RELATED CORRESPONDENCE

LILCO, July 9, 1982

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
LONG ISLAND LIGHTING COMPANY	)	Docket No. 50-322 (OL)
	)	
(Shoreham Nuclear Power Station, Unit 1)	)	

TESTIMONY OF JOHNNY J. KREPS
AND JACK A. NOTARO FOR THE
LONG ISLAND LIGHTING COMPANY
ON WATER HAMMER PROCEDURES AND TRAINING

1. Q. Have your professional qualifications been submitted with LILCO's testimony on Suffolk County Contention 19: Human Factors -- Procedures?

A. Yes, they have.

2. Q. Do Shoreham's operating procedures address water hammer?

A. Yes. Water hammer is one of many considerations taken into account in the development of Shoreham's procedures to ensure that systems are placed into service in such a manner as to protect equipment and to satisfy the design function of each system.

3. Q. How is water hammer addressed in Shoreham's procedures?

A. In several ways. First, procedures instruct operators to fill and vent a system in a systematic order from the lowest elevation to the system high point as the system is being initially aligned. Second, the steps of the procedure are sequenced such that steam lines are drained, pre-warming systems are placed in operation, loop level systems are put into service and pumps are started prior to opening certain valves. Third, key steps and phrases such as "slowly open valves," "gradually fill piping" and "vent until all air is released" are added. In addition, "Precautions" and "Limitations and Actions" sections are included in procedures to caution the operator as to the potential for water hammer events. (For an example procedure, see Attachment A.)

4. Q. Where steps are sequenced or where key steps and phrases are used, is it specifically stated that this is to prevent water hammer?

A. No. It is neither practical nor desirable to specifically indicate at each step or sequence of steps that this is being done to minimize or preclude water hammer. To do so would add considerable bulk in the form of extraneous and redundant information and, thus, detract from the purpose and utilization of the procedure. The "what to do" is more important

than the "why" and results in clearer, more concise instructions. Operators are aware of the "whys" through training and experience.

5. Q. Does Shoreham have procedures specifically for the prevention or minimization of water hammer?

A. No. Shoreham's procedures are written to accomplish defined purposes: (1) a preoperational test of a system to verify system design and function; (2) a startup test to verify system performance under normal and transient conditions; (3) a surveillance test to verify system operability; (4) an operating procedure for aligning, starting, and stopping a system; (5) an alarm response procedure to indicate operator action resulting from an annunciator; (6) an emergency procedure to direct responses to abnormal plant conditions; or (7) administrative procedures to define and document plant activities. Water hammer is one of the concerns addressed in those procedures which relate to fluid systems.

6. Q. Even though there are no specific procedures for water hammer, are Shoreham's procedures prepared in a rigorous fashion that takes into account water hammer concerns?

A. Yes, as we have already indicated. It may be helpful to explain how the procedures are prepared. As

described in Chapter 14 of the FSAR, the Joint Test Group (JTG) has the overall responsibility for development, approval and implementation of preoperational test procedures. The Review of Operations Committee (ROC) serves a similar function with respect to all other plant procedures.

7. Q. Who are the members of the Joint Test Group?

   A. The JTG has as its chairman the Plant Manager and includes as members the Startup Manager, a Stone & Webster Advisory Operations Engineer, and a General Electric Site Operations Representative.

8. Q. Does the JTG actually write the preoperational test procedures?

   A. No. The JTG assigns the responsibility for preparation of each preoperational test procedure to a Test Engineer who is familiar with the design of the system. The Test Engineer develops a draft procedure based on all available information such as test specifications and/or instructions supplied by General Electric for the Nuclear Steam Supply System, design documents supplied by Stone & Webster for the Balance of Plant Systems, system descriptions, functional and logic descriptions and diagrams, technical specifications, FSAR, P&ID's, electrical diagrams, and wiring diagrams. In addition, the Test Engineer has the responsibility

to review and incorporate relevant information from licensee event reports, vendor service and technical information letters, and reports from NSAC, INPO and EPRI to ensure they are adequately reflected in the test procedure. Completed draft procedures are reviewed by members of the Plant Operating Staff, Stone & Webster, General Electric, and members of the Startup Staff. Comments from this review are resolved and incorporated and then the procedure is submitted to JTG for approval. To ensure accuracy of the procedure prior to execution of the test, another review is conducted by the Startup Staff and the Operating QA section to verify that the procedure is complete, reflects all system design changes, and considers any recent relevant reactor operating experiences. Any necessary changes are made and the procedure is returned to the JTG for approval for release for performance.

