

07-188-911

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT NUCLEAR STATION
UNIT II OPERATIONS

02-LOT-001-294-2-08 (Ops) Revision 6

TITLE: REDUNDANT REACTIVITY CONTROL SYSTEM (RRS)

	<u>SIGNATURE</u>	<u>DATE</u>
PREPARER	<u>Blenn Bridges</u>	<u>1-9-91</u>
TRAINING SUPPORT SUPERVISOR	<u>J. Boyd for J. P. Clair</u>	<u>1-11-91</u>
TRAINING AREA SUPERVISOR	<u>John Laminite</u>	<u>1-10-91</u>
PLANT SUPERVISOR/ USER GROUP SUPERVISOR	<u>FOR D. TOOLEY</u>	<u>1/14/91</u>

Summary of Pages

(Effective Date: 1-14-91)

Number of Pages: 32

<u>Date</u>	<u>Pages</u>
January 1991	1 - 32

THIS LESSON PLAN IS A GENERAL REWRITE

MASTER
 TRAINING DEPARTMENT RECORDS ADMINISTRATION ONLY:
 VERIFICATION:
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I. TRAINING DESCRIPTION

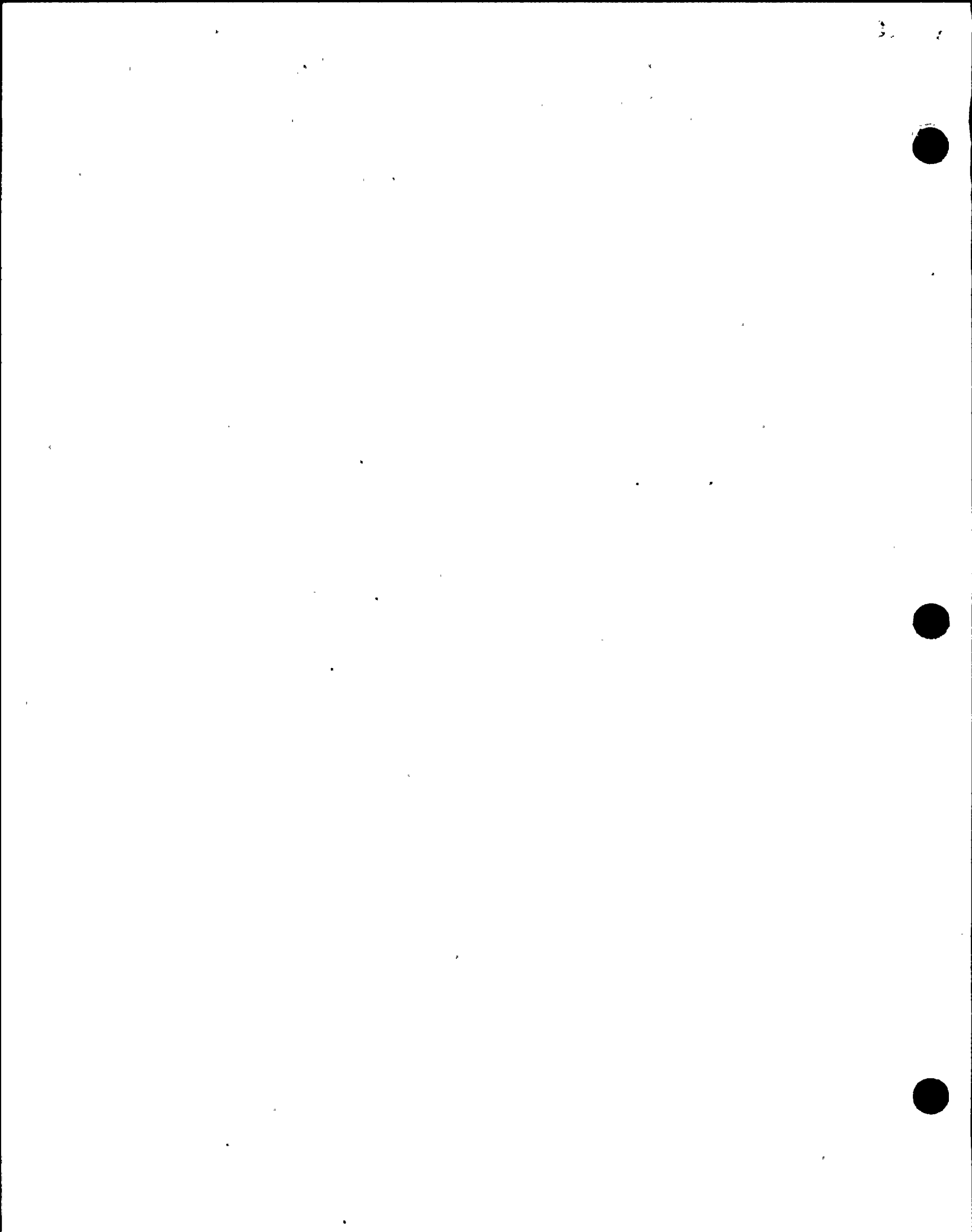
- A. Title of Lesson: Redundant Reactivity Control System (RRS)
- B. Lesson Description: This lesson contains information pertaining to the Redundant Reactivity Control System. The scope of the training is defined by the learning objectives and in general covers the knowledge requirement of a Licensed Control Room Operator.
- C. Estimate of the Duration of the Lesson: 2 hours
- D. Method of Evaluation, Grade Format, and Standard of Evaluation: Written exam, passing grade of 80% or greater
- E. Method and Setting of Instruction: This lecture should be conducted in the classroom.
- F. Prerequisites:
1. Instructor:
 - a. Certified in accordance with NTP-16.
 2. Trainee:
 - a. Initial License Candidate - In accordance with the eligibility of NTP-10.
 - b. Licensed Operator Requal - In accordance with the requirements of NTP-11.
- G. References:
1. Technical Specifications
 - a. 3.3.4.1 ATWS Recirc. Pump Trip Instrumentation
 - b. 3.1.5 Standby Liquid Control System
 2. Procedures
 - a. N2-OP-36b, Redundant Reactivity Control
 - b. N2-OP-97, Reactor Protection System
 - c. N2-OSP-LOG-S001, Shift Checks, Mode 1
 - d. N2-ISP-RRS-@101, Alt. ATM St.Pt and Gross F
 - e. N2-EOP-RPV, Emergency OP Procedure - Reactor Pressure Vessel
 3. NMP2-USAR Vol. 16, Section 7.6
 4. Drawings
 - a. GE Print ELEM944E309TY RRS

*Next Revision
add as a reference
EOP-6*

II. REQUIREMENTS

- A. AP-9, Administration of Training
- B. NTP-10, Training of Licensed Operator Candidates
- C. NTP-11, Licensed Operator Requalification Training
- D. NTP-12, Unlicensed Operator Training

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III. TRAINING MATERIALS

A. Instructor Materials:

1. Classroom/whiteboard and markers
2. Lesson plan O2-LOT-001-294-2-08, RRS
3. TR
4. Transparencies
5. Overhead projector
6. References 1,2a & 2b
7. Op. Tech Chapter RRS

B. Trainee Materials:

1. Op Tech. Chapter RRS
2. Pens, pencils, paper
3. Course evaluation sheet as appropriate

IV. EXAM AND MASTER ANSWER KEYS

- A. Exams will be generated and administered as necessary.
- B. Exams and master answer keys will be on permanent file in the Records Room.



V. LEARNING OBJECTIVES

A. Terminal Objectives:

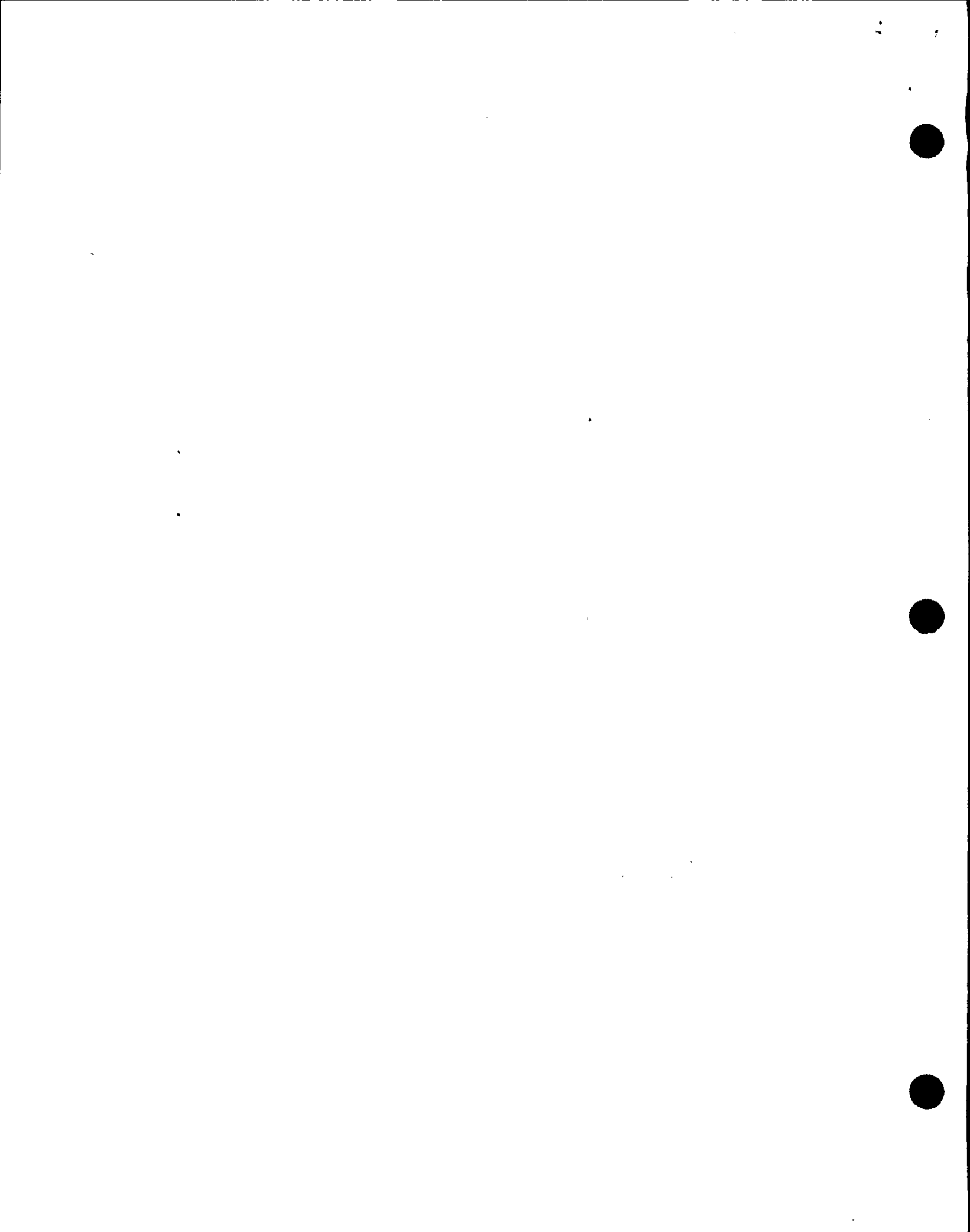
Upon satisfactory completion of this lesson, the trainees will demonstrate the knowledge to:

- | | | |
|--------|---|--------------|
| TO-1.0 | Start Up from inoperable the RRCS System. | (2949010101) |
| TO-2.0 | Reset an ARI initiation signal at Panel P-603. | (2949020101) |
| TO-3.0 | Manually initiate ARI from the Relay Room. | (2949040101) |
| TO-4.0 | Manually initiate RRCS from the Control Room Panel P-603. | (2949050401) |
| TO-5.0 | Verify operation of the RRCS auto-initiation for high reactor pressure. | (2949060401) |
| TO-6.0 | Verify operation of the RRCS auto-initiation for reactor low water level. | (2949070401) |
| TO-7.0 | Disable a feedwater runback caused by RRCS. | (2949110101) |
| TO-8.0 | Respond to a RRCS Test Fault. | (2949120101) |
| TO-9.0 | (SRO ONLY)Direct the actions for Alternate Rod Insertion. | (3449880403) |

