NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-REQ-006-344-2-23 Revision 0

TITLE: EMERGENCY OPERATING PROCEDURES, PRIMARY CONTAINMENT CONTROL, SECTION PCH

	SIGNATURE	DATE
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Summary of Pages

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I. TRAINING DESCRIPTION

A. Title of Lesson: Emergency Operating Procedures, Primary Containment Control, Section PCH

B. Lesson Description: This lesson plan discusses actions taken to control Primary Containment hydrogen and oxygen levels.

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

D. Method of Evaluation, Grade Format, and Standard of Evaluation:

1. Written examination with 80% minimum passing grade.

E. Method of 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. Certified in accordance with NTP-16 or NTP-16.1.

2. Trainee:

a. Certified in accordance with NTP-10 or NTP-11 or

b. Be recommended for this training by the Operations Superintendent (or designee) or the Training Superintendent.

G. References:

1. BWROG Emergency Procedure Guidelines, Rev. 4

2. Plant Procedure N2-EOP-PC Section DWT.

II. REQUIREMENTS

A. Requirements for class:

1. AP-9, Administration of Training

2. NTP-10, Training of Licensed Operator Candidates

3. 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 PCH

B. Trainee Materials:

1. EOP Flowchart for PCH
2. OLP-PCH

IV. EXAM AND MASTER ANSWER KEYS

A. 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 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 PCH Procedure.

EO-2.0 State the entry conditions for the Primary Containment Hydrogen Control.

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

I. INTRODUCTION

A. Student Learning Objectives

B. Purpose

1. This procedure specifies the operator actions necessary to control and maintain hydrogen and oxygen below that which would threaten Primary Containment integrity. EO-1.0

C. Procedural Overview

1. The hydrogen control procedure is executed concurrently with the following procedures:
   a. N2-EOP-DWT Drywell Temperature Control
   b. N2-EOP-PCP Primary Containment Pressure Control
   c. N2-EOP-SPL Suppression Pool Level Control
   d. N2-EOP-SPT Suppression Pool Temperature
2. Concurrent execution is necessary because:
   a. The actions taken to control any one parameter may directly effect control of the others.

b. This procedure is based on the symptomatic approach to emergency response, where the initiating event of the transient is not known in advance. Assignment of priorities to any one of the five parameters is, therefore, not possible.

3. The values and trends of parameters, and the status of plant equipment during the event will dictate the order of execution of each flowpath (procedure).

II. DETAILED DESCRIPTION

A. Entry Conditions

1. Setpoints

a. The conditions which require entry into this procedure are: EO-2.0

1) Suppression pool temperature above 90°F.

- Most limiting pool temperature addressed by Technical Specification.

2) Drywell temperature above 150°F.

- Drywell limiting temperature as specified by Tech Specs.

3) Suppression pool water level above El. 201 ft.
   - Maximum LCO pool level by Tech Specs.

4) Suppression pool water level below El. 199.5 ft.
   - Minimum LCO pool level by Tech Specs.

5) Drywell pressure above 1.68 psig.
   - Limiting Safety System setting for drywell pressure by Tech Specs.
     - ALSO; ECCS setpoint & entry into RPV control.

6) Primary Containment hydrogen concentration above 1.8%.
   - H_2/O_2 analyzer alarm setpoint.

b. The occurrence of any one of these conditions requires entry into this procedure.

c. If an entry condition clears prior to exiting this procedure, and then reoccurs, re-entry at the beginning of the procedure is required.

d. If a second entry condition occurs while performing the procedure, re-entry at the beginning is again required.

e. If all entry condition clear while executing this procedure, this procedure may be exited.

f. Termination of the emergency rather than termination of an event is the basis for exiting conditions for EOP's. Consequently, these procedures may be exited at any point during their execution if the operator determines that an emergency no longer exists. The EOP's have been written so that if an operator remains in a procedure when an emergency no longer exists, they still provide proper guidance. Alternately, if the operator exists a procedure prematurely, reoccurrence of an entry condition will follow and the appropriate EOP procedure will be reentered. (TMR #02-88.232)

2. Setpoint bases

a. The valves selected were chosen on the basis of being simple, readily identifiable and operationally significant. They also provide advance warning of potential emergency conditions allowing action to be taken which may prevent more severe circumstances.

