NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-REQ-006-344-2-22 Revision 0

TITLE: EMERGENCY OPERATING PROCEDURE, LEVEL/POWER CONTROL (C-5)

	SIGNATURE	DATE
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Summary of Pages

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25

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I. TRAINING DESCRIPTION

A. Title of Lesson: Emergency Operating Procedures, Level/Power Control (C-5)

B. Lesson Description: This lesson discusses the actions that are taken to control RPV level and reactor power during a failure to scram event.

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-C5

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. Transparency Package
2. Overhead Projector
3. Whiteboard and Felt Tip Markers
4. EOP Flowchart for C5

B. Trainee Materials:

1. EOP Flowchart for C5

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 Emergency Operating Procedure, use the procedure to place the plant in a stable condition as prescribed in the procedure.

B. Enabling Objectives:

EO-1.0 State the purpose of the Level/Power Control Procedure.

EO-2 0 State the entry conditions for the Level/Power Control Procedure.

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

EO-4.0 State the reason for NOT rapidly injecting into the RPV when injection is restored.

EO-5.0 Explain why the instruction to minimize boron dilution is included in this procedure.

EO-6.0 Discuss the impact of lowering RPV water temperature with the Reactor shutdown, and level recovery from the ATWS.

EO-7.0 Describe all the methods of inserting negative reactivity used at NMP2 with the EOPs.

EO-8.0 Describe the effect of raising RPV water level with the Reactor shutdown with boron injected inside the shroud and not all rods inserted to at least position 02.

VI. LESSON CONTENT

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
I. INTRODUCTION		
A. Student Learning Objectives		
B. Purpose		
The actions specified in this procedure control RPV water level and power under conditions when it cannot be determined that control rod insertion alone will assure that the Reactor will remain shutdown under all condition.		EO-1.0
II. DETAILED DESCRIPTION		
A. Entry Conditions		
This procedure is entered only as directed from the following emergency operating procedures.		EO-2.0
1. N2-EOP-RPV from RC/L branch (RPV Control)		
2. N2-EOP-C1 (Alternate Level Control)		
3. N2-EOP-C4 (RPV Flooding)		
B. Procedural Steps		
1. While executing the following steps:		
a. IF RPV water level cannot be determined THEN Enter contingency #4		
• To be able to perform this procedure, level in the RPV must be able to be determined.		EO-3.0

- Since level in the RPV cannot be determined, RPV Flooding EOP is to be executed to assure continued core cooling.

EO-3.0

b. IF All control rods are inserted to or beyond position 02
OR
It has been determined that the Reactor will remain shutdown under all conditions without boron
THEN
Enter RPV Control at "A"

- When the condition no longer exists that required entry into C-5, it is appropriate to re-enter N2-EOP-RPV in order to restore and maintain RPV water level.

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 and Suppression Chamber pressure can be maintained below the curve.

Show TP of Figure C5-1.

- With an unisolatable break, and injection from external sources water level in the Primary Containment will continue to increase. Should the maximum Primary Containment Water Level Limit be exceeded by continued external source injection, Primary Containment integrity can no longer be assured.

EO-3.0

• Injection into the RPV (and Primary Containment) from external sources is terminated, irrespective of adequate core cooling concerns, to prevent a complete and uncontrolled loss of Primary Containment integrity.		EO-3.0
• With a degraded core and loss of containment, substantial amounts of radioactivity may be released to the general environment. *	NOTE: Given the choice between a degraded core and containment failure, the NMP Unit 2 EOP's choose to maintain Primary Containment integrity.	EO-3.0

d. IF
Emergency RPV Depressurization is required
THEN
Continue at STEP H

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
• Should Emergency Depressurization of the RPV be required, continuing at STEP H provides the direction to minimize the potential for rapid injection of cold unborated water, consistent with the objectives of N2-EOP-C5.		EO-3.0
2. Place ADS logic inhibit switches in "ON"		
• Inhibiting ADS is to prevent the rapid injection of cold, unborated water and, prevent complicating the level control effort.	Review the effect of cold water injection while critical.	EO-4.0 EO-3.0
• Further more injection of water would dilute the incore boron concentration and reduce Reactor coolant temperature.	Explain the effect of boron dilution on the procedural goals.	EO-3.0
• If depressurization is subsequently required, explicit direction is provided, thus any requirement to maintain the ability to auto depressurize the RPV is negated.		

