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INDIAN POINT STATION

UNIT 2

ABNORMAL OPERATING INSTRUCTION 4.2.1 REV. 4

LOSS OF RESIDUAL HEAT REMOVAL SYSTEM

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LOSS OF RESIDUAL HEAT REMOVAL SYSTEM

1 SYMPTOMS/INDICATIONS

1.1 Reduced Residual Heat Removal (RHR) flow.

1.2 480 V SWGR MOTOR TRIP (COMMON).

1.3 RHR pump not running.

1.4 Increasing Reactor Coolant System (RCS) temperature.

1.5 Abnormal RHR heat exchanger temperature differential.

1.6 Component Cooling Water (CCW) flow to RHR heat exchangers lost.

2 AUTOMATIC ACTIONS

None.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                      CAUTION                          *
*                                                       *
*   IF RHR is lost during mid-loop drained down         *
*   condition, RCS could boil in as little time as      *
*   2.5 minutes.                                        *
*                                                       *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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3 OPERATOR ACTIONS

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* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                      CAUTION                          *
*                                                       *
*   DO NOT restore RHR flow UNTIL CCW to RHR heat       *
*   exchangers is re-established.                       *
*                                                       *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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3.1 IF CCW to RHR heat exchangers has become steam bound:

3.1.1 Close following valves:

RHR Heat Exchanger 21 Outlet Butterfly 820B CLOSED _____

RHR Heat Exchanger 22 Outlet Butterfly 820A CLOSED _____

3.1.2 Check open following valves:

RHR Heat Exchanger 21 Inlet Stop 818B
OPEN _____

RHR Heat Exchanger 21 Outlet Stop MOV-822B
OPEN _____

RHR Heat Exchanger 22 Inlet Stop 818A
OPEN _____

RHR Heat Exchanger 22 Outlet Stop MOV-822A
OPEN _____

3.1.3 SLOWLY open following valves to normal throttled position:

RHR Heat Exchanger 21 Outlet Butterfly 820B
THROTTLED _____

RHR Heat Exchanger 22 Outlet Butterfly 820A
THROTTLED _____

3.2 Verify RHR flow:

3.2.1 IF RHR flow is low, ensure RHR pumps are operating normally. _____

```
* * * * * * * * * * * * * * * * * * * * * * * * * *
*                    CAUTION                        *
*                                                   *
*   IF pump(s) not running, determine cause prior   *
*   to restart.                                     *
*                                                   *
* * * * * * * * * * * * * * * * * * * * * * * * * *
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3.2.2 IF RHR pump is steam bound due to RCS low level vortexing, quench pump as follows:

1 Stop RHR pump:

RHR 21 Pump OFF _____
RHR 22 Pump OFF _____

2 Open any combination of Hi-Head SI stops:

MOV-856A OPEN _____
MOV-856D OPEN _____
MOV-856E OPEN _____
MOV-856C OPEN _____

3 Raise RCS level to greater than 62 ft. 10 inches, THEN close stops opened in 3.2.2.2 _____

4

3.2.3 Close RHR heat exchanger flow control valve(s):

RHR Heat Exchanger 21-HCV-638	CLOSED	_____
RHR Heat Exchanger 22-HCV-640	CLOSED	_____

3.2.4 Start RHR pump:

RHR 21 Pump	RUNNING	_____
OR		
RHR 22 Pump	RUNNING	_____

3.2.5 Slowly open one RHR heat exchanger flow control valve(s):

HCV-638	THROTTLED	_____
HCV-640	THROTTLED	_____

3.2.6 Check RHR pump locally to ensure it is running normally. _____

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* * * * * * * * * * * * * * * * * * * * * * * * * *
*                  CAUTION                        *
*                                                 *
*   ONLY ONE RHR pump shall be in service         *
*   when RCS level less than 63 ft. EL.           *
*                                                 *
* * * * * * * * * * * * * * * * * * * * * * * * * *
```

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3.2.7 IF two RHR pumps are required for heat load, start second pump per steps 3.2.3 through 3.2.6. _____

3.2.8 IF RHR pumps are operating normally, check open main flow path valves per COL 4.2.1, Residual Heat Removal System. _____

