 

# Revised Limerick D3 Analysis – NRC Meeting June 16th, 2022

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# Summary

- In response to NRC OI 8, each credited non-safety system in the D3 Analysis for coping with a PPS CCF was reviewed using the NUREG-6303 diversity categories.
- The D3 Analysis will be updated to include a table describing the NUREG-6303 diversity attributes for each credited non-safety system
- During this process of reviewing credited non-safety systems, the non-safety Level 8 trip system was analyzed.
  - System is comprised of four (4) ABB AC70 PLCs
  - [ ]a,c
  - [ ]a,c
  - Reviewing the NUREG-6303 diversity criteria it was determined that the level of diversity was insufficient to credit the non-safety Level 8 trip system in the analyses
- All other credited non-safety systems have sufficient diversity based on the criteria in NUREG-6303

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# New D3 Analysis Table 6-1
# Diverse Non-Safety Systems
# Credited for Coping with a PPS CCF

 

| System | Human Diversity | Design Diversity | Software Diversity | Functional Diversity | Signal Diversity | Equipment Diversity |
|---|---|---|---|---|---|---|
| RBM<br><br>APRM<br><br>RWM | General Electric Company | Independent hardware and MCR displays (ODAs) | Custom GEH code run on an executive loop | Monitors neutron flux in core | LPRM's are direct inputs to APRMs / RBM | NUMAC, Harris 80C36 microprocessor |
| SRM / IRM | General Electric Company | Independent hardware and MCR displays (Analog Meters) | N/A | Monitors neutron flux in core | SRM / IRM detectors directly to associate analog drawer | Analog |
| DFWLCS | ABB (Westinghouse) | Independent hardware and MCR operator workstation / analog meters | • Unix MCR workstation<br>• Control builder for function blocks | Controls reactor level via speed demand to non-safety related reactor feedwater pumps | Independent, non-safety related, reactor level, feedwater flow and steam line flow sensors | AC450 |
| Reactor Feedpump Turbine Trip Circuits, Low Suction Pressures | Bechtel | Independent analog hardware (Independent of both PPS and DFWLCS) | N/A | Provides trip signal to A/B/C reactor feedwater pump turbine speed control system | Independent, non-safety related, feedpump suction pressure switches and time delay relays (5s for C, 10s for B, and 15s for A turbine trips) | Analog |

 

| System | Human Diversity | Design Diversity | Software Diversity | Functional Diversity | Signal Diversity | Equipment Diversity |
|---|---|---|---|---|---|---|
| DEHC | Westinghouse | Independent hardware and MCR operator workstation | • Ovation MCR workstation<br>• Ovation Control Builder for function blocks | Controls reactor pressure via turbine control valves and bypass valves | Independent, non-safety related, reactor and MSL pressure sensors | Ovation 3.3.1 |
| Plant Process Computer (PPC) | Scientech | Independent hardware and MCR operator workstations (multiple) | • R*Time (MCR Displays)<br>• Custom Scientech code (system servers) | Monitors plant parameters via dedicated I/O | • Independent sensors<br>• Monitors shared sensors signal via independent I/O | • RTP I/O<br>• HP servers<br>• Cisco network switches |
| Reactor Feedwater Pump Turbine (RFPT) speed control | Woodward | Independent hardware and dedicated MCR hand switches | Control Assistant | Controls reactor level via speed demand to non-safety related reactor feedwater pumps | • Automatic input from DFWLCS<br>• Manual input from MCR hand switches<br>• Independent speed sensors | MicroNet (Motorola MPC5200) |
| Recirculation Flow Control | Siemens | Independent hardware and dedicated MCR pushbuttons | PLC: Simatic Step 7 for programing | Controls recirculation pump speed (neutron flux) via dedicated inputs from MCR pushbuttons | Manual input from MCR operators | Simatic S7400 Adjustable Speed Drive |

 

| System | Human Diversity | Design Diversity | Software Diversity | Functional Diversity | Signal Diversity | Equipment Diversity |
|---|---|---|---|---|---|---|
| Reactor Manual Control (RMCS) | GE Nuclear | Independent hardware and dedicated MCR control panel | N/A | Controls reactor power via control of rod positions via dedicated inputs from MCR control panel | Manual input from MCR operators | TTL |

