NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-REQ-006-344-2-16 Revision 4

TITLE: EMERGENCY OPERATING PROCEDURE, RPV FLOODING (C-4)

	SIGNATURE	DATE
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TRAINING AREA SUPERVISOR	[signature]	9/6/90
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Summary of Pages

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4/29/96

I. TRAINING DESCRIPTION

A. Title of Lesson: Emergency Operating Procedures, RPV Flooding (C-4)

B. Lesson Description: This lesson discusses the actions taken to flood the RPV whether or not the core is completely shutdown.

C. Estimate of the Duration of the Lesson: 2 hours

D. Method of Evaluation, Grade Format, and Standard of Evaluation: Written Examination with 80% minimum passing grade.

E. Method and Setting of Instruction:

1. Classroom Lecture
2. Assign the Student Learning Objectives as review problems with the students obtaining answers from the text, writing them down and handing them in for grading.

F. Prerequisites:

1. Instructor:
   a. Qualified in instructional skills per NTP-16 and/or 16.1.
2. Trainee:
   a. In accordance with NTP-10 and NTP-11 or
   b. Be recommended for this training by the Operations Superintendent or his designee or by the Training Superintendent.

G. References:

BWROG Emergency Procedure Guidelines, Rev. 4,
Plant Procedure N2-EOP-C3

II. REQUIREMENTS

A. AP-9, Administration of Training

B. NTP-10, Training of Licensed Operator Candidates

C. NTP-11, Licensed Operator Requalification Training

III. TRAINING MATERIALS

A. Instructor Materials:

1. Copy of this Lesson Plan
2. Whiteboard and Felt Tip Markers
3. EOP Flowchart for C4

B. Trainee Materials:

1. EOP Flowchart for C4

IV. EXAM AND MASTER ANSWER KEYS

Will be generated and administered as necessary. They will be on permanent file in the Records Room.

V. LEARNING OBJECTIVES

A. Terminal Objectives:

TO-1.0 Given conditions requiring the use of the Emergency Operating Procedures, use the procedure to place the plant in a stable condition as prescribed in the procedure.

TO-2.0 Given an emergency condition, determine when RPV Flooding is required.

TO-3.0 Given an emergency condition requiring RPV Flooding determine the actions required by EOP-C4, "RPV Flooding".

B. Enabling Objectives:

EO-1.0 State the purpose of the RPV Flooding Procedure.

EO-2.0 State the entry conditions for the RPV Flooding Procedure.

EO-3.0 Given the procedural step, discuss the technical basis for that step.

VI. LESSON CONTENT

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
I. INTRODUCTION		
A. Student Learning Objectives		
B. Purpose		
To inject water into the RPV and increase RPV water level until either the main steam lines flood, or if Reactor is not shutdown, the core is adequately cooled.		EO-1.0
II. DETAILED DESCRIPTION		
A. Entry Conditions		
This procedure is entered only as directed from other emergency procedures.		EO-2.0
1. RPV Control - Level/Pressure		
2. Alternate Level Control		
3. Emergency Depressurization		
4. Level/Power Control		
B. Procedural Steps		
1. While executing the following steps:		
a. IF RPV water level can be determined AND All control rods are not inserted to at least position 02 AND The Reactor will not remain shutdown without boron		

THEN
Exit this procedure and enter C5, Level/Power Control and RPV Control Section RP and execute them concurrently.

- With the Reactor at power and level determinable, the appropriate procedure is C-5, Level/Power (or the potential is present for the Reactor to return to power).

EO-3.0

b. IF
RPV water level can be determined
AND
All control rods are inserted to position 02 OR The reactor will remain shutdown without boron
THEN
Exit this procedure and enter RPV Control Section RL and section RP and execute them concurrently.

- After entering this procedure, if the Reactor is shutdown and RPV water level is known, then it is appropriate to use the directions of RPV Control RL and RP sections.

EO-3.0

- Flooding should be discontinued as soon as RPV Water level can again be determined, due to the severe hydraulic loading imposed on the SRVs and their tailpipes.

EO-3.0

c. IF

Primary Containment water level and Suppression Chamber pressure cannot be maintained below the Maximum Primary Containment Water Level Limit.

THEN

Irrespective of whether adequate core cooling is assured, terminate injection into the Primary Containment from sources external to the Primary Containment until Primary Containment water level pressure can be maintained under the curve.

Show TP of Fig. C4-1.

- This action precludes any further increase in Primary Containment water level, the consequence of not performing this action may be a complete and uncontrolled loss of Primary Containment integrity. Without knowing where the failure of the containment would occur, loss of the Suppression Pool is assumed with a subsequent loss of adequate core cooling.