B. Procedural Steps

1. Monitor and control hydrogen and oxygen concentrations (EOP-6, Att 27).

- Ignition in the confined space of the Primary Containment can generate peak pressures which may exceed the structural capabilities of the drywell, Suppression Chamber or Drywell to Suppression Chamber boundary.
- Provides a smooth transition from general plant procedures to EOPs.

EO-3.0

2. While executing the following steps:

a. IF

The Hydrogen or Oxygen Monitoring System is or becomes unavailable

THEN

Have the Chemistry Department sample the Drywell and Suppression Chamber for hydrogen and oxygen concentrations.

- Manual sampling and analysis is appropriate should the H_2/O_2 Monitoring System become unavailable. EO-3.0

b. IF

Drywell or Suppression Chamber hydrogen concentration cannot be determined to be below 6%

AND

Drywell or Suppression Chamber oxygen concentration cannot be determined to be below 5%.

- If concentrations in the drywell or Suppression Chamber cannot be determined by any means, it must be assumed that levels are in excess of those required to support combustion. EO-3.0
- 6% hydrogen concentration is the minimum required to support a deflagration.

- The associated stoichiometric concentration of oxygen for this condition is 5%.

THEN

Continue at Step (L.P. #18)

3. WAIT until Drywell or Suppression Chamber hydrogen concentration reaches 1%.

Note: 1% is minimum detectable H_2.

- Delaying the performance of the subsequent actions in this procedural leg confirms that H_2 gas concentrations are increasing in either the Drywell or Suppression Chamber and further action is required.

EO-3.0

4. Is the release rate expected to remain below the LCO?

- Hydrogen concentrations near the minimum detectable level (1%) are not by themselves containment threatening.

EO-3.0

a. YES - continue at Step #5

b. NO - continue at Step #8 or #13

5. While executing the following steps.

IF

The offsite radioactivity release rate reaches the offsite release rate LCO

THEN

Secure Primary Containment, purge.

- Unrestricted venting to reduce combustible gas concentration is only appropriate when deflagration concentrations of hydrogen and oxygen are reached.

EO-3.0

6. Purge the Primary Containment to restore and maintain Drywell and Suppression Chamber hydrogen concentration below 1% as follows:

7.

a. IF...oxygen concentration in the space being purged is at or above 5%
THEN...initiate and maximize the air or nitrogen purge flow (OP-61A, Sections 5.0 or 3.0).

- Air or nitrogen purge is used so that the H_2 can be purged, air purge is preferred due to the high flow rates that can be achieved.

EO-3.0

b. IF...oxygen concentration in the space being purged is below 5%
THEN...initiate and maximize the drywell nitrogen purge flow (OP-61A, Section 3.0).

- Nitrogen purge is used so the inerted atmosphere can be maintained. EO-3.0

Execute the following concurrently: EO-3.0

- Gas concentrations may vary between the Drywell and Suppression Chamber
  - H_2 generation even in conjunction with a small break inside the drywell may raise drywell H_2 concentrations but not Suppression Chamber.

Conversely

  - H_2 generation event in conjunction with SRV lift may raise Suppression Chamber H_2 concentrations but not drywell.

8. Monitor and control hydrogen and oxygen concentration in the drywell.
   - Ignition in the confined space of the Primary Containment can generate peak pressures which may exceed the structural capabilities of the Drywell, Suppression Chamber or Drywell to Suppression Chamber boundary. EO-3.0

- Assures normal methods have been employed prior to more complex actions.

9. WAIT until drywell hydrogen concentration reaches 4% but is below 5%
   AND
   Drywell oxygen concentration is below 5%.
   - This confirms gas concentrations in the drywell are within the vendor limitations for recombiner operation and are below combustible concentrations. EO-3.0
   - Starting recombiners below 4% would be ineffective due to an insufficient supply of hydrogen to support recombination.