 

# D3 Analysis Changes

 

# Impacted D3 Analyses Without the L8 Trip Device

- Section 3.2 Event 15.1.2 FW controller failure-maximum demand with no turbine bypass
- Section 3.3 Event 15.1.2 FW controller failure-maximum demand with turbine bypass
- Section 3.4 Event 15.1.3 Pressure regulator failure-open
- Section 3.19 Event 15.3.1 Trip of two recirculation pumps
- Section 3.34 Event 15.6.5 LOCA inside containment-main steam line break
- Section 5.6 Spurious HPCI initiation

 

# Summary of Analysis Conclusions Without the L8 Trip Device

- Event 15.1.2 FW controller failure-maximum demand with no turbine bypass:
  - Only one of the three feedpump turbines will trip due to low suction pressure (C feedpump). Pumps A and B are not tripped on low suction pressure and will ramp up to maximum demand and inject into the RPV.
- Event 15.1.2 FW controller failure-maximum demand with turbine bypass:
  - Only one of the three feedpump turbines will trip due to low suction pressure (C feedpump). Pumps A and B are not tripped on low suction pressure and will ramp up to maximum demand and inject into the RPV. DFWLCS and DEHC control level and pressure, respectively.
- Event 15.1.3 Pressure regulator failure-open:
  - Auto MSIV isolation on main steam line pressure low is specified for DPS, thus the main turbine will trip on reverse power (from turbine protection system) leading to a loss of motive steam to the feedpumps
- 15.3.1 Trip of two recirculation pumps:
  - Current analysis indicates Level 8 trip is avoided after the two recirculation pumps tripped, and level and pressure are controlled by the DFWLCS and DEHC, respectively and the reactor power is reduced by the decrease in core flow. Operation procedure requires a manual scram after the two pump trip to avoid operation in the instability region of the power/flow map. Even if it is assumed that the level swells and exceed the Level 8 trip setpoint, the main and feedpump turbines will not trip because the Level 8 trip is assumed to fail to respond. Results would be the same
- 5.6.5 LOCA inside containment-main steam line break:
  - Turbine will trip on reverse power after MSIV auto closure. Subsequently recirculation pumps trip on 13kV bus fast transfer. Reactor power decreases due to recirculation pump trips and depressurization. Manual scram will occur upon EOP entry.
- 5.6 Spurious HPCI initiation:
  - Steam lines will be flooded regardless of tripping the RFPTs or not due to worst case initial conditions set a low reactor pressure and the turbine offline. Water will be introduced into the Main Steam Lines and operator response to high reactor level is as currently noted in the D3 response.

 

# D3 Analysis Markups

 

# Section 3.2 Event 15.1.2 FW controller failure-maximum demand with no turbine bypass

 

# Section 3.2 Event 15.1.2 FW controller failure-maximum demand with no turbine bypass

### 3.2.1 Sequence of Events (UFSAR Table 15.1-3)

| TIME (sec) | EVENT (2) (WITHOUT TURBINE BYPASS) |
|---|---|
| 0 | Initiate simulated failure of feedwater controller to upper limit on feedwater flow. |
| 8.3 | **Level 8 vessel level setpoint trips main turbine and feedwater pumps.** |
| 8.3(est) | **Reactor scram trip actuated from main turbine stop valve position switches.** |
| 8.3 | **Recirculation Pump Trip (RPT) actuated by stop valve position switches.** |
| 8.5 | Turbine bypass valves fail to open. |
| 8.5 | **Main turbine stop valves closed.** |
| 8.6 | **Recirculation pump motor circuit breakers open causing recirculation drive flow to coast-down.** |
| 10.5 | First groups 1 to 3 actuated due to high pressure. |

 