EO-3.0

2. Are all control rods inserted to at least position 02?
   a. YES - continue at STEP #14
   b. NO - continue at STEP # 3
3. Will the Reactor remain shut down without boron?
   a. YES - continue at STEP #14
   b. NO - continue at STEP # 4
   - These two steps determine which "sub" path in C4 is most appropriate.
4. While executing the following STEPS:
   IF
   All control rods are inserted to at least position 02 OR The Reactor will remain shutdown without boron

AND

RPV water level cannot be determined

THEN

Continue at step #14

- Should the Reactor become shutdown there is no need to continue in this "Sub" path as the actions are directed toward preventing power excursions while maintaining adequate core cooling. EO-3.0

5. Terminate and prevent all injection in to the RPV except from boron injection systems and CRD.

- The consequences of a return to criticality here, where the cooldown may be very rapid, could include significant damage to both the core and the RPV. EO-3.0
- Therefore, to control the rate of positive reactivity addition, all sources of cold unborated water are prevented from injecting.
- Boron and CRD are not terminated because they are being utilized to shutdown the Reactor.

6. Can any SRV be opened.
   a. YES - continue at STEP #7
   b. NO - Continue at STEP #9
      - In order to utilize step #7, at least one SRV must be open.

7. WAIT - until RPV pressure is below the minimum Alternate RPV Flooding Pressure.

   Show TP of Figure C4-1. EO-3.0

   - Definition - the minimum RPV pressure at which steam flow through the open SRVs is sufficient to preclude the temperature of the hottest fuel rod from exceeding 1500°F even if the Reactor core is not completely covered or the Reactor is at power. EO-3.0

8. IF
   At least 4 SRVs can be opened
   THEN
   Close the following valves:
   a. MSIVs
   b. Main Steam Line Drains
   c. RCIC Isolation Valves
   d. RHR steam condensing isolation valves.

- These valves are closed to prevent damage due to excessive thermal stress and/or excessive loading of pipe hangers, and flooding of turbine driven equipment.
- If at least 4 are not open, these are left open to help keep the RPV depressurized during flood up.

EO-3.0

9. CAUTION: A rapid increase in injection into the RPV may induce a large power excursion and result in substantial core damage.

- This caution warns against to rapidly injecting relatively cold, unborated water into a Reactor cold, unborated water into a Reactor that may be just slightly shutdown.

EO-3.0

a. Commence and, irrespective of pump NPSH and vortex limits, slowly raise injection into the RPV with the following systems until RPV pressure is above the Minimum Alternate RPV Flooding Pressure for the number of SRVs which can be opened.

Show TP of Fig. C4-2.

- With RPV pressure below the Minimum Alternate Flooding Pressure, sufficient steam flow to cool the core through steam cooling alone dose not exist. Therefore, injection must be re-established. EO-3.0
- Injecting to maintain RPV pressure above the Minimum Alternate Flooding Pressure assures that either: EO-3.0
  - The RPV will flood.
  - The core will be adequately cooled if it returns to criticality.

b. Systems

1) Feed water pumps - If necessary defeat high RPV water level trip interlocks.
2) Condensate pumps
3) CRD

- The systems listed here were chosen because they inject outside the shroud (allows for mixing of the cold unborated water with the warm, borated water prior to reaching the core).

EO-3.0

10. IF

No SRV is open

OR

RPV pressure cannot be raised to above the Minimum Alternate RPV Flooding pressure (Figure C4-2)

Show Figure C4-2

TP

THEN

Commence and, irrespective of pump NPSH and vortex limits, slowly raise injection into the RPV with the following systems until RPV pressure is above the Minimum Alternate RPV Flooding Pressure for the number of SRVs which can be opened.

Show Figure C4-2

TP

a. HPCS - If necessary, defeat high RPV water level isolation interlocks
b. LPCS
c. LPCI - with injection through the heat exchanger as soon as possible.

d. Serving water to RHR crosstie
e. Fire System
f. Eccs keep full systems
g. Condensate Transfer
   - If RPV pressure cannot be maintained above MAFP using the preferred systems, these systems must be used.
   - These systems are alternates because they either:
     - Inject inside the shroud, or
     - Take a suction on low quality water.

Show TP of Figure C4-2.

EO-3.0

11. IF
No SRV is open
OR
RPV pressure cannot be raised to above the Minimum Alternate RPV Flooding Pressure.
THEN
Primary Containment Flooding is required-Exit this procedure and Enter C6, Primary Containment Flooding and RPV Control at "C" and execute them concurrently.

Show TP of Figure C4-2.

• If flooding conditions cannot be established, the covering of the core is attempted by flooding the containment.		EO-3.0
12. Control injection to maintain RPV pressure above the Minimum Alternate RPV Flooding Pressure for the number of SRVs which can be opened but as low as practicable.	Show TP of Figure C4-2.	
• Maintaining RPV pressure above the Minimum Alternate Flooding Pressure assures that either:		EO-3.0
- The RPV will flood		
- If the Reactor returns to criticality it will be adequately cooled.		
• Injection is throttled to:		EO-3.0
- Minimize the thermal and hydraulic loads resulting from the flooding evolution.		
- Minimize the dilution rate of the borón.		

