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THREE MILE ISLAND NUCLEAR STATION
UNIT #2 ABNORMAL PROCEDURE 2203-1.1
LOSS OF BORON (MODERATOR DILUTION)

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THREE MILE ISLAND NUCLEAR STATION

UNIT #2 ABNORMAL PROCEDURE 2203-1.1

LOSS OF BORON (MODERATOR DILUTION)

1.0 SYMPTOMS

1.1 Chemistry analysis indicates a decreasing boron concentration in the Reactor Coolant System.

1.2 Neutron flux levels increasing or with the control rod drive system under automatic ICS control, the control rods are inserting.

1.3 The pressurizer and/or makeup tank levels are increasing.

1.4 "Feed and Bleed Enabled" alarm is actuated (at Panel 8).

1.5 With the reactor vessel head removed, the fuel transfer canal and/or spent fuel pool water levels are increasing.

2.0 IMMEDIATE ACTION

2.1 Automatic Action

None

2.2 Manual Action

2.2.1 For a case where there is a large low borated water inflow and/or the inflow is readily identified, immediately secure the appropriate pump(s) and/or valve(s) to stop the inflow.

2.2.2 Verify the proper makeup and pruification demineralizer is in service.

2.2.3 Commence RCS Boration to maintain Control Rod drives within the insertion limits if applicable.

3.0 FOLLOW UP ACTION

3.1 Initiate a chemistry sampling program for surveillance of boron concentration in order to determine where changes have occurred.

3.1.1 For the case where the reactor vessel head is in place and normal letdown and makeup are in progress, with the CH System secured, sampling should be initiated from the following

areas:

   a.   RC System via the letdown

   b.   Pressurizer

   c.   Makeup Tank

3.1.2   For the case where the reactor vessel head is removed or in place, but only the DH System is in operation, sampling should be initiated from the RC System via the DH System.

3.1.3   The purpose of this sampling is to both aid in locating the source for the loss of boron and to gauge the rate of this loss.

3.2   Determine the amount of shutdown margin available in accordance with 2103-1.9, Reactivity Balance Calculations.

3.2.1   If the shutdown margin is <1% $\Delta K/K$, with K_{eff} <1 or if <2% $\Delta K/K$ with K_{eff} $\geq$1 immediately initiate and continue to emergency borate as follows until the required shutdown margin is restored.

3.2.1.1   If BAMT is T.S. source and is lined up thru MU Pumps (2301-M2 Att 2A).

   a.   Start CA-P-4A or 4B

   b.   Open MU-V10

   c.   If MU-V10 fails to open, open MU-V127.

   d.   Start MU-P-1A, B, or C if not already operating.

   e.   If there is a bubble in the pressurizer maintain level constant by controlling RCS letdown valve MU-V376. If the pressurizer is solid maintain RCS pressure below 500 psig using MU-V376.

3.2.1.2   If RBAT is T.S. source and is lined up thru MU Pumps (2301-M2 Att 2B)

   a.   Open WDS-V111

   b.   Start WDS-P-3

2.0

    c.   Start either CA-P-4A or 4B

    d.   Open MU-V10

    e.   If MU-V10 fails to open, open MU-V127

    f.   Start MU-P-1A, B or C if not already operating.

    g.   If there is a bubble in the pressurizer maintain level constant by controlling RCS letdown valve MU-V376. If the pressurizer is solid maintain RCS pressure below 500 psig using MU-V376.

3.2.1.3   If BWST is T.S. source and is lined up thru DHR Pumps (2301-M2 Att 3)

3.2.1.3.1   If DH-P-1A is operating:

    a.   Close breaker for DH-V5A at MCC 2-11 EA and open valve

    b.   Stop DH-P-1A

    c.   Close DH-V100A

    d.   Open DH-V102A

    e.   Start DH-P-1A

3.2.1.3.2   If DH-P-1B is operating

    a.   Close breaker for DH-V5B at MCC2-21EA and open valve

    b.   Stop DH-P-1B

    c.   Close DH-V100B

    d.   Open DH-V102B

    e.   Start DH-P-1B

3.2.1.4   If BAMT is T.S. source and is lined up thru MU Pump Bypass (2301-M2 attach 4A)

    a.   Start either CA-P-4A or 4B

    b.   Open MU-V10. If MU-V10 fails to open, open MU-V127.

3.2.1.5   If RBAT is T.S. source and is lined up thru MU Pump Bypass
(2301-M2 Att 48)

    a.   Open WDS-V111

    b.   Start WDS-P-3A

    c.   Start CA-P-4A or 4B

    d.   Open MU-V10. If MU-V10 fails to open, open MU-V127.

3.3   Maintain the RC System boron concentration as directed by the Shift
Supervisor/Shift Foreman in accordance with 2103-1.2, Soluble Poison
Concentration Control.

3.4   If the cause of the loss of boron (moderator dilution) is still not
known, refer to the below listed enclosures for guidance on locating
the possible cause.

3.4.1   Enclosure 1

Loss of Boron Checklist (RV Head in Place with Makeup System
Operational and DH System secured.