10. Place hydrogen recombiners in service taking suction directly on the drywell
    AND
    Operate the drywell unit coolers.
    - Operation of the drywell unit coolers serves to re-distribute the hydrogen throughout the drywell, there by diluting localized regions of high hydrogen concentrations to minimize the potential for a deflagration event. EO-3.0

11. WAIT until drywell hydrogen concentration reaches 5%
    OR
    Drywell oxygen concentration reaches 5%.
12. Secure all hydrogen recombiners taking suction on the drywell (continue at Step #16).
    - The unit coolers do not need to be secured at this point, since they may be operated up to the 6% hydrogen limit. EO-3.0
    - If concentrations have increased to the levels specified in this step, recombiner operation has been ineffective.
    - 5% oxygen is deflagration limit and 5% hydrogen is vendor limit on recombiner.
13. Monitor and control hydrogen and oxygen concentrations in the Suppression Chamber.
    - Ignition in the confined space of the Primary Containment can generate peak pressures which may exceed the structural capabilities of the Drywell, Suppression Chamber or Drywell to Suppression Chamber boundary. EO-3.0

14. WAIT until Suppression Chamber hydrogen Suppression Chamber oxygen concentration is below 5%.
    - This confirms gas concentrations in the Suppression Chamber are within the vendor limitations for recombiner operation and are below combustible concentrations.
    - Starting recombiners below 4% would be ineffective due to insufficient supply of hydrogen to support recombination.

EO-3.0

15. Place hydrogen recombiners in service taking suction directly on the Suppression Chamber (OP-62, Section E.2).
16.
    a. IF
    No hydrogen recombiner can be placed in service taking suction directly on the Suppression Chamber
    AND
    Drywell hydrogen concentration is below 5%
    AND
    Drywell oxygen concentration is below 5%

THEN

Place hydrogen recombiners in service taking suction indirectly on the Suppression Chamber by way of the drywell.

- As drywell pressure decreases due to recombiner operation, it should drop below Suppression Chamber pressure permitting Suppression Chamber gases to flow through the vacuum breakers into the drywell.

EO-3.0

17. WAIT until Suppression Chamber hydrogen concentration reaches 5%

OR

Suppression Chamber oxygen concentration reaches 5%.

Note: 5% hydrogen is the vendor limit, 5% oxygen is deflagration limit.

- The gas concentrations specified in this step define the upper limit of the permissible recombiner operating range.

EO-3.0

18. Secure all hydrogen recombiners taking suction on the Suppression Chamber.

- Security recombiners is warranted to prevent equipment or Primary Containment damage.

EO-3.0

19. WAIT until Drywell or Suppression Chamber hydrogen concentration reaches 6%
    AND
    Drywell or Suppression Chamber oxygen concentration is above 5%.

20. Emergency RPV depressurization is required, enter RPV control and execute it concurrently with this procedure.
    - Entry into RPV control ensures the reactor is scrammed prior to depressurizing.
    - Depressurization is required to place the RPV in the lowest possible energy state.

    EO-3.0

21. Secure operation of drywell unit coolers.
    - Eliminate potential ignition source.

    EO-3.0

22. While executing the following step
    a. IF
       Suppression Chamber sprays have been initiated
       AND
       Suppression Chamber pressure drops below 1.68 psig

THEN

Terminate suppression pool sprays

- Avoids creating a negative containment pressure. EO-3.0

b. IF

Drywell sprays have been initiated

AND

Drywell pressure drops below 1.68 psig

THEN

Terminate drywell sprays

- Avoids creating a negative containment pressure. EO-3.0

23. Irrespective of the release rate, perform the following, in order to restore and maintain either:

a. Drywell and Suppression Chamber hydrogen concentration below 6%

OR

b. Drywell and Suppression Chamber oxygen concentration below 5%.

- Venting, regardless of release rate, is necessary to prevent an uncontrolled and unpredictable breach in the Primary Containment. EO-3.0

- The controlled release of radioactivity to the environment is preferable to containment failure, which may result in the loss of adequate core cooling and uncontrolled release of radioactivity.