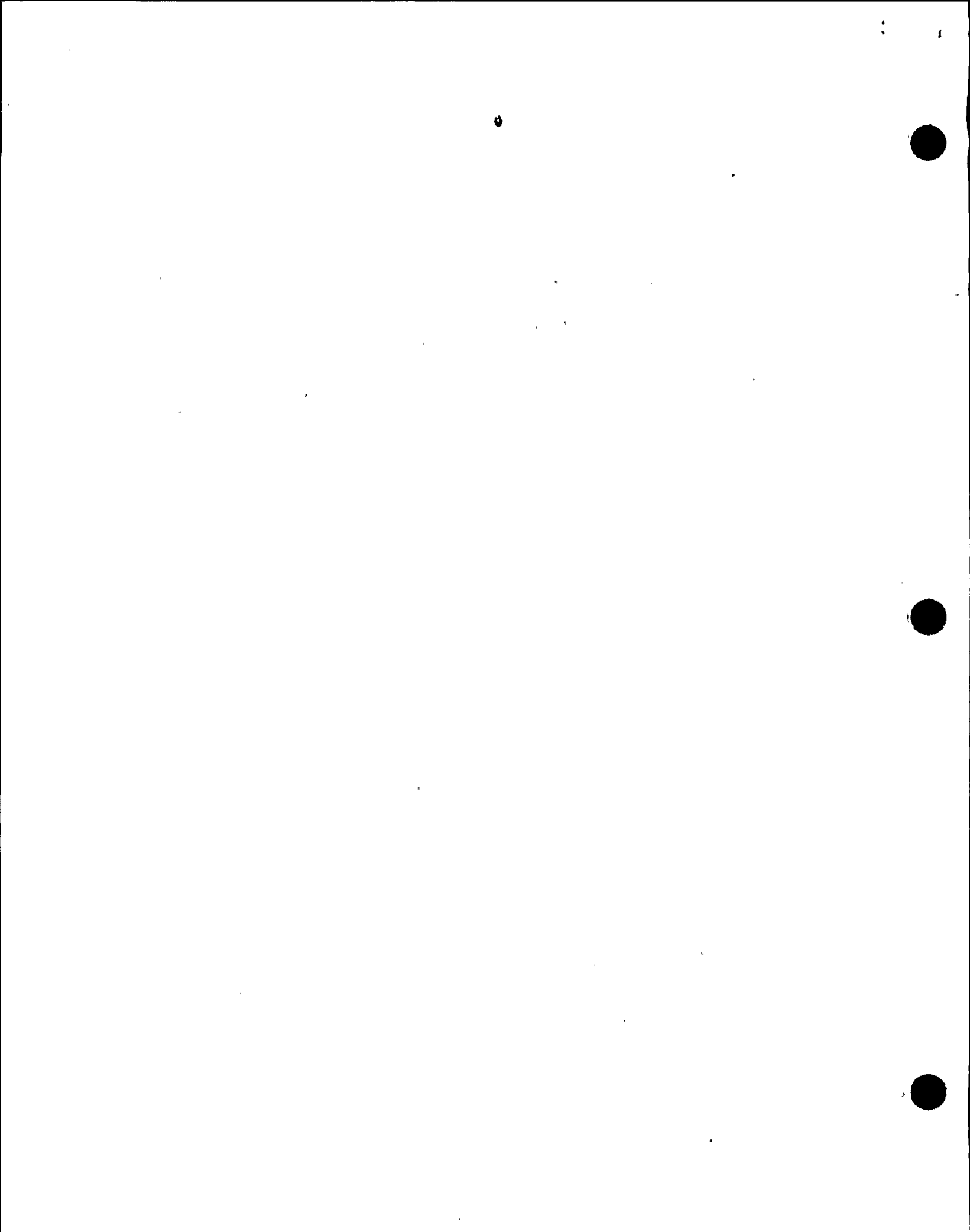


B. Enabling Objectives

- EO-1.0 Explain the purpose and function of the Redundant Reactivity Control System (RRCS).
- EO-2.0 Describe the purpose and function of each of the major components of the RRCS system listed below:
 - a. Control Panel on P-603
 - b. Relay Room Panels C22-P001, and C22-P002
 - c. RRCS Logic
 - d. ARI Valves
 - e. APRMs
- EO-3.0 Describe the locations of the RRCS System controls and indicating lights.
- EO-4.0 State the setpoint and describe the purpose of the following interlocks:
 - a. ARI initiation
 - b. RCS pump down shift and trip
 - c. FW runback
 - d. SLS initiation
- EO-5.0 Describe the RRCS indications that would be observed following:
 - a. RPV pressure greater than RRCS setpoint
 - b. RPV water level less than RRCS setpoint
 - c. Rx. power not downscale after 25 seconds and RRCS initiated
 - d. Rx. power not downscale after 98 seconds and RRCS initiated
 - e. Manual initiation
 - f. RRCS test fault occurs
- EO-6.0 Given a specific set of plant conditions, determine how the RRCS system responds.
- EO-7.0 Describe how the RRCS system is utilized during the performance of the EOP's.



- EO-8.0 Describe the interrelationship of the following systems with the RRCS system:
- a. Electrical distribution
 - b. Standby Liquid Control (SLS)
 - c. Control Rod Drive (RDH)
 - d. Reactor Recirculation (RCS)
 - e. Feedwater Control (FWS)
 - f. Reactor Vessel Instrumentation (RVI)
 - g. Neutron Monitoring (NMS)
- EO-9.0 Explain the basis for each precaution and limitation listed in N2-OP-36B RRCS.
- EO-10.0 Regarding the RRCS system, determine and use the correct procedure to identify the actions and/or locate information related to the following:
- a. Startup
 - b. Shutdown
 - c. Normal Operations
 - d. Off-Normal operations
 - e. Annunciator responses
- EO-11.0 Given NMP2 Technical Specifications and a set of plant conditions, determine the appropriate bases, limiting conditions for operation, limiting safety system setting, and/or action statement as applicable.
- EO-12.0 Regarding the RRCS system, 1) locate the correct drawing and 2) use drawings to perform the following:
- a. Identify electrical and mechanical components
 - b. Trace the flowpath of fluids or electricity
 - c. Identify interlocks and setpoints
 - d. Describe system operation
 - e. Locate information about specific components
 - f. Identify system interrelations



I. INTRODUCTION

Student Learning Objectives

A. Purpose

The Redundant Reactivity Control System (RRCS) is a system designed in conjunction with other systems to prevent and/or to mitigate the potential consequences of an Anticipated Transient Without Scram (ATWS) event.

Show TP of objectives

Passout TR and Evaluation Forms

Inform trainees of method of evaluation

EO-1

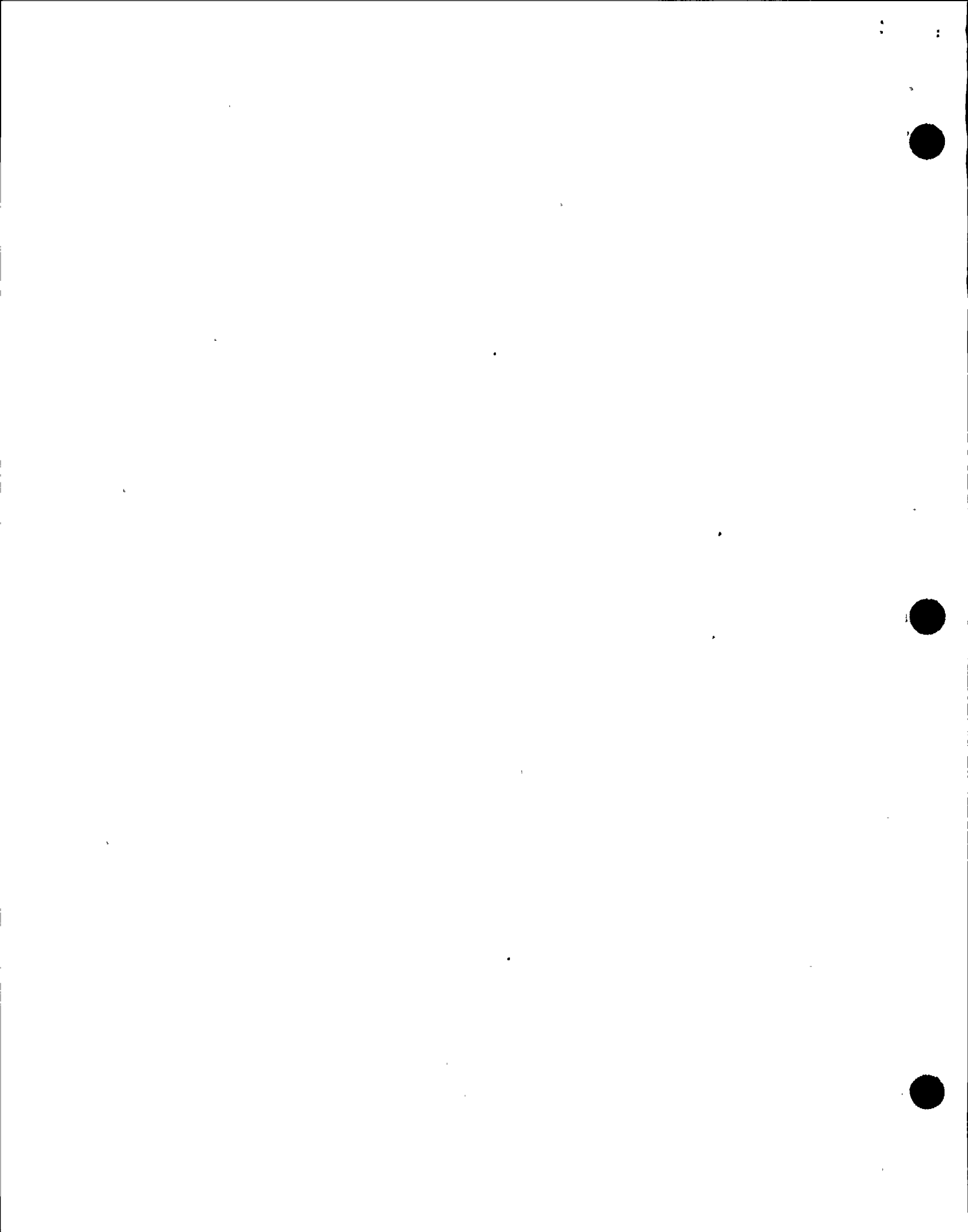
B. Design Basis

1. An ATWS event is an extremely low probability event requiring a multi-system malfunction.
2. Ultimate goal of RRCS is Rx. Shutdown to ensure long term core cooling capability and meeting clad oxidation limits.
3. RRCS functions to prevent an ATWS by initiating an ARI and/or mitigates the consequences of by reducing reactivity levels in the core by FW Runback, RCS pump down shifts/trips, and boron injection (SLS).

Examples of ATWS Events

1. Closure of MSIVs
2. Failure of Control Rods to insert
3. Loss of feed leading to low RPV level.
4. Turbine Trip

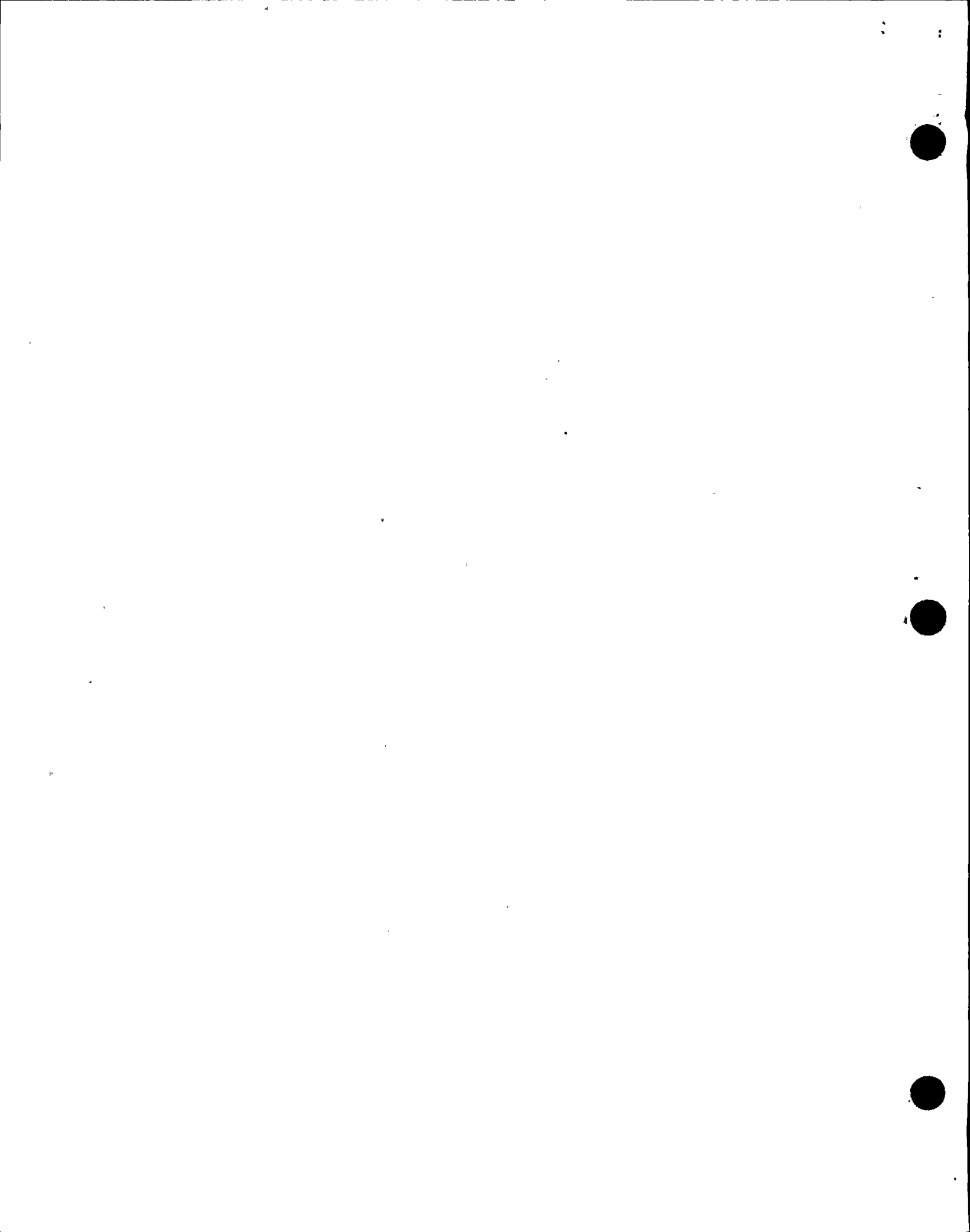
These are ECCS design criteria as outlined by 10CFR50.46



C. General Description

1. RRCS was designed to ease the severity of an Anticipated Transient Without Scram (ATWS).
 - a. Serves as a backup to the CRD System.
 - b. Provides alternate methods of Rx. Scram.
2. Actuation Signals
 - a. RRCS actuated by:
 - 1) Rx. vessel high dome pressure (1050 psig), or
 - 2) Rx. vessel low-low water level (108.8") or
 - 3) Manually
3. Reactivity control is effected by one or more functions.
 - a. The Alternate Rod Insertion (ARI) is intended to prevent an ATWS condition by depressurizing the scram discharge air header through valves separate from the RPS scram valves.
 - b. If ARI does not lower reactor power sufficiently, Reactor Recirculation pump motors will be tripped.
 - c. If power level remains high, a Feedwater System runback occurs.
 - d. If power level is still too high, SLS will inject borated water (poison) into the Rx. vessel.

Ask students the definition of reactivity.



II. DETAILED DESCRIPTION

A. Redundant Reactivity Control System (RRCS)

EO-2

1. Consists of:

a. Two RRCS control panels: C22-P001 and C22-P002, their associated ATWS detection and actuation logic and the necessary interface logic to perform specific functions in response to an ATWS event.

b. A control panel for manual initiation of the RRCS located in the MRC on P-603.

Show Transparency of Figure 4

EO-3

2. RRCS has two Divisions of the logic:

Division 1, 2.

a. Each division has two channels A, B.

b. Each channel acts identically.

c. Each channel has a manual High RPV pressure, and Low RPV water level logics

- Only one division of RRCS required to activate to cause RRCS initiation.