# Section 3.2 Event 15.1.2 FW controller failure-maximum demand with no turbine bypass

### 3.2.2 Automatic Control Actions in the presence of postulated PPS CCF, diverse from PPS

1. ~~SRVs cycle to relieve pressure as required~~Reactor feedpump "C" tripped on low suction pressure, with feedpumps "A" and "B" injecting water at their maximum rate of approximately 16 Mlb/hr. [Note: Feedpump turbine "C" trips after a 5-second delay, "A" and "B" not tripped on low suction pressure due to time delays of 15 and 10 seconds, respectively.
2. ~~Redundant Reactivity Control System (RRCS) initiates on High Reactor RPV Pressure resulting in reactor scram, and Recirculation Pump Trip (RPT actuation)~~DEHC fully opens the turbine control valves, with postulated failure of the turbine bypass valves, resulting in reactor pressure, power, and water level operating at higher values. However, RPV water level did not reach Level 8.

### 3.2.3 EOP Entry Conditions

~~The operator will promptly enter T-101 RPV Control EOP (Reference 14) upon recognition of any of the following entry conditions:~~

~~1. RPV water level below +12.5 inches (Level 3)~~
~~2. RPV pressure above 1096 psig~~

~~A reactor scram condition with APRM above 4%~~No EOP entry conditions.

 

# Section 3.2 Event 15.1.2 FW controller failure-maximum demand with no turbine bypass

### 3.2.4 Operator Actions per RPV Control EOP with postulated PPS CCF

No entry into the EOPs for operator action for mitigating this event. However, upon recognition of unexpected increase in reactivity, operator will take action to reduce reactor power or shutdown the reactor in accordance with procedure OT-104 (Reference 10), "LGS Unexpected/Unexplained Positive or Negative Reactivity Insertion Operating Procedure", and OT-102 (Reference 48), High Reactor Pressure. Upon recognition of a reactor feedpump trip, operator may also take action in accordance with procedure OT-100 (Reference 47), Reactor Low Level, to reduce reactor power to less than 85%. Because automatic level control is lost, the operator may initiate a reactor scram.

~~Enter T-101 RPV Control EOP (Reference 14). Monitor RPV water level, pressure, power, control rod positions.~~

~~6. Restore feedwater flow to control reactor water level using manual Woodward speed control of the feedwater system pump(s).~~

~~Stabilize RPV pressure at a pressure below 1096 psig *using ADS SRVs*.~~

Required operator response time for manual actions >10 minutes from initiation of event.

 

# Section 3.2 Event 15.1.2 FW controller failure-maximum demand with no turbine bypass

### 3.2.5 Summary of Diverse Features from PPS

Based upon the analysis for this event, the following diverse features are available, for the postulated CCF of the PPS:

1. Reactor water level NR & ***WR indication***
~~***2. Reactor Water Level Low (Level 3) alarm***~~
~~3.~~2. Reactor pressure
~~4.~~3. Reactor Pressure High alarm
~~5.~~4. Reactor power (APRM)
~~6.~~5. APRM Not Downscale indication
~~7.~~6. Turbine Trip Status
~~8.~~7. Control rod position
8. Reactor feedpump turbine low suction pressure trip
9. ~~RRCS~~DEHC
10. Woodward turbine speed control system
***11. Manual control of ADS SRVs***

### 3.2.6 Conclusion

For the postulated event of Feedwater Controller Failure – Maximum Demand (without Turbine Bypass), concurrent with a postulated CCF of PPS, sufficient automatic control functions and information that are/will be independent of the PPS are available to mitigate the event with the addition of the diverse manual control of individual ADS SRVs. The reactor core is adequately cooled and RCPB integrity is maintained. Since this transient does not result in any fuel failures or any release of primary coolant to either the secondary containment or the environment, there are no radiological consequences associated with this transient. Thus, BTP 7-19 3.3(b) Acceptance Criteria for this AOO are satisfied.

