# Draft Submittal
(Pink Paper)

BRUNSWICK 2007-301

# SIMULATOR SCENARIOS

**BRUNSWICK JULY-AUG EXAM - 325, 324/2007-301**
**DRAFT SIMULATOR SCENARIOS (4)**

**PROGRESS ENERGY CAROLINAS**
**BRUNSWICK TRAINING SECTION**

# 2007 NRC EXAM SCENARIO #1



**BRUNSWICK JULY-AUG EXAM - 325, 324/2007-301**
**DRAFT SIMULATOR SCENARIO 1 OF 4**

## SCENARIO DESCRIPTION

Unit 2 is operating at maximum power, End Of Cycle with level transmitter N026B and ERFIS out of service.

A swap of RB Supply & Exhaust Fans will be required to support maintenance activities. Following the swap of RB fans, RBCCW Pump 2C will trip and 2B RBCCW Pump will fail to Auto-Start on pressure, but will be able to be manually started.

After restart of the 2B RBCCW Pump, Reactor Recirculation Pump 2A will runback to Limiter #2. After addressing the Technical Specifications and discussions with I&C, the 2A Recirculation Pump Limiter #2 signal will be reset and power returned to the pre-event level.

Reactor Instrument Penetration line break occurs (X49A) and line is isolated affecting instrument N026B for Remote Shutdown Panel Level Indication R604BX. Technical Specifications must be addressed.

Off-Site Power will be lost. DG4 will auto start and tie to E4. DG3 will auto start and briefly tie to E3, but will then trip on overcurrent and E3 will be unavailable. E1 and E3 cannot be cross-tied due to the overcurrent lockout. If the crew attempts to crosstie E7 and E8 the cross-tie breaker at E8 will fail. The loss of E3/E7 results in loss of level transmitters N026A and N027A. HPCI and RCIC are available for RPV level control. SRVs are available for pressure control. The HPCI injection valve will fail to auto open but can be manually opened. Additionally, RBCCW cooling will be shifted to conventional service water. 120V Panels 2-AB, 2-ABRX and 32AB will be transferred to alternate.

A steam leak will occur in the drywell. Drywell coolers will trip and the RHR Loop "B" drywell spray valve (E11-F016B) cannot be opened causing drywell temperature to rise above 300°F requiring emergency depressurization **(CRITICAL TASK)**. Following emergency depressurization reactor pressure and drywell reference leg temperature will be in the unsafe region of the RPV saturation limit

The only available level instruments (N004A, N004C, N036 and N027B) will begin to exhibit indications of reference leg flashing. With no valid indication of RPV level, the crew will enter the Reactor Flooding Procedure.

The crew will increase available injection to maximum until at least 5 SRVs are open and Reactor pressure is at least 50 psig above suppression chamber pressure (Minimum Reactor Flooding Pressure) **(CRITICAL TASK)**. Once these conditions are established the crew will throttle flow to maintain at least the required 50 psig differential but as low as possible.

When RPV flooding conditions have been established, the scenario may be terminated.

**SIMULATOR SETUP**

Initial Conditions

IC 188 Scenario #1

ENP 24 for IC 14

Rx Pwr 100%

Core Age EOC

EVENTS

| Event Number | Trigger | Trigger Description | |
|---|---|---|---|
| 1 | NA | NA | Swap RBCCW Pumps |
| 2 | 1 | Manual | 2C RBCCW Pump Trips, 2B fails to auto start |
| 3 | 2 | Manual | Runback of 2A Recirculation Pump to Limiter #2 |
| 4 | NA | NA | Increase power following runback reset |
| 5 | 3 | Manual | Penetration X49A Line Break ,B21-N026B fails downscale |
| 6 | 4 | Manual | Loss Of Off-Site Power, DG #3 Differential Fault, Reactor Scram |
| 7 | NA | NA | HPCI injection valve fails to auto open |
| 8 | 5 | Manual | Steam Leak In The Drywell, Emergency Depressurization |
| 9 | | | RHR Loop "B" drywell spray valve fails to open |
| 10 | NA | NA | Level Instrument failure, Reference Leg flashing, Reactor Flooding required |

Interventions Summary
(Shaded entries = Active)

Malfunctions Summary

| Malf ID | Mult ID | Description | Current Value | Target Value | Rmptime | Actime | Dactime | Trig |
|---|---|---|---|---|---|---|---|---|
| ES028F | | HPCI INJ VLV FAILS AUTO OPEN | True | True | | | | |
| | | | | | | | | |
| EE009F | | LOSS OF OFF-SITE POWER | False | True | | | | 4 |
| DG026F | | DG3 DIFFERENTIAL FAULT | True | True | | | | |
| NB006F | A | MSL BREAK BEFORE FLOW RESTRICTOR | 0 | 4.00 | 00:05:00 | | | 5 |
| RC026F | | RECIRC PMP "A" RUNBACK TO LIMITER #2 | False | True | | | 00:00:05 | 2 |
| NB014F | | Penetration X49A Line Break | True | True | | | | 3 |
| NB025F | | REF LEG FLASHING | True | True | | | | |

## Remotes Summary

| Remf ID | Mult ID | Description | Current Value | Target Value | Rmptime | Actime | Trig |
|---|---|---|---|---|---|---|---|
| EP_IACS993P | | DW CLR A & D OVERRIDE – NORMAL/STOP | NORMAL | STOP | | 00:05:00 | 6 |
| EP_IACS994P | | DW CLR A & D OVERRIDE – NORMAL/STOP | NORMAL | STOP | | 00:04:00 | 6 |
| AI_VHAI107L | | U1-U2 WET HDR X-TIE VLV v5063 | SHUT | OPEN | | | 10 |
| SW_IAVSW193 | | SW-V193 MAN ISOL NSW TO RBCCW | OPEN | CLOSE | | | 8 |
| SW_VHSW146L | | CONV SW TO RBCCW HSX V146 | SHUT | OPEN | | | 8 |
| RP_IARPSB | | RESTART RPS MG SET B | NORMAL | RESET | | | 9 |
| RP_IAEPAMGB | | PRS M-G SET B EPA BKRS | SET | SET | | | 9 |
| ED_ZIEDH08 | | PNL 2AB PWR (E7=NORM/E8=ALT) | NORMAL | ALT | | | 7 |
| ED_ZIEDH11 | | PNL 2AB-RX PWR (E7=NORM/E8=ALT) | NORMAL | ALT | | | 7 |
| ED_ZIEDHX0 | | PNL 32AB PWR (E7=NORM/E8=ALT) | NORMAL | ALT | | | 7 |

## Override Summary

| Tag ID | Description | Position/ Target | Actual Value | Override Value | Rmptime | Actime | Dactime | Trig |
|---|---|---|---|---|---|---|---|---|
| K1J36A | CONT SPRAY VLV E11-F016B | AUTO | OFF | OFF | | | | |
| K1J36A | CONT SPRAY VLV E11-F016B | CLOSE | ON | ON | | | | |
| K1J36A | CONT SPRAY VLV E11-F016B | OPEN | OFF | OFF | | | | |
| K4522A | RBCCW PMP C AUTO | OFF | OFF | ON | | | | 1 |
| K4522A | RBCCW PMP C AUTO | AUTO | ON | OFF | | | | 1 |
| K4522A | RBCCW PMP C AUTO | ON | OFF | OFF | | | | 1 |
| K4521A | RBCCW PMP A AUTO | AUTO | OFF | OFF | | | | 1 |

## Annunciator Summary

| Window | Description | Tagname | Override Type | OVal | AVal | Actime | Dactime | Trig |
|---|---|---|---|---|---|---|---|---|
| | NONE | | | | | | | |
| | | | | | | | | |

## Batch Files

| File | Trigger | Description |
|---|---|---|
| | | NONE |

## Special Instructions

Load scenario file 2007 NRC Scenario 1.scn

Ensure ENP-24 for IC-14 @ P603.

**SHIFT BRIEFING**

Plant Status

The plant is operating at maximum power, End of Cycle.

Equipment Out of Service

No equipment is out of service

Plan of the Day

Maintain current power.

Following shift turnover, Place the 2D RB Supply & Exhaust Fans in service and secure 2C Fans. Maintenance personnel are standing by to perform PMs: No clearance is required.

## SCENARIO INFORMATION

Examiner Notes

Procedures Used in Scenarios:

EVENT 1

EVENT 2

- Annunciator 2-UA-3, Window 2-5 (RBCCW Pump Trip)
- 0AOP-16 (RBCCW Pump Trip)

EVENT 3/4

- Annunciator 2-A-6, Window 3-2 (Recirc Pump Runback)
- 2AOP-04.0 (Low Core Flow)
- Procedure 2OP-02, Section 5.3 (Recirc Pump Runback)
- Technical Specification 3.4.1 (Recirculation Pump Runback – Single Loop)

EVENT 5

EVENT 6

- 2EOP-01-RSP (REACTOR SCRAM PROCEDURE)
- 2EOP-01-RVCP (REACTOR VESSEL CONTROL PROCEDURE)
- 0AOP-36.1

EVENT 8/9

- 2EOP-01-RVCP (REACTOR VESSEL CONTROL PROCEDURE)
- 0EOP-02-PCCP (PRIMARY CONTAINMENT CONTROL PROCEDURE)

EVENT 10

- 2EOP-01-RVCP (REACTOR VESSEL CONTROL PROCEDURE)
- 0EOP-01-RXFP (REACTOR FLOODING PROCEDURE)

Critical Tasks

Perform emergency depressurization when drywell average temperature cannot be restored and maintained below 300°F.