- Both channels in a division must activate for that division to activate.

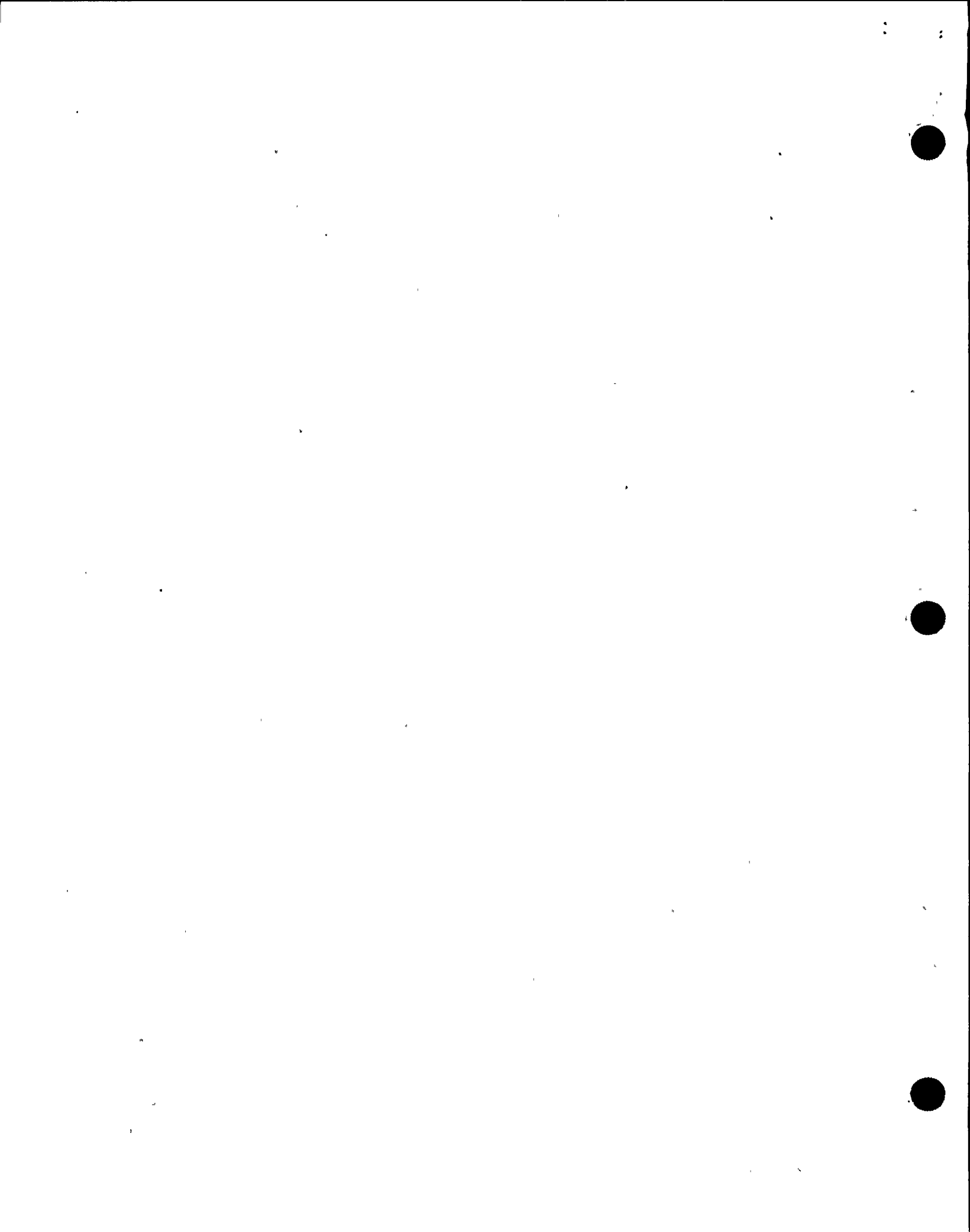
Show Transparency of Figure 2

- This is a energize to function logic system.

B. Alternate Rod Insertion (ARI)

1. ARI is the preventive aspect of RRCS. It Provides a parallel means of rapid control rod insertion.

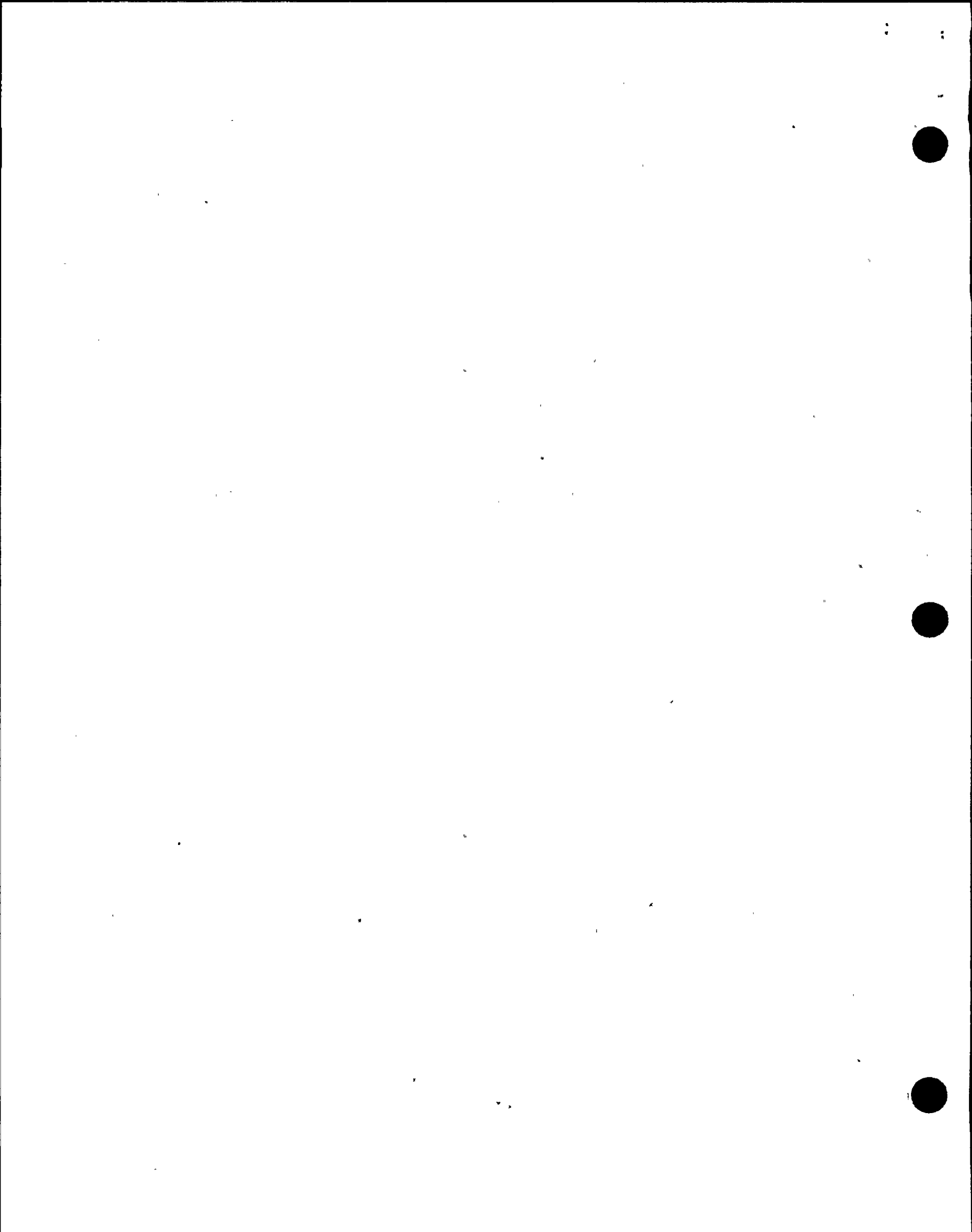
Indicate to students that each of the preventive/ mitigating functions will be covered individually, to be tied altogether later.



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|---|--|------|
| 2. ARI initiation signals | | EO-4 |
| a. High dome pressure, Low-low water level, or Manual | •Dome pressure of 1050 psig | EO-6 |
| b. When received, 8 RRCS-ARI valve solenoids are <u>energized</u> . | •RPV water level 108.8"
8 valves assumes both divisions of RRCS has activated. | EO-2 |
| c. This seals in for a minimum of 30 seconds to ensure that all control rods have time to insert fully. | •30 seconds allows time for the Scram Air Header to depressurize and the slowest control rod to fully insert (00 position)
•Valves remain energized until the reset pushbuttons on P-603 are depressed. | |
| d. With the RRCS - ARI valves energized the following occurs. | Show Transparency of Figure 3.
Discuss operation of ARI values | |
| 1) VLVs 162 and 163 energize as long as one energizes it will reposition to block and vent the scram air header, if one of these vlv's do not reposition the header will still be depressurized through the check vlv installed around the vlv's. | | |
| 2) Vlv's 156 through 159 energize open to vent off the branches of the scram air header. | | |



- | | | |
|---|--|-------------------------|
| <p>3) Vlv's 160 and 161 energize open to vent the air off the SDV drain and vent vlv's causing them to close.</p> <p>4) All vlv's are sized such that the Control Rods will begin inserting approx. 15 sec. after the vlv's are energized.</p> <p>3. Local initiation of ARI from Relay Room panels C22-P001 and/or C22-P002.</p> <p>a. Keylock switches 2SA and 2SC (Div. I) 2SB and 2SD (Div. II) are both taken to the "ON" position this will insert two test signals into the ARI logics resulting in an ARI with no other RRCS functions from that division.</p> <p>b. Verify at P-603 "RRCS ARI INITIATE" light is on.</p> <p>4. Indications expected during an ARI only.</p> <p>a. Manual from Relay Room</p> <p>1) P-603 Indications</p> <p>a) ARI INT light at RRCS control panel on the Division that was manually activated.</p> <p>2) Relay Room Panel(s) indications</p> <p>a) ARI INIT'D light at C22-P002-2</p> | <p>•Ask students, why it is important to have the SDV vent and drain valves go closed?</p> <p>Keylock switches are located in the center cabinet of each division (P001-2 and P002-2) (3 cabinets total)</p> <p>Show Transparency of Figure 4 to indicate which lights will come on.</p> <p>These indicators will be on the center cabinet C22-P002-2.</p> | <p>EO-3</p> <p>EO-5</p> |
|---|--|-------------------------|



- b) VLV's F160B, F162B, F162D,
F163B, RED lighted at
C22-P002-2.

C. Recirculation Pump Transfer/Trip

EO-4

1. This transfer/trip will result in a rapid flow reduction. The reduction in flow will result in the void fraction increasing, inserting negative reactivity, reducing Rx. power.

EO-2

2. High-to-low speed transfer of RCS pumps.

- a. Creates voids inserting negative reactivity.

Show Transparency of Figure 2 trace logic.

- b. Reduces power generation.

- 1) Initiation signal

EO-6

- a) A high vessel dome pressure signal. (1050 psig)

- b) Either RRCS division will trip the RRS pumps from their normal power supplies to their low speed LFMG sets.

•This function only occurs on a high RPV pressure condition

- c) Div. I RRCS trips the 3A and 3B circuit breakers
Div. II RRCS trips the 4A and 4B circuit breakers

3. RRCS indications

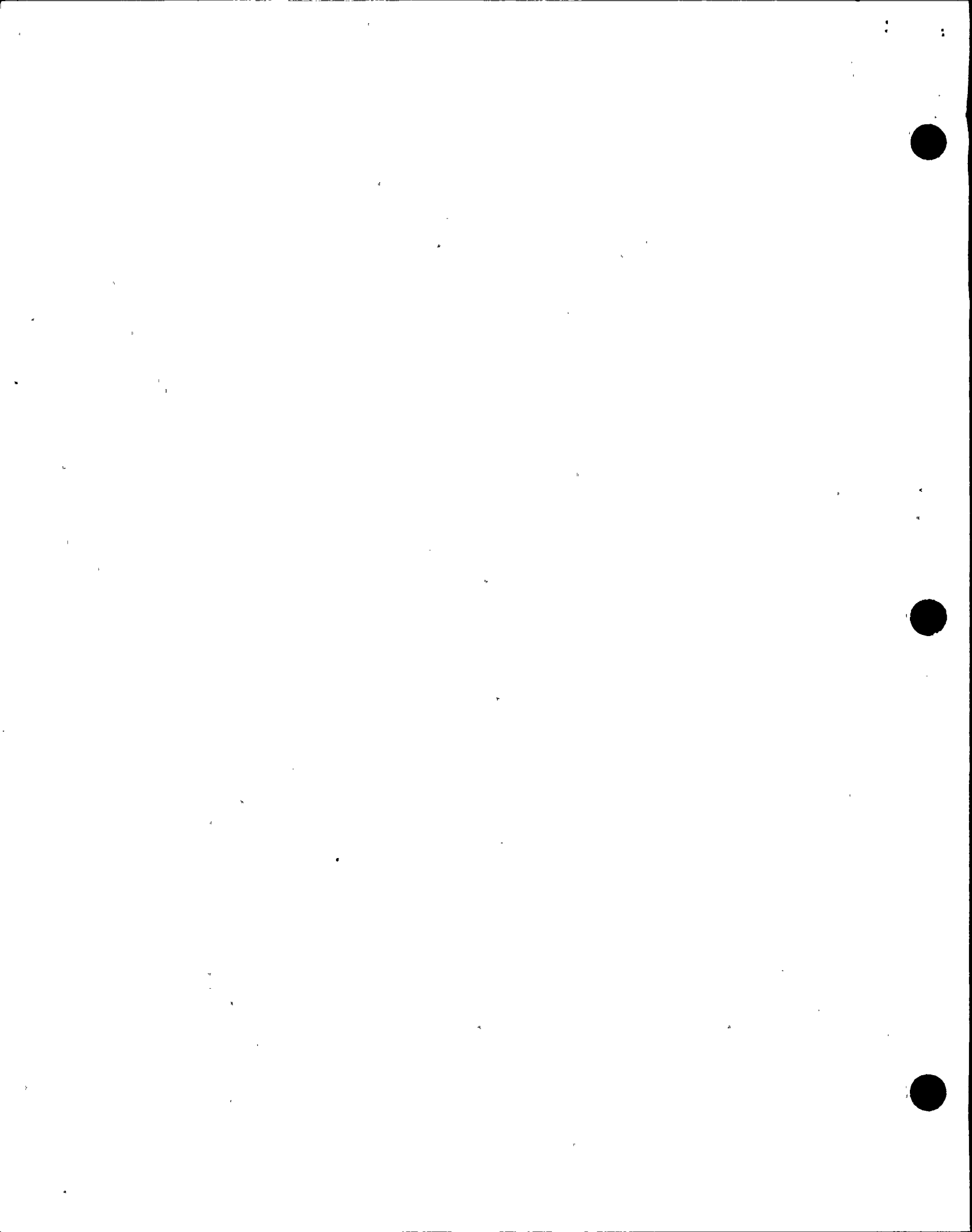
EO-5

- a. MCR P-603 panel

- 1) LFMG TRANSFER lights

Assumption on the indications is that both divisions have activated. The ARI INT lights on P-603 will also be lighted.