 

# Section 3.3 Event 15.1.2 FW controller failure-maximum demand with turbine bypass

 

# Section 3.3 Event 15.1.2 FW controller failure-maximum demand with turbine bypass

### 3.3.1 Sequence of Events (UFSAR Table 15.1-3):

| TIME (sec) | EVENT (1) (WITH TURBINE BYPASS) |
|---|---|
| 0 | Initiate simulated failure of feedwater controller to upper limit on feedwater flow. |
| 8.4 | **Level 8 vessel level setpoint trips main turbine and feedwater pumps.** |
| 8.4 | **Reactor scram trip actuated from main turbine stop valve position switches.** |
| 8.4 | **RPT actuated by stop valve position switches.** |
| 8.6 | **Main turbine stop valves closed and turbine bypass valves start to open.-** |
| 8.6 | **Recirculation pump motor circuit breakers open causing recirculation drive flow to start to coast down.** |
| 11.2 | First group of SRVs open due to high pressure. |

 

# Section 3.3 Event 15.1.2 FW controller failure-maximum demand with turbine bypass

### 3.3.2 Automatic Control Actions in the presence of postulated PPS CCF, diverse from PPS

1. ~~Turbine bypass valves fast opening upon turbine trip~~ ~~SRVs cycle to relieve pressure as required~~Reactor feedpump "C" tripped on low suction pressure, with feedpumps "A" and "B" injecting water at their maximum rate of approximately 16 Mlb/hr. [Note: Feedpump turbine "C" trips after a 5-second delay, "A" and "B" not tripped on low suction pressure due to time delays of 15 and 10 seconds, respectively. However, RPV water level did not reached Level 8]
2. ~~Pressure control system~~DEHC modulates the turbine ~~bypass~~ control and bypass valves to control pressure.

 

# Section 3.3 Event 15.1.2 FW controller failure-maximum demand with turbine bypass

### 3.3.3 EOP Entry Conditions

No EOP entry conditions. ~~The operator will promptly enter T-101 RPV Control EOP (Reference 14) upon recognition of any of the following entry conditions:~~

~~RPV water level below +12.5 inches (Level 3)~~

~~RPV pressure above 1096 psig~~

~~A reactor scram condition with APRM above 4%~~

 

# Section 3.3 Event 15.1.2 FW controller failure-maximum demand with turbine bypass

### 3.3.4 Operator Actions per RPV Control EOPs with postulated PPS CCF

1. No entry into the EOPs for operator action for mitigating this event. However, upon recognition of unexpected increase in reactivity, operator will take action to reduce reactor power or shutdown the reactor in accordance with procedure OT-104 (Reference 10), "LGS Unexpected/Unexplained Positive or Negative Reactivity Insertion Operating Procedure", and OT-102 (Reference 48), High Reactor Pressure . Upon recognition of a reactor feedpump trip, operator may also take action in accordance with procedure OT-100 (Reference 47), Reactor Low Level, to reduce reactor power to less than 85%. Because automatic level control is lost, the operator may initiate a reactor scram.

~~7. Enter T-101 RPV Control EOP (Reference 14). Monitor RPV water level, pressure, power, control rod positions.~~

~~8. Restore feedwater flow to control reactor water level using manual Woodward speed control of the feedwater system pumps.~~

~~9. Stabilize RPV pressure at a pressure below 1096 psig using the turbine bypass valves.~~

Estimated Time Available for Operator Actions: >10 minutes.

 

# Section 3.3 Event 15.1.2 FW controller failure-maximum demand with turbine bypass

### 3.3.5 Summary of Diverse Features from PPS

Based upon the analysis for this event, the following diverse indications are available, for the postulated CCF of the PPS:

1. Reactor water level NR & ***WR indication***
2. ~~***Reactor Water Level Low (Level 3) alarm***~~
3. Reactor pressure
4. ~~Reactor Pressure High alarm~~
5. ~~4.~~ Reactor power (APRM)
6. ~~5.~~ APRM Not Downscale indication
7. ~~6.~~ Turbine Trip Status
8. ~~7.~~ Control rod position
9. ~~RRCS~~
8. Reactor feedpump turbine low suction pressure trip
10. ~~9.~~ DEHC
11. ~~10.~~ Woodward turbine speed control system
12. ~~11.~~ ~~Reactor Water Level 8 trip channels~~

 

# Section 3.4 Event 15.1.3 Pressure regulator failure-open

 