Establish and maintain RPV pressure at least 50 psig above suppression chamber pressure with at least 5 SRVs open.

## EVENT 1 SHIFT TURNOVER, SWAPPING OF RB SUPPLY & EXHAUST FANS

The crew swaps RB HVAC Fans per SCO direction

Malfunctions required – None

Objectives:

SCO – Directs BOP to shift from the 2C to the 2D RB Supply & Exhaust Fans to support Maintenance

BOP – Starts 2D RB HVAC Fans in service & removes 2C fans from service per 2OP-37.1 Section 8.9

Success Path:

RB HVAC Supply & Exhaust Fans fans 2A, B, D in service, 2C secured.

**Simulator Operator Activities:**

- **When asked, as the Reactor Building Auxiliary Operator, report that pre-start checks on RB HVAC Fans have been completed**
- **When asked, as the RBAO, report that the fans appear to be operating normally.**

## EVENT 1 SHIFT TURNOVER/SWAPPING OF RB SUPPLY & EXHAUST FANS

**Required Operator Actions**

**SRO**

**Normal Operation – Swapping of RB Supply & Exhaust Fans**

- Directs BOP to shift from the 2C to the 2D RB Supply & Exhaust Fans to support Maintenance

**BOP**

**Normal Operation -Swapping of RB Supply & Exhaust Fans**

- Starts 2D RB HVAC Fans in service & removes 2C fans from service per 2OP-37.1 Section 8.9

**APPLICANT'S ACTIONS OR BEHAVIOR:**

## EVENT 2 RBCCW PUMP TRIP/PUMP in AUTO FAILS TO AUTO START

The crew responds to a trip on one of the operating RBCCW Pumps

Malfunctions required:

- 2B RBCCW Pump will fail to auto-start on a low RBCCW discharge header pressure

Objectives:

SCO – Directs BOP to enter and execute 0AOP-16.0: RBCCW System Failure

BOP – Enters 0AOP-16.0 to respond to the 2C Pump failure and 2B Pump failure to start

Success Path:

2B RBCCW Pump is manually started (by placing its control switch to ON) and RBCCW is returned to normal operation (normal discharge pressure).

**Simulator Operator Activities:**

- **WHEN** directed by lead examiner, activate **TRIGGER 1**
- **WHEN** asked, as the RBAO, report that the 2C RBCCW Pump motor is hot to the touch.
- **WHEN** asked, as the RBAO, report that the power supply breaker for 2C RBCCW Pump is tripped on magnetics.
- **WHEN** asked, as I&C, report that the power supply breaker for 2C RBCCW Pump is tripped on magnetics.

## EVENT 2 RBCCW PUMP TRIP

**Required Operator Actions**

Transient Response – Entry into 0AOP-16.0: Failure of RBCCW System

**SRO**

- Directs BOP operator to enter and execute 0AOP-16.0
- Directs start of 2B RBCCW pump

**BOP**

- Refers to Annunciator Response 2-UA-3 2-5 (RBCCW Pump Trip)
- Enter 0AOP-16
- Manually starts 2B RBCCW Pump
- Verifies RBCCW System is operating normally

**APPLICANT'S ACTIONS OR BEHAVIOR:**

## EVENT 3 2A REACTOR RECIRCULATION PUMP RUNBACK TO LIMITER #2

The crew responds to a spurious runback of the 2A Recirculation Pump speed controller to Speed Limiter #2. The scoop tube lockup circuit is defeated. (can not be locked up)

Malfunction required:

- 2A Reactor Recirlation MG Set will experience a spurious runback signal to the Limiter #2 setpoint
- Lockout circuit on scoop tube will be defeated (override)

Objectives:

SCO Directs RO to enter and execute 2AOP-04.0: Low Core Flow

Evaluates Technical Specification (T.S. 3.4.1) requirements for single Recirculation Loop operation (flow mismatch requires declaration of the loop with the lower speed Recirculaton Pump as Inoperable)

Following determination of the Runback signal being spurious, direct reset of the 2A Reactor Recirculation Pump Limiter #2 signal to return of power to the pre-event power level

RO Enters 2AOP-04.0 to respond to the 2A Reactor Recirculation MG runback

When directed by the SCO, resets the Runback signal per 2OP-02, Section 8.3

Inserts control rods to get below the Melll line per ENP-24

Success Path:

The runback condition on the 2A Reactor Recirculation Pump is identified, 2AOP-04.0 is entered and executed, power level is stabilized, Technical Specification requirements are evaluated for single Recirculation Loop operation, and the Runback Signal is successfully reset per 2OP-02.0 following resolution.

**Simulator Operator Activities:**

**WHEN** directed by the lead examiner, activate **TRIGGER 2.**

**WHEN** asked, as the Turbine Building Auxiliary Operator (TBAO), wait 3 minutes and report that there are no apparent problems at the 2A Reactor Recirculation Motor Generator.

**Simulator Operator Activities (continued)**

**WHEN** asked, as I&C, wait 5 minutes and report that the cause of the Runback to Limiter #2 was due to an error in installation of a jumper during the performance of a surveillance currently in progress.

**WHEN** asked, as I&C, report that the lockout circuit has been repaired and will be retested next shift. The runback may be reset.

**WHEN** asked, as I&C, communicate with the Reactor Operator to balance/verify the demand vs. actual speed control signal, in support of resetting of the runback **[Instructor Aids – Panels – Recirc MG Set Bailey Position Error]**

**WHEN** asked, as NE, provide guidance on moving under MeIII and state that the rod pattern does not need to be symmetrical.

## EVENT 3 2A REACTOR RECIRCULATION PUMP RUNBACK TO LIMITER #2

**Required Operator Actions**

**Transient response – Entry into 2AOP-04.0: Low Core Flow**

**SRO**

- Directs RO to enter and execute 2AOP-04.0: Low Core Flow
- Contacts I&C for support
- Evaluates Technical Specification (T.S. 3.4.1.A) requirements for single Recirculation Loop operation (flow mismatch requires declaration of the loop with the lower speed Recirculaton Pump as Inoperable)
- Following determination of the Runback signal being spurious, directs reset of the 2A Reactor Recirculation Pump Limiter #2 signal to return of power to the pre-event power level
- Contacts Nuclear Eng. for guidance

**RO**

- Enters 2AOP-04.0 to respond to the 2A Reactor Recirculation MG runback
- When directed by the SCO, resets the Runback signal per 2OP-02, Section 8.3
- Inserts control rods to get below the MelII line per ENP-24

**APPLICANT'S ACTIONS OR BEHAVIOR:**

## EVENT 4 INCREASING POWER FOLLOWING RUNBACK SIGNAL RESET

The crew will take action to restore reactor power to the pre-runback level.

Malfunctions required:

None

Objectives:

SCO Directs RO to raise reactor power to 90% by raising Recirculation Flow on "A" Loop

RO Raises reactor power per 2OP-02.0 by raising "A" Recirculation Pump Speed

Success Path:

Reactor power is raised to approximately the pre-runback level.

**Simulator Operator Activities:**

**WHEN** asked, as the Reactor Engineer, report that power may be raised without ramp limitations, to 90% using Reactor Recirculation flow.

## EVENT 4 INCREASING POWER FOLLOWING RUNBACK SIGNAL RESET

**Required Operator Actions**

**Normal Operating Procedures – 2OP-02**

**SRO**

- Contacts Load dispatcher regarding power increase
- Direct RO to raise reactor power to 90% using 2OP-02

**RO**

- When directed, raises reactor power to approximately 90% using Reactor Recirculation Flow per 2OP-02.0.

**APPLICANT'S ACTIONS OR BEHAVIOR:**

## EVENT 5 INSTRUMENT LINE PENETRATION FAILS

The crew will observe and report the parameter changes impacted by the instrument failure. The SCO will diagnose the failure and evaluate the impact to plant operation, including Technical Specification action statement(s).

Malfunctions required:

- Penetration X49A Level instrument B21-N026B will fail.

Objectives:

SCO – Diagnose the failure of the level instrument and evaluate the impact of the loss in TS (3.3.3.2 – Remote Shutdown Monitoring Instrumentation- 30 days).

Success Path:

SCO correctly evaluates the impact of the loss of the instrumentation, including the correct Technical Specification action statement.

**Simulator Operator Activities:**

- **WHEN** directed by the lead examiner, activate **TRIGGER 3.**

## EVENT 5 INSTRUMENT LINE PENETRATION FAILS

**Required Operator Actions:**

**SCO**

- Evaluate the plant impact and Technical Specification requirements for the instruments affected. (3.3.3.2 – Remote Shutdown Monitoring Instrumentation- 30 days)

**APPLICANT'S ACTIONS OR BEHAVIOR:**

## EVENT 6 REACTOR SCRAM, LOSS OF OFF-SITE POWER, DG #3 FAILURE

The crew will respond to a loss of off-site power resulting in a reactor scram and a corresponding failure of Emergency Diesel Generator #3 due to an electrical fault on Bus E3.

Malfunctions required:

- Off-site power will be lost due to a grid disturbance resulting in a reactor scram. Immediately following the starting and synchronization of #3 Emergency Diesel Generator, an electrical fault will develop on Emergency Bus E3, resulting in a tripping of #3 Diesel Generator and unavailability of the Emergency Bus.