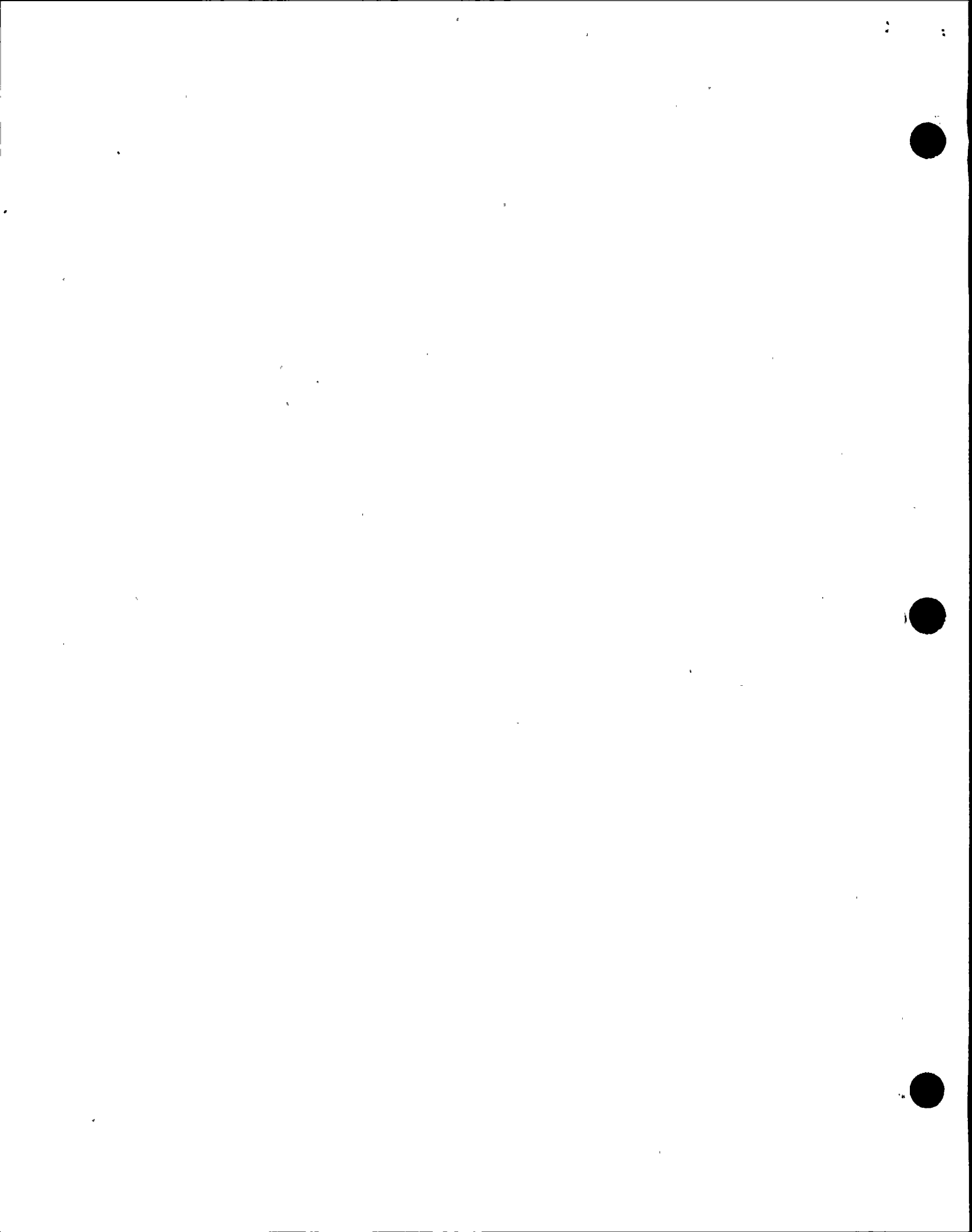
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| <ul style="list-style-type: none"> b. Relay Room Panels <ul style="list-style-type: none"> 1). LFMG XFER lights 2) POTENT ATWS lights 3) CONFIRM ATWS lights 4) RRCS TROUBLE lights 5) RPV DOME PRESSURE HIGH CHANNEL A,
CHANNEL B lights 6) VLVs F160A(B), F162A(B, C, D),
F163A(B) 4. Recirculation Pump Trip (RPT) <ul style="list-style-type: none"> a. Mitigates the consequences of an ATWS event by tripping the RCS pumps early in the event to reduce core flow. b. Initiation signals <ul style="list-style-type: none"> 1) A vessel low-low water level signal (108.8"). <li style="text-align: center;">OR 2) After a high pressure RRCS initiation if APRM power is <u>not</u> downscale or INOP 25 seconds after the initiation. 3) Either RRCS Division will trip the RCS pumps from their normal power supplies by opening the RCS pump motor breakers. | <p>C22-P001-2, C22-P002-2</p> <p>The ARI INIT'D lights at the P00 panels will also be lighted</p> <p>Transparency of Figure 2 Trace Logic</p> <p>Either division will trip the 1A, 1B, 2A and 2B circuit breakers.</p> | <p>EO-5</p> <p>EO-4</p> <p>EO-6</p> |
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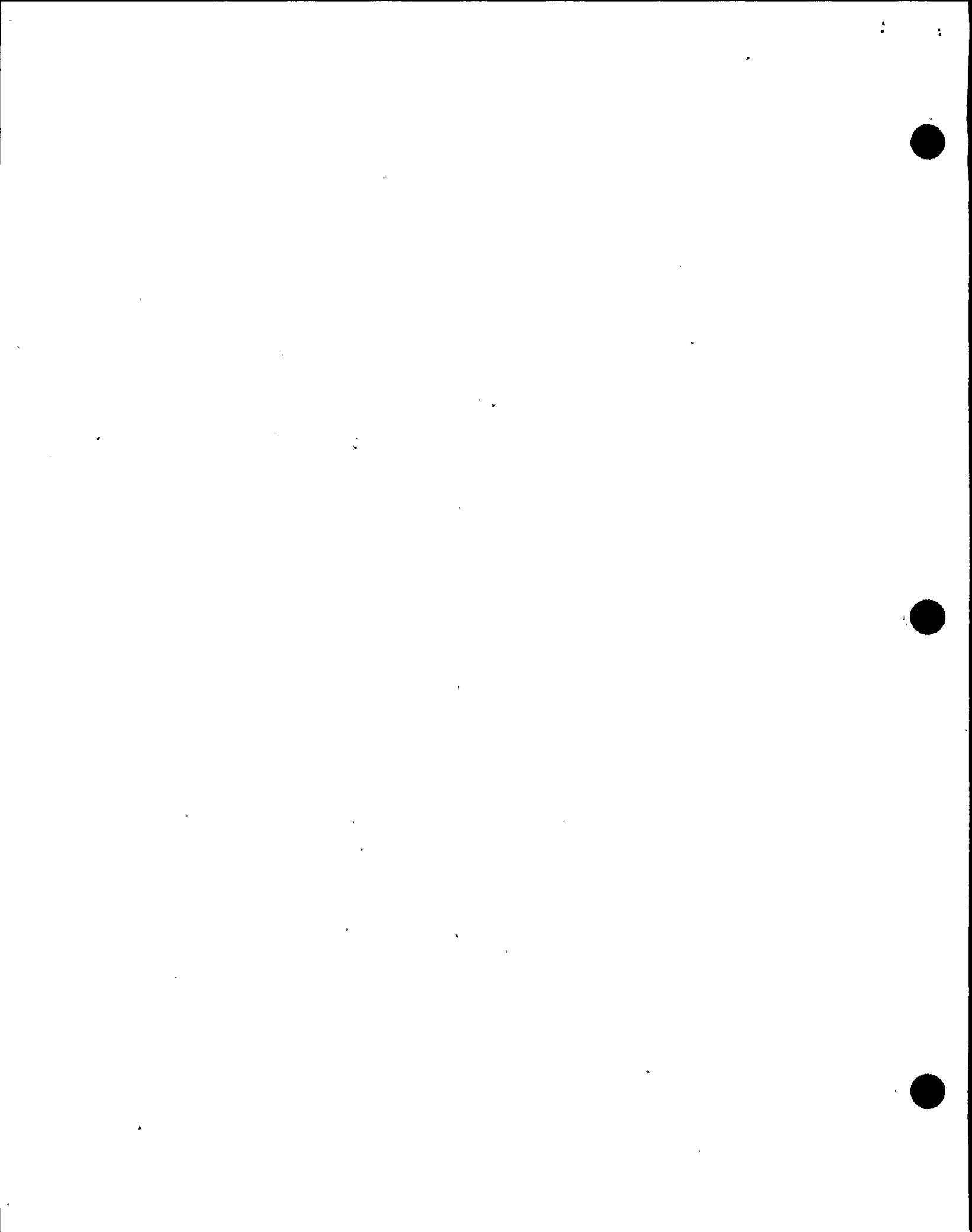


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| <p>5. RRCS Indications</p> <p>a. MCR P-603 Panel</p> <p> 1) LFMG Transfer lights</p> <p>b. Relay Room Panels</p> <p> 1) LFMG XFER lights</p> <p> 2) POTENT ATWS lights</p> <p> 3) CONFIRM ATWS lights</p> <p> 4) RRCS TROUBLE lights</p> <p> *5) RECIRC PUMP TRIP lights</p> <p> *6) RPV WATER LEVEL LOW CHANNEL A,
 CHANNEL B lights</p> <p> 7) VLVs F160A(B), F162A(B,C,D),
 F163A(B) red lights.</p> <p>D. <u>RCS LFMG Trip</u></p> <p> 1. Is part of the RCS pump trip aspect of RRCS.</p> <p> a. Serves the same mitigating function.</p> <p> 2. Initiating signals that trip the LFMG 15 Hz power:</p> <p> a. Rx vessel low-low water level</p> <p> b. 25 seconds after a high vessel dome pressure signal occurs and a sufficient power reduction (APRM not downscale) has not occurred.</p> | <p>•Assumption on the indications is that both divisions have activated.</p> <p>The ARI INT lights at P-603 will also be lighted.</p> <p>•C22-P001-2, C22-P002-2</p> <p>•The ARI INIT'D lights at the P00 panels will also be lighted.</p> <p>Transparency of Figure 2 trace through logic</p> | <p>EO-5</p> <p>EO-4</p> <p>EO-6</p> |
|--|--|-------------------------------------|



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| <p>3. Either RRCS division will trip the RCS pumps from their low-speed power supply by opening breakers 1A/B and 2A/B.</p> <p>4. RRCS indications</p> <p> a. Same as described in B.5.</p> <p>E. <u>Feedwater Runback</u></p> <p>1. This function mitigates the consequences of an ATWS event by stopping feedwater flow into the Rx vessel which reduces the core subcooling.</p> <p>2. Initiation signal</p> <p> a. A high vessel dome pressure signal</p> <p> b. Starts a 25-second Time Delay (TD) timer.</p> <p> c. After 25 seconds, if the APRM power level has not been reduced below the APRM downscale level or INOP:</p> <p> 1) Then the Feedwater Control Valve(s) will be runback to 0% flow (fully shut) by the Feedwater control logic AND the Rx Feedpumps minimum flow valves will be opened.</p> | <p>Show Transparency of Figure 2 trace through the logic</p> | <p>EO-5</p> <p>EO-4</p> <p>EO-6</p> |
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- A solenoid vlv other than the standard min. flow vlv control solenoid is energized to open the min. flow vlvs.
- All FW control vlvs