# Section 3.4 Event 15.1.3 Pressure regulator failure-open

### 3.4.1 Sequence of Events (UFSAR Table 15.1-4)

| TIME (sec) | EVENT |
|---|---|
| 0.0 | Simulate maximum limit flow to main turbine. |
| 0.4 | Main turbine bypass valves open. |
| 4.7 | **Vessel water level (Level 8) trip initiates main turbine and feedwater turbine trips.** |
| 4.7 | **Main turbine stop valve position initiates reactor scram and RPT.** |
| 4.8 | **Turbine stop valves closed.** |
| 4.9 | **Recirculation pump motor circuit breakers open causing decrease in core flow to natural circulation.** |
| 46.8 | **Main steam line isolation on low turbine inlet pressure.** |
| 51.8 | **MSIVs closed**. Bypass valves remain open, exhausting steam in steam lines downstream of isolation valves. |
| 52.0 | **RCIC and HPCI systems initiation on low level (Level 2).** |
| >100.0 | Group 1 Main Steam Relief Valves (MSRVs) actuate and cycle. |

 

# Section 3.4 Event 15.1.3 Pressure regulator failure-open

### 3.4.2 Automatic Control Actions in the presence of postulated PPS CCF, diverse from PPS

1. ***MSIVs isolate on Main Steam Line Pressure – Low.*** (Note: Needed to avoid uncontrolled blowdown of RPV.)

2. After MSIVs are closed, main turbine trips on reverse power, and steam to the feedpump turbines is shut off.

~~2.~~3. Redundant Reactivity Control System (RRCS) initiates on High Reactor RPV Pressure resulting in reactor scram, and Recirculation Pump Trip (RPT actuation).

### 3.4.3 EOP Entry Conditions

The operator will promptly enter T-101 RPV Control EOP (Reference 14) upon recognition of any of the following entry conditions:

1. RPV water level below +12.5 inches (Level 3)
2. RPV pressure above 1096 psig
3. A reactor scram condition with APRM above 4%

 

# Section 3.4 Event 15.1.3 Pressure regulator failure-open

### 3.4.4 Operator Actions per RPV Control EOPs with postulated PPS CCF

1. Enter T-101 RPV Control EOP (Reference 14). Monitor RPV water level, pressure, power, control rod positions.

2. If reactor scram has not initiated, initiate a reactor scram.

~~2.~~3. Stabilize RPV pressure at a pressure below 1096 psig ***using ADS SRVs***.

~~3.~~4. Depressurize the RPV ***using ADS SRVs*** to the desired pressure, at a cooldown rate below 100°F/hr.

~~4.~~5. Restore and maintain RPV water level between +12.5 inches and +54 inches using condensate pumps when RPV pressure decreases below pump shutoff head (approximately 680 psig).

Estimated Time Available for Operator Actions: >10 minutes from initiation of event.

 

# Section 3.4 Event 15.1.3 Pressure regulator failure-open

### 3.4.5 Summary of Diverse Features from PPS

Based upon the analysis for this event, the following diverse features are available, for the postulated CCF of the PPS:

1. Reactor water level NR, ***WR, and FZ*** indication
2. ***Reactor Water Level Low (Level 3) alarm***
3. Reactor pressure
4. Reactor power (APRM)
5. APRM Not Downscale indication
6. Control rod position indications
7. RRCS
~~8. Reactor Water Level 8 trip channels~~
~~9.~~8. ***Manual control of ADS SRVs***
~~10.~~9. ***Auto MSIV isolation on Main Steam Line Pressure- Low***
~~11.~~ Manual controls of condensate pumps
~~12.~~10. ~~Main steam line pressure~~

### 3.4.6 Conclusion

For the postulated event of Pressure Regulator Failure - Open, concurrent with a postulated CCF of PPS, sufficient automatic control functions, indications that are /will be independent of the PPS, and operator actions, will be available to mitigate the event with the added DPS functions. The reactor core is adequately cooled and RCPB integrity is maintained. Since this transient does not result in any fuel failures or any release of primary coolant to either the secondary containment or the environment, there are no radiological consequences associated with this transient. Thus, BTP 7-19 3.3(b) Acceptance Criteria for this AOO are satisfied.