3. While executing the following steps.
   IF
   Reactor power is above 4% or cannot be determined
   AND
   Suppression Pool temperature is above the boron injection initiation temperature — Show TP of Fig. 5-2
   AND
   An SRV is open or opens OR Drywell pressure is above 1.68 psig
   AND
   RPV water level is above -14 in
   THEN
   Continue at Step # I

   - The four conditions listed are indicative of heat being deposited in the Suppression Pool. — EO-3.0
   - Action must be taken to mitigate these conditions as; — EO-3.0
     * NPSH to ECCS pump could be lost and core damage result.
     * Primary Containment integrity could be lost with a subsequent release of radioactivity to the general environment.

- Should any one or more of the conditions listed NOT exist, then there is no requirement to lower RPV water level as the rate of Suppression Pool heat up is within the capacity of the Suppression Pool Cooling System.
- Reject as much heat as possible to the Main Condenser, place all Suppression Pool Cooling in service, and concurrently inject boron while efforts to insert control rods continue.

EO-3.0

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

EO-4.0

   a. Using only the systems below, maintain RPV water level between -14 in. and 202.3 in.

      - The systems chosen for RPV water level control are those which inject outside the shroud.
      - These are preferred because they allow for mixing of the cold water, with the warm water prior to it reaching the core.

EO-3.0

1) Condensate/Feedwater
2) CRD
3) RCIC with suction from the CST
   a) If necessary, defeat low RPV pressure isolation interlocks.
   b) Maintain turbine speed greater than 1500 rpm.
   c) Elevated Suppression Chamber pressure may trip the RCIC turbine.

NOTE: CRD utilized to allow attempts at rod insertion.

EO-3.0

b. IF
RPV water level cannot be maintained above -14 in.
THEN
Maintain RPV water level between -45. and 202.3 in.

- -45 inches is the Minimum Steam Cooling Water Level.
- This if is the lowest RPV level of which the uncovered portion of the core will generate sufficient steam to preclude any clad temperature from exceeding 1500°F.

EO-3.0

c. IF
RPV water level cannot be maintained above -45 in.
THEN
Emergency RPV Depressurization is required; continue at step #8 and enter RPV Control Section RP.

Show entry point into EOP-RP

- Depressurizing is preferred over restoring RPV level through the use of systems which inject inside the shroud because;
  - * Large power excursion may result.
  - * The depressurization will cause large voids which will in itself shut down the Reactor.
  - * Following depressurization Reactor power will stabilize at a lower power level.

EO-3.0

- Depressurization is not required until -45 inches because;
  - * Adequate core cooling is maintained (Minimum Steam Cool Water Level).

EO-3.0

* The time level is decreasing to -45 inches can be used to line up and start pumps previously indicated systems.

EO-3.0

5. Is any main steam line open?
   a. YES - Bypass IAS and low RPV water level MSIV isolation interlocks and restore the IAS supply to the containment.
   b. NO - Continue at STEP #6

- A YES response - bypassing IAS and low RPV water level interlocks will prevent the loss of the main condenser as a heat sink when level is reduced below the isolation setpoint.

EO-3.0

- A NO response - The main condenser is isolated from the RPV. The actions in this procedure do not allow the reopening of the MSIVs. If no steam line is open the procedure directs the lowering of RPV level.

EO-3.0

6. Irrespective of any consequent Reactor power or RPV water level oscillations, lower RPV water level by terminating and preventing all injection into the RPV <u>except</u> from boron injections systems and CRD until:

   a. Reactor power drops below 4%

      OR

   b. RPV water level reaches -14 in.

      OR

   c. All SRVs remain closed AND Drywell pressure remains below 1.68 psig

      - The power oscillation are expected They have been analyzed and determined to be within the thermal design capabilities of the fuel.
      - Terminate and Prevent Injection means to take the most direct action which will stop and preclude injection flow into the RPV which for HPCS, LPECCS is "Pull to Lock".
      - Injection into the RPV is not re-established until:

Review the effect of lowering level with respect to reactor power (briefly)

EC-3.0

* Suppression Pool heat up is terminated, OR
* RPV water level decreases to -14 inches.

EO-3.0

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

EO-4.0

a. Using only the systems below, maintain RPV water level between -45 in and the level to which it was lowered to in STEP #6.
   1) Condensate/Feedwater
   2) CRD

      CAUTION:

      a) Operating RCIC below 1500 rpm may result in equipment damage.
      b) Elevated Suppression Chamber pressure may trip the RCIC turbine.

   3) RCIC with suction from the CST
      a) If necessary, defeat low RPV pressure isolation interlocks.

- Event at low RPV pressures RCIC can provide some injection hence the instruction to bypass.

EO-3.0

- The systems listed inject outside the shroud which permits the relatively cold unborated water to mix with the warmer water in the downcomer and lower head.