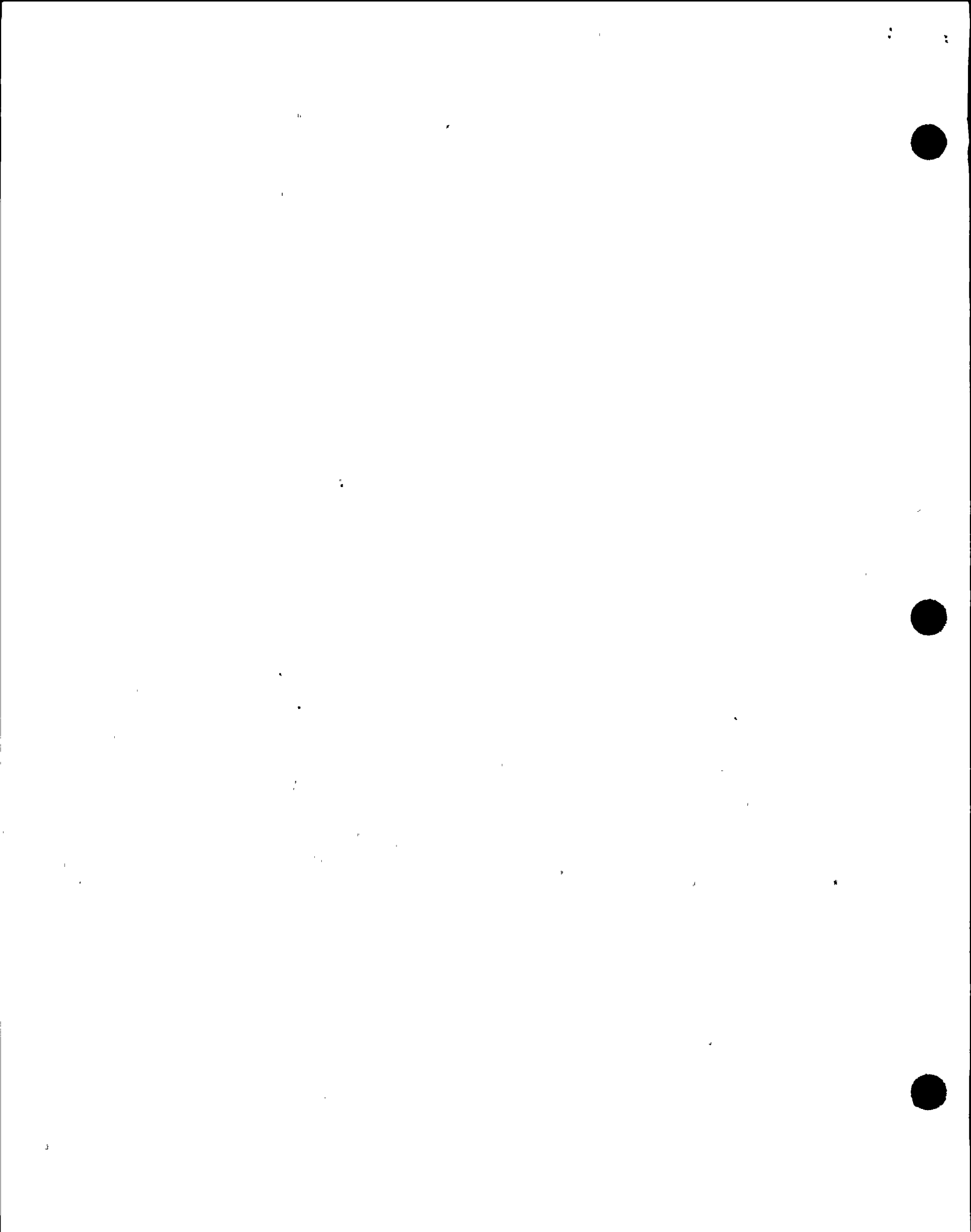
- 2) Feedwater Control will be shifted from Auto to Manual and remain in Manual.
- 3) This occurs for both the Manual and Automatic mode of feedwater control.
- 4) The runback will be completed within 15 seconds of receipt of the RRCS signal.
- 5) Control of the Feedwater System is returned to the operators 25 seconds after the FW Runback signal is initiated. FW control will be in manual.
- 6) This function may be inhibited manually to prevent severe plant transients during surveillance testing.
 - a) Inhibit switch is located on Panel 603.
 - b) Switch operation is controlled administratively.

•Point out that if power is still being generated Rx Water level will continue to decrease.

Point out switch contacts on Figure 2 Transparency

Ann 603430 alarms when this switch is taken to off.

E0-5



3. RRCS Indications

a. MCR P-603

1) FW RUNBACK INT lights

•ARI INT lights will be lighted

b. Relay Room Panels

•C22-P001-2 & C22-P002-2

1) LFMG XFER lights

2) POTENT. ATWS lights

ARI INIT'D lights will be lighted at the
P00 panels.

3) CONFIRM ATWS lights

4) RRCS TROUBLE lights

5) RPV DOME PRESSURE HIGH CHANNEL A,
CHANNEL B, lights6) VLVs F160A(B), F162A (B, C, D),
F163A(B) red lights

7) FW R BACK INT'D lighted

8) RECIRC pump trip

F. Standby Liquid Control System (SLS)

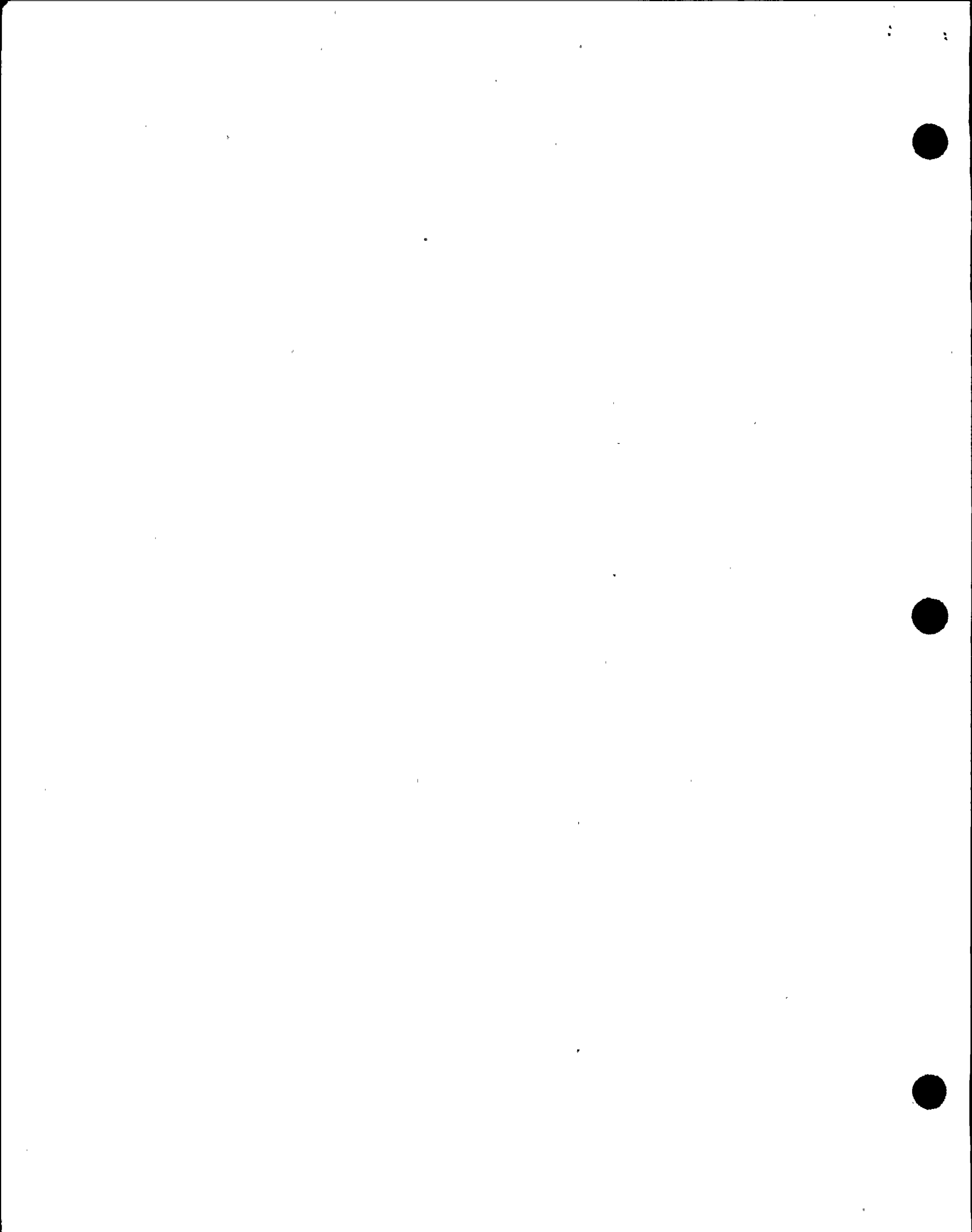
1. If control rod insertion does not shutdown the Rx, SLS will automatically inject borated water into the Rx vessel (after a time delay) to:

a. Stop the fission process

b. Achieve a hot S/D condition

c. Eventually allow a cold S/D condition to be reached.

EO-5



2. Initiation Signals
 - a. High vessel dome pressure or,
 - b. Low-low vessel water level (not sealed in) (108.8") or,
 - c. Manual (P603). AND Rx. power not downscale or APRMs Inop.
3. Actions
 - a. A 98 second timer starts when an RRCS initiation signal is first received.
 - b. After 98 seconds, if the initiation signal is still present and a sufficient power reduction (APRM not downscale) has not occurred or APRM INOP then RRCS will initiate SLS.
 - c. Either RRCS division can initiate SLS.
4. SLS Operation
 - a. Injection point is CSH line.
 - b. Manual SLS pump initiation or an RRCS automatic signal will isolate WCS.
 - 1) Prevents WCS system from diluting or cleaning up the borated solution.
 - 2) WCS isolation signal is sealed-in as long as an SLS initiation signal is present.

Transparency of Figure 2 trace logic.



5. RRCS Indications

- a. MCR P-603
 - 1) None
- b. Relay Room Panels
 - 1) RWCU ISOLATE
 - 2) POTENT ATWS
 - 3) CONFIRM ATWS

- ARI INT lights plus others as plant conditions vary will be on. EO-5
- C22-P001-2, C22-P002-2

ARI INIT'D lights plus others as plant conditions vary will be on.

G. Average Power Range Monitors (APRM's)

EO-2

1. APRM's provide a reactor power signal to the RRCS permissive logic.
2. APRM Downscale Trip Signal
 - a. If present, this signal informs RRCS that APRM indicated power has dropped low enough to represent a sufficient power reduction for ATWS purposes.
3. RRCS Permissive Signal
 - a. Generated if APRM power is above the downscale trip level if the affected APRM is not bypassed.
 - b. Permits:
 - 1) Feedwater runback,
 - 2) LFMG trip,
 - 3) Boron injection

- Signal generated by APRM downscale trip unit, set pt. 4% or less.



- c. Also generated by an APRM inoperative condition, if the affected APRM is not bypassed.
- 4. APRM assignments
 - a. RRCS Div. I
 - 1) Channel A
APRMS A and E
 - 2) Channel B
APRMS B and F
 - b. RRCS Div. II
 - 1) Channel A
APRMS C and E
 - 2) Channel B
APRMS D and F

- Ask students what causes an APRM INOP signal.
- INOP signal generated by an APRM INOP trip unit, set pts: less than 14 LPRM inputs, drawer mode switch not in "Operate", drawer module unplugged.

III. INSTRUMENTATION, CONTROLS AND INTERLOCKS

A. Instrumentation

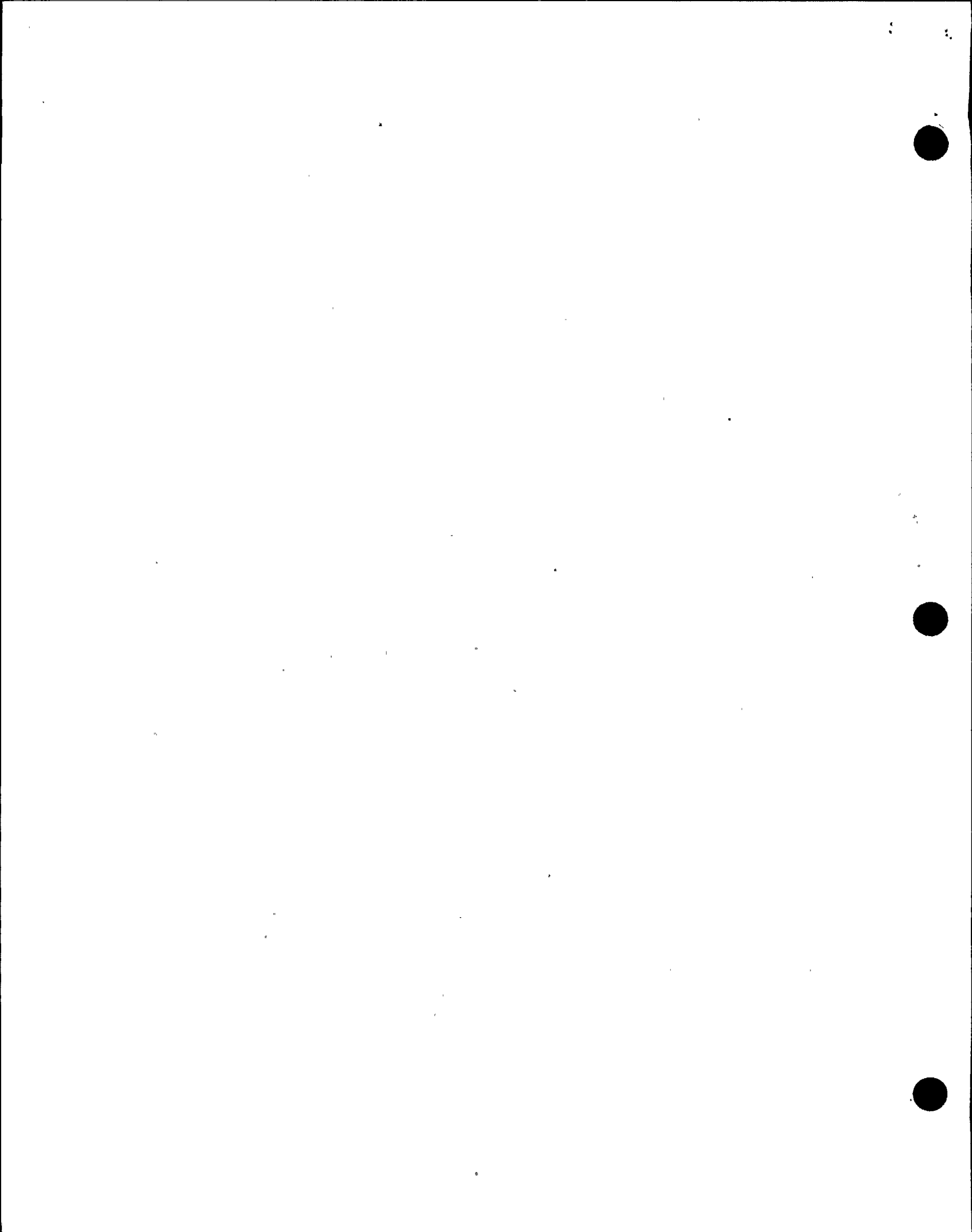
- 1. Indicating Lights located on P603 one matrix per Div.
 - a. OUT OF SERVICE
 - 1) SLS storage tank level, < 0 gallons (Div. I/II)
 - 2) Loss of 125 VDC power supply to Channel A or B logic

Show Transparency of Table 2

EO-5

Matrix often referred to as the "rubics cube"