3.3 Ensure Component Cooling Water (CCW) is cooling RHR as follows:

1 Check RHR temperature less than 350F. _____

2 Check CCW temperature 110 to 120F. _____

3 Check CCW flow greater than 3000 gpm. _____

4 Check open RHR heat exchanger CCW isolation stops per step 3.1.2 and 3.1.3. _____

5 IF CCW malfunction is indicated, proceed to A 4.1.1, Loss of Component Cooling. _____

6 IF leakage into CCW is indicated, proceed to A 4.1.2, Leakage into Component Cooling System. _____

3.4 IF RHR temperature or flow cannot be restored to normal, proceed to appropriate section of procedure:

Section 3.5 RCS Not Drained. _____

Section 3.6 RCS Drained, Reactor Head On, Steam Generator Manways In Place. _____

Section 3.7 Reactor Head Off. _____

Section 3.8 Steam Generator Manways Removed. _____

3.5 RCS Not Drained

3.5.1 Maintain steam generator level between 35 to 65 percent with auxiliary feedwater pumps per SOP 21.3, Auxiliary Feedwater System. _____

3.5.2 IF RCS is above 212F, proceed as follows:

1 Control RCS temperature using atmospheric steam dumps. _____

2 IF CCR Foxboros or Instrument Air is not available to atmosphere steam dumps THEN refer A 27.1.9. _____

3 Control Pressurizer level and RCS pressure using charging pumps and Letdown Backpressure Control PCV-135 per SOP 3.1, Charging, Sealwater and Letdown Control. _____

3.6 RCS Drained, Reactor Head on, Steam Generator Manways in Place

1 Break one rupture disc on Pressurizer Relief Tank (PRT) to provide full flow path from PRT to Containment floor. _____

2 Evacuate all personnel from Containment. _____

3 Close one door 80 ft. airlock. _____

4 Close one door 95 ft. EL airlock. _____

5 Open following Pressurizer valves:

Pressurizer Relief Valve PCV-455C	OPEN	_____
Pressurizer Power Relief Stop 535	OPEN	_____
Pressurizer Relief Valve PCV-456	OPEN	_____
Pressurizer Power Relief Stop 536	OPEN	_____

6 Place Containment Sump Pump 29 in off. _____

7 Place Containment Sump Pump 210 in off. _____

8 Start one safety injection (SI) pump with suction from Refueling Water Storage Tank (RWST). _____

9 Open one of following stops:

Loop 21 Cold Leg Hi-Head SI Stop MOV-856A
OPEN _____

Loop 22 Cold Leg Hi-Head SI Stop MOV-856D
OPEN _____

Loop 23 Cold Leg Hi-Head SI Stop MOV-856E
OPEN _____

Loop 24 Cold Leg Hi-Head SI Stop MOV-856C
OPEN _____

10 WHEN minimum level in recirculation sump is about one foot below top of sump (45 ft. EL or greater), stop SI pump. _____

11 Close stop opened in step 9. _____

12 Align flow from recirculation pumps through RHR Heat Exchanger 22 as follows:

Recirculation Pump Discharge Stop MOV-1802A
OPEN _____

OR

Recirculation Pump Discharge Stop MOV-1802B
OPEN _____

RHR Heat Exchanger 22 Outlet Stop 746 OPEN _____

13 Align flow from recirculation pumps through RHR Heat Exchanger 21 as follows:

RHR Heat Exchanger 22 Inlet Isolation MOV-745B
OPEN _____

RHR Heat Exchanger 22 Inlet Isolation MOV-745A
OPEN _____

RHR Heat Exchanger 21 Inlet Stop 742 OPEN _____

RHR Heat Exchanger 21 Outlet Stop MOV-747
OPEN _____

```
* * * * * * * * * * * * * * * * * * * * * * * *
*                  CAUTION                    *
*                                             *
*   Failure to maintain water level at least  *
*   one foot below top of recirculation       *
*   sump (45 ft. EL or greater), will cause   *
*   recirculation pumps to lose NPSH.         *
*                                             *
* * * * * * * * * * * * * * * * * * * * * * * *
```

14 Start one OR both recirculation pumps. _____

15 Adjust RHR heat exchanger outlet hand flow control valves to maintain reactor core average exit temperature less than 180F.

