

07-187-91

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

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

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

	<u>SIGNATURE</u>	<u>DATE</u>
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Summary of Pages

(Effective Date: 12/10/90)

Number of Pages: 20

<u>Date</u>	<u>Pages</u>
December 1990	- 20

THIS LESSON PLAN IS A GENERAL REWRITE
THIS LESSON PLAN SUPERSEDES LESSON PLAN #N2-OLP-C4

CONTROLLED DOCUMENT
TRAINING DEPARTMENT RECORDS ADMINISTRATION ONLY

VERIFICATION: _____

DATA ENTRY: _____

RECORDS: _____

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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: Classroom Lecture
- F. Prerequisites:
 - 1. Instructor:
 - a. Certified in accordance with NTP-16.
 - 2. Trainee:
 - a. Certified in accordance with NTP-10.
- G. References:
 - 1. BWROG Emergency Procedure Guidelines, Rev. 4
 - 2. Plant Procedure N2-EOP-C3, Rev. 4

II. REQUIREMENTS

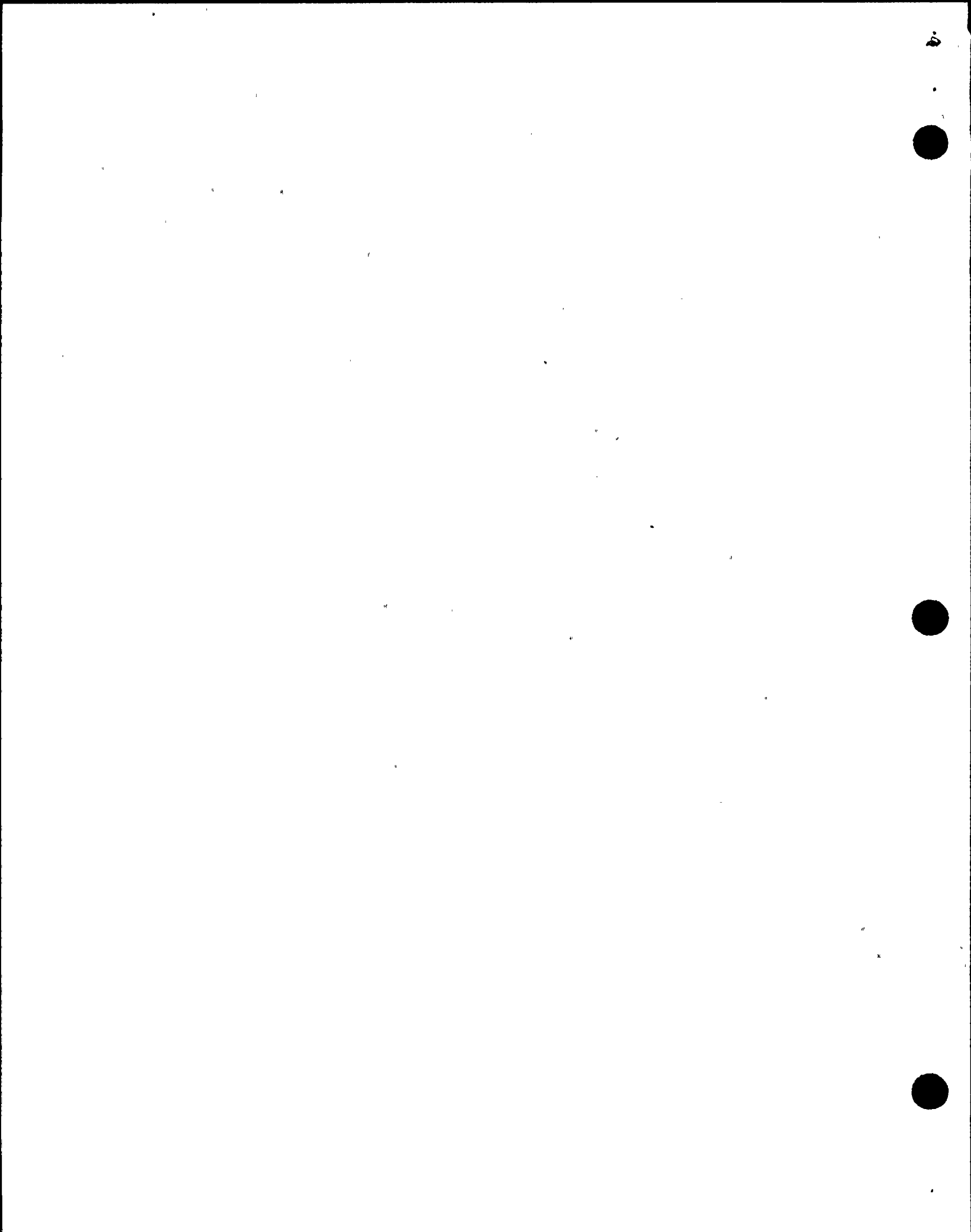
- A. AP-9, Administration of Training
- B. NTP-10, Training of Licensed Operator Candidates

III. TRAINING MATERIALS

- A. Instructor Materials:
 - 1. Transparencies Package
 - 2. Overhead Projector
 - 3. Whiteboard and Felt Tip Markers
 - 4. EOP Flowchart for C4
 - 5. Training Record
- B. Trainee Materials:
 - 1. EOP Flowchart for C4
 - 2. Course Evaluation Form

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

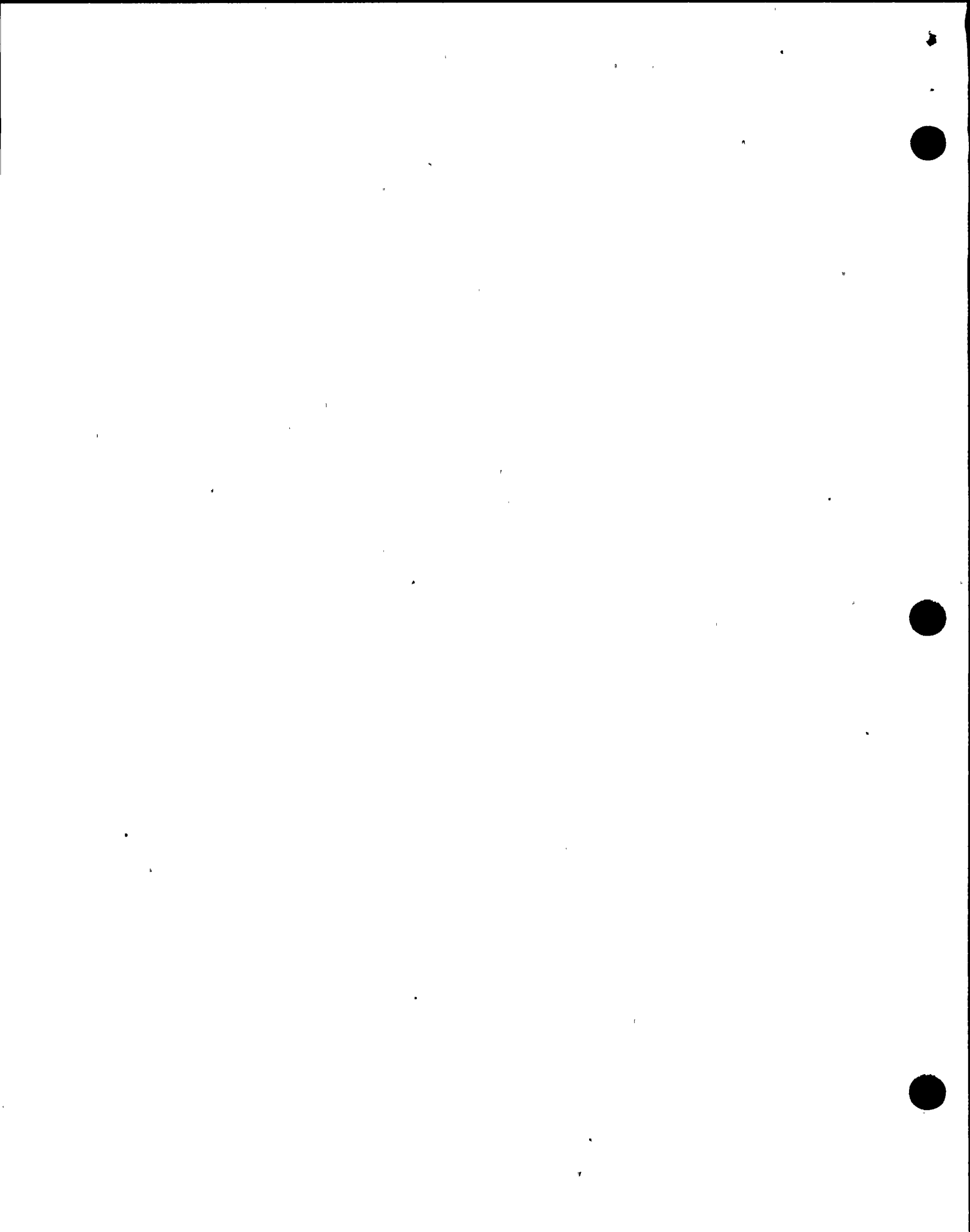
Upon completion of this training, the trainee will have gained the knowledge to perform the following:

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 (SRO ONLY) Direct the actions required per EOP-C4, Cooling without Level Restoration (RPV Flooding). (3449540603)
- TO-3.0 Manually inject poison solution into the reactor from the Control Room. (2000250501)
- TO-4.0 Perform RPV/containment service water flooding from the Control Room. (2059330101)
- TO-5.0 Perform RHR keep full pump alternate RPV injection from the Control Room. (2059340401)
- TO-6.0 Perform RHR alternate shutdown cooling from the Control Room. (2059390101)
- TO-7.0 Manually initiate HPCS from the Control Room. (2060050101)
- TO-8.0 Perform manual injection of LPCS from the Control Room. (2099020401)
- TO-9.0 Inject to the vessel using the condensate transfer pumps. (2569180501)

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.



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.

- 1. RPV Control - Level/Pressure
- 2. Alternate Level Control
- 3. Emergency Depressurization
- 4. Level/Power Control

- B. Procedural Steps

Preliminary Activities:

- 1. Introduce self to class (if unfamiliar).
- 2. Distribute TR for completion.
- 3. Distribute Course Evaluation Forms and describe their use.
- 4. Discuss Method of Evaluation.

Review Learning Objectives with the class.

NOTE: TP's may be used to highlight points of interest on flowchart; use TP's to show procedural steps if flowchart not used.

EO-2.0



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.

Show entry point into EOP-C5.

- With the Reactor at power and level determinable, the appropriate procedure is C5, Level/Power (or the potential is present for the Reactor to return to power).

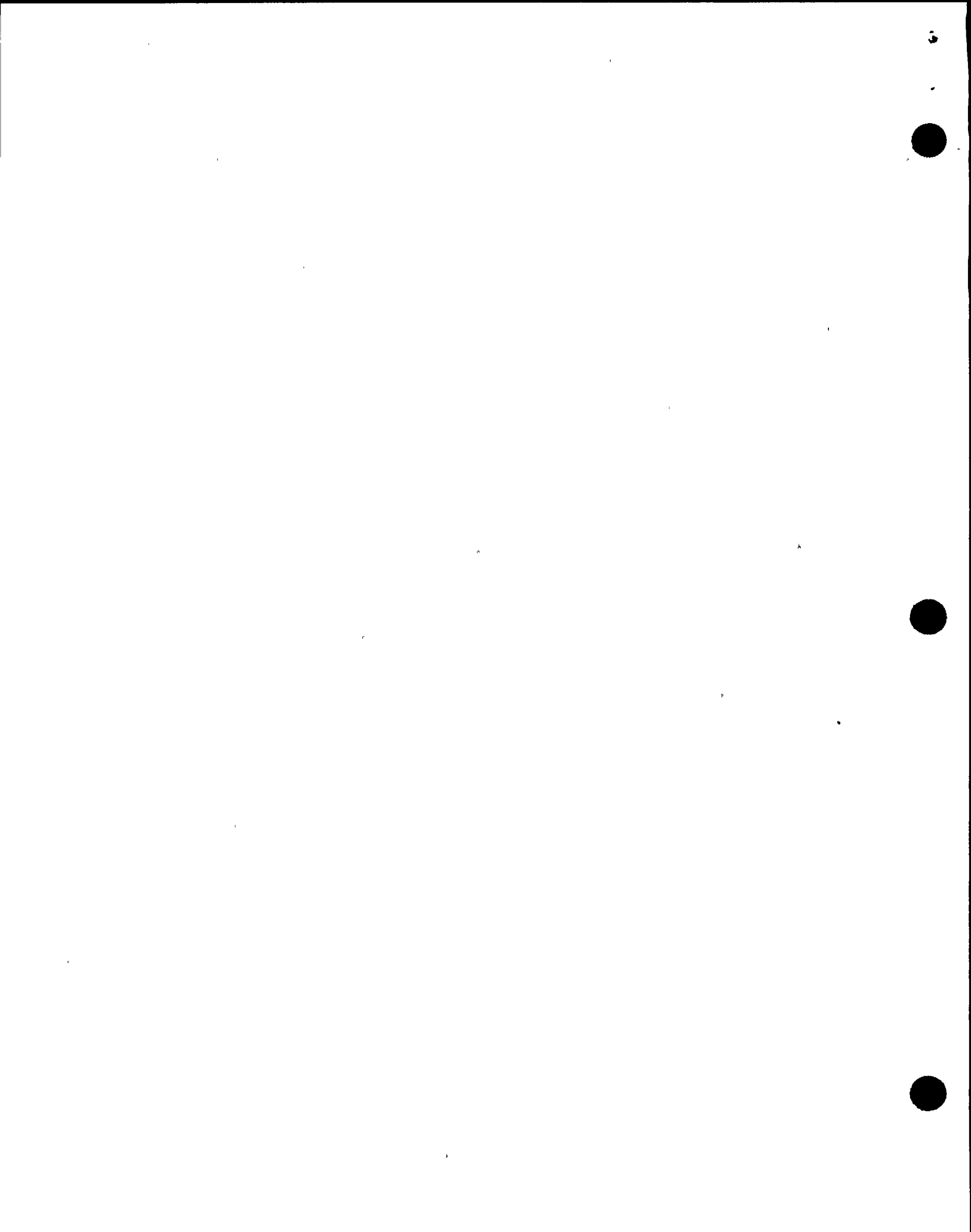
EO-3.0

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.
- 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.

Show entry point into EOP-RPV.