One light per division

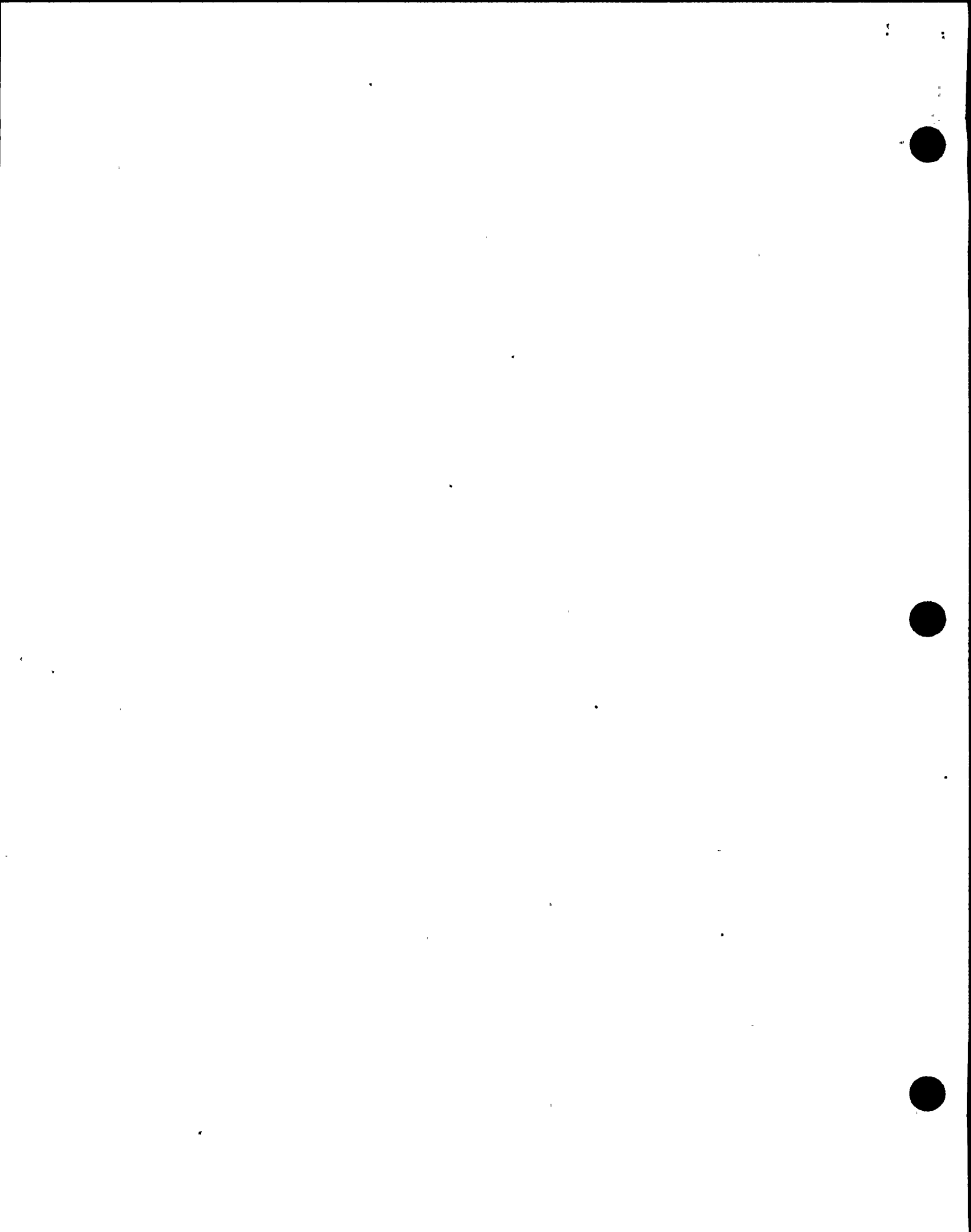


- b. MANUAL INT
Manual Init. Switches armed and depressed.
 - c. ARI INT
ARI signal present.
 - d. ARI READY TO RESET
30 seconds have elapsed since ARI initiation.
 - e. FW RUNBACK INT
RRCS Runback signal to FWS logic.
 - f. READY TO RESET
10 minute timer has timed out, for total elapsed time of 10 minutes and 98 seconds.
 - g. LFMG TRANSFER
 - h. TEST FAULT
2. Relay Room Panels
- a. RPV DOME PRESSURE HIGH
Channel A, Channel B
 - 1) RPV dome press. \geq 1050 psig
 - b. RPV WATER LEVEL LOW
Channel A, Channel B
 - 1) RPV water level \leq 108.8" (L2)
 - c. POTENT ATWS
 - 1) RPV level \leq 108.8" (L2)
 - 2) RPV pressure \geq 1050 psig

Emphasize 10 minutes plus the 98 second timer.

Since both divisions are identical with exception of vlvs operated only one division will be listed here in the lesson plan a complete listing is in Table 4.

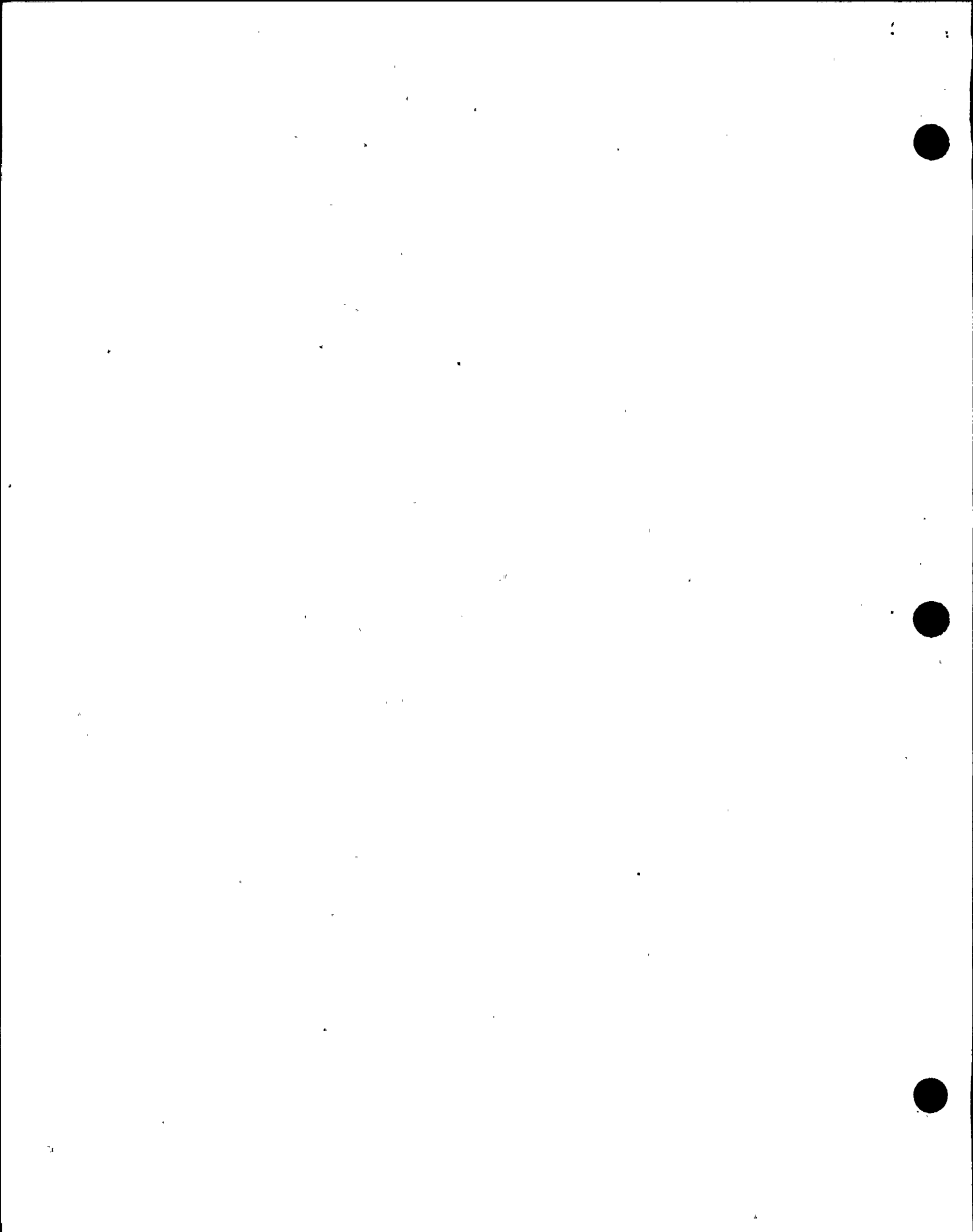
EO-5



- 3) One or both Divisional Manual Initiation switches armed and depressed.
- d. ARI INT'D
 - 1) RRCS ARI logic satisfied and energized.
- e. RWCU ISOLATE
 - 1) RRCS signal to the RWCU system to isolate present.
- f. CONFIRM ATWS
 - 1) RPV pressure \geq 1050 psig
 - 2) RPV level \leq 108.8" (L2)
 - 3) One or both Divisional Manual Initiation switches armed and depressed.
- g. RRCS READY FOR RESET
 - 1) Ten minute timer has timed out.
- h. MANUAL INIT SWITCH ARMED
 - 1) Manual initiation switch arming collar rotated to the armed position.
- i. MANUAL INITIATION
 - 1) Divisional initiation switches armed and depressed.



- j. ARI READY FOR RESET
 - 1) 30 seconds timer has timed out after initiation.
- k. TEST FAULT
 - 1) Failure sensed in sensors, logics, or protective devices.
- l. ATM CALI GROSS FAILURE
 - 1) Analog trip module failure.Sensor output to high or downscale
- m. RRCS TROUBLE
 - 1) One or more of the items listed under the ANN. Response. See Table 4.Too numerous to list here, refer to Table 4 of Op. Tech. or page 22 of the procedure.
- n. LFMG XFER
 - 1) RRCS logic for LFMG transfer to slow speed energized.
- o. RECIRC PUMP TRIP
 - 1) RRCS logic for RR pump trip to zero speed energized.
- p. FW R BACK INT'D
 - 1) RRCS FW runback logic energized
- q. SLCS STG TK LVL LO CH A(B)
 - 1) SLS storage tank level ≤ 0 "
 - 2) Loss of 125v DC to Channel A(B) logic



3. Annunciators on P603

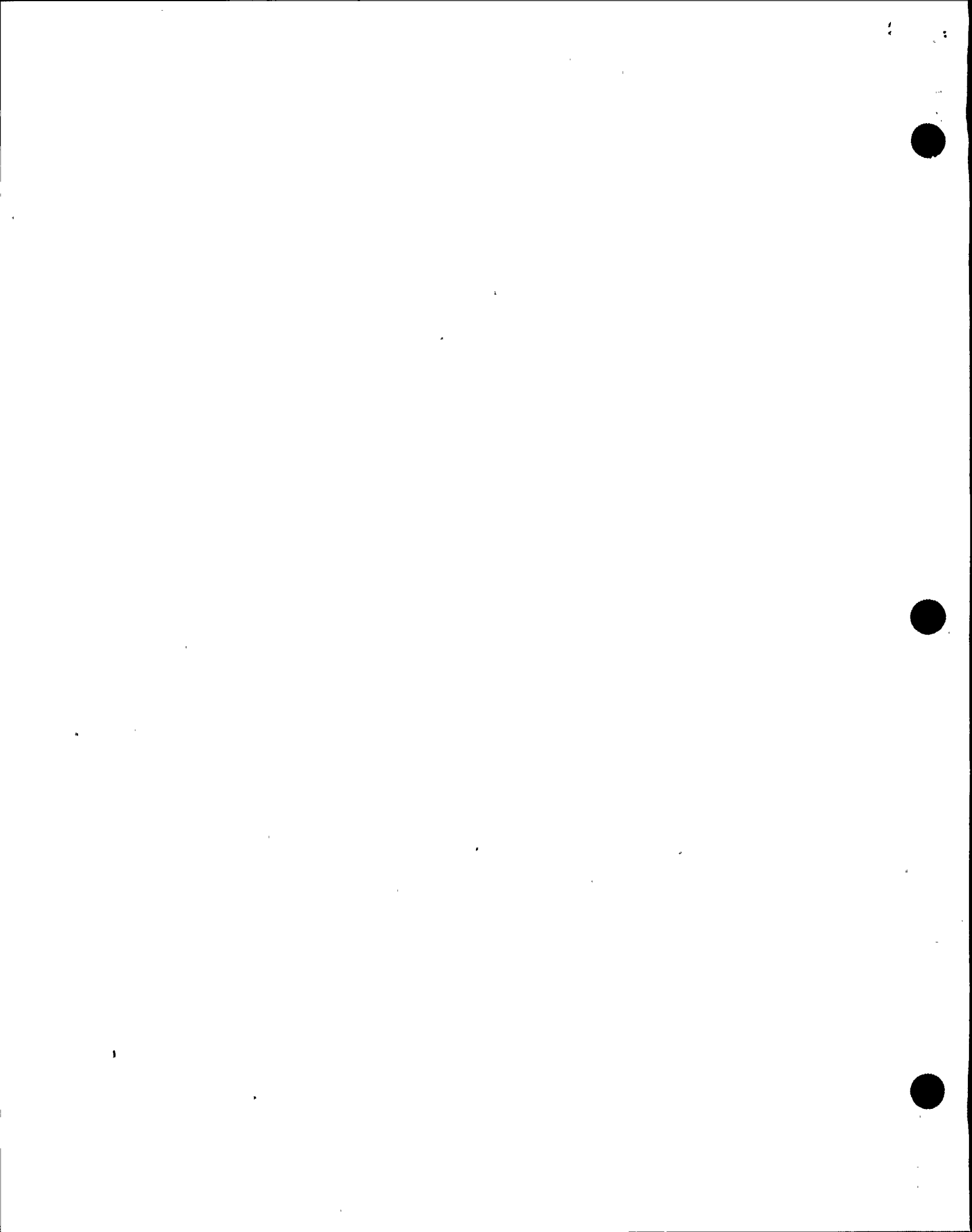
- a. Div. I/II RRCS MANUAL INITIATION
Armed 603421
- b. Div. I/II RRCS Potential. ATWS 603422
 - 1) RPV Level less than 108.8 inches
(Level 2).
 - 2) RPV Pressure greater than 1050
psig.
 - 3) One on both Div. I(II) RRCS Manual
Initiation Switches armed and
depressed.
- c. Div. I/II RRCS CONFIRMED ATWS 603439
One or more of the following conditions
exist concurrent with APRM's not
downscale or INOP. (98 sec. T.D.)
 - 1) RPV water level less than
108.8 inches.
 - 2) RPV pressure greater than
1050 psig.
 - 3) One or both Div. I(II) RRCS
Manual Initiation Switches
armed and depressed.
- d. Div. I/II RRCS RECIRC. PUMPS TRIP 603423
 - 1) RPV Level less than 108.8".
(trip to zero speed).