RHR Heat Exchanger 21 Flow Control HCV-638 THROTTLED _____

RHR Heat Exchanger 22 Flow Control HCV-640 THROTTLED _____

16 Monitor level in recirculation sump. _____

17 Maintain required level in sump by starting and stopping recirculation pump(s) as necessary. _____

18 Raise level in recirculation sump if necessary by repeating steps 3.6.8 through 3.6.11. _____

3.7 Reactor Head Off

3.7.1 INITIAL CONDITIONS

1 Recirculation pumps are operable. _____

2 Submersible pump with 400 gpm capacity is available and suspended from polar crane. _____

NOTE: Pump is stored at Tensolite warehouse.

3 Recirculation sump is clean and ready to be filled with borated water. _____

4 6-inch hose is connected to discharge of submersible pump at 95 ft. EL Vapor Containment (VC) and routed to recirculation sump (46 ft. EL VC). _____

5 Hose is lashed down to preclude lifting and spraying 46 ft. EL VC. _____

6 End of hose is placed just off bottom of recirculation sump. _____

7 Recirculation sump level indicators at Central Control Room (CCR) are operable. _____

8 Following motor control centers are energized.

MCC 26A	ENERGIZED	_____
MCC 26B	ENERGIZED	_____
MCC 28	ENERGIZED	_____

9 Operator is at recirculation sump. _____

10 Crane operator is at 95 ft. EL VC. _____

11 Communications established between recirculation sump and polar crane operators. _____

3.7.2 Place submersible pump motor plug in Control Rod Drive (CRD) Fan 21 power station jack. _____

3.7.3 Select CRD Fan 21. _____

```
* * * * * * * * * * * * * * * * * * * * * * *
*                  CAUTION                  *
*                                           *
*   Siphon effect may be created when       *
*   submersible pump is placed in Reactor   *
*   Cavity, overflowing recirculation sump. *
*                                           *
* * * * * * * * * * * * * * * * * * * * * * *
```

3.7.4 Lower submersible pump into Reactor Cavity using polar crane. _____

3.7.5 IF siphon exists:

Close valve on 6-inch hose (46 ft. EL VC) _____

OR

Remove submersible pump from Reactor Cavity to prevent overflowing recirculation sump. _____

```
* * * * * * * * * * * * * * * * * * * * * * *
*                  CAUTION                  *
*                                           *
*    Failure to maintain water level at least *
*    one foot below top of recirculation sump *
*    (45 ft. EL or greater) will cause      *
*    recirculation pumps to lose NPSH.      *
*                                           *
* * * * * * * * * * * * * * * * * * * * * * *
```

3.7.6 Start submersible pump. _____

3.7.7 Establish flow from recirculation pumps through RHR heat exchangers to RCS by performing steps 3.6.12 through 14. _____ 14

3.7.8 IF Reactor Cavity level is below 93 ft. 2 inches, proceed as follows:

1 Start one SI pump with suction from RWST. _____

2 Open one of following stops:

Loop 21 Cold Leg Hi-Head SI Stop MOV-856A OPEN _____
Loop 22 Cold Leg Hi-Head SI Stop MOV-856D OPEN _____
Loop 23 Cold Leg Hi-Head SI Stop MOV-856E OPEN _____
Loop 24 Cold Leg Hi-Head SI Stop MOV-856C OPEN _____

3 WHEN Reactor Cavity water level is 93 ft. - 10 inches, stop SI pump.

4 Close stop opened in step 2 above. _____

3.7.9 Adjust following to maintain constant level in Reactor Cavity and recirculation sump:

RHR Heat Exchanger 21 Flow Control HCV-638 THROTTLED _____

RHR Heat Exchanger 22 Flow Control HCV-640 THROTTLED _____

Valve on 6-inch hose (46 ft. EL VC) THROTTLED _____

```
* * * * * * * * * * * * * * * * * * * * * * * *
*                  CAUTION                    *
*                                             *
*   400 GPM minimum is required to maintain   *
*   RCS and Reactor Cavity temperature below  *
*   200F.                                     *
*                                             *
* * * * * * * * * * * * * * * * * * * * * * * *
```