9. Q. Who are the members of the Review of Operations Committee (ROC)?

A. ROC has as its Chairman the Plant Manager and includes as members the Technical Support Manager, Operating Engineer, Maintenance Engineer, Instrument and Control Engineer, Reactor Engineer, and Health Physics Engineer. Alternate Chairmen are the Chief Operating Engineer and the Chief Technical Engineer.

10. Q. Does the Review of Operations Committee actually write plant procedures?

A. No. The function of ROC is to advise the Plant Manager on all matters related to nuclear safety. Among their responsibilities is the review of plant procedures and proposed tests. As individuals, apart from their committee duties, they may write some plant procedures.

11. Q. Who does write the plant procedures?

A. The Plant Manager, a Chief Engineer or the appropriate section head will designate an individual from the Plant Operating Staff, Startup Staff, Stone & Webster, or the GE Test, Design, and Analysis Group to prepare a draft procedure. This individual will utilize all sources of available information such as those previously indicated in the preparation of preoperational test procedures to ensure that the procedure will accomplish its defined purpose. Completed draft procedures are reviewed by members of the Plant Staff, Startup Organization, GE, and S&W as appropriate. When comments from this review have been resolved and incorporated, the procedure is submitted to ROC for review and approval and to the Plant Manager for final approval. Approved procedures also undergo a periodic review to ensure they reflect current system design and have incorporated recent reactor operating experiences.

12. Q. Are isometric drawings used in the preparation of Shoreham procedures?

A. Yes. All drawings and documents available are utilized in procedure preparation. In addition, physical walkdowns of each system are conducted by procedure writers, Startup Test Engineers, and members of the operations section to ensure procedure completeness and to see that descriptions, locations, and terminology are consistent with the as-built configuration.

13. Q. In addition to procedures and excluding plant design, in what other ways is water hammer addressed at Shoreham?

A. The plant training program discusses water hammer and the importance of minimizing or preventing such events. There are technical specifications which are directly related to water hammer. And the preoperational and startup testing programs provide experience in the cause, effect, and mitigation of water hammer, if it occurs as systems are filled, vented, drained, started, and stopped to verify system design and function under normal and transient conditions.

14. Q. How does the training program address hammer?

A. In a number of ways. First, in the classroom lectures and discussions related to the HPCI, RCIC, core spray, and RHR systems, water hammer is one of the topics stressed. These systems contain loop level systems to

prevent water hammer and decrease injection time. (Attachment B is a representative lesson plan.) The training and examinations in the areas of fluid flow and fluid dynamics also address water hammer. Second, another portion of the training includes system walkdowns and utilization of operating procedures. This builds familiarity with system configuration and procedural steps necessary to minimize or preclude water hammer and other potential equipment hazards. Third, another portion of the overall training program is the "Required Reading List." This is utilized to disseminate information to plant personnel on experiences, problems and events from within the industry and would include water hammer related documents such as SILs, I&E Bulletins, and LER's. (Attachment C provides two SILs which have been on the Required Reading List.)

15. Q. What technical specifications are directly related to water hammer?

A. The technical specifications for ECCS (RHR, Core Spray, and HPCI) and RCIC require monthly venting at system high points to verify that these systems are filled to prevent water hammer damage and to provide cooling injection as quickly as possible, if necessary. Other technical specifications require demonstration of the operability of mechanical snubbers to ensure system

integrity is maintained during or following events (such as water hammer) which initiate dynamic loads.

16. Q. Are there any technical specifications related to the loop level systems?

A. There are currently no technical specifications which directly address loop level systems. However, the procedures written for performance and documentation of the monthly high point venting, as well as the operating and surveillance procedures for systems which have loop level systems, do have instructions for operation and verification of operability of the loop level systems. In addition, there are alarm response procedures which provide operator actions for loop level system annunciators.

17. Q. What annunciators are associated with the loop level systems?

A. There are four loop level systems, one for HPCI, one for RCIC, and one for each loop of RHR/Core Spray. Each of these systems is provided with three alarms: high flow, low pressure and pump failure. The pump failure is actually indicated by a "system degraded" alarm for the respective system serviced by the loop level pump. (Examples of the alarm response procedures are included as Attachment D.)