Show Transparency of Table 3

•Point out that this is a red Annunciator and is indicative that SLS will be soon or should be injected.



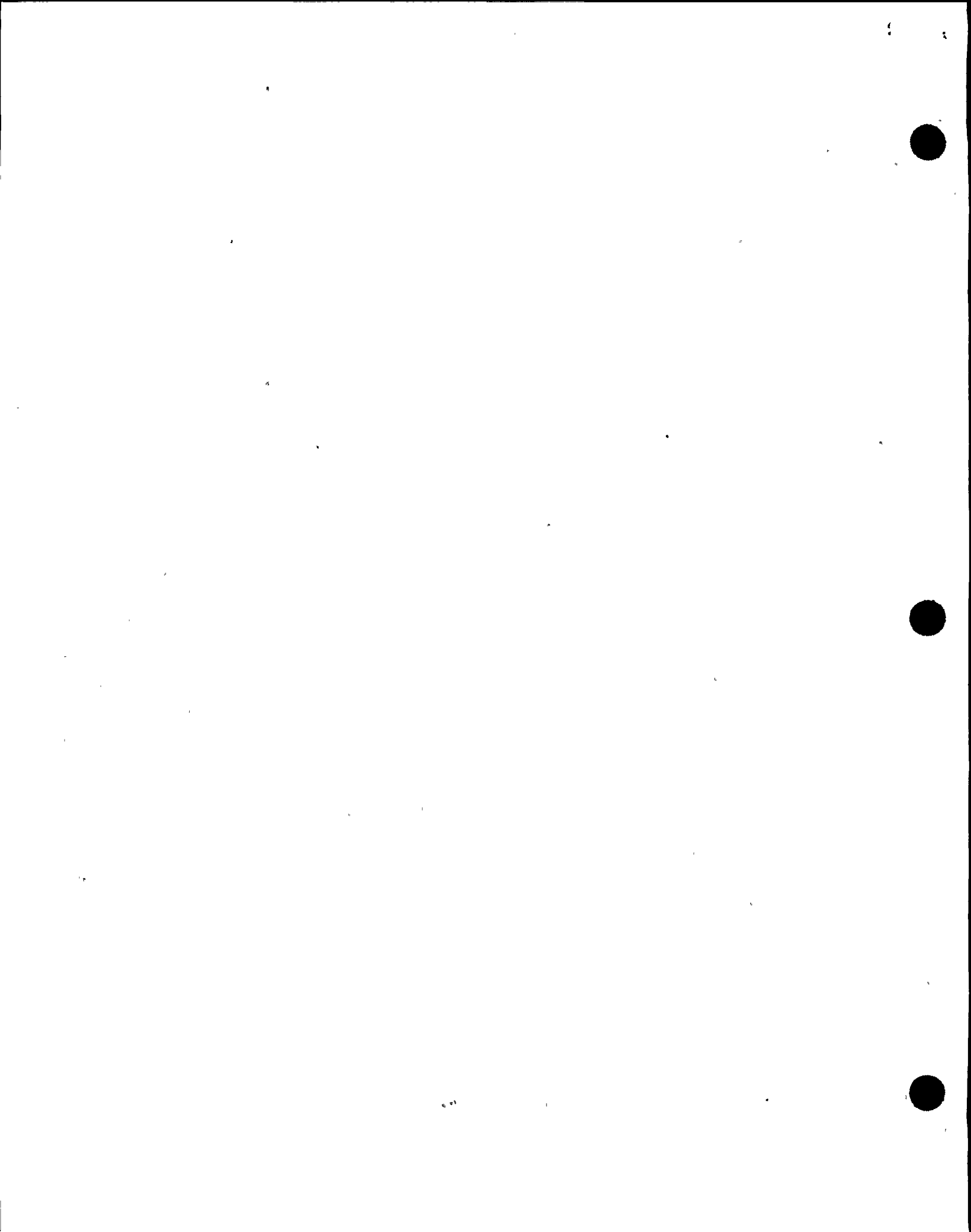
- 2) RPV press. greater than 1050 psig (Trip to LFMG, at T + 25 seconds may trip to zero speed).
- e. Div. I/II RRCS FW RUNBACK INITIATED 603431
RPV pressure greater than 1050 psig with APRM's not downscale (25 sec. T.D.).
- f. Div. I/Div. II RRCS MANUAL INITIATION 603432
Div. I(II) Manual Initiation Switches armed and depressed.
- g. Div. I/II RRCS OUT OF SERVICE 603440
 - 1) SLS Storage Tank less than 0 inches level.
 - 2) Loss of 125 VDC power supply
 - 1) RPV water level
- h. Div. I/II RRCS TROUBLE 603445
 - 1) SLS Storage Tank less than 0 inches level.
 - 2) Loss of 125 VDC power supply.
- i. Div. I/II RRCS FW RUNBACK DISABLE 603430
 - 1) FW runback disable switch in the "ON" position.



B. Controls

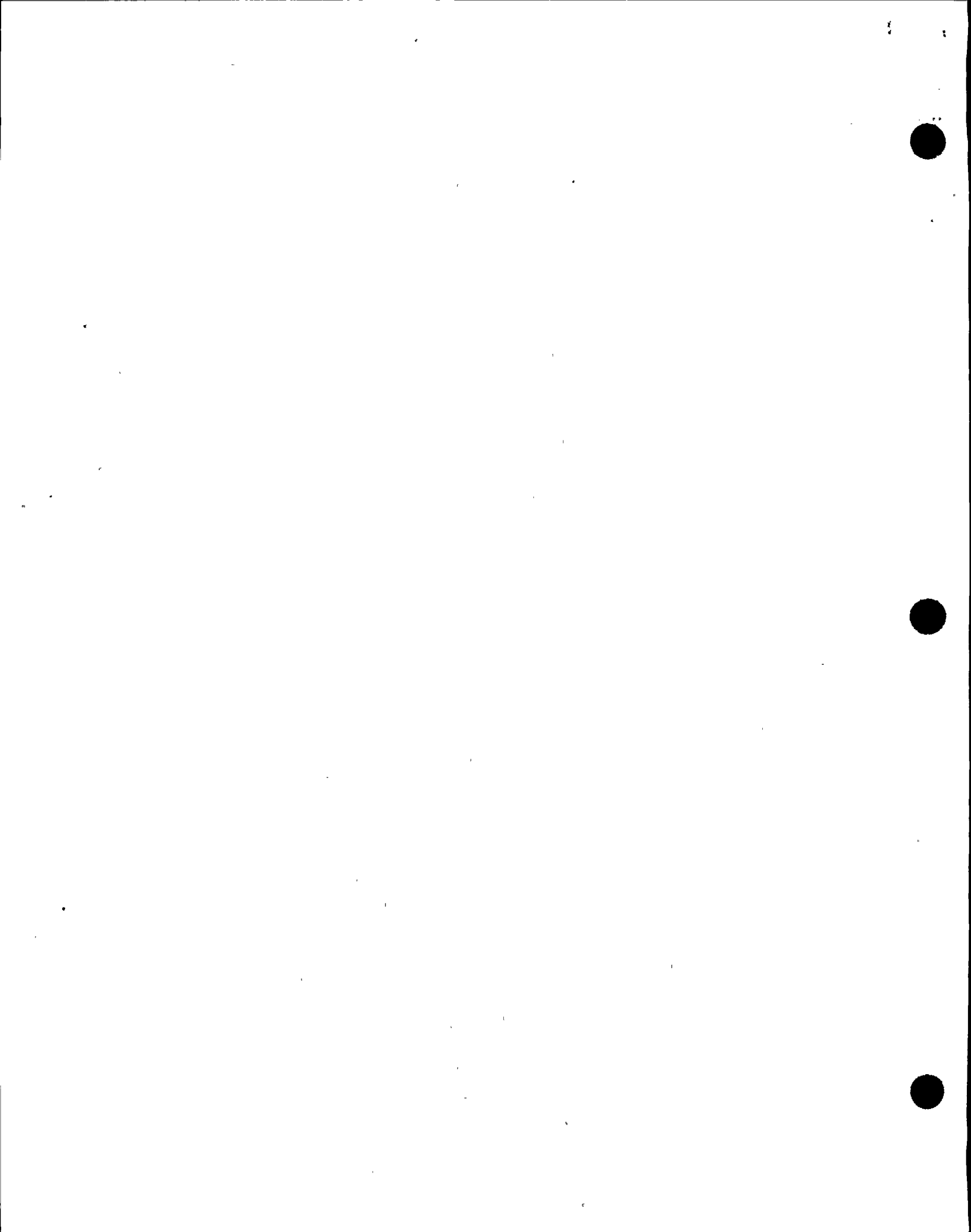
1. RRCS Manual Initiation Switches
 - a. Controls located on the Reactor Control Panel (P603).
 - b. Must Arm and Depress both channel pushbuttons in one division for RRCS activation.
2. ARI reset pushbutton switches (S3A through S3D).
 - a. Located on P603.
 - b. Reset is prohibited for 30 seconds following RRCS-ARI initiation.
 - 1) Allows all control rods enough time to insert fully.
3. RRCS reset pushbutton switches (S4A through S4D)
 - a. Located on P603.
 - b. The high dome pressure, low-low Rx level, and manual RRCS initiation signals to the SLS logic seal-in for 10 minutes after the SLS permissive timer (98 second TD) is satisfied.

Show Transparency of Figure 4



- | | | |
|---|---|------|
| 4. ARI Manual Initiation (Test) switches:
a. Used to test the RRCS-ARI function, only. Two (2) position keylock switches (test or normal). In test, switch simulates a high dome pressure or low-low level signal in its sub channel, and initiates ARI.
b. Located on the RRCS control panels in the Relay Room. | Test switches used either during surveillance testing by the I&C department OR as directed by EOPs only.

Switches in the back side of C22-P001-2 and C22-P002-2. | EO-3 |
|
C. <u>Interlocks</u> | | EO-4 |
| 1. RRCS-ARI seals-in for 30 seconds to ensure full rod insertion. Requires operator action to reset. | | |
| 2. Feedwater runback logic can be manually overridden after 25 seconds. | | |
| 3. SLS pump initiation is sealed in for 10 minutes. Requires operator action to reset. | | |
| 4. Operator can manually override an RRCS initiation signal to either SLS pump by stopping the SLS pump. | | |
| 5. The isolation signal to WCS is sealed-in during SLS pump operation. | | |



IV. SYSTEM OPERATION

A. Normal Operation

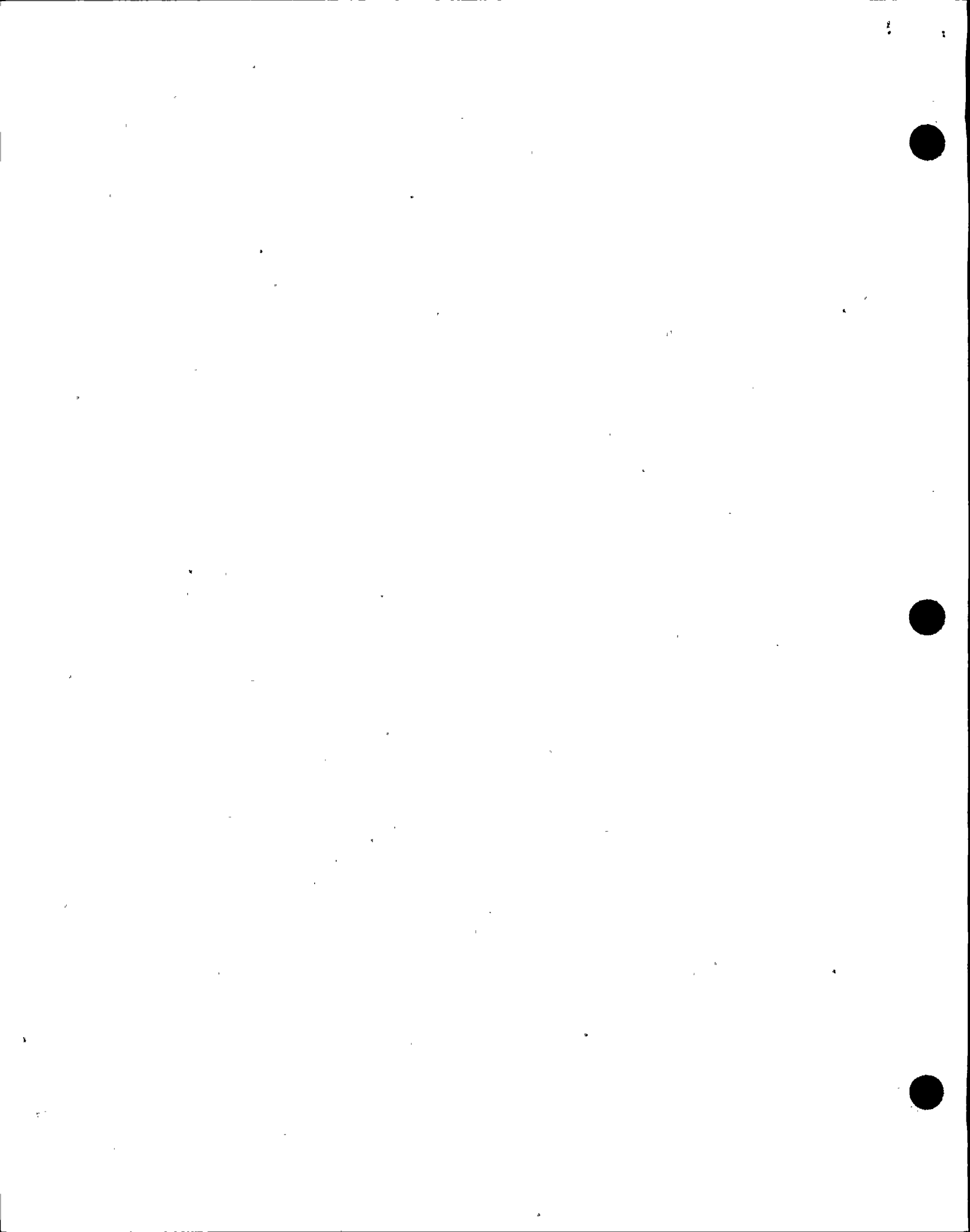
1. RRCS must be operable and in standby status during normal operation.

