entry into the EOPs, the operator is assumed to isolate the reactor 30 seconds after reaching the automatic isolation setpoint of Level 1.5. It is further assumed that the operator will operate one condensate pump to inject water into the RPV. This action is assumed to occur at 5 minutes after RPV drops to Level 2 (operator is instructed to control water level above Level 3 with available injection systems). The reactor is depressurized through the break. Refer to Figures 1, 2 and 3 for analysis results. The calculated peak cladding temperature is 1032 °F which is well below the 2200 °F limit.

## SUMMARY

For the postulated event of a shutdown cooling suction line break inside the containment, sufficient automatic control functions, information, and controls that are independent of EMUX are available in the main control room to mitigate the event and maintain the fuel clad temperature below its limit, assuming that all operator actions will be limited to the main control room for the first hour. Sufficient water inventory is available for decay heat removal during that one hour period. Subsequently, reactor cold shutdown conditions and post accident recovery operations can be initiated using the Remote Shutdown System.

## EVENT: BOTTOM DRAIN LINE BREAK INSIDE CONTAINMENT

This event is postulated to be a break of RPV bottom drain line coincident with a undiscovered common mode failure of the Essential Multiplex System (EMUX) in such a manner that all valid and correct EMUX control and monitoring data transmissions are lost.

### AUTOMATIC ACTIONS

After a RPV bottom drain line break inside containment, the reactor would be expected to automatically scram on High Drywell Pressure. Because of the assumed EMUX common mode failure, this scram is postulated to fail. In addition, all ECCS systems are assumed not be available because of the postulated common mode failure . The reactor feedpumps are assumed to fail at the beginning of the event. For the postulated line break, reactor scram is assumed to occur on a Low Water Level 2 ATWS scram signal which is diversed from the SSLC. The MSIVs should close when RPV water level drops to Level 1.5 but because of the assumed common mode failure, the MSIVs will not close automatically.

### EOP ENTRY CONDITIONS:

The following alarms are provided by equipment independent of the EMUX. These are the entry conditions for emergency operating procedures expected for a LOCA inside the primary containment from instruments that are hardwired.

| | SAR Appendix 18F Reference |
|---|---|
| 1. DRYWELL PRESSURE HIGH [FIXED POSITION], | Column 8, 18F–121 |

### OPERATOR ACTIONS PER EOPS

The expected princ'pal operator actions are given herein. All control functions and process parameters are provided by eq :ment independent of EMUX.

Upon entering the EOPs developed from the RPV Control Guideline on High Drywell Pressure as an entry condition, and concurrently entering EOPs developed from the Primary Containment Control Guideline on Drywell Pressure High alarm as an entry condition, the following sets of actions are executed concurrently:

I. RPV Control

1. Initiate a manual scram if a scram has not been initiated .
2. Initiate reactor isolation if it should have been isolated automatically but did not.
3. Maintain RPV water level (water level signal is hardwired) above Level 3 using the condensate pumps and the CRD pumps.
4 If RPV water level cannot be maintained above Level 3, maintain RPV water level above top of the active fuel.
5 When RPV water level drops below top of the active fuel, perform an emergency depressurization.

## OPERATOR ACTIONS PER EOPS (continued)

II. Primary Containment Control:

1. Initiate wetwell sprays using the fire protection system and the firewater addition mode of RHR(C) for primary containment pressure control.
2. If necessary, initiate drywell spray using the fire protection system and the firewater addition mode of RHR(C ) for primary containment pressure control (drywell pressure signal is hardwired).

## CONTAINMENT RESPONSE

The increase in suppression pool temperature due to vessel blowdown energy and decay heat is conservatively bounded by the other inside containment LOCA events and therefore will be less than 70 °F over a time period of one hour. From this calculation, it is concluded that initiation of suppression pool cooling using RHR will not be required for the first hour of this postulated scenario in which all operator actions are limited to those performed in the main control room. The RHR suppression pool cooling function is assumed to be not available because of the EMUX common mode failure. Subsequent operator actions at the Remote Shutdown System will include initiation of the RHR suppression pool cooling function.

## COMPARISION TO CHAPTER 6 LOCA ANALYSIS

The analysis in Chapter 6 assumed the operability of 1 HPCF, RCIC, 2 loops of LPFL and 8 ADS valves. In addition, the automatic reactor isolation on Low Water Level 1.5 is assumed to be functional. The calculated peak clad temperature is 1008 °F as given in Table 6.3-4.

## LOCA ANALYSIS

The complete circumferential break of the RPV bottom drain line was analyzed. For this case only the control rod drive makeup system and one condensate pump were assumed to be available for RPV makeup. The CRD takes suction from the the condensate system (hotwell) or from the CST.