Objectives:

SCO – Executes the Emergency Operating Procedures: Enters 2EOP-01-RSP, Reactor Scram Procedure and, subsequently, enters 2EOP-01-RVCP, Reactor Vessel Control Procedure (if Rx Press is >1060 psig or Rx Level 100"))

Directs the RO to control reactor and containment parameters
- Control pressure using SRVs with a pressure band of 800-1000 psig
- Control Level using HPCI/RCIC with a band of 170" to 200"

Directs BOP to enter and execute AOP-36.1 in response to the loss of off-site power and Diesel Generator failure

Contacts System Load Dispatcher to determine Distribution Grid status

RO Responds to the reactor scram and takes actions to control level and pressure in the established control bands using HPCI, RCIC, and SRVs

BOP Report Electric Plant status
- Loss of off-site power
- DG #4 loaded to Bus E4
- DG #3 tripped due to overcurrent trip on bus

Places PCB auto-reclosers to OFF
Directs AO to cross-tie air
Ensures 2B Nuclear Service Water Pump is running, starts 2B and 2C Conventional Pumps
Starts Control Room and Battery Room HVAC
Direct Transfer of RBCCW Cooling to Conventional Service Water
Start 2B CRD Pump
Direct RPS to be restarted

Success Path:

SCO successfully enters 2EOP-01, 2EOP-01-RSP, Reactor Scram Procedure and, subsequently, enters 2EOP-01-RVCP, Reactor Vessel Control Procedure and directs activities relating to reactor vessel control (RPV pressure and level) and directs activities relating to the loss of electrical power. RO takes actions to control reactor level and pressure (HPCI, RCIC, SRV operation). BOP enters 0AOP-36.1 and takes actions, as directed to address the loss of electrical power.

## EVENT 6 REACTOR SCRAM, LOSS OF OFF-SITE POWER, DG #3 FAILURE

**Simulator Operator Activities**

**WHEN** directed by lead examiner, activate **TRIGGER 4**

**IF** contacted as Load Dispatcher, report that there has been storm damage to the Transmission Grid and that there is, currently, not a projected time for return to service.

**IF** asked as Unit 1 for permission to cross-tie air, agree.

**WHEN** it is requested to cross tie air, report that the Unit 1 cross-tie valve V5071 is open.

**IF** asked to transfer RCC to CSW, wait 5 minutes and activate **TRIGGER 8.**

**IF** asked to restart RPS, wait 3 minutes and activate **TRIGGER 9**.

**IF** requested to transfer 2AB, 2AB-RX and 32AB to alternate, wait 2 minutes and activate **TRIGGER 7.**

IF asked by I&C to investigate Bus E3, wait 3 minutes and report the EDG trip is due to an electrical lockout and is being investigated.

## EVENT 6 REACTOR SCRAM, LOSS OF OFF-SITE POWER, DG #3 FAILURE

**Required Operator Actions**

**SRO**

- Executes the Emergency Operating Procedures: Enters 2EOP-01-RSP, Reactor Scram Procedure and, subsequently, enters 2EOP-01-RVCP, Reactor Vessel Control Procedure (if Rx Press is >1060 psig or Rx Level 100")
- Enters and executes EOP-PCCP when Torus Temperature reaches 95 degrees.
- Directs the RO to control reactor and containment parameters
- Control pressure using SRVs with a pressure band of 800-1000 psig
- Control Level using HPCI/RCIC with a band of 170" to 200"
- Directs BOP to enter and execute AOP-36.1 in response to the loss of off-site power and Diesel Generator failure
- Contact System Load Dispatcher to determine Distribution Grid status
- Directs Transfer of RBCCW Cooling to Conventional Service Water
- Directs RPS to be restarted.

**RO**

- Takes actions to scram the reactor per 2EOP-01-RSP, Reactor Scram Procedure
- Perform actions to control Reactor Vessel Level and Pressure using HPCI, RCIC, and Safety Relief Valves

**BOP**

ReportsElectric Plant status

-Loss of off-site power

-DG #4 loaded to Bus E4

-DG #3 tripped due to overcurrent trip on bus

Places PCB auto-reclosers to OFF

Directs AO to cross-tie air

Ensures 2B Nuclear Service Water Pump is running, starts 2B and 2C Conventional Pumps

Starts Control Room and Battery Room HVAC

Transfers of RBCCW Cooling to Conventional Service Water

Starts 2B CRD Pump

Execute applicable steps of 0AOP-36.1 is response to the loss of off-site power and failure of the #3 Emergency Diesel Generator and Emergency Bus E3

**APPLICANT'S ACTIONS OR BEHAVIOR:**

## EVENT 7 HPCI INJECTION VALVE FAILS TO OPEN

The crew will respond to a failure of the HPCI injection valve to fail to automatically open on a valid initiation signal.

Malfunctions required:

- The 2-E41-F006, HPCI Injection Valve, will fail to automatically open on a valid initiation signal

Objectives:

SCO/RO Identifies that the HPCI Injection Valve has failed to open on a valid initiation signal

RO Opens the HPCI Injection Valve by taking the control switch to the "OPEN" position and commences injection with HPCI

Success Path:

HPCI injection is established at rated flow by operator action to open the HPCI injection valve.

**Simulator Operator Activities:**

**None**

## EVENT 7 HPCI INJECTION VALVE FAILS TO OPEN

**Required Operator Actions:**

**SRO/RO** Identifies the HPCI Injection Valve, 2-E41-F006, has failed to open on a valid initiation signal

**RO** Opens the 2-E41-F006 by taking the control switch to the "OPEN" position and establishing injection flow to the reactor from HPCI.

**APPLICANT'S ACTIONS OR BEHAVIOR:**

## EVENT 8/9 STEAM LEAK IN DRYWELL REQUIRING EMERGENCY DEPRESSURIZATION

The crew will respond to a steam leak in the drywell in conjunction with a failure of the ability to spray the containment, subsequently leading to a requirement to Emergency Depressurize the reactor due to high drywell temperature.

Malfunctions required:

- A steam leak will occur in the drywell, resulting in elevated drywell temperatures
- A failure will be inserted, preventing the opening of the "B" Loop Drywell Spray injection valve
- Cross tie of E7 to E8 will not function

Objectives:

SCO

Recognize conditions of the steam leak in the drywell (elevated temperatures and pressures) and provide direction to the RO and BOP.
Direct execution of applicable steps of 2EOP-02-PCCP (Primary Containment Control Procedure).

When drywell temperature cannot be maintained <300°F, direct Emergency Depressurization of the reactor

Refer to Caution 1 and determine that the Reactor Saturation Graph will enter the "Unsafe" region during the depressurization

RO/BOP

Continue to maintain control of Reactor Water Level and Pressure, as directed by the SCO
Must manually trip RCIC when High level trip setpoint is reached (206")
Place "B" Loop of RHR in Suppression Pool Cooling when directed
Attempt to place "B" Loop in Suppression Chamber and Drywell Sprays per SEP-02/03 when directed
Identify and report failure of "B" Loop Drywell Spray valve to open and take actions to attempt to open the valve
When directed, Emergency Depressurize the reactor (high drywell temperature)
Control injection from Low Pressure systems to maintain reactor water level during depressurization.

Success Path:

When 300°F is exceeded in the drywell, the reactor is Emergency Depressurized and level is restored/maintained in the normal band (170" to 200")

## EVENT 8/9 STEAM LEAK IN DRYWELL REQUIRING EMERGENCY DEPRESSURIZATION

**Simulator Operator Activities:**

**WHEN** directed by the lead examiner, activate **TRIGGER 5**

**IF** asked, report that the breaker for the 2-E11-F016B appears to have normal indication and that the thermal overload appears to be reset.

**IF** asked, report that the 2-E11-F016B is mechanically bound and will not open.

**WHEN** to lock-out drywell coolers, activate **TRIGGER 6.**

**IF** requested to support E7 to E8 cross-tie, acknowledge request

## EVENT 8/9 STEAM LEAK IN DRYWELL REQUIRING EMERGENCY DEPRESSURIZATION

**Required Operator Action:**

**SRO**

- Recognize conditions of the steam leak in the drywell (elevated temperatures and pressures) and provide direction to the RO and BOP.
- Direct execution of applicable steps of 2EOP-02-PCCP (Primary Containment Control Procedure).
- When drywell temperature cannot be maintained <300°F, direct Emergency Depressurization of the reactor
- Refer to Caution 1 and determine that the Reactor Saturation Graph will enter the "Unsafe" region during the depressurization

**RO/BOP**

- Continue to maintain control of Reactor Water Level and Pressure, as directed by the SCO
- Must manually trip RCIC when High level trip setpoint is reached (206")
- Place "B" Loop of RHR in Suppression Pool Cooling when directed
- Attempt to place "B" Loop in Suppression Chamber and Drywell Sprays per SEP-02/03 when directed
- Identify and report failure of "B" Loop Drywell Spray valve to open and take actions to attempt to open the valve
- Control injection from Low Pressure systems to maintain reactor water level during depressurization.
- When directed, Emergency Depressurize the Reactor by opening 7 ADS valves
- Control Low Pressure Injection Systems to prevent Reactor Vessel overfeed on re-flood following Emergency Depressurization

**APPLICANT'S ACTIONS OR BEHAVIOR:**

## EVENT 10 LEVEL INSTRUMENT FAILURE DUE TO REFERENCE LEG FLASHING – REACTOR FLOODING REQUIRED

The crew will respond to indications of Reactor Pressure Vessel Level reference leg flashing, resulting in a loss of all level instrumentation.