EO-3.0

EO-3.0

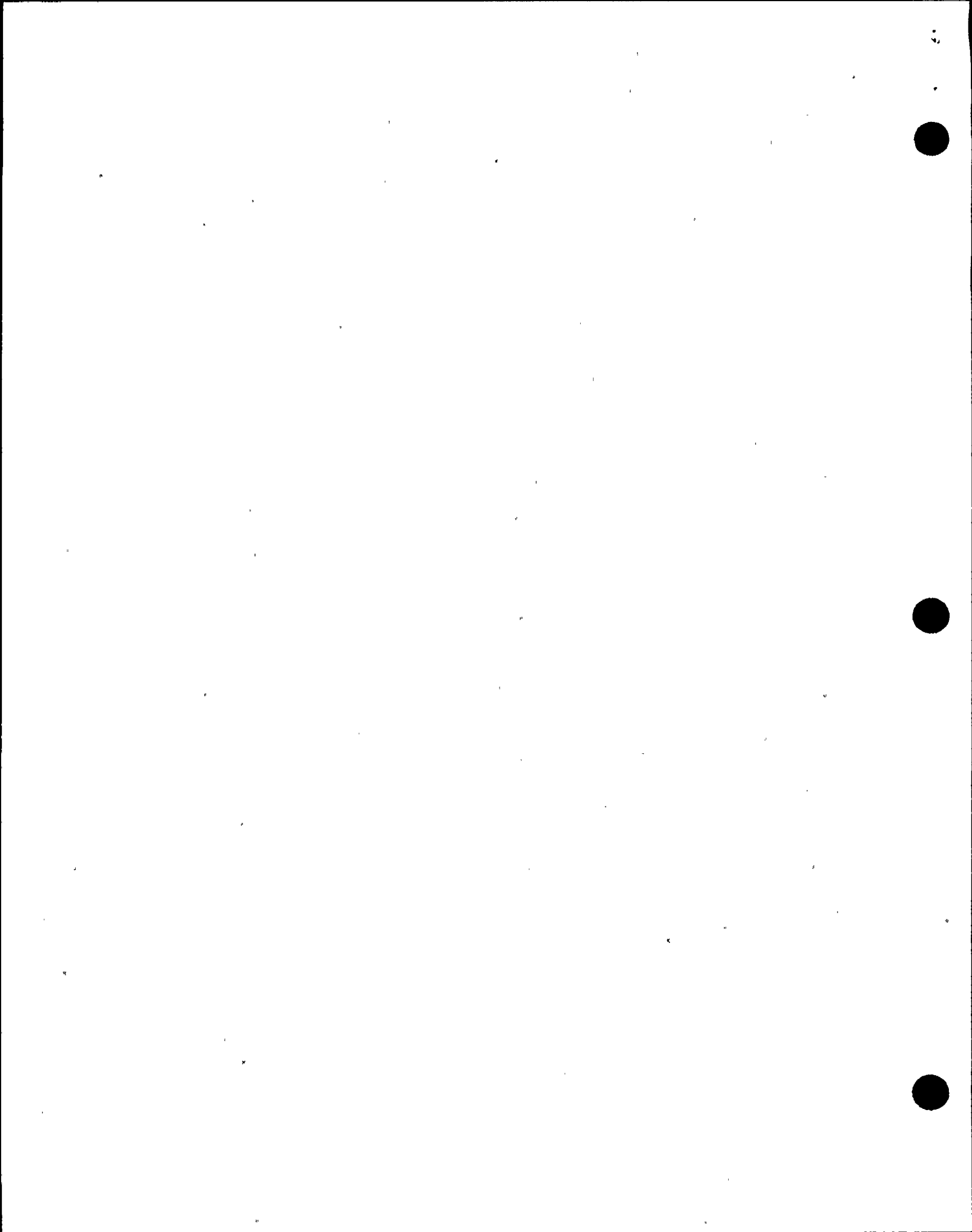
c. IF

Primary Containment water level and Suppression Chamber pressure cannot be maintained below the Maximum Primary Containment Water Level Limit (Figure C4-1).

Show TP of Fig. C4-1.

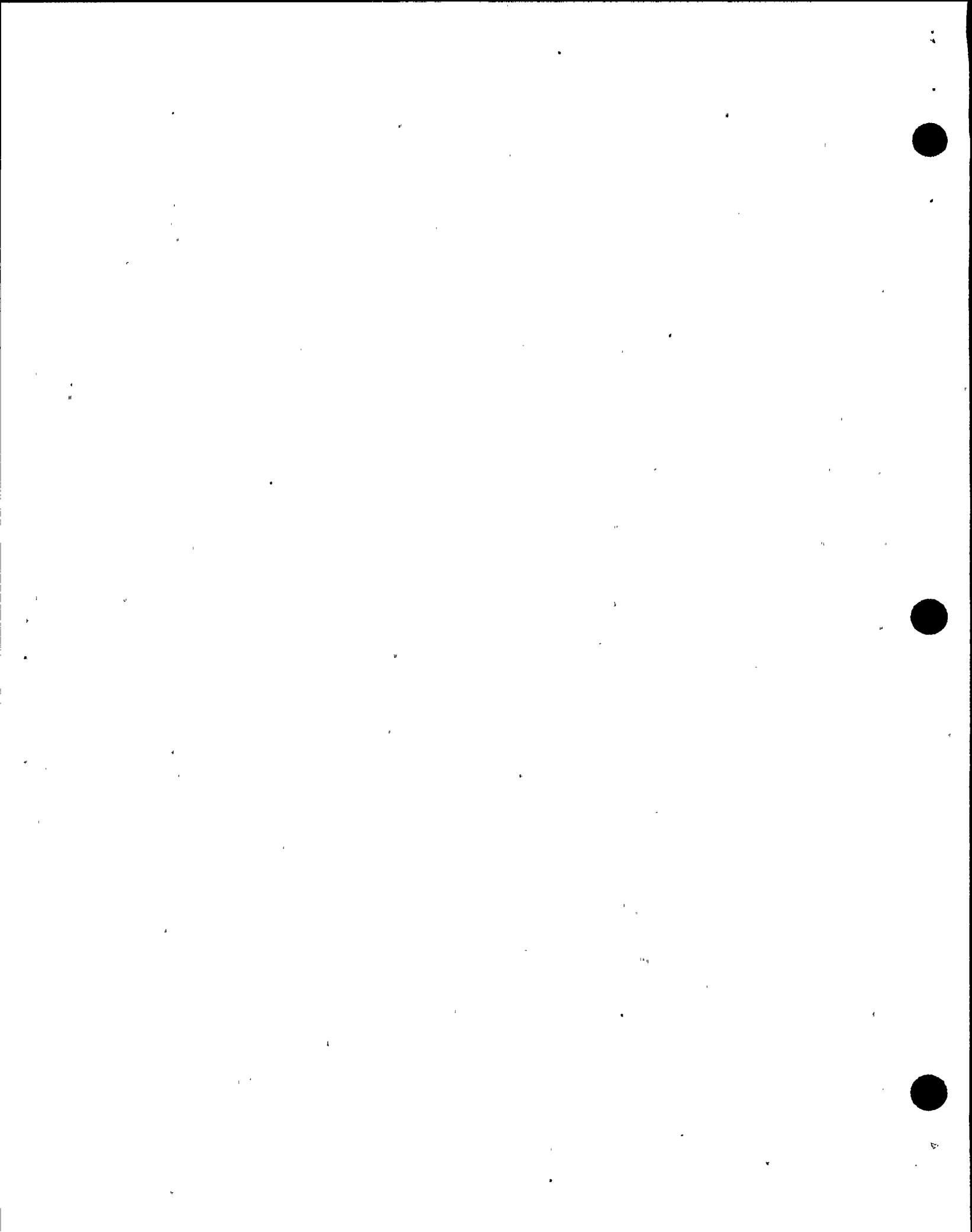
THEN

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.



- 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.
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

EO-3.0



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.