After scram the CRD continues to inject water into the RPV but the CRD flow is not enough to overcome the break flow. The water level continues to drop and the core is uncovered . Upon entry into the EOPs, the operator is assumed to isolate the reactor 30 seconds after reaching the automatic isolation setpoint of Level 1.5. It is further assumed that the operator will operate one condensate pump to inject water into the RPV. This action is assumed to occur at 5 minutes after RPV drops to Level 2 (operator is instructed to control water level above Level 3 with available injection systems). When water level drops below the top of active fuel, the operator is assumed to re-open the MSIVs and perform an emergency depressurization (per EOPs) to depressurize the reactor and thus permit condensate system flow to the RPV. Refer to Figures 1, 2 and 3 for analysis results. The calculated peak cladding temperature is 1173 °F which is well below the 2200 °F limit.

## SUMMARY

For the postulated event of RPV bottom drain line break inside the containment, sufficient automatic control functions, information, and controls that are independent of EMUX are available in the main control room to mitigate the event and maintain the fuel clad temperature below its limit, assuming that all operator actions will be limited to the main control room for the first hour. Sufficient water inventory is available for decay heat removal during that one hour period. Subsequently, reactor cold shutdown conditions and post accident recovery operations can be initiated using the Remote Shutdown System.

# EVENT: 15.2.2.2.1.3 GENERATOR LOAD REJECTION WITH FAILURE OF ALL BYPASS VALVES, 15.2.3.2.1.3 TURBINE TRIP WITH FAILURE OF ALL BYPASS VALVES

These events are postulated to occur coincident with a undiscovered common mode failure of the Essential Multiplex System (EMUX) in such a manner that all valid and correct EMUX control and monitoring data transmissions are lost. The reactor response to these two events are similar.

## AUTOMATIC ACTIONS

Upon a turbine/generator trip, the reactor scrams immediately. The scram signals generated by turbine stop valve or control valve instruments are hardwired to RPS. The SRVs open on spring setpoint since it is assumed that the SRVs cannot be open by its normal relief mode due to the postulated common mode failure. One CRD continues to injects water into the RPV since it is normally in operation.

## EOP ENTRY CONDITIONS:

The following alarm condition is provided by equipment independent of the EMUX and is an entry condition to the emergency operating procedures:

| | SAR Appendix 18F Reference |
|---|---|
| 1. RPV WATER LEVEL LOW [FIXED POSITION]. | Column 8, 18F–14. |

## OPERATOR ACTIONS

For this event scenario, the CRD pumps are used to inject water into the RPV. It is assumed that because of the failure of the bypass valves, the bypass valves can not be reopen for decay heat removal.

1. Enter EOPs developed from the RPV Control Guideline, upon receiving the RPV Water Level Low alarm.
2. Restore and maintain water level (water level signal is hardwired) above Level 3 using both CRD pumps and one condensate pump if reactor pressure decreases below its shutoff head.
3. If water level cannot be maintained above Level 3, control water level above top of active fuel.
4. If water level drops below top of active fuel, perform an emergency depressurization (because of the assumed failure of the bypass valves and the control capability of ADS and SRVs, this operation is not possible).

## CONTAINMENT RESPONSE

The increase in suppression pool temperature due to decay heat is calculated to be approximately 40 °F over a time period of one hour. From this calculation, it is concluded that initiation of suppression pool cooling using RHR will not be required for the first hour of this postulated scenario in which all operator actions are limited to those performed in the main control room. The RHR suppression pool cooling function is assumed to be not available because of the EMUX common mode failure. Subsequent operator actions at the Remote Shutdown System will include initiation of the RHR suppression pool cooling function.

## COMPARISON TO CHAPTER 15 ANALYSIS

The analysis in Chapter 15 only simulated the first five seconds of the turbine/generator trip with bypass failure event. The primary purpose is to analyze the effect on fuel thermal margins.

## ANALYSIS RESULTS

The analysis assumed the use of both CRD pumps for RPV makeup. Since the reactor pressure does not decrease below the shutoff head of the condensate pump, the operator will not be able to operate the condensate pumps for makeup to the RPV. This is assumed to occur approximately 5 minutes after RPV water level drops to Low Level 2. The SRVs are assumed to open on the spring relief setpoint and discharge steam to the suppression pool. The turbine bypass valves are assumed to fail and hence cannot be used for pressure control and decay heat removal. Refer to Figures 1, 2, and 3 for analysis results. The peak clad temperature is 1310 °F, well below the 2200 °F limit.

## SUMMARY

For the postulated event of turbine trip or generator trip with total failure of the bypass valves coincident with an EMUX common mode failure, sufficient information and controls that are independent of EMUX are available in the main control room to mitigate the event, assuming that all operator actions will be limited to the main control room for the first hour. Sufficient water inventory is available for decay heat removal during that one hour period. Subsequently, reactor cold shutdown conditions and post accident recovery operations can be initiated using the Remote Shutdown System.