Objectives:

SCO — As the eactor depressurizes, recognize indications of reference leg flashing and it impact, being no level instrumentation being available

Enter and execute EOP-01-RxFP,Reactor Flooding Procedure, provide direction to the RO/BOP operators

RO/BOP — Implement directions given by SCO to establish required Reactor Flooding Conditions to ensure adequate core cooling

Success Path:

Reactor Pressure Vessel Injection has been established resulting in at least 5 safety relief valves (SRVs) being open with at least 50 psid (but as low as possible) between the Reactor and Suppression Chamber Pressure.

**Simulator Operator Activities:**

- **None**

## EVENT 10 LEVEL INSTRUMENT FAILURE DUE TO REFERENCE LEG FLASHING – REACTOR FLOODING REQUIRED

**Required Operator Actions:**

**EOP Action – Entry into and Execution of Reactor Flooding Procedure**

SCO

- As the reactor depressurizes, correctly evaluate indications to determine Level Instrument Reference Leg Flashing is occurring
- Enter and execute EOP-01-RxFP,Reactor Flooding Procedure to ensure adequate core cooling

RO/BOP

- Observe and report indications of Reactor Vessel Level indication reference leg flashing
- Carry out directions of SCO to establish Reactor Flooding conditions (5 or more SRVs open with at least 50 psig delta p between suppression pool and reactor.)

**APPLICANT'S ACTIONS OR BEHAVIOR:**

**Simulator Operator Activities:**

**WHEN** directed by the lead examiner, place the simulator in **FREEZE.**

## CAUTION

## DO NOT RESET THE SIMULATOR PRIOR TO RECEIPT OF CONCURRENCE TO DO SO FROM THE LEAD EXAMINER

## 8.9 Swapping Reactor Building Ventilation Fans

R
Reference
Use

### 8.9.1 Initial Conditions

1. Reactor Building Ventilation System is in service in accordance with Section 5.1 or 8.1. ☐

### 8.9.2 Procedural Steps

1. **PERFORM** the following to swap a Reactor Building Exhaust Fan:

   a. **PLACE** the selected fan control switch in *START* **AND HOLD**. ☐

   b. **ENSURE** the selected fan discharge damper opens. ☐

   c. **RELEASE** the selected fan control switch. ☐

   d. **ENSURE** the selected fan is running by observing the control switch red fan light is on. ☐

   e. **PLACE** the selected fan control switch in *STOP*. ☐

2. **PERFORM** the following to swap a Reactor Building Supply Fan:

   a. **PLACE** the selected fan control switch in *STOP*. ☐

   b. **PLACE** the selected fan control switch in *START* **AND HOLD**. ☐

   c. **ENSURE** the selected fan discharge damper opens. ☐

   d. **RELEASE** the selected fan control switch. ☐

   e. **ENSURE** the selected fan is running by observing the control switch red fan light is on. ☐

### 8.9.2 Procedural Steps

3. **ENSURE** *REACTOR BLDG NEG PRESSURE, VA-PI-1297*, at a minimum of 0.25 inches of water. ☐

4. **ENSURE** *MSIV PIT EXHAUST AIR CHECK DAMPER, VA-2A-CV-RB*, did **NOT** close. ☐

PLANT OPERATING MANUAL

VOLUME XXI

ABNORMAL OPERATING PROCEDURE

UNIT
0

# 0AOP-16.0

# *RBCCW SYSTEM FAILURE*

REVISION 18

## 1.0 SYMPTOMS

1.1 *RBCCW PUMP DISCH HEADER PRESS LOW* (UA-03 2-5) in alarm

1.2 *RBCCW HEAD TANK LEVEL HI/LO* (UA-03 1-5) in alarm

1.3 *PUMP A SEAL CLOSED CLG WTR FLOW LO* (A-06 1-4) in alarm

1.4 *PUMP B SEAL CLOSED CLG WTR FLOW LOW* (A-07 6-5) in alarm

R15 1.5 *RBCCW HX OUTLET HDR TEMP HI* (UA-03 1-3) in alarm

1.6 UNIT 2 Only: *DRYWELL CHILLER TRIP* (UA-05 5-10) in alarm

1.7 High temperature alarms on equipment supplied by RBCCW.

R15 1.8 High NSW or CSW header pressure approaching pump shutoff head (approximately 90 psig).

## 2.0 AUTOMATIC ACTIONS

2.1 **IF** system pressure decreases to 65 psig, **THEN** the standby RBCCW pump will start. ☐

2.2 **IF** non-regenerative heat exchanger outlet temperature increases to greater than 135°F, **THEN** RWCU will isolate. ☐

2.3 **IF** Drywell Equipment Drain Sump **OR** Reactor Building Equipment Drain Tank temperature increases to 180°F, **THEN** recirculation of the affected system initiates. ☐

## 3.0 OPERATOR ACTIONS

### 3.1 Immediate Actions

None

## 3.0 OPERATOR ACTIONS

### 3.2 Supplementary Actions

| | |
|---|---|
| **NOTE:** | High drywell pressure and temperature alarms should be anticipated. |

3.2.1 **PERFORM** the following as necessary to maintain RBCCW discharge header pressure greater than 60 psig:

1. **START** available RBCCW pumps. ☐
2. **ISOLATE** any identified leaks due to pipe rupture. ☐

3.2.2 **IF** 2D RBCCW Pump is in service to either drywell **THEN PERFORM** the following:

1. **IF** 2D RBCCW Pump is the source of the leakage, **THEN PERFORM** the following:
   a. **SECURE** 2D RBCCW Pump. ☐
   b. **ISOLATE** the unit from the leak. ☐
2. **IF** a loss of heat sink (Unit 1 RB Chiller) has occurred, **THEN ENSURE** 2D RBCCW Pump is tripped. ☐

| | |
|---|---|
| **NOTE:** | A complete loss of RBCCW is defined as discharge header pressure below 60 psig, high temperature alarms on components supplied by RBCCW, and all available RBCCW Pumps running. |

3.2.3 **IF** there is a complete loss of RBCCW, **THEN PERFORM** the following:

1. **TRIP** all RBCCW pumps (including 2D RBCCW Pump if operating on the affected unit). ☐
2. **CLOSE** the following valves:
   - *RBCCW TO DW ISOL VLVS, RCC-V28* ☐
   - *RBCCW TO DW ISOL VLVS, RCC-V52* ☐
3. **TRIP** RWCU pump(s). ☐

## 3.0 OPERATOR ACTIONS

4. **ISOLATE** the RWCU System. ☐

5. **REDUCE** the speed of both reactor recirculation pumps to minimum. ☐

6. **MANUALLY SCRAM** the reactor **AND ENTER** 1(2)EOP-01-RSP. ☐

7. **TRIP** both reactor recirculation pumps. ☐

**NOTE:** CRD pumps may **NOT** be operated for greater than 20 minutes without cooling water except as directed by the Unit SCO under the following conditions:

- A CRD pump is available **AND** alternate control rod insertion is required

**OR**

- CRD pump operation is required for reactor vessel level control

8. **IF** CRD pumps are **NOT** needed for control rod insertion **OR** reactor vessel level control, **THEN TRIP** both CRD pumps. ☐

3.2.4 **IF** there is a partial loss of RBCCW pressure or service water, **THEN PERFORM** the following:

R15

1. **IF** any of the following conditions exist, **THEN REFER** to 0AOP-18.0 or 0AOP-19.0:

   - High temperatures on equipment cooled by RBCCW ☐
   - NSW or CSW header pressure approaching pump shutoff head (approximately 90 psig) ☐
   - *RBCCW HX OUTLET HDR TEMP HI* (UA-03 1-3) in alarm ☐

## 3.0 OPERATOR ACTIONS

2. **MONITOR** recirculation pump seal temperature on *RECIRC. PUMP TEMP* recorder, *B32-TR-R601*. ☐

3. **IF** either of the following conditions exist, **THEN SHUT DOWN** the affected reactor recirculation pump(s):

   - Seal heat exchanger inlet temperature for Seal 1 or Seal 2 exceeds 200°F ☐

   - RBCCW to the recirculation pump seal heat exchangers is lost for more than 10 minutes. ☐

4. **IF** the Reactor Mode Switch is in *RUN* **AND** both reactor recirculation pumps have been shut down, **THEN INSERT** a manual reactor scram. ☐

5. **REDUCE** system heat load by removing the following systems from service:

   - RWCU ☐

   - Fuel Pool Cooling ☐

   - Drywell Equipment Drain Cooler ☐

   - Reactor Building Equipment Drain Cooler ☐

   - Reactor Building, PASS, and Radwaste Sample Stations ☐

6. **MONITOR** drywell temperature and pressure. ☐

7. **IF** abnormal primary containment condition occurs, **THEN REFER** to 0AOP-14.0. ☐

8. **IF** entry conditions are reached, **THEN ENTER** 0EOP-02-PCCP. ☐

9. **IF** RBCCW can **NOT** be restored, **THEN COMMENCE** a plant shutdown in accordance with 0GP-05. ☐

10. **IF** necessary to maintain spent fuel pool water temperature below 125°F, **THEN REFER** to 0AOP-38.0. ☐