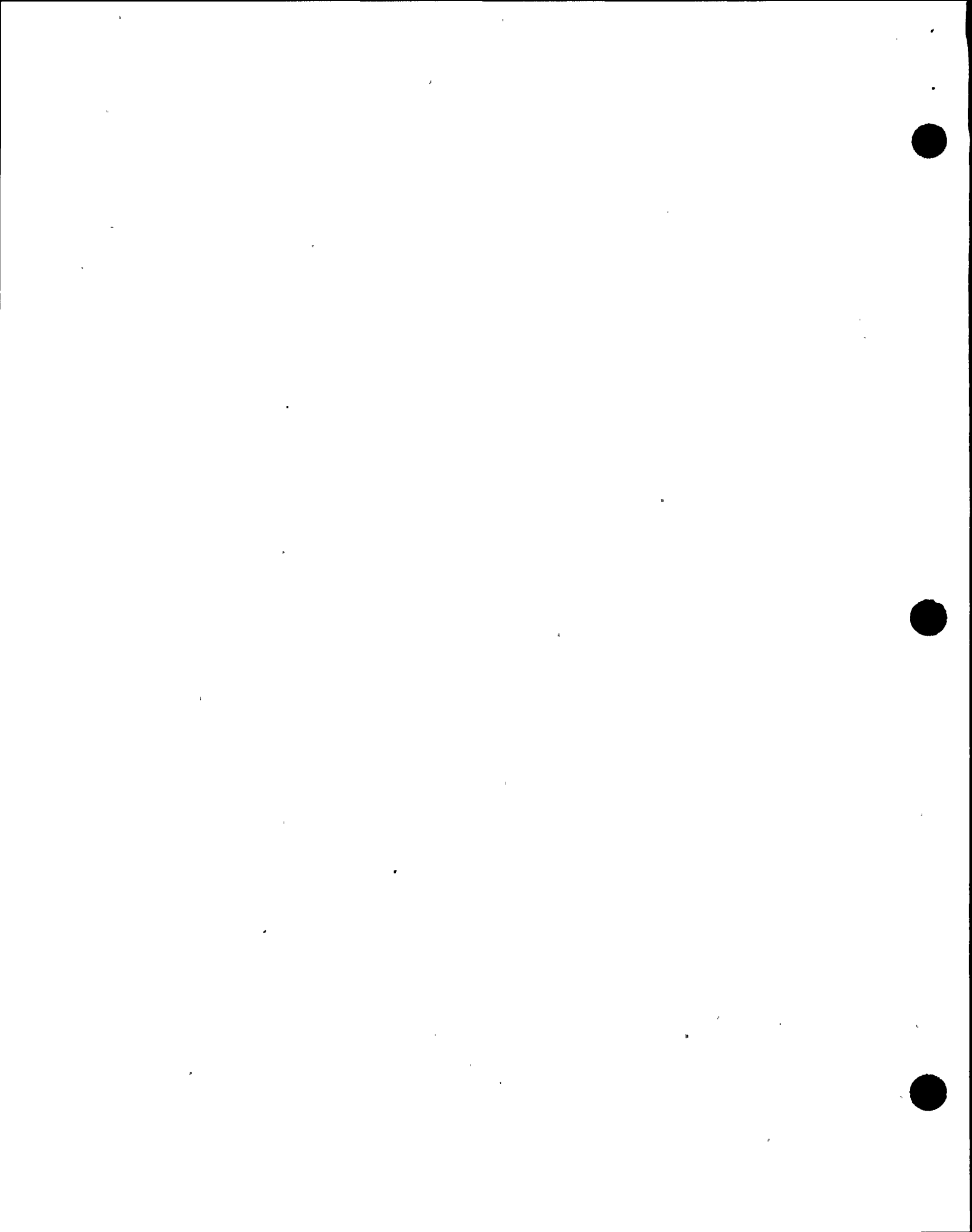


6. Can any SRV be opened.
 - a. YES - continue at STEP #7
 - b. NO - Continue at STEP #9
 - In order to utilize step #7, at least one SRV must be open.
7. WAIT - until RPV pressure is below the minimum Alternate RPV Flooding Pressure (Figure C4-2).
 - Definition - the minimum RPV pressure at which steam 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.
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.

Show TP of Figure C4-2.

EO-3.0

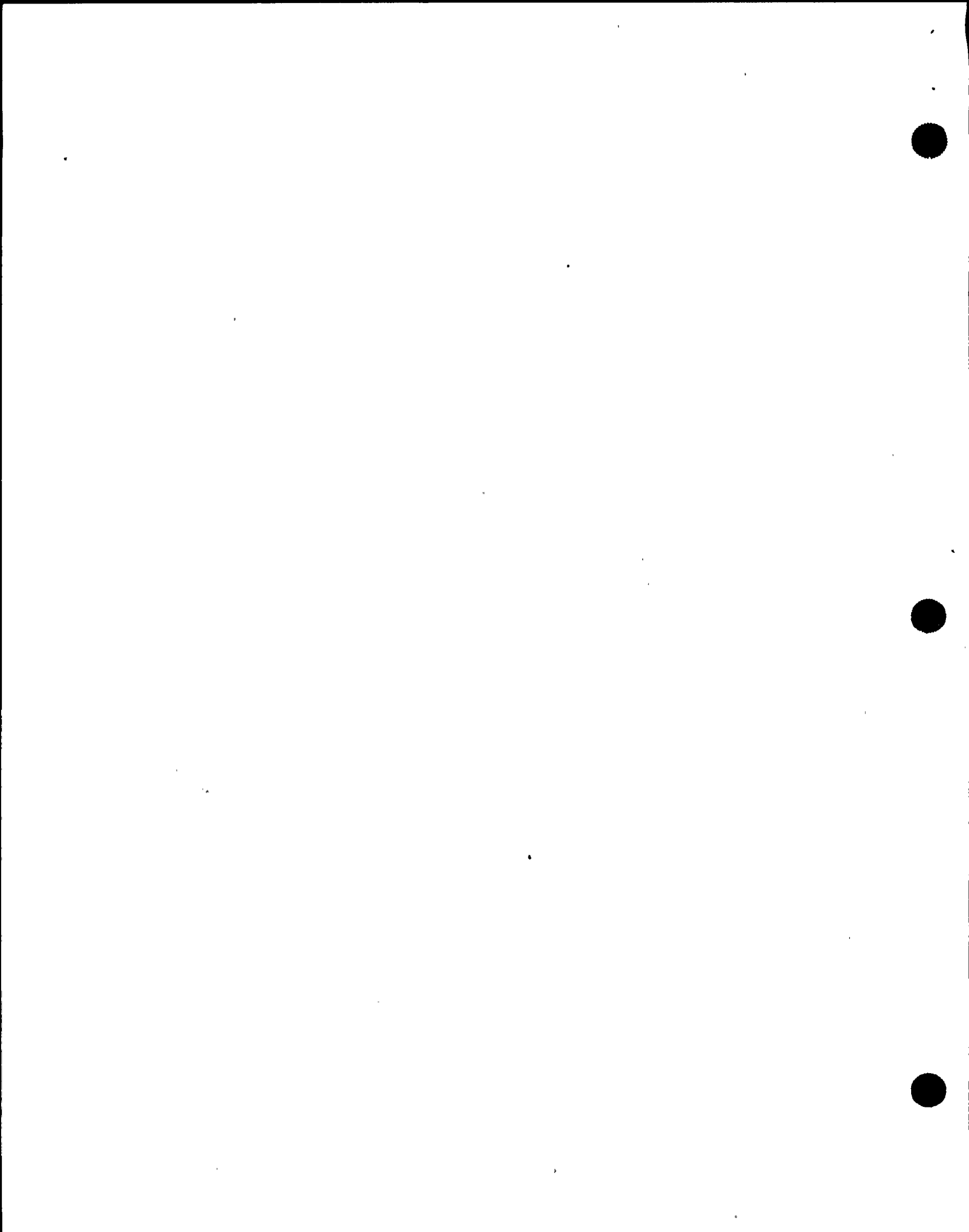
EO-3.0



- 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.
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.
 - 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.

EO-3.0

EO-3.0



- With RPV pressure below the Minimum Alternate Flooding Pressure, sufficient steam flow to cool the core through steam cooling alone does 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:
 - 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