 

# Section 3.19 Event 15.3.1 Trip of two recirculation pumps

 

# Section 3.19 Event 15.3.1 Trip of two recirculation pumps

### 3.19.1 Sequence of Events (UFSAR Table 15.3-2)

| TIME (sec) | EVENT |
|---|---|
| 0.0 | Trip of both recirculation pumps initiated. |
| 5.2 | **Vessel water level (Level 8) trip initiates turbine trip and feedwater pumps trip.** |
| 5.2 | **Turbine trip initiates bypass operation.** |
| 5.2 | **Turbine trip initiates reactor scram trip.** |
| 9.9 | Group 1 MSRVs open. |
| 12.9 | Group 1 MSRVs close. |
| 43.5 | **Level 2 vessel level setpoint initiates steam line isolation and HPCI/RCIC start.** |

 

# Section 3.19 Event 15.3.1 Trip of two recirculation pumps

### 3.19.2 Automatic Control Actions in the presence of postulated PPS CCF, diverse from PPS

1. ~~RRCS initiates upon condition of Reactor Water Level 2:~~DFWLCS maintains normal water level control.

    ~~a. ARI initiation (Level 2)~~
    ~~b. RPT actuation (Level 2 with 9 second delay)~~

2. Pressure regulator controls pressure by modulation of the turbine control valves

### 3.19.3 EOP Entry Conditions

No EOP entry conditions.~~The operator will promptly enter T-101 RPV Control EOP (Reference 14) upon recognition of any of the following entry conditions:~~

~~RPV water level below +12.5 inches (Level 3)~~

~~RPV pressure above 1096 psig~~

~~A reactor scram condition with APRM above 4%~~

 

# Section 3.19 Event 15.3.1 Trip of two recirculation pumps

### 3.19.4 Operator Actions per RPV Control EOP with postulated PPS CCF

No entry into the EOPs for operator action for mitigating this event. Operator takes immediate action to manually scram the reactor in accordance with procedure OT-112 Unexpected/Unexplained Change in Core Flow (Reference 46), to avoid operation in the reactor instability region after both recirculation pumps tripped.

~~Enter T-101 RPV Control EOP (Reference 13). Monitor RPV water level, pressure, power, control rod positions.~~

~~4. Restore and maintain RPV water level between +12.5 inches and +54 inches using DFWLCS. (Note: Includes restoration of feedpump turbines and re-establish automatic level control).~~

~~5. Stabilize RPV pressure at a pressure below 1096 psig using the turbine bypass valves.~~

Estimated Time Available for Operator Actions: >10 minutes

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# Section 3.19 Event 15.3.1 Trip of two recirculation pumps

### 3.19.5 Summary of Diverse Features from PPS

Based upon the analysis for this event, the following diverse features are required, for the postulated CCF of the PPS:

1. Reactor water level NR indication
~~2. ***Reactor Water Level Low (Level 3) alarm***~~
~~3.~~2. Reactor pressure (WR)
~~4.~~3. Reactor power (APRM)
~~5. APRM Not Downscale indication~~
~~6.~~4. Control rod position indications
~~7. RRCS~~
~~8.~~5. DFWLCS
~~9.~~6. DEHC

### 3.19.6 Conclusion

For the postulated event of Trip of Both Recirculation Pumps, concurrent with a postulated CCF of PPS, sufficient automatic control functions, indications that are independent of the PPS, and operator actions, are available to mitigate the event. The reactor core is adequately cooled and RCPB integrity is maintained. Since this transient does not result in any release of primary coolant to either the secondary containment or the environment, there are no radiological consequences associated with this transient. Thus, BTP 7-19 3.3(b) Acceptance Criteria for this AOO are satisfied.