3.7.10 WHEN 42 ft. 3 inches recirculation sump level light is de-energized, proceed as follows:

1 Stop recirculation pumps. _____

2 Close HCV-640. _____

3 Close HCV-638. _____

3.7.11 Repeat step 3.7.8 as necessary to maintain Reactor Cavity level. _____ 14

3.7.12 WHEN 44 ft. 11 inches recirculation sump level light is energized, proceed as follows:

1 Start one OR both recirculation pumps. _____

2 Adjust following to maintain constant level in Reactor Cavity and recirculation sump:

RHR Heat Exchanger 21 Flow Control HCV-638 THROTTLED _____

RHR Heat Exchanger 22 Flow Control HCV-640 THROTTLED _____

3.8 Steam Generator Manways Removed

3.8.1 INITIAL CONDITIONS

1 Recirculation pumps are operable. _____

2 Recirculation sump is clean and ready to be filled with borated water. _____

3 Special cover plates with 6-inch hose connections are available at hot leg manways of steam generators 21 and 23. _____

4 Hoses are connected to steam generators 21 and 23 manways and are routed to recirculation sump. _____

5 Blank cover plates available at all other steam generator manways. _____

6 Recirculation sump level indicators at CCR are operable. _____

7 Following motor control centers are energized:

MCC-26A ENERGIZED _____
MCC-26B ENERGIZED _____

8 Operator is at recirculation sump. _____

3.8.2 Ensure all loose materials removed from steam generator manways. _____

NOTE: IF NOT possible to complete installation of all covers, water may be allowed to spill over open manways.

3.8.3 Install blank covers on all steam generator cold leg manways.

Steam Generators 21 Cold Leg Manways _____
Steam Generators 22 Cold Leg Manways _____
Steam Generators 23 Cold Leg Manways _____
Steam Generators 24 Cold Leg Manways _____

3.8.4 Install blank covers on steam generator 22 and 24 hot leg manways.

Steam Generator 22 Hot Leg Manway _____
Steam Generator 24 Hot Leg Manway _____

3.8.5 Install cover plates with hose connection on steam generators 21 and 23 hot leg manways. _____

Steam Generator 21 Hot Leg Manway _____
Steam Generator 23 Hot Leg Manway _____

3.8.6 Attach hoses to connections on cover plates for steam generator 21 and 23 hot legs.

Steam Generator 21 Hot Leg HOSE CONNECTED _____
Steam Generator 23 Hot Leg HOSE CONNECTED _____

3.8.7 Slowly raise RCS level to provide flow through hoses from steam generator hot leg manways to recirculation sump, as follows:

1 Start one SI pump with suction from RWST. _____

2 Open one of following stops:

Loop 21 Cold Leg Hi-Head SI Stop MOV-856A OPEN _____
Loop 22 Cold Leg Hi-Head SI Stop MOV-856D OPEN _____
Loop 23 Cold Leg Hi-Head SI Stop MOV-856E OPEN _____
Loop 24 Cold Leg Hi-Head SI Stop MOV-856C OPEN _____

3 WHEN minimum level in recirculation sump is about one foot below top of sump (45 ft. EL or greater), stop SI pump. _____

4 Close stop opened in step 2 above. _____

3.8.8 Establish flow from recirculation pumps through RHR heat exchangers to RCS by performing steps 3.6.12 through 3.6.14. _____ 14

3.8.9 Adjust following to maintain constant level in recirculation sump:

RHR Heat Exchanger 21 Flow Control HCV-638 THROTTLED _____

RHR Heat Exchanger 22 Flow Control HCV-640 THROTTLED _____

Valve on 6-inch hoses (46 ft. EL VC) THROTTLED _____

3.8.10 WHEN 42 ft. 3 inches recirculation sump level light is de-energized, proceed as follows:

1 Stop recirculation pumps. _____

2 Close HCV-640. _____

3 Close HCV-638. _____

3.8.11 Repeat step 3.8.7 as necessary to maintain level in recirculation sump about one foot below top of sump. _____ 14

3.8.12 WHEN 44 ft. 11 inches recirculation sump level light is energized, proceed as follows:

1 Start one OR both recirculation pumps. _____

2 Adjust following to maintain constant level in recirculation sump:

RHR Heat Exchanger 21 Flow Control HCV-638 THROTTLED _____

RHR Heat Exchanger 22 Flow Control HCV-640 THROTTLED _____