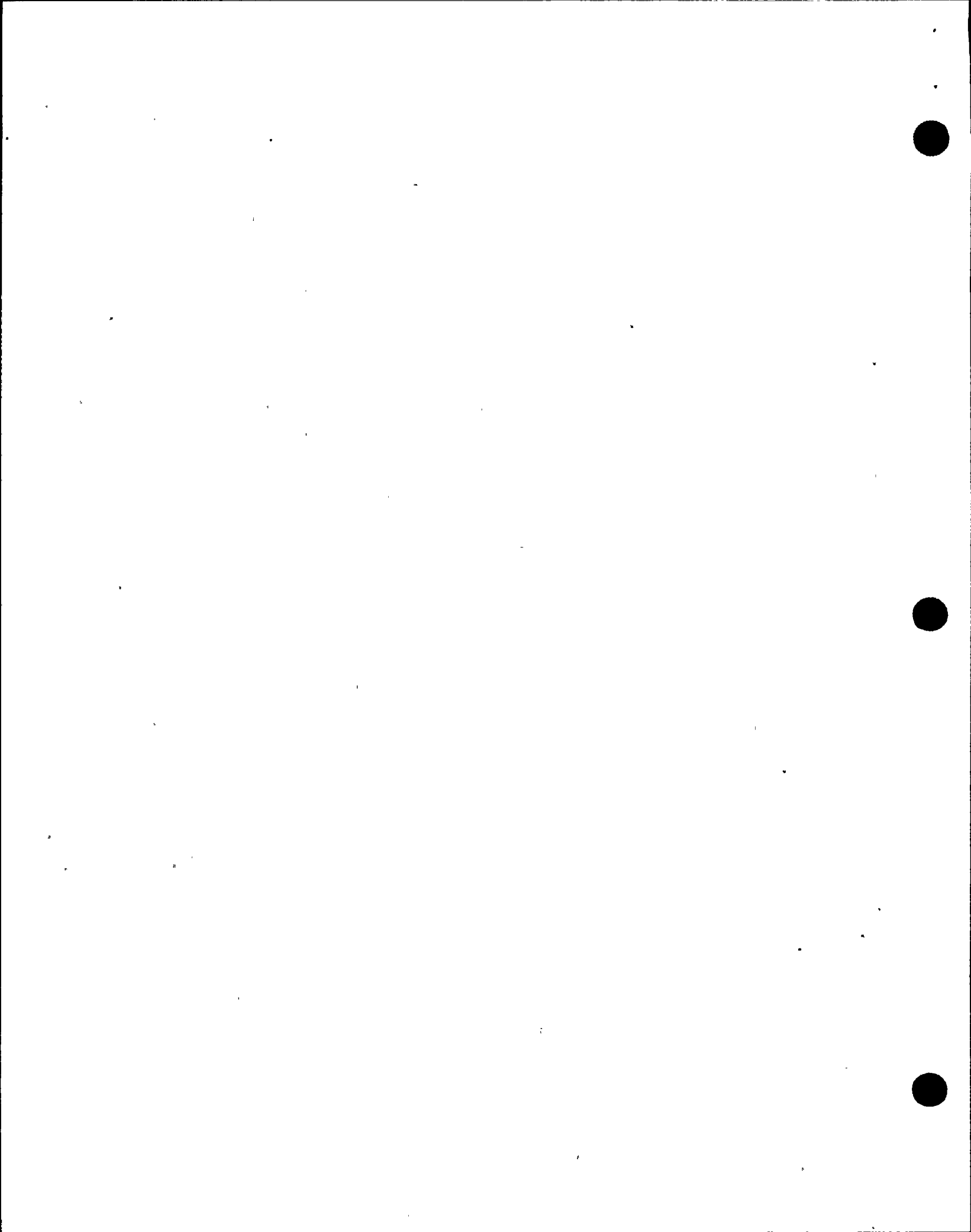
RPV pressure cannot be raised to above the Minimum Alternate RPV Flooding pressure (Figure C4-2)

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.

- 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.

Show TP of Figure C4-2.



- d. Serving water to RHR crosstie
- e. Fire System
- f. Eccs keep full systems
- g. Condensate Transfer
 - If RPV pressure cannot be maintained above the minimum alternate RPV flooding pressure 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.

EO-3.0

11. IF

No SRV is open

OR

RPV pressure cannot be raised to above the Minimum Alternate RPV Flooding Pressure.

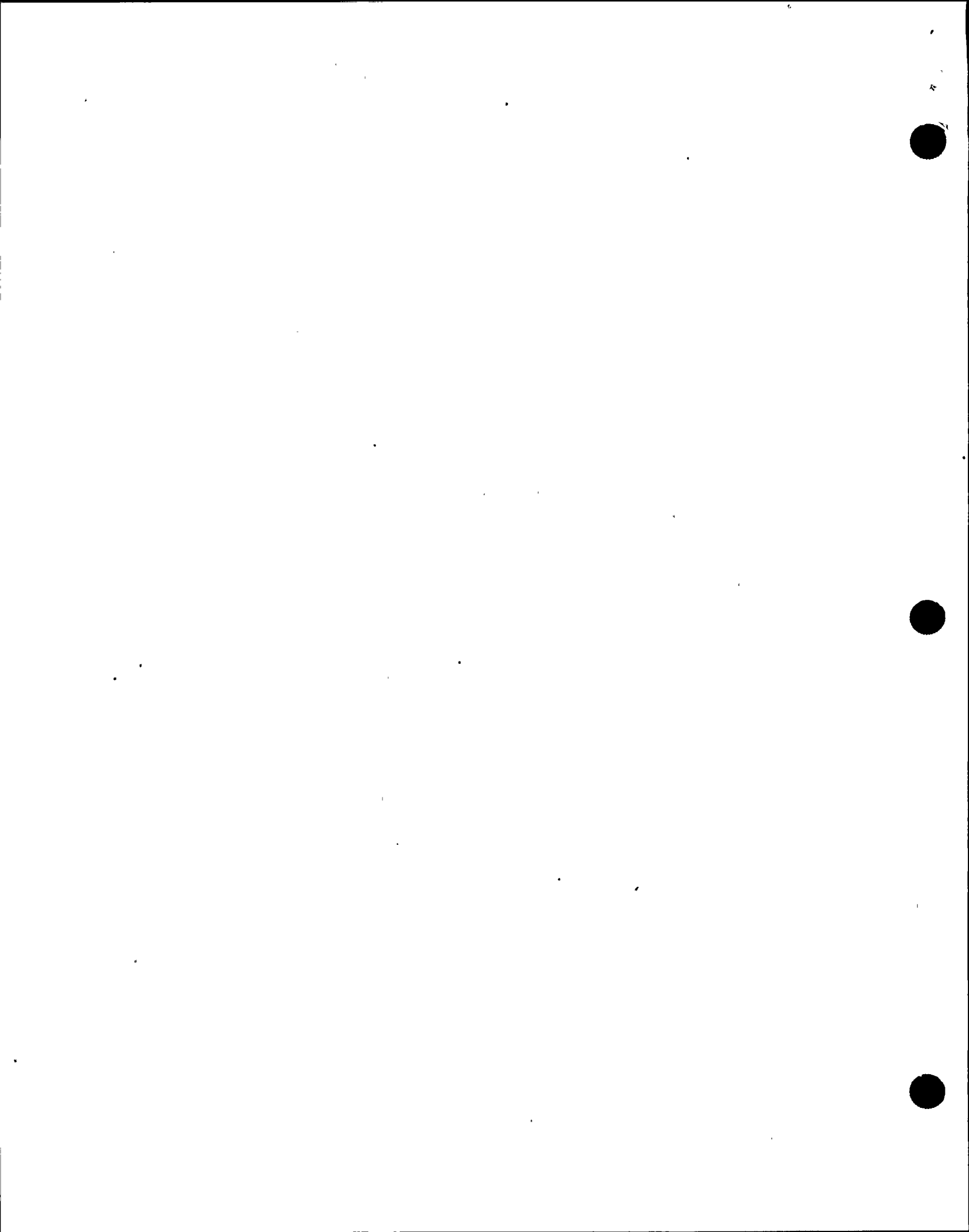
THEN

Primary Containment Flooding is required-Exit this procedure and Enter EOP-C6, Primary Containment Flooding and EOP-RPV, show entry points into EOP-C6 and EOP-RPV. RPV Control at "C" and execute them concurrently.

Show TP of Figure C4-2.