 

# Section 3.34 Event 15.6.5 LOCA inside containment-main steam line break

 

# Section 3.34 Event 15.6.5
# LOCA inside containment-main steam line break

### 3.34.1 Sequence of Events (UFSAR Table 6.2-16)

| TIME (sec) | EVENTS |
|---|---|
| 0 | Break occurs. |
| 0 | **Scram assumed to occur.** |
| 0 | **Isolation signal.** |
| 0.5 | **MSIVs start to close. ** |
| 1.0 | Vessel water level reaches main steam line elevation. |
| 5.5 | **MSIV fully closed.** |
| 30 | **ECCS flow starts.** |
| 59 | End of blowdown. |
| 430 | Vessel refloods. |

 

# Section 3.34 Event 15.6.5
# LOCA inside containment-main steam line break

**3.34.2 Automatic Control Actions in the presence of postulated PPS CCF, diverse from PPS**

1. ***MSIV closure upon Main Steam Pressure-Low.***

2. Main turbine trips on reverse power after MSIV closure shutting off steam to the main turbine and steam to the feedpump turbines ~~trip when RPV water level exceeds Level 8~~.

3. The recirculation pumps tripped following the main turbine trip on reverse power and subsequent 13kV bus fast transfer.

4. Condensate pumps inject water into the RPV when reactor depressurizes to below the pump shutoff head.

~~4. When reactor water level decreases below 38 inches (Level 2), RRCS initiates ARI resulting in a reactor scram, and RPT actuation.~~

5. ***Initiate one loop of CS when Drywell pressure is above 1.68 psig and RPV pressure decreases below 455 psig.***

 

# Section 3.34 Event 15.6.5
# LOCA inside containment-main steam line break

### 3.34.3 EOP Entry Conditions

The operator will promptly enter T-101 RPV Control EOP (Reference 14) upon recognition of any of the following entry conditions:

1. RPV water level below +12.5 inches (Level 3)
2. RPV pressure above 1096 psig
3. A reactor scram condition with APRM above 4%
4. Drywell pressure above 1.68 psig

The operator will promptly enter the T-102 Primary Containment Control EOP (Reference 14) upon recognition of the following entry conditions:

1. Drywell pressure above 1.68 psig

 

# Section 3.34 Event 15.6.5
# LOCA inside containment-main steam line break

### 3.34.4 Summary of Relevant Operator Actions per RPV Control and Primary Containment Control EOPs with postulated PPS CCF

1. Enter T-101 RPV Control EOP (Reference 13). Monitor RPV water level, pressure, power, control rod positions.

   a. Initiate a manual reactor scram.

   ~~a.~~b. ***Initiate Reactor Enclosure isolation.***

   ~~b.~~c. Restore and maintain RPV water level between +12.5 inches and +54 inches using condensate pumps.

2. Enter T-102 Primary Containment Control EOP (Reference 15).

   a. When drywell temperature cannot be maintained below 145°F:

      i. Operate all available drywell cooling, defeating isolations if necessary.

   b. Initiate containment cooling using one loop of ***RHR Suppression Pool Cooling***.

   c. Before suppression pool (chamber) pressure exceeds 7.5 psig, Suppression Pool Spray is Required. Initiate ***Suppression Pool Spray*** at the DPS (diverse feature identified in Position 4 analysis).

Estimated Time Available for above Operator Actions: ~~>10~~< 5 minutes. Although this time can be chosen to be longer than 10 minutes, 5 minutes is conservatively chosen for the operator to perform a manual scram to terminate the energy discharge to the containment. This time will result in ample margins to the containment design limits, and can be validated to be achievable.

3. Upon recognition of a LOCA, enter SE-10 LOCA (Reference 38).

   When greater than 3 hours have elapsed following the LOCA, manually initiate SLCS pumps to inject into the RPV, using ~~the local CIMs for pump control if necessary~~SLC pump controls at DPS.