## 3.0 OPERATOR ACTIONS

3.2.5 **IF** in-leakage from components cooled by RBCCW is suspected, **THEN PERFORM** the following:

| | |
|---|---|
| **NOTE:** | In-leakage from a recirculation pump seal cooler may cause high recirculation pump motor temperature, low seal number 1 pressure, low recirculation pump seal staging flow, as well as high activity in the RBCCW system. |

1. **INITIATE** actions to identify and isolate the source of the in-leakage. ☐

2. **IF** source of the in-leakage can **NOT** be determined from available indications, **THEN NOTIFY** E&RC to sample RBCCW from the following locations:

   - Reactor Recirc Pump A Cooler Outlet ☐
   - Reactor Recirc Pump B Cooler Outlet ☐
   - Cleanup NRHX A Shell Side Outlet ☐
   - Cleanup NRHX B Shell Side Outlet ☐
   - Fuel Pool HX A Shell Side Outlet ☐
   - Fuel Pool HX B Shell Side Outlet ☐

3.2.6 **IF** *RBCCW HEAD TANK LOW LEVEL* (UA-03 1-5) is in alarm, **AND** low level is confirmed, **THEN PERFORM** the following:

1. **MONITOR** RBCCW Head Tank level. ☐

2. **FILL** the RBCCW Head Tank in accordance with 1(2)OP-21 as necessary. ☐

3. **WALK DOWN** accessible system piping to locate leakage. ☐

4. **CHECK** drywell floor drain sump leakage rate. ☐

5. **ISOLATE** any source of leakage. ☐

## 3.0 OPERATOR ACTIONS

R19

**NOTE:** Loss of AC power to the unit could result in the inability to monitor drywell temperature from the Control Room. During the time when the Control Room indication is **NOT** available, *CAC-TR-778*, located at the RSDP, can be used to ensure peak local drywell temperature history is accurately known.

**NOTE:** Maximum drywell temperatures allowed below the 75' elevation are as follows:

- Control Room temperature recorder *CAC-TR-4426* greater than or equal to 260°F
- RSDP temperature recorder *CAC-TR-778* greater than or equal to 258°F, Points 1, 3, and 4

R19

3.2.7 **IF** all RBCCW pumps are off, **THEN PERFORM** the following:

1. **IF** drywell temperature has previously exceeded or is currently greater than the maximum temperature allowed, **THEN PERFORM** the following:

   a. **PLACE** all RBCCW pump control switches in *OFF*. ☐

   b. **RESTART** RBCCW in accordance with the infrequent operation section of 1(2)OP-21 for high drywell temperature. ☐

2. **IF** drywell temperature has **NOT** exceeded the maximum temperature **AND** the RBCCW pumps have lost electrical power or will **NOT** start, **THEN PERFORM** the following:

   a. **IF** the affected unit's 4KV E buses are deenergized, **THEN REFER** to 0AOP-36.1. ☐

   b. **IF** RBCCW pump breakers local thermal or magnetic trips have activated, **THEN RESET** the tripped device. ☐

   c. **RESTART** RBCCW in accordance with 1(2)OP-21 when available. ☐

## 3.0 OPERATOR ACTIONS

d. **WHEN** RBCCW is returned to service, **THEN RESTORE** plant systems to operation in accordance with their respective operating procedures. ☐

**CAUTION**

RBCCW shall **NOT** be restored to service unless all safety required loads have sufficient service water flow.

3.2.8 **WHEN** directed by the EOPs, **THEN OPEN** the following valves to restore service water to RBCCW following a LOCA closure:

- *RBCCW HX SERVICE WATER INLET VALVE, SW-V103* ☐
- *RBCCW HX SERVICE WATER OUTLET VALVE, SW-V106.* ☐

## 4.0 GENERAL DISCUSSION

RBCCW failure interrupts cooling water supply to the following components:

(1) Reactor Recirculation Pumps
(2) CRD Pumps
(3) RWCU Recirculation Pumps, Precoat Pump, and Nonregenerative Hx
(4) Drywell Coolers
(5) Penetration Coolers
(6) Fuel Pool Heat Exchangers
(7) Drywell Equipment Drain Heat Exchanger
(8) RBEDT Heat Exchanger
(9) Reactor Building Sample Station
(10) Radwaste Building Sample Station
(11) Postaccident Sample System Sample Coolers
(12) Drywell Plate and Frame Heat Exchanger (when 2D RBCCW Pump in service)

RBCCW system failure could be due to a pipe rupture, pump failure, or loss of service water. This procedure attempts to reduce the system heat load on a partial loss of pressure due to pump failure, or high temperature due to service water failure. In the case where no RBCCW pumps are running and any drywell local temperature below the 75' elevation has exceeded 260 degrees, restart of the RBCCW pumps will be controlled using Infrequent Operation sections in 1(2)OP-21 in order to protect RBCCW piping integrity inside the drywell. If a loss of all pumps has occurred, and elevated drywell temperature existed, system piping may contain voids, which could lead to waterhammer upon an uncontrolled restart.

## 5.0 REFERENCES

5.1 0AOP-14.0, Abnormal Primary Containment Conditions

5.2 0AOP-18.0, Nuclear Service Water System Failure

5.3 0AOP-19.0, Conventional Service Water System Failure

5.4 0AOP-36.1, Loss of Any 4160V Buses Or 480V E-Buses

5.5 0AOP-38.0, Loss Of Fuel Pool Cooling

5.6 1(2)APP-UA-03, Annunciator Panel Procedure for Panel UA-03

5.7 1(2)APP-A-06, Annunciator Panel Procedure for Panel A-06

5.8 1(2)APP-A-07, Annunciator Panel Procedure for Panel A-07

5.9 2APP-UA-05, Annunciator Panel Procedure for Panel UA-05

5.10 0EOP-02-PCCP, Primary Containment Control Procedure

5.11 0ENP-24.0, Reactor Engineering Guidelines

5.12 1(2)EOP-01-RSP, Reactor Scram Procedure

5.13 0GP-05, Unit Shutdown

5.14 1(2)OP-21, Reactor Building Closed Cooling Water System Operating Procedure

R15 5.15 IER #92-21-03(IFI); FACTS #93B9034

5.16 EWR #09588, Operation of CRD Pumps without RBCCW

5.17 GE SIL No. 459, S2

5.18 Technical Memorandum No. B/M-90-001

R19 5.19 NRC Generic Letter 96-06, Assurance of Equipment Operability and Containment Integrity During Design Basis Conditions

5.20 ESR 01-00400, AST Implementation for Fuel Handling

## 6.0 ATTACHMENTS

None

## REVISION SUMMARY

Revision 18 is an editorial correction to replace the Desdemona font used for check-off boxes and to enhance wording in Notes.

Revision 17 clarifies conditions under which a CRD pump may be operated for greater than 20 minutes without cooling.

Revision 16 adds clarifying information in a NOTE above steps required to be performed for a complete loss of RBCCW.

Revision 15 – Added new Step 3.2.4.4 to instruct the Operator to scram the reactor upon loss of forced recirculation (Mode Switch in RUN) as required by 1(2)AOP-04.0.

Revision 14 – Format changes to meet the requirements of 0AP-005 and Microsoft Word XP. This revision makes non-intent changes to steps for clarity. This change does NOT implement an intent change. Additional administrative changes classified as "editorial": are bolding action verbs, italicizing components, change of cover page logo, removal of the "bar code" from the cover page, and adding place keeping aids.

Revision 13 incorporates EC 47025, Permanent RB/DW Chiller Installation. New Supplementary Action steps 2 and 3 have been added to address actions required if the 2D RBCCW Pump is in service to either drywell.

Revision 12 incorporates actions required in response to NRC Generic Letter 96-06. This action added a step to prevent RBCCW pump restart if all pumps were lost and any local drywell temperature below the 75' elevation exceeded 260 degrees Fahrenheit.

Revision 11 switches the order of steps in the Supplementary Actions section to clarify the actions to be taken for a complete loss of RBCCW and corrects procedure references.

## RBCCW PUMP DISCH HEADER PRESS LOW

### AUTO ACTIONS

NONE

### CAUSE

1. RBCCW pump trip due to any of the following:
   a. Overload device.
   b. Load shed sequence for applicable emergency bus.
   c. Circuit malfunction.
2. Gross leakage or piping failure.
3. Improper valve lineup.
4. Increased heat load.
5. Circuit malfunction.

### OBSERVATIONS

1. RBCCW pump indicates tripped or associated emergency 4160 volt bus has received an undervoltage or loss of off-site power signal.
2. RBCCW Pump Discharge And Header Pressure Indicator, RCC-PI-671-1, indicates less than 68 psig.
3. If RBCCW header pressure reaches 65 psig as indicated on RCC-PI-671-1, then the standby RBCCW pump should start.

### ACTION

1. For RBCCW pump trip, start the standby pump if auto start has not occurred.
2. If pressure cannot be restored, refer to AOP-16.0, Reactor Building Closed Cooling Water System Failure.
3. If a circuit malfunction is suspected, ensure that a Trouble Tag is prepared.