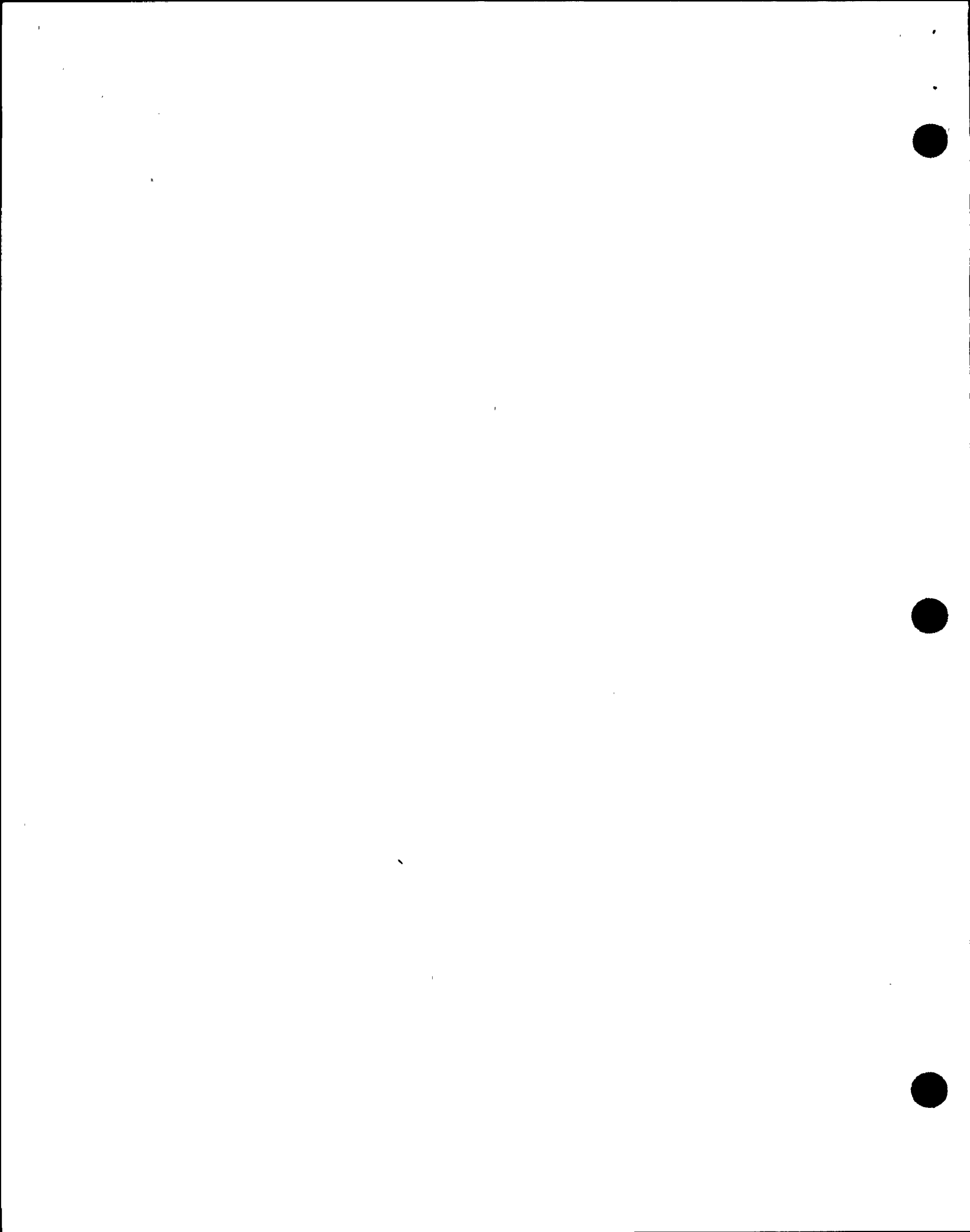


- If flooding conditions cannot be established, the covering of the core is attempted by flooding the containment. EO-3.0
12. Control injection to maintain RPV pressure above the Minimum Alternate RPV Flooding Pressure for the number of SRVs which can be opened but as low as practicable. Show TP of Figure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



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.

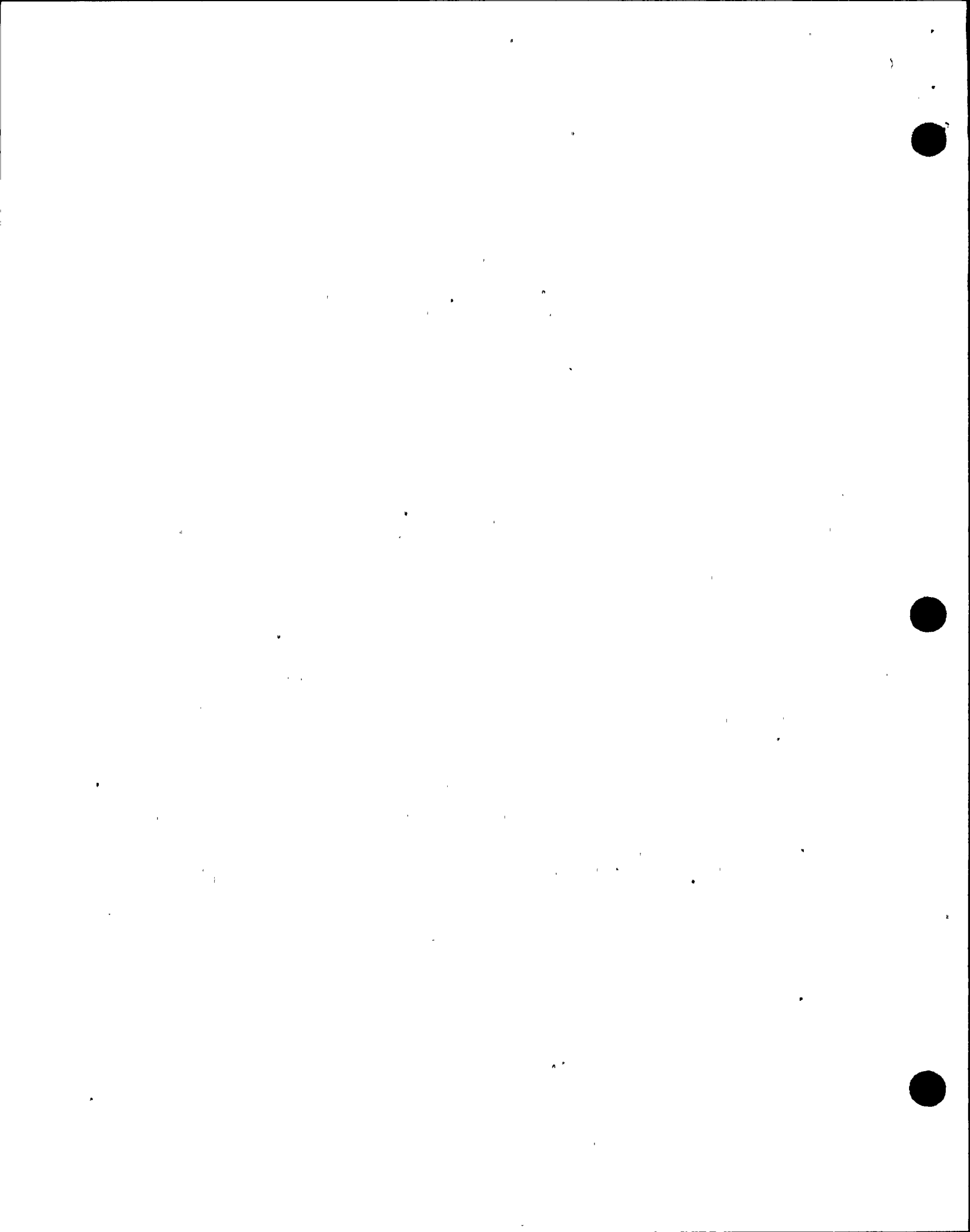
EO-3.0



- 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.
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.
 - 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.

EO-3.0

EO-3.0



- 61 psig is the Minimum RPV 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 (4) is sufficient to remove decay heat.
- 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.