18. Q. What are the operator actions for a loop level high flow alarm?

A. The immediate action for a high flow alarm would be to initiate an investigation to determine the cause. Possible causes would include a system leak, venting or draining evolutions, or an incorrect valve line-up. The high flow condition would be corrected by isolating the leak, terminating venting or draining evolutions or restoring system line-up to normal. The system would then be filled and vented.

19. Q. What are the operator actions for a loop level low pressure alarm?

A. This alarm could be caused by pump failure, high flow, system leakage, or voided lines. To determine the cause, the operator would observe the status of the loop level pump and place it in service if possible. If the pump was already operating, then an inspection of system piping and valves would be initiated to determine the source of leakage or voiding. This inspection would include a physical walkdown of the system, alignment verification, observation of other system parameters such as temperature and pressure, and surveillance testing. When the cause has been determined and corrected, the system would be filled and vented.

20. Q. What would be the operator action for a pump failure?

A. If a pump failure should occur (for example, because of loss of control power or thermal overload), it would be indicated by a "system degraded" alarm. The immediate operator action would be to valve in the alternate loop level supply from the condensate transfer system and vent at high points to ensure the system is full. Subsequent action would then be an investigation to determine the cause of the loop level pump failure, initiate corrective action, and, when the pump is operable, return it to service.

21. Q. Would the presence of any of these alarms result in the affected system being declared inoperable?

A. Not immediately. The purpose of these alarms is to alert the operator to a potential problem whose further degradation could result in a reduction in system reliability and operability. An alarm on the loop level system does not, by itself, indicate that the system is unable to perform its intended function but does indicate possible impairment to the system in that the likelihood of a water hammer occurrence may be increased.

22. Q. Would it not be safer to immediately declare the system inoperable when a possible impairment is indicated?

A. No. Any damage resulting from a water hammer event occurring during system activation would most probably be limited to snubbers and hangers. Even if a breach

of piping or other failure should occur, the system could then be isolated, declared inoperable, and further corrective action initiated within the guidance of the technical specifications.

23. Q. In summary, what has been done at Shoreham in the terms of procedures and training related to water hammer?

A. First, water hammer is considered during the development, review and implementation of procedures. Appropriate steps, sequence of steps and precautions are included in the procedures to take water hammer into account. Second, water hammer is addressed in operator training by including lectures and discussions concerning it in classroom training; by increasing operator awareness of system design, configuration and function during system walkdown and procedures training; by having operators participate in system preoperational and startup testing to gain experience and familiarity, and by disseminating information on experiences at other plants.

Submitted: _____

Approved: _____
(Plant Manager)

MC-1

Attachment A to LILCO's
7/9/82 Testimony on
Water Hammer Procedures
and Training

SP Number 23.121.Ø1
Revision 2
Date Eff. 6/11/82
TPC _____
TPC _____
TPC _____

RESIDUAL HEAT REMOVAL (RHR) SYSTEM

1.0 PURPOSE

To provide detailed instructions to the Station Operating Personnel for the operation of the Residual Heat Removal (RHR) System.

2.0 RESPONSIBILITY

The Operating Engineer shall be responsible for insuring the proper implementation of this procedure.

PPF1Ø21.2ØØ-6.421

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3.0 DISCUSSION

3.1 The purpose of the Residual Heat Removal System (RHRS) is to remove post power energy from the reactor under both operational and accident conditions. Five basic modes of the RHRS operation are provided to meet the requirements of these conditions:

3.1.1 Low Pressure Coolant Injection (LPCI)

3.1.2 Suppression Pool Cooling

3.1.3 Containment Spray

3.1.4 Steam Condensing

3.1.5 Shutdown Cooling

3.2 The RHRS can also be used for fuel pool cooling by means of manual valves to assist in spent fuel decay heat removal. The RHRS can be used for reactor vessel and suppression pool draining, using appropriate precautions to prevent over-draining.

3.3 Normally, heat is transferred from these energy sources to the Service Water System through the Loop A and Loop B heat exchangers; however, as a "last resort" mode, service (sea) water can be supplied as a direct cooling medium through the RHRS.