### DEVICE/SETPOINTS

| | |
|---|---|
| Pressure switch RCC-PS-673 | 68 psig |

### POSSIBLE PLANT EFFECTS

1. Loss of RBCCW cooling capacity could result in a unit shutdown.

### REFERENCES

1. LL-9353 - 35
2. AOP-16.0, RBCCW System Failure

PLANT OPERATING MANUAL

VOLUME XXI

ABNORMAL OPERATING PROCEDURE

UNIT
2

# 2AOP-04.0

# *LOW CORE FLOW*

REVISION 16

## 1.0 SYMPTOMS

1.1 Reduction in core flow, reactor recirculation pump motor amps, reactor power, generator output, etc.

1.2 The following alarms may also appear in particular instances:

- *RECIRC FLOW A LIMIT* (A-06 3-2)
- *RECIRC FLOW B LIMIT* (A-07 2-4)
- *SPEED CONTROL A SIGNAL FAIL* (A-06 5-I)
- *SPEED CONTROL B SIGNAL FAILURE* (A-07 4-3)
- *RECIRC M-G A DRIVE MTR TRIP* (A-06 2-3)
- *RECIRC M-G B DRIVE MTR TRIP* (A-07 1-5)
- *OPRM PBA/CDA ALARM* (A-05 5-8)
- *OPRM UPSC TRIP* (A-05 6-8)
- *APRM UPSCALE* (A-06 2-8)

## 2.0 AUTOMATIC ACTIONS

2.1 Reactor scram if OPRM detects instability when it is enabled

## 3.0 OPERATOR ACTIONS

### 3.1 Immediate Actions

3.1.1 **IF** the Reactor Mode Switch is in *RUN* **AND** both reactor recirculation pumps have tripped, **THEN INSERT** a manual reactor scram. ☐

3.1.2 **IF** reactor recirculation pump speed is lowering **AND** a recirculation runback has **NOT** occurred, **THEN PLACE** the affected pump(s) *SCOOP TUBE A(B) LOCK* switch to *TRIP*. ☐

## 3.0 OPERATOR ACTIONS

### 3.2 Supplementary Actions

**NOTE:** Reactor recirculation pump speed mismatch and jet pump loop flows should be maintained within the following limits:

- 20% speed and jet pump loop flows within 10% (maximum indicated difference 7.5 $x10^6$ lbs/hr) with total core flow less than 58 $x10^6$ lbs/hr
- 10% speed and jet pump loop flows within 5% (maximum indicated difference 3.5 $x10^6$ lbs/hr) with total core flow greater than or equal to 58 $x10^6$ lbs/hr

**NOTE:** Process Computer Point U2CPWTCF, when validated, is the primary indication of total core flow, and should be used for stability region compliance. U2CPWTCF is invalid, U2NSSWDP or Attachment 1 may be used as an alternate indication for total core flow.

**NOTE:** As the stability region is approached, Process Computer Point B018, Total Core Flow, and recorder 2B21-PDR/FR-R613, located on H12-P603, will read lower than Process Computer Point U2CPWTCF.

**NOTE:** The following computer screens may be used for reference:

- 802, Power/Flow - OPRM Operable - TLO
- 803, Power/Flow - OPRM Inoperable - TLO
- 804, Power/Flow - OPRM Operable - SLO
- 805, Power/Flow - OPRM Inoperable - SLO
- 806, Power/Flow - OPRM Operable - FWTR
- 807, Power/Flow - OPRM Inoperable - FWTR.

3.2.1 **PERFORM** the following to determine the current operating point on the applicable Power-Flow Map:

1. **IF** reactor recirculation pump speed **AND** jet pump loop flow mismatch is within the allowable limits, **THEN DETERMINE** the current operating point using the applicable Power-Flow Map, as specified by 0ENP-24.0. ☐

## 3.0 OPERATOR ACTIONS

2. **IF** reactor recirculation pump speed **OR** jet pump loop flow mismatch is **NOT** within the allowable limits **OR** the plant is in single loop operation, **THEN PERFORM** the following:

**NOTE:** To compensate for signal noise, an average of several core DP readings should be used. Process Computer Point B017 or ERFIS point B21DA014 is the preferred method for obtaining this average.

a. **IF** a valid total core flow from U2CPWTCF **OR** U2NSSWDP is **NOT** available, **THEN DETERMINE** total core flow using Attachment 1. ☐

b. **DETERMINE** the current operating point using the applicable Power-Flow Map, as specified by 0ENP-24.0. ☐

3.2.2 **IF** OPRM System is operable **AND** the current operating point is in the Scram Avoidance Region, **THEN** use one of the following methods to immediately exit the region:

**NOTE:** When raising core flow with two reactor recirculation pumps operating, pump speeds and jet pump loop flow mismatch should be maintained within the allowable limit.

**NOTE:** Total core flow should **NOT** exceed 45 x $10^6$ lbs/hr (58%) in single loop operation.

**CAUTION**

If operating in the Scram Avoidance Region, a reactor recirculation pump shall **NOT** be started to exit the region.

- **RAISE** core flow ☐
- **INSERT** control rods in accordance with 0ENP-24.0, Form 2, Immediate Reactor Power Reduction Instructions. ☐

## 3.0 OPERATOR ACTIONS

R1, R9

3.2.3 **IF** the temperature differential between the coolant within the dome and the bottom head drain can **NOT** be maintained less than 145°F during the performance of this procedure, **THEN INSERT** a manual reactor scram. ☐

3.2.4 **IF** OPRM System is inoperable, **THEN PERFORM** the following:

1. **IF** either of the following conditions are met, **THEN INSERT** a manual reactor scram:

   - The current operating point is in Region A ☐

**NOTE:** Instability may be indicated by any of the following:

- *OPRM PBA/CDA ALARM* (A-05 5-8) is in alarm
- *OPRM UPSCALE TRIP* (A-05 6-8) is in alarm
- A rise in baseline APRM noise level. SRM power level and period meters may also be oscillating at the same frequency
- LPRM and/or APRM upscale or downscale alarms being received
- Sustained reactor power oscillations with a peak to peak duration of less than 3 seconds.

R1

   - Indications of thermal hydraulic instability exist **AND** the current operating point is in Region B, the 5% Buffer Region, or the OPRM Enabled Region. ☐

## 3.0 OPERATOR ACTIONS

**CAUTION**

If operating in Region B, a reactor recirculation pump shall **NOT** be started to exit the region.

2. **IF** the current operating point is in Region B, **THEN** use one of the following methods to exit the region:

**NOTE:** Total core flow should **NOT** exceed 45 x $10^6$ lbs/hr (58%) in single loop operation.

**NOTE:** When raising core flow with two reactor recirculation pumps operating, pump speeds and jet pump loop flow mismatch should be maintained within the allowable limit.

- **RAISE** core flow ☐
- **INSERT** control rods in accordance with 0ENP-24.0, Form 2, Immediate Reactor Power Reduction Instructions. ☐

**NOTE:** Operating time in the 5% Buffer Region should be minimized.

3. **IF** the current operating point is in the 5% Buffer Region, **THEN INCREASE** monitoring nuclear instrumentation for thermal hydraulic instability. ☐

3.2.5 **IF** both reactor recirculation pumps have tripped, **THEN PERFORM** the following:

1. **REDUCE** CRD flow to 30 gpm. ☐
2. **IF** the Reactor Mode Switch is **NOT** in *RUN,* **THEN PLACE** the plant in Mode 3 with 12 hours. ☐

3.2.6 **IF** the plant is in single loop operation, **THEN PERFORM** the following:

1. **REDUCE** CRD flow to 30 gpm. ☐

## 3.0 OPERATOR ACTIONS

| | |
|---|---|
| **NOTE:** | Total core flow should be maintained greater than 30.8 x $10^6$ lbs/hr to prevent the idle loop from cooling down and possibly exceeding the 100°F per hour cooldown rate. |

R9

2. **IF** total core flow is less than 30.8 x $10^6$ lbs/hr, **THEN RECORD** the following at 15 minute intervals:

- Bottom head drain temperature ☐
- Idle loop temperature ☐

3.2.7 **NOTIFY** the duty Reactor Engineer. ☐

3.2.8 **MONITOR** individual LPRM bar graphs from RBM ODAs or PPC for reactor power oscillations. ☐

R1

3.2.9 **MONITOR** the following for reactor power oscillations:

- APRMs ☐
- SRMs ☐
- SRM period meters ☐

3.2.10 **MONITOR** core thermal parameters **AND ADJUST** the following per the Reactor Engineer's recommendations:

- Rod position ☐
- Reactor recirculation pumps speeds ☐

3.2.11 **MONITOR** plant parameters including the following:

- Off-gas activity ☐
- Stack gas activity ☐
- Reactor recirculation pump variables ☐
- Recirculation loop temperatures ☐

## 3.0 OPERATOR ACTIONS

**CAUTION**

Operating time in the 5% Buffer Region should be minimized.

3.2.12 **IF** OPRM System is inoperable, **AND** entry into the 5% Buffer Region is required, **THEN INCREASE** monitoring nuclear instrumentation for thermal hydraulic instability. ☐

**CAUTION**

Intentional entry into Region B is prohibited.

**CAUTION**

Following a recirculation runback or scoop tube lockout, the speed demand signal must be nulled to actual pump speed or a flow transient will result when runback or scoop tube is reset.

**CAUTION**

Manual control of recirculation flow should be reasonably slow to avoid rapid power changes.