• When H_2 and O_2 concentrations are restored and can be maintained, the operator should secure venting.

EO-3.0

24.

a. IF

Suppression pool water level is below El. 217 ft.

THEN

1) Initiate suppression pool sprays (EOP-6, Att 22).

a) Use only RHR pumps which do not have to be run continuously in the LPCI mode for adequate core cooling.

2) Vent the Suppression Chamber (EOP-6, Att 25).

- With pool level below El. 217, the Suppression Chamber spray nozzles are not submerged.
- Spraying while venting through the Suppression Chamber/pool provides scrubbing action, minimizing the amount of radioactivity released.
- This action is contingent on adequate core cooling.

EO-3.0

b. IF
Suppression pool water level is at or above El. 217 ft.
OR
The Suppression Chamber cannot be vented
THEN
Vent the drywell (EOP-6, Att 25)

- El. 217 ft. is the maximum level at which installed instruments can convey pool level, even though the Suppression Chamber vent is physically located above this point, level cannot be accurately determined.

EO-3.0

c. IF

The Suppression Chamber can be vented

OR

The drywell can be vented.

THEN

Initiate and maximize the drywell purge flow.

- Purging is only permitted if venting is in progress for the following reasons:
  - Without an open vent path, purging does not appreciably lower hydrogen concentration.
  - Raises Primary Containment pressure, which significantly increases the peak pressure which might result if a deflagration were to occur.

EO-3.0

d. IF
Suppression pool water level is below El. 217 ft.
AND
Drywell temperature and pressure are within the drywell spray initiation. Initiation Limit (Figure PC-2)
THEN

1) Trip recirculation pumps
2) Trip drywell unit coolers
3) Initiate drywell sprays (EOP-6, Att 22)
   - Use only RHR pumps which do not have to be run continuously in the LPCI mode for adequate core cooling.
   - Drywell sprays are initiated to aide in suppressing the peak pressure that would occur should a deflagration happen.
   - This action is contingent upon adequate core cooling.

EO-3.0

25. WAIT until Drywell or Suppression Chamber hydrogen concentration cannot be restored and maintained below 6%
AND
Drywell or Suppression Chamber oxygen concentration cannot be restored and maintained below 5%.

- Delaying the performance of subsequent actions in this procedural leg confirms that the previous attempts to lower gas concentrations have been unsuccessful, and further action is required. — EO-3.0

26.

a. IF
Suppression pool water level is below El. 217 ft.
THEN
Irrespective of whether adequate core cooling assured, initiated suppression pool sprays (EOP-6, Att 22).

- This action is required in order to prevent containment failure which may cause a complete loss of suppression pool, adequate core cooling possibly uncontrolled release of radioactivity. — EO-3.0

b. IF
Suppression pool water level is below El. 217 ft.
AND
Drywell temperature and pressure are within the drywell spray initiation pressure limit (Fig. PC-2).
THEN
Irrespective of whether adequate core cooling is assured.

1) Trip recirculation pumps
2) Trip drywell cooling fans
3) Initiate drywell sprays (EOP-6, Att 22)
   - Drywell sprays are initiated to aide in suppressing the peak pressure that would occur should a deflagration happen.
   - This action is done irrespective of adequate core cooling due to the inability to control the hydrogen and oxygen.

EO-3.0

III. WRAP-UP

A. Summary

The purpose of the Primary Containment hydrogen control section is to specify actions for controlling combustible gas concentrations.

Actions of increasing severity are taken depending on the concentrations of combustible gases. If concentrations are below flammable limits, venting is performed only if the resulting release rates are within LCO limits. Directions are also given to utilize the hydrogen recombiners as long as the concentrations are within the limits of use for these.

If flammable limits are approached, direction is given to perform an emergency RPV depressurization, vent the containment irrespective of the resulting release rates, and to use drywell sprays. Finally, if concentrations cannot be restored, then direction is given to spray the suppression chamber and drywell irrespective of adequate core cooling.