3.4 The RHRS consists of two independently operable systems referred to as Loop A and B or Sys I and II.

3.5 A discussion of each operating mode will precede the appropriate procedure in this document. Because of its function as one of the Emergency Core Cooling System (ECCS), the Low Pressure Coolant Injection (LPCI) mode of operation is not covered in these procedures, but is detailed in SP23.2Ø4.Ø1 (Reference 11.14), as is the Containment Spray mode. <2

3.6 The RHRS operates on either normal or emergency power.

NOTE: 1. All equipment component identification numbers are preceded with the system number 1E11 unless specified otherwise.

2. All Main Control Room control panel component identification numbers are preceded by the system number 1H11 unless specified otherwise.

3. All RHRS control manipulations are performed at *PNL-6Ø1 and *PNL-6Ø2, unless specified otherwise. <2

3.7 The following procedures are provided for operation of the RHRS:

K2

4.0 PRECAUTIONS

4.1 As a part of the ECCS (LPCI Mode), conformance with Technical Specifications is required under all conditions (including Standby). Technical Specifications shall be consulted prior to rendering any part of the RHRS inoperable.

4.2 The Core Spray and RHR loop level system pumps should be kept in service at all times during Standby status to maintain RHRS discharge piping full. Since there are no RHRS pressure indicators in the control room, loop fill pressure of approximately 40 psig can be seen on 1E21*PI-ØØ1A and B for the CSS on *PNL-6Ø1. Also observe that annunciators LINE FILL PUMP A/B DISCH

PRESS LOW (1116) and LINE FILL PUMP A/B FLOW HIGH (1117) are not illuminated. K2

4.3 In Shutdown Cooling and Fuel Pool Cooling modes, RHRS flow shall be maintained greater than 4ØØ gpm to prevent the minimum flow valve(s) opening. Failure to do so will result in pumping reactor or fuel pool water to the suppression pool.

4.4 When in Shutdown Cooling, Fuel Pool Cooling or Steam Condensing modes, the CS and RHR loop level pumps shall be isolated from RHRS. Failure to do so will result in 1E21*P-49A and/or B loop level pumps pumping suppression pool water into the reactor if RHRS pressure becomes less than loop level pump pressure.

4.5 Before initiating Steam Condensing, Fuel Pool or Shutdown Cooling modes, the RHRS shall be flushed to the suppression pool and/or to Radwaste until water is of sufficient purity for RPV use.

4.6 Heat all steam lines and the RHR heat exchanger slowly with steam traps open when entering the Steam Condensing mode.

4.7 Exercise care not to inadvertently spray the drywell, particularly during testing modes. Even with the RHR pumps shut down, system pressure would cause spray actuation with incorrect valve alignments.

4.8 When venting, filling, flushing or draining, limit and control spillage since this water is potentially radioactive.

4.9 Maintain suppression pool temperatures in compliance with Reference 11.8 in all operating modes. K2

4.10 Manual valves to the fuel pool cooling system shall not be opened while containment integrity is required.

4.11 When opening reactor Shutdown Cooling valves *MOV-Ø47 and *MOV-Ø48, open them one at a time and maintain close surveillance of reactor water level.

4.12 If an RHR pump suppression pool suction valve is opened while that loop is in the Shutdown Cooling Mode, a rapid reactor Water level decrease will occur - until the NSSSS interlock shuts *MOV-Ø47 and -Ø48, at +12.5 inches reactor water level.

4.13 Do not allow steam and water to be simultaneously admitted to the shell side of the RHRS heat exchangers.

4.14 If the Steam Condensing mode is inadvertently isolated, be prepared to immediately and intermittently actuate a relief valve to maintain reactor pressure nearly constant.

4.15 Maintain constant surveillance of reactor water level, heat exchanger water level, and RCIC inlet pressure in the Steam Condensing mode.

5.0 PREREQUISITES

Prerequisite conditions and operating support systems shall be as specified in the Prerequisite Checklist SPF23.121.Ø1-1.

6.0 LIMITATIONS AND ACTIONS

6.1 Technical Specifications

6.1.1 During Power Operation, Startup or Hot Shutdown (CONDITONS 1, 2, or 3) the LCO's of References 11.1, 11.2, 11.3, 11.5, 11.7, 11.8 and 11.9 - as applicable - shall apply. <2

6.1.2 During Cold Shutdown and Refueling (CONDITIONS 4, and 5) the LCO°s of References 11.1, 11.2, 11.6 and 11.4 - as applicable - shall apply.