3.4.2   Enclosure 2

Loss of Boron Checklist (RV Head Removed or In Place but only
DH System in operation).

3.5   Initiate the appropriate action to eliminate the problem.

3.6   When the loss of boron (moderator dilution) has been stopped, cease
the sampling program initiated in Step A above and return the
systems to their normal conditions for the mode of operation
which the unit is in.

3.7   Determine the shutdown margin available in accordance with 2103-
1.9, Reactivity Balance Calculations.

3.0

Enclosure 1 - Loss of Boron Checklist (RV Head in Place
With Makeup System Operational and DH System
Secured)

Possible Cause	Corrective Action
1. The Makeup System is introducing a fluid of lower boron concentration into RC System.	1. Close, or verify closed, MU-V10 (Boric Acid & DW Addition Isolation Valve) MU-V294, (DW Addition Isolation Valve) and MU-V290 (MU Pump DW Suction Isolation).
2. If a batch deboration process is or was in progress, failure of valves MU-V10, (Boric Acid & DW Addition Isolation Valve) and MU-V294, (DW Addition Isolation Valve), to close tight could cause a deboration of RC System.	2. Close, or verify closed, MU-V10, (Boric Acid & DW Addition Isolation Valve) and MU-V294, (DW Addition Isolation Valve). Use manual verification if necessary.
3. If a mixed flow batch process is or was in progress, freezing of the boric acid addition line could cause a diluent to flow into the RC System.	3. Check for level decrease in RBAT or BAMT. Check the heat tracing on the boric acid addition line to verify operation. Close, or verify closed, MU-V10, Boric Acid & DW Addition Isolation Valve. If required, use alternate boric acid addition line for any further boration.
4. If a feed and bleed deboration process is or was in progress, failure of valves MU-V10, (Boric Acid & DW Addition Isolation Valve) and MU-V294, (DW Addition Isolation Valve), to close tight could cause further RC System deboration.	4. Close, or verify closed, MU-V10, Boric Acid & DW Addition Isolation Valve and MU-V294, DW Addition Isolation Valve. Use manual verification if necessary.
5. If a feed and bleed mixed flow process is or was in progress, freezing of the boric acid addition line could cause a diluent to flow into the RC System.	5. Check for level decrease in RBAT or BAMT. Check the heat tracing on the boric acid addition line to verify operation. Close, or verify closed, MU-V10 Boric Acid & DW Addition Isolation Valve. If required, use alternate boric acid addition line for any further boration.

4.0

Enclosure 1 - continued

Possible Cause	Corrective Action
6. If a flow path is inadvertently lined up to the deborating demineralizer(s), boron concentration could drop until saturation is attained.	6. Close, or verify closed, MU-V10, (Boric Acid & DW Addition Isolation Valve) and WDL-V45 (Deborating Demineralizers Inlet Valve). If required, also close deborating demineralizer isolation valves WDL-V81A/B and WDL-V118A/B.
7. Other means of diluents entering the RC System are through the following MU System valves: MU-V285A/B (Makeup & Purification Demineralizers N_2/DW Supply Valves) MU-V292A/B (Makeup & Purification Demineralizers DW Backflush Valves).	7. Close, or verify closed, MU-V285A/B, (Makeup & Purification Demineralizers N_2/DW Supply Valves) and MU-V292A/B, (Makeup & Purification Demineralizers Backflush Valves). If required, remove spool piece from demineralized water supply line to Makeup & Purification Demineralizers (MU-K1A/B).

Enclosure 2 - Loss of Boron Checklist (RV Head is Removed, or
in Place but Only the DH System is in Operation)

Possible Cause	Corrective Action

1. Decay Heat Pump(s) (DH-P-1A/B) taking suction from the following sources which may have lower boron concentrations than the RC System:

   a) from SF Cooling System

   b) from SF Cooling System purification

   c) from NaOH Storage Tank

1. Cease suction from these sources as follows:

   a) Close, or verify closed, valves DH-V110 and DH-V101A/B, DH Suction from SF System Valves (Manual Valves)

   b) Close, or verify closed, valves SF-V107 and SF-V125, SF Cooling & Purification Loops Isolation Valves. Also verify that the demineralized water supply to the SF Demineralizer (SF-K1) is secured by verifying closed SF-V186, SF Demineralizer N_2/DW Supply Valve. If required, secure the SF purification loop and isolate from the DH System by closing SF-V122, SF Purification to DH System Isolation Valve.

   c) Close, or verify closed, valves DH-V8A/B, NaOH Storage Tank Isolation Valves. If this is considered to be the source for boron dilution, also consult chemistry department as to effects of NaOH in RC System.

2. During refueling when the transfer tubes are open, the possible inflow of lower boron concentration SF Pool water into the Fuel Transfer Canal could cause RC System boron dilution.

2. Verify that SF Pool and Fuel Transfer Canal water levels are the same and check for possible flow through the transfer tube from the SF Pool to the Fuel Transfer Canal. Adjust system flow as necessary and close FH-V1A/3, Transfer Tube Isolation Valves, if required while corrective action is underway.