 

# Section 3.34 Event 15.6.5
# LOCA inside containment-main steam line break

### 3.34.5 Summary of Diverse Features from PPS

Based upon the analysis for this event, the following diverse features are required, for the postulate of the PPS:

1. Reactor water level NR and ***WR*** indication
2. ***Reactor Water Level Low (Level 3) alarm***
3. Reactor pressure
4. Reactor power (APRM)
5. APRM Not Downscale indication
6. Control rod position indications
~~7. RRCS~~
~~8.~~7. ***Core Spray ~~loop~~ Loop-A flow***
~~9.~~8. ***Core Spray ~~loop~~ Loop-A pressure***
~~10.~~9. ***Suppression pool water level***
~~11.~~10. Suppression pool pressure
~~12.~~11. Drywell temperature
~~13.~~12. ***Drywell pressure (NR)***
~~14.~~13. ***Drywell pressure high alarm***
~~15.~~14. Containment isolation status display
~~16.~~15. ***Manual initiation of Reactor Enclosure isolation***
~~17.~~16. ***Auto initiation of one loop ~~of~~ CS Loop-A****
~~18.~~17. ***Auto MSIV isolation on Main Steam Line Pressure- Low***
~~19.~~18. ***Manual initiation of one RHR loop for suppression pool cooling and spray*** [Spray identified in Position 4 analysis

~~Local CIM controls for SLCS pumps~~

Section 3.34.5 Continued on next slide

 

# Section 3.34 Event 15.6.5
# LOCA inside containment-main steam line break

*From 6.3.2.5 of UFSAR (Reference 7):

"Certain technical specification LCO periods are justified based on NEDO-24708A which states that for postulated LOCAs, one low pressure ECCS (one LPCI loop or one CS loop) and ADS to depressurize is adequate to reflood the vessel and maintain core cooling sufficient to preclude fuel damage. NEDC-30936P-A, specifically applicable to LGS references NEDO-24708A and reaffirms this conclusion, with the advisory regarding the possible necessity of an alternate cooling path following 2 hours of post large-break LOCA LPCI injection into the core shroud."

### 3.34.6 Conclusion

For the postulated Main Steam Line Break event inside containment, concurrent with a postulated CCF of PPS, sufficient automatic control functions and information that are/will be independent of the PPS, and operator actions, are/will be available to mitigate the event. The radiological consequences of the postulated LOCA are given in UFSAR Table 15.6-18. The automatic diverse MSIV isolation upon RPV level decreasing to Level 1, diverse manual isolation of the Reactor Enclosure and operation of the SGTS, and the use of local CIM SLCS pump initiation for suppression pool pH control maintain the current UFSAR radiological release calculation bases. As indicated, the control room, Exclusion Area Boundary (EAB), and Low Population Zone (LPZ) calculated doses are within 10CFR100 limits. In addition, adequate core cooling is maintained by operation of one diverse CS loop, and containment integrity is maintained by operation one diverse RHR loop for suppression pool cooling, consistent with the assumptions in UFSAR Section 6.2.1.1.3.3.1.6 Long-Term Accident Responses, Case C: Loop-no containment spray. In addition, adequate core cooling and containment integrity are maintained, the Acceptance Criteria stated in BTP 7-19 3.3(c) for this PA are satisfied.

Section 3.34.5 Continued from previous slide

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# Section 5.6 Spurious HPCI initiation

 

# Section 5.6
# Spurious HPCI initiation

**5.6** [ ]a,c

[ ]a,c

**5.6.1** [ ]a,c

[ ]a,c

 

# Section 5.6
# Spurious HPCI initiation

**5.6.2** [ ]a,c

[

]a,c

Section 5.6.2 continued on next slide

 

# Section 5.6
# Spurious HPCI initiation

## Section 5.6.2 continued from previous slide

[

]a,c

 

# Section 5.6 Spurious HPCI initiation

**5.6.3** [ ]a,c

[

]a,c

[

]a,c

 

# Section 5.6 Spurious HPCI initiation

**5.6.4** [ ]a,c

[

]a,c

 

# Section 5.6 Spurious HPCI initiation

**5.6.5** [ ]a,c

[

]a,c

[

]a,c

 

# Section 5.6 Spurious HPCI initiation

**5.6.6** [ ]a,c

[

]a,c

 

# SRM-SECY-93-087 Position 4

 

# D3 Analysis Update Schedule

 

# D3 Analysis Rev. 2 Schedule

[

]a,c