6.1.3 Only one loop shall be used for Shutdown Cooling when RPV temperatures are >200°F.

6.1.4 Reactor Vessel cooldown rate shall not exceed 100oF/hour.

6.1.5 RPV shall not be cooled below 70°F with head torqued down.

6.1.6 *MOV-Ø5Ø shall not be opened whenever LPCI mode of RHR is required.

6.2 Mechanical/Electrical Limitations

6.2.1 When the RHR pump white auto trip light is dim the trip can be reset from *PNL-6Ø1. When bright, the trip must be reset at the breaker.

6.2.2 Because of the several ways in which RHRS can be used it is easy to induce flashing, water hammer, overpressurization, overheating and pump runout. Extraordinary care shall be taken to protect this vital system.

Normal full flow conditions for a single pump are:

7700 gpm
183 psid across pump
136 amps motor current
6 psig suction pressure

6.2.3 Minimum flow bypass valve *MOV-Ø45 (A or B) will close when flow on FR-001 reaches 4ØØ gpm, regardless of whether one or both pumps have generated this flow. With both pumps in the same loop running, a closed manual discharge valve on one of the pumps (*16V-ØØØ2A-D) will result in that pump running with zero flow. <2

6.2.4 Avoid flashing the service water (tube side) in the heat exchanger in the Steam Condensing and Shutdown Cooling modes by limiting steam and water admission rates, respectively. Limit tube outlet temperatures to <125oF as seen on 1E41-TR-1ØØ (*PNL-6Ø1).

7.0 MATERIALS OR TEST EQUIPMENT

N/A

8.0 PROCEDURE

8.1 Normal Performance

NOTE: This procedure assumes the operation of the A Loop. Operation of the B Loop is shown in parenthesis () where applicable. K2

8.1.1 Filling and Venting with Loop Level Pumps

8.1.1.1 Perform manual valve lineup and power operated valve lineup per SPF23.121.Ø1-4A and SPF23.121.Ø1-4B.

8.1.1.2 Start Loop Level Pumps per Reference 11.17 if not previously running. K2

8.1.1.3 Open Loop Cross Connect Line fill valves *Ø4V-ØØ11, ØØ42 and ØØ43.

8.1.1.4 Open HX-A vent *MOV-Ø55A and *MOV-Ø56A until *LIC-ØØ2A indicates full, then close valves.

8.1.1.5 Open HX B vent *MOV-Ø55B and *MOV-Ø56B until *LIC-ØØ2B indicates full, then close valves.

CAUTION: For the following steps, minimize spillage and use appropriate precautions to prevent personnel and equipment contamination.

8.1.1.6 Open C RHR Pump discharge vent valves *Ø1V-3111C and *Ø1V-3112C until all air is released, then close.

8.1.1.7 Open Loop A Fill Line vent valves *Ø1V-3174, and *Ø1V-3175 until all air is released, then close.

8.1.1.8 Open LPCI Injection Line A vent valves *Ø1V-3192 and *Ø1V-3193 until all air is released, then close.

8.1.1.9 Open LPCI Crosstie Line vent valves *Ø1V-31Ø7 and *Ø1V-31Ø8 until all air is released, then close.

8.1.1.10 Open Loop A Drywell Spray Vent valves *Ø1V-3113A and *Ø1V-3114A until all air is released, then close.

8.1.1.11 Open Loop A Test to Suppression Pool valve *MOV-Ø4ØA and vent valves *Ø1V-3115A and *Ø1V-3116A until all air is released, then close all three valves. <2

8.1.1.12 Open RHR Pump A Suction Vent valves *Ø1V-31Ø9A and *Ø1V-311ØA until all air is released, then close.

8.1.1.13 Open RHR Pump C Suction vent valves *Ø1V-31Ø9C and *Ø1V-311ØC until all air is released, then close.

8.1.1.14 Open D RHR Pump Discharge vent valves *Ø1V-3111D and *Ø1V-3112D until all air is released, then close.

8.1.1.15 Open Loop B Fill vent valves *Ø1V-313Ø, *Ø1V-3131 and *Ø1V-3128, *Ø1V-3129 until all air is released then close.