B. Off Normal Operation

1. Upon receipt of the RRCS Rx vessel high dome pressure signal (1050 psig) from the RVI, RRCS will:
 - a. Send a signal to trip the RCS pumps to the LFMG's (a high-to-low transfer),
 - b. Send a signal to initiate the ARI function.
 - c. Activate logic that provides a 25 second time delay, after which, if sufficient power reduction is not indicated (APRM not downscale or INOP), further signals will be sent to initiate a Feedwater runback and a trip of the LFMG's, and
 - d. Activate logic that provides a 98 second time delay, after which, if sufficient power reduction is not indicated (APRM not downscale or INOP), it sends a signal to initiate SLS, and isolate WCS.

It may prove helpful here to start a time line where time \emptyset is the instant the high pressure signal is received. Instructor's option.

EO-6



2. Upon receipt of the Rx vessel low-low water level signal (108.8") from the RVI, RRCS will:
 - a. Send a signal to trip the RCS pumps' main power (60 Hz) supply and the LFMG power (15 Hz) supply.
 - b. Send a signal to initiate the ARI function, and
 - c. Activate logic that provides a 98 second time delay, after which, if sufficient power reduction is not indicated (APRM not downscale or INOP), a signal will be sent to initiate SLS and isolate WCS.
3. Upon initiation of a manual RRCS signal, RRCS:
 - a. Sends a signal to initiate the ARI function, and
 - b. Activate logic that provides a 98 second time delay, after which, if sufficient power reduction is not indicated, (APRM not downscale or INOP), it sends a signal to initiate SLS and isolate WCS.

It may prove helpful here to construct a time line where time 0 is the instant the low-low level signal is received
- Instructor Option -

- Remind trainees that manual RRCS activation does not cause any RRCS function other than ARI and potentially SLS.



C. EOP Operation

1. EOP-RQ

- a. Asks if ARI has initiated, if the response is NO
 - 1) RRCS is directed-initiated
 - 2) This action independently depressurizes the scram air header and realigns the SDV vent and drain valves.
- b. Directs ARI reset
 - 1) Allows defeating the ARI logic trips if necessary.
 - 2) ARI may interfere with other methods of inserting rods, it is therefore appropriate to reset and if necessary to defeat interlocks to reset ARI.

•Show a TP of the RQ leg of EOP-RPV here for clarification.

EOP-6, Attachment 14 directs how to defeat these interlocks.

V. SYSTEM INTERRELATIONS

EO-8

A. Electrical Distribution

1. 120 VAC supplied from Div I (2VBA*UPS2A) and Div II (2VBA*UPS2B) through 2VBS*PNL101A and 2VBS*PNL301B respectively. Status lights and logic circuitry are the major loads in each division.



2. 125 VDC supplied from Div I (2BYS*202A) and Div II (2BYS*PNL202B) for ARI solenoid valves and logic power supplies.
- B. Standby Liquid Control System (SLS)
Will automatically inject a neutron absorbing borated solution into the reactor to stop the fission process, achieve a hot shutdown condition, and eventually enable the operator to reach a cold shutdown condition.
 - C. Control Rod Drive System (CRD)
Provides the valves needed for the ARI function of the RRCS.
 - D. Reactor Recirculation System (RCS)
Pump trips provide a mitigating function for ATWS events.
 - E. Feedwater Control System (FWS)
Feedwater runback provides a mitigating function for ATWS events. Also provides indication that the ATWS feedwater runback has initiated and whether manual control is available.
 - F. Reactor Vessel Instrumentation (RVI)
Provides high dome pressure and low-low level signal to the RRCS.

EO-8



G. Neutron Monitoring System (NMS)

APRM's provide a signal representative of reactor power to the RRCS logic. APRM status (inop, bypass) is also provided.

H. Reactor Water Cleanup System (WCS)

System receives isolation signals upon the initiation of the SLS System.

VI. DETAILED SYSTEM REFERENCE REVIEW

Review each of the following referenced documents with the class.

A. Procedures

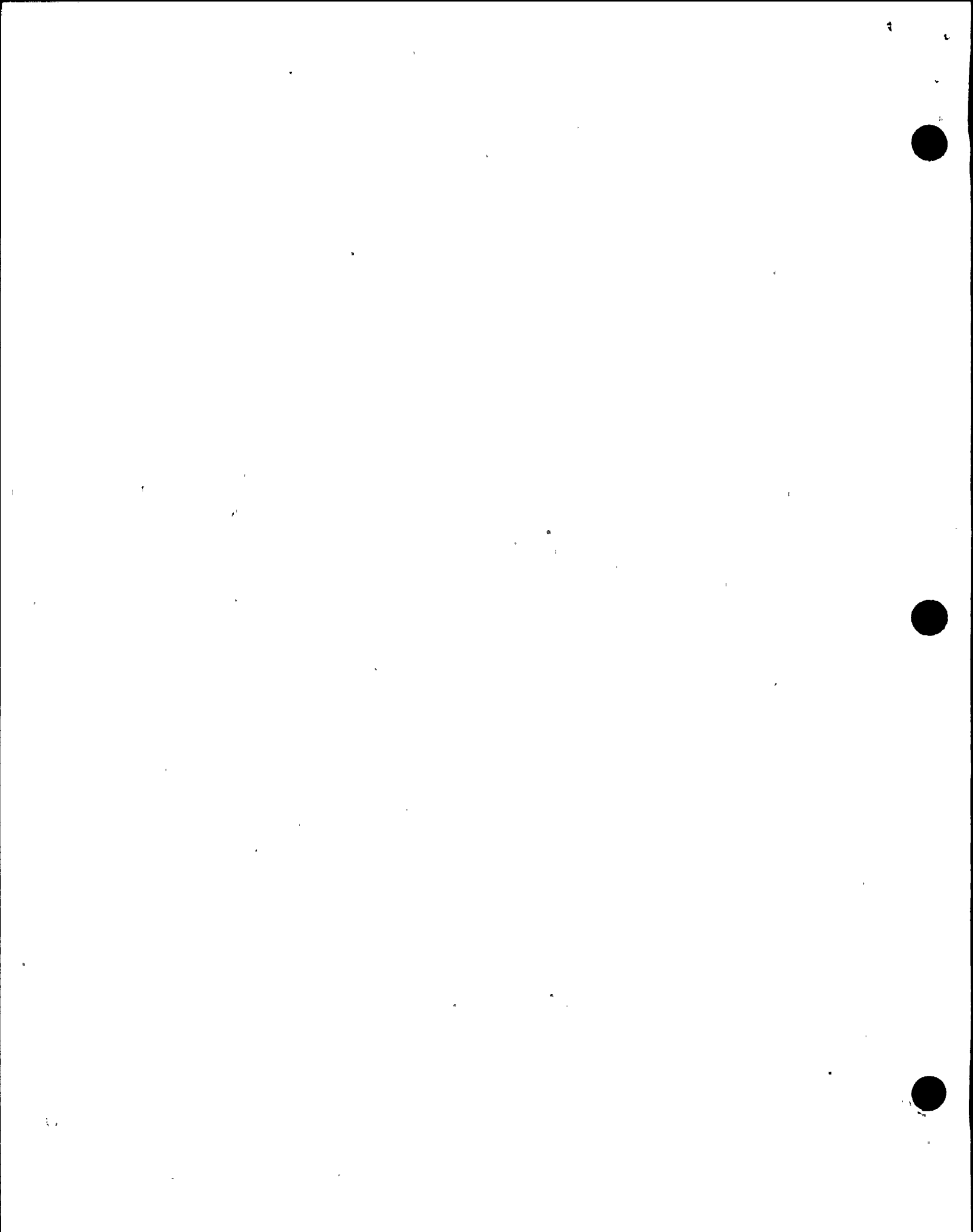
1. N2-OP-36B Redundant Reactivity Control
 - a. Precautions and Limitations (Section D of the procedure)
 - 1) If Standby Liquid Control is inadvertently initiated, initiation can be terminated by taking both SLS pump keylock control switches to stop.

EO-9

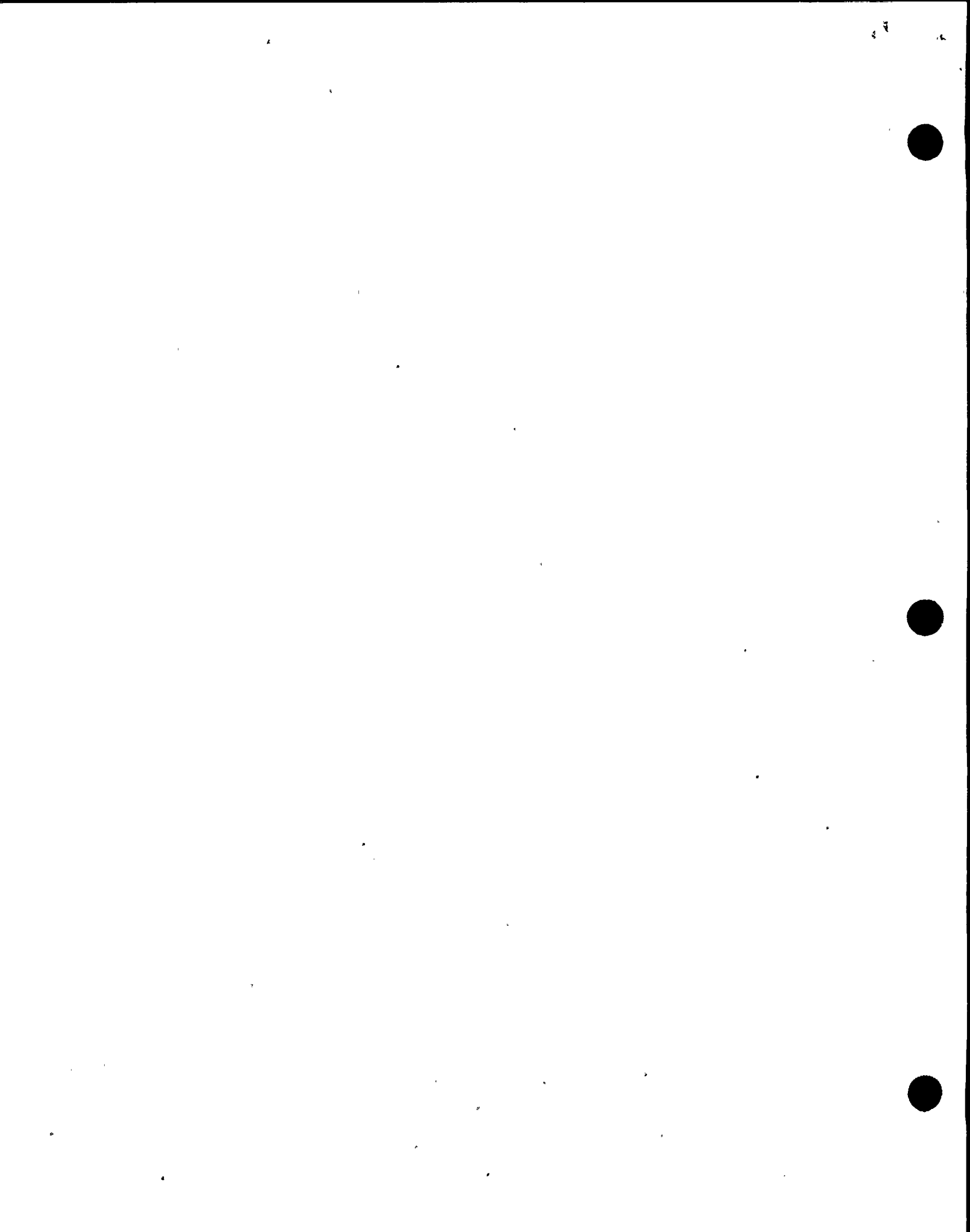
EO-10



- This precaution/limitation is a reminder to the operators of how to stop SLS injection rapidly in the event of inadvertant initiation. Clean up of SLS injection would be necessary prior to resuming reactor operation. Clean up could be a very time consuming process.
- 2) Division I consists of Channel A and Channel B, and Division II consists of Channel A and Channel B. Both channels must be reset/energized to reset/initiate that Division.
- This precaution/limitation is a reminder to the operators that both channels in a division must be tripped (energized) for RRCS initiation and to completely reset a division of RRCS both channels in that division must be reset.



- 3) The "RRCS FW Runback Disable" switch (C33A-S6) should be used to inhibit the RRCS auto FW runback signal during surveillance testing of the RRCS System, when spurious ATWS trip signals may occur.
 - This precaution/limitation is in the procedure because of the severe nature of this FW Runback. An inadvertant FW Runback with the plant at power will result in a rapid loss of RPV level jeopardizing core cooling, causing ECCS actuators and a potential loss of plant control. Placing this switch in "off" during surveillances that may cause inadvertant initiation of this feature is good operating practice.
- b. RRCS Test Fault
 - 1) Cover the annunciator response for this condition ANN. 603445.



B. Technical Specifications

EO-11

3/4.3.4.1 ATWS Recirculation Pump Trip
Interpretation #73 Minimum Operable Channels for
Various Instrumentation Systems

C. Drawing

EO-12

GE Elem. 944E309TY RSS

VII. RELATED PLANT EVENTS.

- A. Refer to Addendum "A" and review related events
with class (if applicable)

VIII. SYSTEM HISTORY

- A. Refer to Addendum "B" and review related
modifications with class (if applicable).

IX. WRAP-UP

- A. Review the student learning objectives.

X. SIMULATOR EXERCISE

17 12