3.2.13 **IF** both reactor recirculation pumps are operating, **THEN PERFORM** the following:

1. **IF** OPRM System is inoperable, **THEN ENSURE** Region B is **NOT** entered. ☐

2. **ADJUST** reactor recirculation pump speed as necessary to maintain pump speed and jet pump loop flow mismatch within required limits. ☐

3. **ENSURE** thermal limits are **NOT** violated. ☐

## 3.0 OPERATOR ACTIONS

3.2.14 **IF** all of the following conditions occur, **THEN DETERMINE** total core flow from U2NSSWDP **OR** Attachment 1 **AND NOTIFY** the Reactor Engineer for computer point substitution:

- The plant is in single loop operation ☐
- Reactor power is greater than or equal to 23% ☐
- Computer point U2CPWTCF is **NOT** available ☐

3.2.15 **CONFIRM** all systems and components are operating within the Precautions and Limitations Section of 2OP-02. ☐

3.2.16 **IF** 2AOP-04.0 entry was due to reactor recirculation pump trip **OR** runback, **THEN NOTIFY** NIT within 5 hours to back up OPRM data for evaluation. ☐

3.2.17 **NOTIFY** Chemistry to sample for iodine within two to six hours following a change of thermal power of more than 15% in one hour. ☐

3.2.18 **IF** entry condition for this procedure was a reactor recirculation pump trip, **THEN PERFORM** the following:

1. **REVIEW** 0GP-14 for applicability. ☐
2. **PERFORM** the following to facilitate recovery from loss of a recirculation loop: ☐

**NOTE:** An idle reactor recirculation pump should **NOT** be started with the discharge valve open.

a. **CONTINUE** plant operation with the idle reactor recirculation pump discharge open. ☐

b. **MAINTAIN** total core flow between 30.8 x $10^6$ lbs/hr (40%) and 45 x $10^6$ lbs/hr (58%) to provide adequate backflow through the idle loop. ☐

c. **IF** desired to keep the loops differential temperature less than or equal to 50°F, **THEN RAISE** the operating reactor recirculation pump speed **AND REDUCE** the seal purge flow to a minimum of 3 gpm. ☐

## 4.0 GENERAL DISCUSSION

Several varieties of recirculation flow system malfunctions can cause a decrease in core coolant flow. The Reactor Recirculation System creates forced circulation of reactor coolant through the core. It is a piping system designed primarily to provide driving flow for the reactor jet pumps which, in turn, provide the coolant flow through the reactor core. The system is comprised of two separate and parallel recirculation loops. The tripping of one recirculation pump will reduce core flow from l00% to approximately 60%. In this case, flow would reverse through the 10 idle jet pump diffusers, and the other 10 jet pumps would continue to function. If both recirculation pumps trip, natural circulation will provide approximately 30% of rated core flow and a gradual reduction in flow is the only result. However, due to core thermal hydraulic instability uncertainties, the reactor must be manually scrammed in response to a dual recirculation pump trip with the reactor mode switch in RUN. Recent problems identified with core flow measurement in single loop operation, and with recirculation pump speeds outside the allowable mismatch, have created the need (under some circumstances) to use core differential pressure to determine entry into the region of thermal hydraulic instability. Core differential pressure was chosen as a means to estimate core flow due to its relationship to core flow. Recirculation pumps will automatically trip on low water level +105" or high pressure 1137 psig.

The OPRM system provides alarms and automatic trips as applicable. If the OPRM System is inoperable, then Tech Specs require an alternate method to detect and suppress thermal hydraulic instability oscillations in accordance with BWR Owners Group Guidelines for Stability Interim Corrective Action, June 6 1994. This requires three stability monitoring regions (Region A - manual scram, Region B - immediate exit, and 5% Buffer).

## 5.0 REFERENCES

R1 5.1 NEDO-32465-A, Licensing Topical Report, Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applicability GE Nuclear Energy, August 1996.

5.2 Technical Specifications

5.3 2OP-02, Reactor Recirculation System Operating Procedure

R4 5.4 General Electric Service Information Letter No. 251/251, Supplement 1

5.5 General Electric Service Information Letter No. 517

5.6 Core Operating Limits Report (COLR)

5.7 0ENP-24, Reactor Engineering Guidelines

5.8 Off-Site Dose Calculation Manual (ODCM)

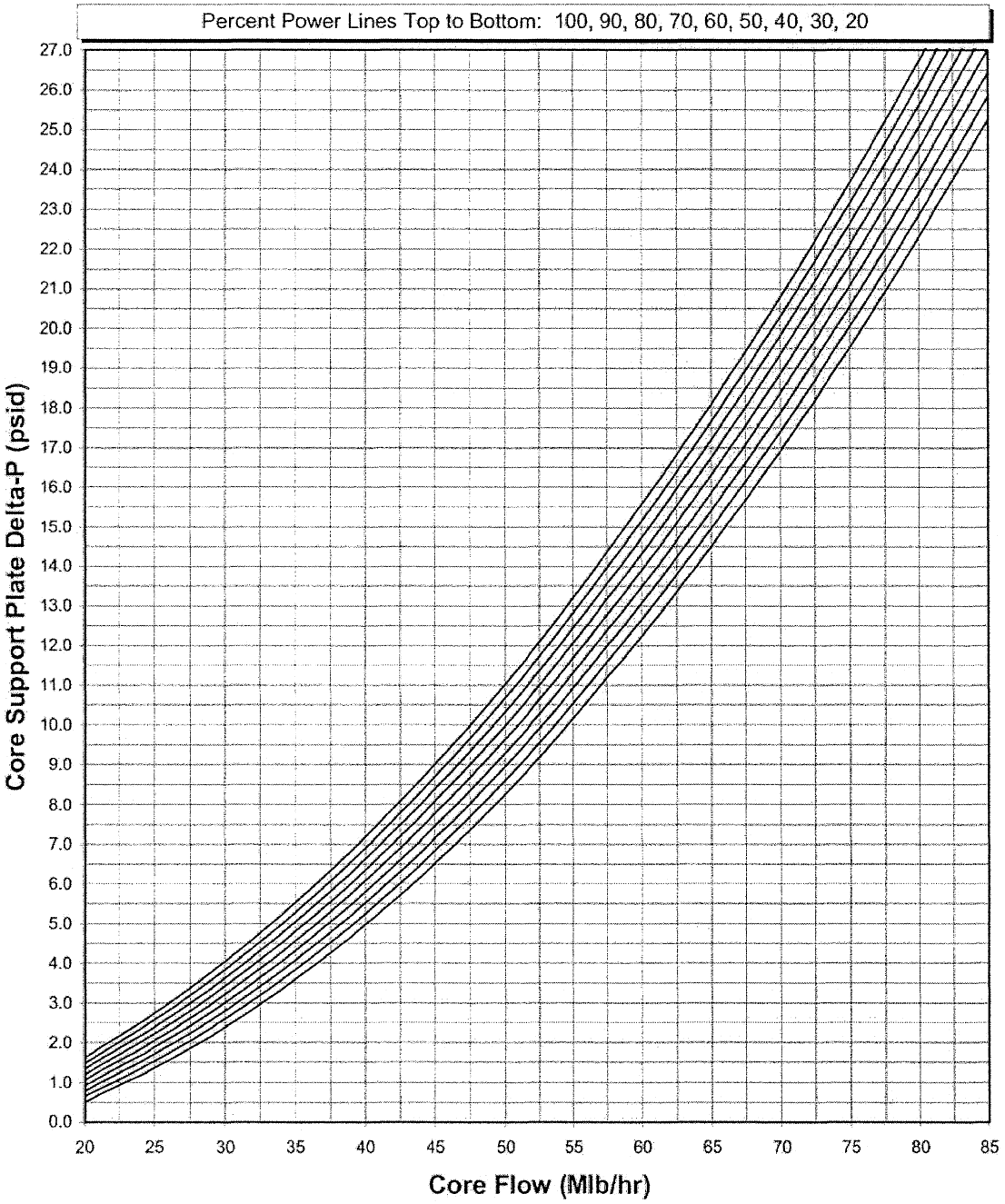
R9 5.9 LER 1-99-002 (Insertion of Manual Reactor Trip Due to Reactor Vessel Bottom Head Stratification)

5.10 0GP-14, Extended Single Recirculation Loop Operation

## 6.0 ATTACHMENTS

1 Estimated Total Core Flow vs.Core Support Plate Delta-P

## Estimated Total Core Flow vs. Core Support Plate Delta P for B2C18



## REVISION SUMMARY

Revision 16 incorporates EC 62929 by updating the title of Attachment 1 to reflect B2C18.

Revision 15 adds jet pump loop flow limit to recirc speed mismatch criteria.

Revision 14 incorporates EC 46653 (child 62488) by adding PPC point U2NSSWDP as an alternate for determining total core flow. This revision also adds a caution that an idle recirc pump may not be restarted to exit the scram avoidance region.

Revision 13 incorporates EC 50100 by updating annunciator A-05 5-8 noun name to 'OPRM PDA/CDA ALARM' and EC 56472 by updating the core flow-core d/p figure for the current fuel cycle and update map numbers. Added a step to notify NIT for backing up OPRM data.

Revision 12 – Incorporated EC 55156 which adds computer screens 811 and 812 to Note prior to Step 3.2.1 and corrected nomenclature for screens 806, 807, 808, and 809.

Revision 11– Format changes to meet the requirements of 0AP-005 and Microsoft Word XP. Steps that are not time dependant have been re-ordered to provide an easier transition. Other steps that have common sub-steps have been grouped together. These changes do NOT implement an intent change or a change in procedure methodology. Additional administrative changes classified as "editorial": are bolding action verbs, italicizing components, change of cover page logo, removal of the "bar code" from the cover page, and adding place keeping aids.