8.1.1.16 Open LPCI Injection Line B vent valves *Ø1V-3122 and *Ø1V-3123 until all air is released, then close.

8.1.1.17 Open LPCI Crosstie Line vent valves *Ø1V-317Ø and *Ø1V-3171 until all air is released, then close.

8.1.1.18 Open Head Spray Line vent valves *Ø1V-3Ø72, *Ø1V-3Ø73 until all air is released, then close.

8.1.1.19 Open Loop B Drywell Spray vent valves *Ø1V-3113B and *Ø1V-3114B until all air is released, then close.

8.1.1.20 Open Loop B Test to Suppression Pool Valve *MOV-Ø4ØB and vent valves *Ø1V-3115B and *Ø1V-3116B until all air is released, then close all three valves.

8.1.1.21 Open RHR Pump B Suction vent valves *Ø1V-31Ø9B and *Ø1V-311ØB until all air is released, then close.

8.1.1.22 Open RHR Pump D Suction vent valves *Ø1V-31Ø9D and *Ø1V-311ØD until all air is released, then close.

8.1.1.23 Ensure that Shutdown Cooling Suction valve MOV-Ø47 is closed, then open MOV-Ø48 and vent valves *Ø1V-3124 and *Ø1V-3125 until all air is released, then close all three valves.

8.1.1.24 Open casing drain valves for five minutes on each RHR pump, then close.

*P-Ø14A - *Ø1V-3ØØ3A, *Ø1V-3ØØ4A
*P-Ø14C - *Ø1V-3ØØ3C, *Ø1V-3ØØ4C
*P-Ø14B - *Ø1V-3ØØ3B, *Ø1V-3ØØ4B
*P-Ø14D - *Ø1V-3ØØ3D, Ø1V-3ØØ4D

8.1.1.25 Open casing vent valves on each RHR pump until all air is released, then close: K2

*P-Ø14A - *Ø1V-3ØØ5A, *Ø1V-3ØØ6A
*P-Ø14C - *Ø1V-3ØØ5C, *Ø1V-3ØØ6C
*P-Ø14B - *Ø1V-3ØØ5B, *Ø1V-3ØØ6B
*P-Ø14D - *Ø1V-3ØØ5D, *Ø1V-3ØØ6D

8.1.1.26 Open RCIC Suction Line vent valves *Ø1V-3Ø74, *Ø1V-3Ø75 until all air is released, then close.

8.1.1.27 Close Loop Cross Connect Line fill valves *Ø4V-ØØ11, ØØ42, ØØ43.

8.1.2 Filling and Venting with Condensate Transfer System

8.1.2.1 Perform manual valve lineup and power operated valve lineup per SPF23.121.Ø1-4.1 and SPF23.121.Ø1-4.2.

8.1.2.2 Unlock and open A Loop/B Loop Fill Header Cross Connect valve *Ø4V-ØØ14 and Cross Connect Line Fill valves *Ø4V-ØØ11, ØØ42 and ØØ43.

8.1.2.3 Verify that Condensate Transfer system is operating per Reference 11.18 and that adequate water volume is available for RHRS system filling;

8.1.2.4 Open Condensate Fill valve to RHRS *Ø4V-ØØ16.

8.1.2.5 Complete vent and fill per steps 8.1.1.4 through 8.1.1.27.

8.1.2.6 If Loop Level Fill Pumps are available for use in the Standby condition close Condensate Transfer System supply valve *Ø4V-ØØ16 and lock-closed Inter-Loop Connect valve *Ø4V-ØØ14. If the Condensate Transfer System is to be used in Standby leave these valves open and ensure that the Condensate Transfer System remains in service for CSS and RHRS.

NOTE: This may slowly increase Suppression Pool level if any flow test valves are leaking; find leaking valve(s) and close tightly.

8.1.2.7 Close Cross Connect Line fill valves *Ø4V-ØØ11, ØØ42, ØØ43. K2

8.1.3 Standby Status

8.1.3.1 Complete Standby Status Checklist SPF23.121.Ø1-2.

8.1.4 Suppression Pool Cooling & Spray

The Suppression Pool Cooling mode is manually initiated and consists of a closed loop from and to the suppression pool through the RHRS pumps and heat exchangers. Either one, or both loops can be used for this mode.

A LPCI initiation, either auto or manual, will cause the RHRS to automatically revert to the LPCI mode.