Systems:

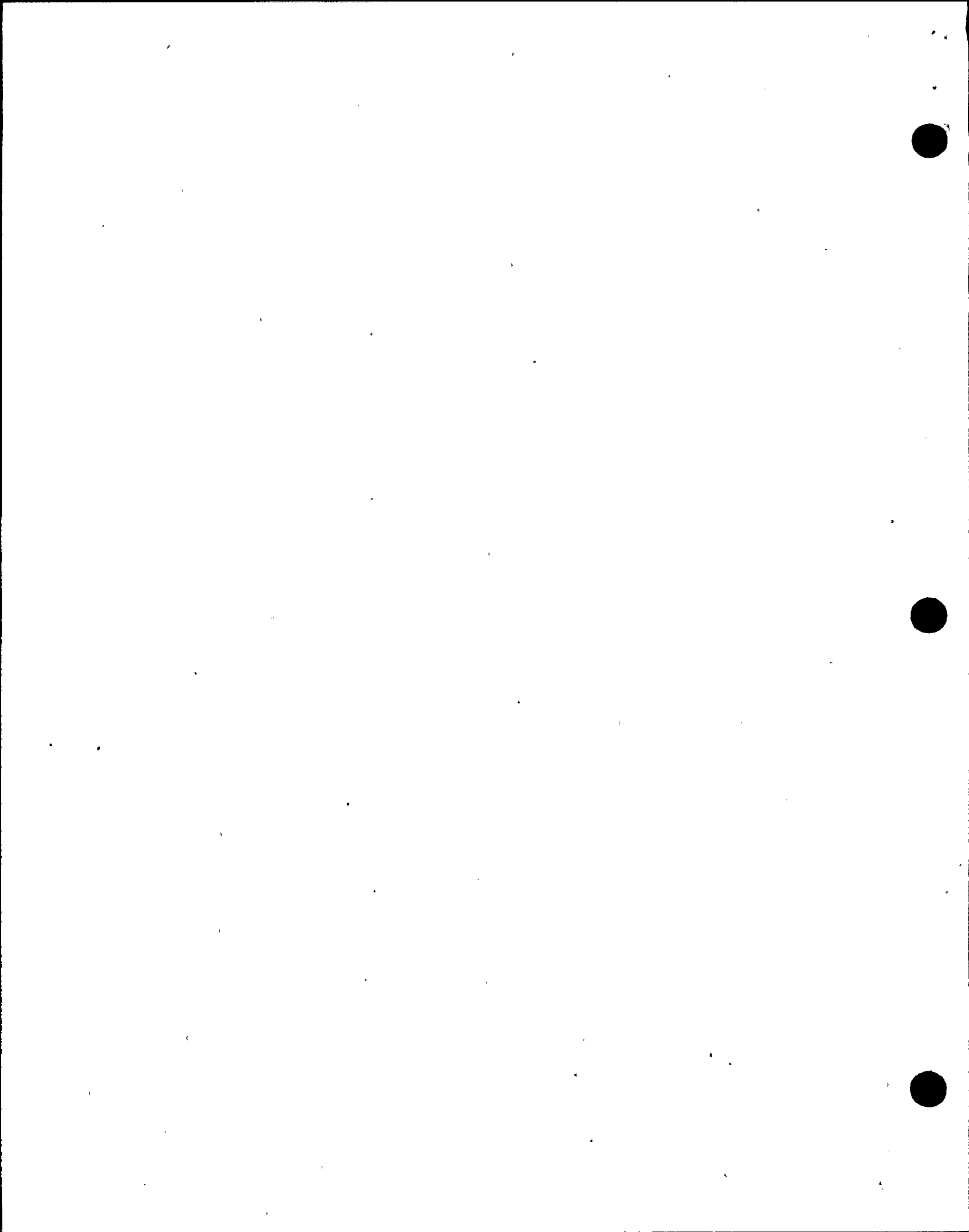
- 1) HPCS - if necessary, defeat high RPV water level trip interlocks.
- 2) Feedwater pumps - if necessary, defeat high RPV water level trip interlocks.

Q: What is the definition of "Minimum RPV Flooding Pressure"?

EO-3.0

A: 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 (4) is sufficient to remove decay heat.

EO-3.0



- 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

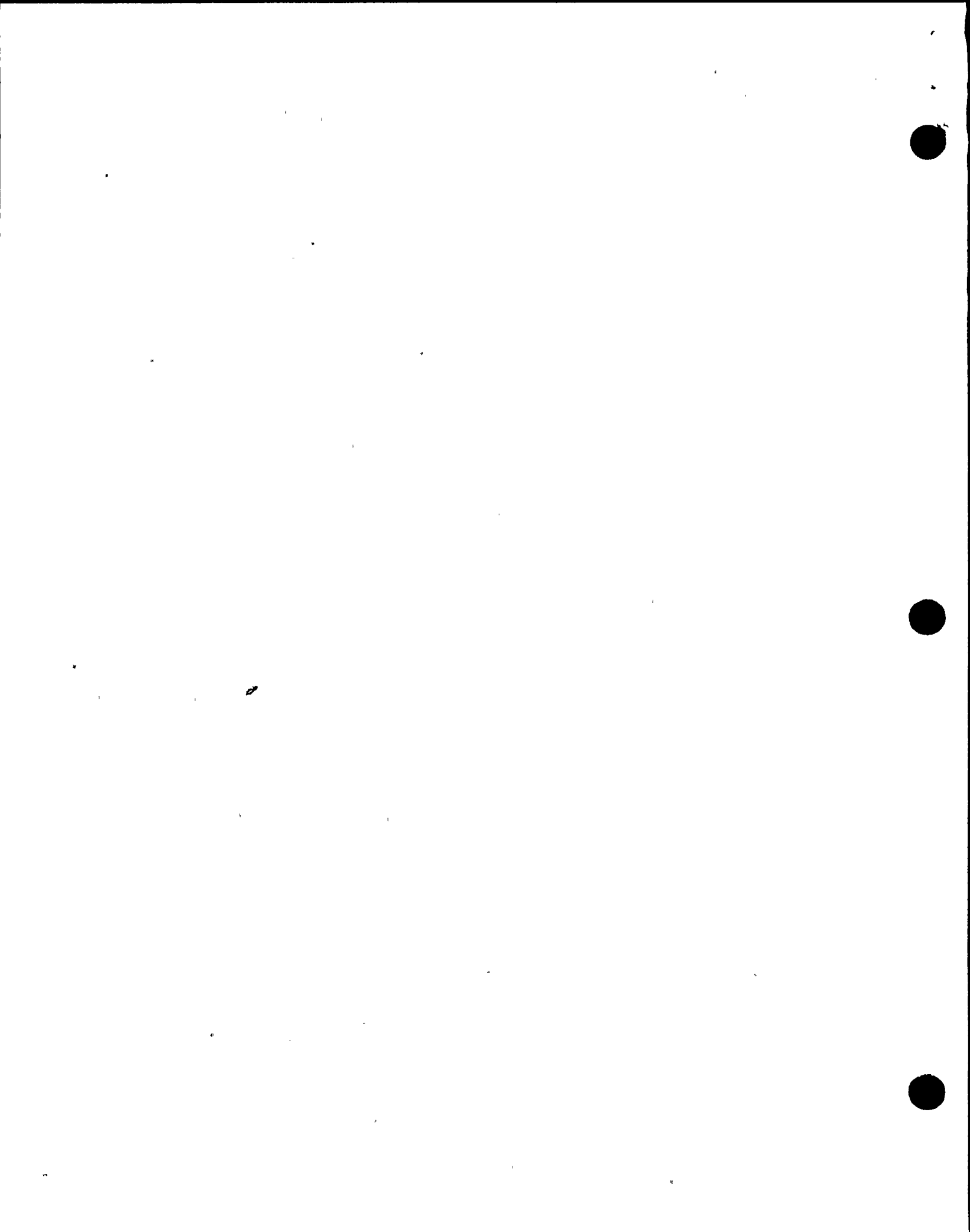
RPV pressure cannot be maintained at least 61 psig above Suppression Chamber pressure