Revision 10 incorporates EC 46730 'Power Range Neutron Monitoring', EC 47907 'EPU Implementation' and EC 49331 'B2C16 Reload Core Design (figure 1).

Revision 9 incorporates ESR 00-00260 by updating Figure 1 (Core Flow vs Core Plate Differential Pressure) for cycle B2C15. This revision also deletes confusing wording in a caution and deletes a caution that was duplicated on the same page.

Revision 8 provides additional instructions for obtaining and documenting FCBB to ensure Tech Spec Compliance.

## 8.3 Recovery from Reactor Recirculation Pump Runback

C
Continuous
Use

### 8.3.1 Initial Conditions

1. Reactor Recirculation Pump operation was previously in accordance with Section 5.2. ☐

**NOTE:** Recirculation Pump runback to approximately 49% speed occurs when reactor water level is less than or equal to 182 inches **AND** feedwater flow A or B is less than or equal to 16.4% of rated flow. A Recirculation Pump speed runback to 34% will occur when the Recirculation Pump discharge valve is **NOT** fully open or total feedwater flow is less than 16.4% of the rated flow. Both of these conditions will require a manual reset of the runback.

2. The conditions that caused the runback have cleared. ☐

3. The system operation has stabilized. ☐

**CAUTION**

R23

If the OPRM system is inoperable, Then operation shall be in accordance with the applicable Power to Flow Map in the COLR with the following restrictions:

- **IF** entry into Region A occurs, **THEN** a manual scram is required.
- **IF** entry into Region B, the 5% Buffer Region, or the OPRM Enabled Region occurs **AND** indications of Thermal Hydraulic Instability exist, a manual scram is required.
- **IF** entry into Region B occurs (intentional entry is **NOT** allowed), **THEN IMMEDIATELY EXIT** by inserting control rods or increasing Recirc flow.
- Entry into the 5% Buffer Region should warrant increased monitoring of reactor instrumentation for signs of Thermal Hydraulic Instability. Time in the 5% Buffer Region should be minimized.

### 8.3.2 Procedural Steps

**CAUTION**

The OPRM System monitors LPRMs for indication of thermal hydraulic instability (THI). **WHEN** ≥ 25% power **AND** ≤ 60% recirculation flow, alarms and automatic trips are initiated upon detection of THI. Pump operations shall be within the limits of the applicable Power-Flow Map, as specified in the COLR. Care should be taken to avoid the Scram Avoidance Region.

R23

**CAUTION**

Following a Recirculation Pump runback, manual control of pump speed must be established prior to resetting the runback or a flow transient can result when the reset runback push button is depressed. The controller can be adjusted to obtain any pump speed below the runback limit. If desired, I&C can assist in adjusting the controller.

1. **ADJUST** the potentiometer on *RECIRC PUMP 2A(B) CONTROL* lowering the speed demand signal until the speed signal shows a slight decrease in pump speed using multiple indicators. ☐

2. **MONITOR** Recirculation Pump speed and be prepared to manually lock out the scoop tube if speed increases rapidly. ☐

3. **RESET** the recirculation runback for Reactor Recirculation Pump A(B) as follows:

   a. **DEPRESS** the *RECIRC RUNBACK RESET* push button for Reactor Recirculation Pump A(B). ☐

   b. **ENSURE** reactor power and flow are stabilized. ☐

4. **ADJUST** flow as directed by the Unit SCO. ☐

## 5.3 Speed/Power Increases Using the Recirculation Pump A(B) Speed Control

R Reference Use

### 5.3.1 Initial Conditions

1. Reactor Recirculation Pumps in operation in accordance with Section 5.2. ☐

2. Feedwater flow is greater than 16.4% **AND** Recirculation Pump flow limits are cleared. ☐

### 5.3.2 Procedural Steps

**NOTE:** Recirculation Pump speed changes are performed when directed by 0GP-04 and 0GP-12. Other operating procedures are used simultaneously with this procedure as directed by 0GP-04, 0GP-12, or the Unit SCO. Speed changes are accomplished by slowly turning the potentiometer clockwise for increases and counterclockwise for decreases.

**NOTE:** Speed limiters number 1 and 2 must be manually reset prior to increasing pump speed above the respective speed limit setpoint.

**NOTE:** The following indications should be observed to ensure proper response to increased speed demand from a Recirculation Pump speed controller:
a. Recirculation Pump speed increases.
b. Recirculation loop flow increases.
c. Reactor power increases.

**CAUTION**

The OPRM System monitors LPRMs for indication of thermal hydraulic instability (THI). **WHEN** $\geq$ 25% power **AND** $\leq$ 60% recirculation flow, alarms and automatic trips are initiated upon detection of THI. Pump operations shall be within the limits of the applicable Power-Flow Map, as specified in the COLR. Care should be taken to avoid the Scram Avoidance Region.

R23

**CAUTION**

**WHEN** increasing or decreasing recirculation pump speeds with Recirculation Pump A (B) speed control potentiometer, small changes of 2% to 4% should be made. With core flow less than $58 \times 10^6$ lbs/hr, pump speeds are to be maintained within 20% and jet pump loop flows are required within 10% (maximum indicated difference $7.5 \times 10^6$ lbs/hr). With core flow greater than or equal to $58 \times 10^6$ lbs/hr, pump speeds are to be maintained within 10% and jet pump loop flows are required within 5% (maximum indicated difference $3.5 \times 10^6$ lbs/hr).

### 5.3.2 Procedural Steps

**CAUTION**

Attempting to increase pump speed past the high speed electrical stops can cause controller saturation and result in large power transients during subsequent reduction in pump speed (OE-7476).

**CAUTION**

The 2A Reactor Recirc Pump speed controller has exhibited speed spikes of 0.5% to 2.0% (both up and down) predominately in the upper range of operation, resulting in unexpected reactivity changes.

**CAUTION**

Operation of the Recirc Pumps with greater than approximately 2% speed mismatch at the upper end of the controller range could result in exceeding the normal limit for individual loop flow specified in Section 6 (49,000 gpm). The guidelines provided in this section do **NOT** allow exceeding normal operating limits. If normal operating limits are or will be exceeded, the mismatch must be reduced.

**CAUTION**

If the OPRM system is inoperable, Then operation shall be in accordance with the applicable Power to Flow Map in the COLR with the following restrictions:

- **IF** entry into Region A occurs, **THEN** a manual scram is required.
- **IF** entry into Region B, the 5% Buffer Region, or the OPRM Enabled Region occurs **AND** indications of Thermal Hydraulic Instability exist, a manual scram is required.

R23

- **IF** entry into Region B occurs (intentional entry is **NOT** allowed), **THEN IMMEDIATELY EXIT** by inserting control rods or increasing Recirc flow.
- Entry into the 5% Buffer Region should warrant increased monitoring of reactor instrumentation for signs of Thermal Hydraulic Instability. Time in the 5% Buffer Region should be minimized.

1. **INCREASE** Recirculation Pump speed in increments as directed by the Unit SCO by slowly turning the *RECIRC PUMP 2A(2B) SPEED CONTROL* potentiometer in the clockwise direction. ☐

PEN X 49B ELEV 86'-0" AZIMUTH 315°

AUTO ACTIONS

1. The following excess flow check valve for the broken instrument line will close:
   a. B21-IV-2455 (X49B-A) - excess flow check valve on Instrument Line B21-7013 for B21-LT-NO26A.

CAUSES

1. Pipe break in the above instrument line.
2. Circuit malfunction.

OBSERVATIONS

1. Amber line break indicating light for penetration X49B-A on RTGB Panel XU-2 (Control Switch Module RIP-CS-1200) will be on for the broken instrument line.
2. Valve closed indicating light for penetration X49B-A on RTGB Panel XU-2 (Control Switch Module RIP-CS-1200) will be on for the excess flow check valve on the broken instrument line.

ACTIONS

1. Investigate the abnormal condition per 0OI-44.
2. If the cause of the annunciator is an instrument line break or a circuit malfunction is suspected, ensure that a WR/WO is prepared.

DEVICE/SETPOINTS

Excess flow check valve B21-IV-2455 1.5 - 3.0 gpm

POSSIBLE PLANT EFFECTS

1. Release of radioactivity into the secondary containment.
2. Invalid initiation signals and indications from the instruments supplied by the affected instrument line.
3. Excess flow check valve closure may result in a technical specification LCO.

REFERENCES

1. LL-9361 - 23
2. Technical Specification 3.6.1.3
3. 0OI-44, Excess Flow Check Valve Position Indication Evaluation

3.3 INSTRUMENTATION

3.3.3.2 Remote Shutdown Monitoring Instrumentation

LCO 3.3.3.2 The Remote Shutdown Monitoring Instrumentation Functions shall be OPERABLE.

APPLICABILITY: MODES 1 and 2.

ACTIONS

---NOTE---
Separate Condition entry is allowed for each Function.

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| A. One or more required Functions inoperable. | A.1 Restore required Function to OPERABLE status. | 30 days |
| B. Required Action and associated Completion Time not met. | B.1 Be in MODE 3. | 12 hours |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.3.3.2.1 | Perform CHANNEL CHECK for each required instrumentation channel that is normally energized. | 31 days |

(continued)

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.3.3.2.2 | Perform CHANNEL CALIBRATION for each required instrumentation channel. | 24 months |