13. WAIT - until all control rods are inserted to at least position 02
    OR
    The Reactor will remain shutdown without boron.
14. Can at least 4 SRVs be opened?
    a. YES - continue at STEP #16
    b. NO - continue at STEP #15
15. Is a HPCS or Feedwater pump available for injection?
    a. YES - continue at STEP #16
    b. NO - continue at STEP #17
16. Close the following valves:
    a. MSIVs
    b. Main steam line drain valves
    c. RCIC isolation valves
    d. RHR steam condensing isolation valves

- If four SRVs are open the operator can be reasonably assured that the RPV is being and will remain depressurized. Therefore, all other steamlines can then be isolated to protected steam driven equipment and piping.

EO-3.0

- If the feedwater pumps or HPCS are available the steam lines can be isolated since these pumps are capable of flooding the RPV at high pressure.

EO-3.0

17. Commence and, irrespective of pump NPSH and vortex limits, raise injection into the RPV with the following systems until:
    a. At least 4 SRVs are open
    AND
    b. RPV pressure is not dropping and is 61 psig or more above Suppression Chamber pressure

- When RPV water level cannot be determined, RPV pressure indication must be used to confirm that sufficient water is being injected to flood the RPV.

EO-3.0

- The confirmation of RPV flooding is accomplished by establishing the following plant conditions.
    1) RPV pressure maintained 61 psig above Suppression Chamber pressure.

2) At least four SRVs open.

- 61 psig is the minimum Flooding Pressure. This pressure is defined to be the lowest differential pressure between the RPV and the Suppression Chamber at which steam flow through the Minimum Number of SRVs required for Emergency Depressurization is sufficient to remove all decay heat from the core by boiling heat transfer.

Differential pressure across the SRV's.

EO-3.0

- Increasing injection until RPV pressure is above the Minimum Flooding Pressure assures that sufficient water is being injected to remove all decay heat generated and to ultimately flood the RPV.

EO-3.0

Systems:

1) HPCS - if necessary, defeat high RPV water level trip interlocks.
2) Feedwater pumps - if necessary, defeat high RPV water level trip interlocks.

3) LPCS
4) LPCI with injection through the heat exchangers as soon as possible.
5) CRD
6) Service water to RHR crosstie
7) Fire system
8) ECCS Keep Full system
9) SLC (test tank)
10) SLC (boron tank)
11) Condensate transfer

18. IF
Less than 4 SRVs are open
OR
RPV pressure cannot be maintained at least 61 psig above Suppression Chamber pressure
THEN
Primary Containment Flooding is required;
Exit this procedure and enter C6, Primary Containment Flooding and RPV Control at "C" and execute them concurrently.

Show entry point into C6.

19. Control injection to maintain at least 4 SRVs open and RPV pressure at least 61 psig above Suppression Chamber pressure but as low as practicable.

- Once the Minimum Flooding Pressure has been established, it must be maintained to assure that the RPV will flood. EO-3.0
- Maintaining pressure above 61 psig but as low as practicable will reduce the flooding rate, thereby minimizing the thermal and hydraulic loads on the RPV. EO-3.0

20. WAIT - until
    a. RPV water level instrumentation is available
    AND
    b. Hottest Drywell temperature is below 212°F
    AND
    c. RPV pressure has remained at least 61 psig above Suppression Chamber pressure for at least the Minimum Core Flooding Internal. Show TP of Fig. C4-3.
        - The MCFI is the greatest amount of time to flood the RPV to the TAF with RPV pressure at the Minimum RPV flooding pressure and at least 4 SRV's open. EO-3.0

21. Terminate all injection into the RPV and reduce RPV water level until RPV water level indication is restored.

22. IF
RPV water level indication is not restored within the Maximum Core Uncovery Time Limit after commencing termination of injection into the RPV.
THEN
Return to "B" STEP #17

- The MCUTL is the greatest amount of time that the core can remain uncovered with heat transfer to water or steam and clad temperature will not exceed 1500°F.

Note: Indication if restored when a consistent change in an RPV water level instrument is observed or a trend between RPV level instruments is established.

Show Fig. C4-3

EO-3.0

23. Exit this procedure and enter RPV Control Section RL at "A" and Section RP at "C" and execute them concurrently.

Show entry points to Rl and RP.

II. WRAP-UP

A. Summary:

Actions of this procedure to inject water into the RPV and increase RPV water level until either the main steamlines flood or, if the Reactor is not shutdown, the core is adequately cooled by a combination of submergence and steam cooling. The steps of this procedure may be required to assure adequate core cooling under plant conditions were RPV water level cannot be determined.