THEN

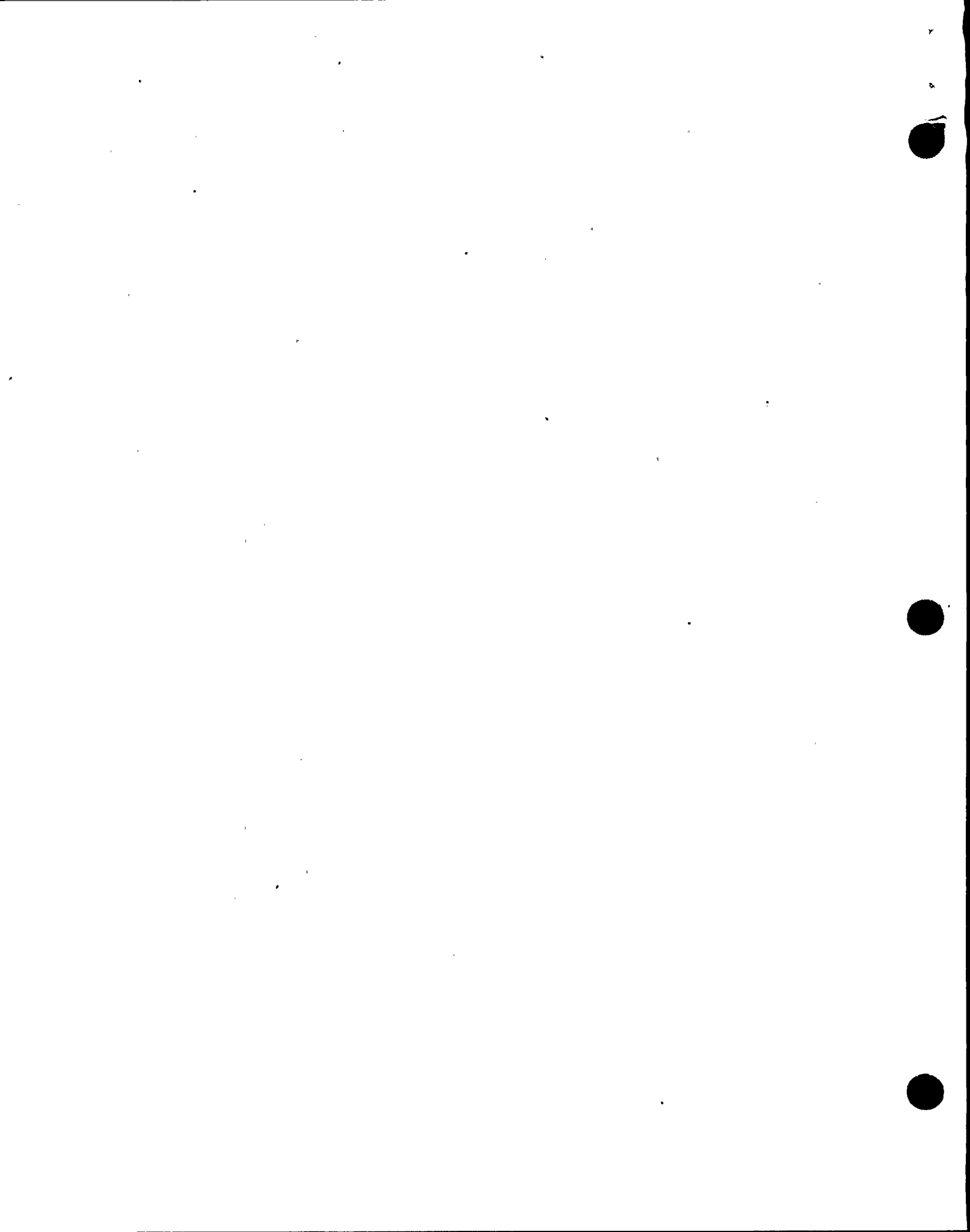
Primary Containment Flooding is required;
Exit this procedure and enter EOP-C6,
Primary Containment Flooding and EOP-RPV,
RPV Control at "C" and execute them
concurrently.

Show entry points into EOP-C6 and EOP-RPV.

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 Interval (Figure 4-3).
Show TP of Fig. C4-3.
- The Minimum Core Flooding Interval 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 Maximum Core Uncovery Time Limit 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.

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

Q: When is RPV water level indication considered restored?

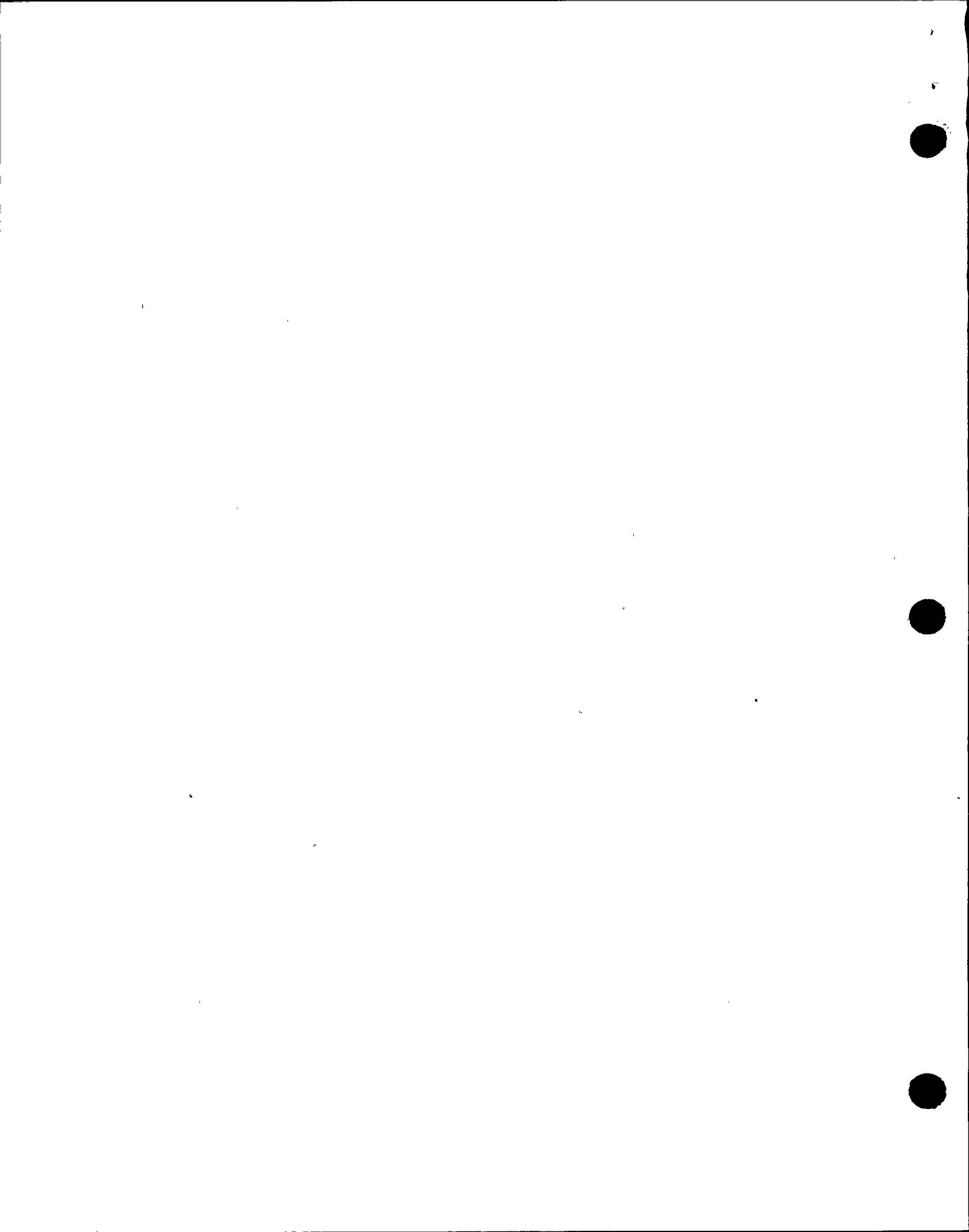
A: Indication is restored when a consistent change in an RPV water level instrument is observed or a trend between RPV level instruments is established.

EO-3.0

Show entry points into EOP-RL and EOP-RP.

Q: What is the purpose of EOP-C4?

A: Provides actions to inject water into the RPV and increase RPV water level until either the MSL's flood or, if the Rx is not shutdown, the core is adequately cooled.



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.

Q: If RPV water level can be determined, and all control rods are not inserted to at least position 02 and the Rx will not remain shutdown without boron, which procedure is entered from EOP-C4?

A: N2-EOP-C5.

Q: If RPV water level can be determined, and all control rods are inserted to at least position 02 and the Rx will remain shutdown without boron, which procedure is entered from EOP-C4?

A: N2-EOP-RPV.