EO-6.0

- The power oscillations may produce level oscillations that would make level control difficult, thus the -45 inch lower limit.

NOTE: level is <u>deliberately</u> lowered to only -14 inches.

b. IF
RPV water level cannot be maintained above -45 in.
THEN
Emergency RPV Depressurization is required continue at Step #8 and enter RPV control section RP.

c. Continue at step #13

- When RPV level can not be maintained above -45 in., Emergency Depressurization is required to permit injection from low head pump. EO-3.0

8. Terminate and prevent all injection into the RPV <u>except</u> from boron injection systems, CRD and RCIC until RPV pressure is below the Minimum Alternate RPV Flooding Pressure.

Show TP of Table C5-1.

- Terminate and prevent injection means to take the most direct action which will stop and preclude injection flow into the RPV, which for HPCS and LP ECCS is "Pull to LOCK". EO-3.0
- RCIC is left on because the injection rate is low and it aids in depressurization. EO-3.0

- CRD and Boron are utilized to help shut down the Reactor.

9. Can any SRV be opened?
   a. YES - Continue at STEP #10
   b. NO - Continue at STEP #11
      - If YES response - wait until RPV pressure is below the Minimum Alternate RPV Flooding Pressure, to start injection.
      - If NO response - injection starts immediately.

EO-3.0

10. WAIT - until RPV pressure is below the Minimum Alternate RPV Flooding Pressure.

Show Table C5-1
TP

   a. As long as RPV pressure remains above the Minimum Alternate Flooding Pressure, the core is adequately cooled irrespective of whether any water is being injected into the RPV.
   b. The Minimum Alternate Flooding Pressure is defined to be the lowest RPV pressure at which steam flow out of the open SRVs is sufficient to preclude any clad temperature from exceeding 1500°F even if the core is not completely covered.

EO-3.0

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

EO-4.0

a. Irrespective of pump NPSH and vortex limit, commence and slowly raise injection into the RPV with the following systems to restore and maintain RPV water level above -14 in.

1) Condensate/feedwater

2) CRD

3) RCIC with suction from the CST

a) If necessary, defeat low RPV pressure isolation interlocks.

b) IF
RPV water level cannot be restored and maintained above -14 in.
THEN
Maintain RPV water level above -45 in.

c) IF
RPV water level cannot be maintained above -45 in.
THEN
Irrespective of pump NPSH and vortex limits, commence and slowly raise injection into the RPV with the following systems to restore and maintain RPV water level above -45 in.

1) HPCS
2) LPCS
3) LPCI with injection through the heat exchanger as soon as possible.
4) Service water to RHR crosstie
5) Fire System
6) ECCS Keep full systems

- These are systems that inject inside the shroud or of lower quality but must be utilized at this point.

Review need for slow injection due to reactor power oscillations. EO-4.0

EO-3.0

12. IF
RPV water level cannot be restored and maintained above -45 in.
THEN
Primary Containment Flooding is required enter contingency #6.
    a. If water level cannot be restored, as last resort attempts are made to cover the core by flooding the containment. — EO-3.0

13. WAIT - until OP - 101C is entered from EOP-RPV and RPV water level is above 159.3 in.
    a. The requirement to wait until water level is above 159.3 in. ensures that C5 is not exited prematurely.
    b. Since SLC injection is inside the shroud it is not appropriate to restore RPV water level until either one of the below two conditions exist. — EO-3.0, EO-5.0, EO-8.0
        1) All control rods are inserted to at least position 02, OR
        2) It has been determined that the Reactor will remain shutdown under all conditions without boron. — Discuss the negative reactivity effects that are maintaining the core shutdown. — EO-6.0 .

c. When either one of the above conditions exists, RPV control section RC/L is entered.	Show entry point into EOP-RC/L.
14. Exit this procedure and proceed to cold shutdown IAW OP-101C.	Describe entry point to OP-101C.

III. WRAP-UP

A. Summary

The actions specified in this procedure control RPV water level and power under conditions when it cannot be determined that control rod insertion alone will ensure that the Reactor will remain shutdown under all conditions. Whenever entry into this procedure is required, the previously effective RPV water level control procedure is exited. This precludes the possibility of having concurrently effective but conflicting steps directing control of RPV water level.

The actions to control RPV water level in this procedure are different from those contained in the RPV Water Level Control procedure for two reasons:

1. When boron is injected into the RPV, the systems used to control level must be selected so as to minimize the potential for diluting the boron concentration or injection cold water into the core region.
2. RPV level must be controlled so as to not only adequately cool the core, but to also minimize the Suppression Pool water temperature rise.