This mode of RHRS will be used to maintain suppression pool temperature within limits whenever cooling is required in the absence of a LPCI injection signal, including when RCIC or HPCI is in use (testing or otherwise); in the event temperature approaches 95°F during power operation; during use in the Steam Condensing mode and in the event of RPV relief valve operation.

This procedure presumes the RHRS to be initially in Standby Status.

NOTE: The "A" loop is the preferred loop for this function since it can more readily be "lined up" to reject water to Radwaste (*MOV-Ø5Ø normally closed).

8.1.4.1 Determine which loop is to be operated. This will depend upon plant conditions, pool temperature and any other concurrent RHRS operational modes.

8.1.4.2 Verify RHR Control Room MOV valve lineup is correct per SPF23.121.Ø1-4.2 for the loop selected. <2

8.1.4.3 Open heat exchanger Service Water outlet valve 1P41*MOV-Ø34A(B) and verify flow on FI-ØØ6A(B).

8.1.4.4 Close the LPCI Injection Valve *MOV-Ø36A(B) and Heat Exchanger Bypass valve *MOV-Ø34A(B).

8.1.4.5 Open Suppression Pool Cooling and Spray Shutoff valve *MOV-Ø4ØA(B) (Keylock).

8.1.4.6 Start selected RHR pump(s) by placing their C.S. to AUTO-AFTER-START. Verify running current <136 amps/pump.

8.1.4.7 Verify minimum flow valve *MOV-Ø45A(B) open after 1Ø seconds.

CAUTION: Do not exceed 136 amps/pump during continuous operation.

8.1.4.8 Slowly open Suppression Pool Cooling Inlet throttle valve *MOV-Ø42A(B) to establish desired flow rate. Observe flow increase on *FI-ØØ1A(B), that pump current increases and that MOV-Ø45A(B) closes at ≥4ØØ gpm. <2

8.1.4.9 If desired, throttle open Suppression Pool Spray *MOV-Ø41A(B) to give 5ØØ gpm spray. This will reduce airborne activity in the Suppression Pool generated during HPCI, RCIC, or Relief Valve Testing/Operation.

8.1.4.10 Start additional pump(s) as necessary to restore or maintain Suppression Pool temperature less than:

120°F during steam condensing mode
95°F during reactor power operation
105°F during testing of ECCS or relief valves (during power operation)

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8.1.5 Return to Standby (from Suppression Pool Cooling)

NOTE: 1) When shutting down Suppression Pool Cooling it is desirable, initially, to reduce the total flow in each loop to less than runout capacity of one pump.

2) The following method prevents draining discharge piping and forming air pockets.

8.1.5.1 If only one pump is running proceed with Step 8.1.5.3. With two pumps running (in the same loop): throttle inlet to Suppression Pool *MOV-Ø42A(B) to obtain $\leq$77ØØ gpm loop flow.

8.1.5.2 Stop one pump by placing its Control Switch to AUTO-AFTER-STOP and verify pump amps decrease to zero.

8.1.5.3 With one pump running, throttle Suppression Pool Inlet Throttle valve *MOV-Ø42A(B) and Suppression Pool Spray Valve *MOV-Ø41A(B) to zero flow (*FI-ØØ1A(B)).

8.1.5.4 As loop flow approaches zero, stop the pump by placing its Control Switch to AUTO-AFTER-STOP and verify amps decrease to zero.

8.1.5.5 Close minimum flow valve *MOV-Ø45A(B).

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8.1.5.6 Verify Suppression Pool Inlet *MOV-Ø42A(B) and Suppression Pool Spray Valve *MOV-Ø41A(B) fully shut.

8.1.5.7 Keylock closed Suppression Pool Cooling and Spray Valve *MOV-Ø4ØA(B).

8.1.5.8 Open LPCI Injection Valve *MOV-Ø36A(B) and Heat Exchanger Bypass Valve *MOV-Ø34A(B).

8.1.5.9 Secure RHR Service Water supply by shutting 1P41*MOV-Ø34A(B) if desired.

8.1.5.1Ø Verify RHR in Standby Status by reviewing SPF23.121.Ø1-4.2 for the applicable loop(s).

8.1.6 Shutdown Cooling

The Shutdown Cooling mode is used to remove decay heat from the reactor in the shut down condition with reactor pressure <135 psig. Its purpose is to facilitate reactor servicing and refueling. One or both loops can be used in this mode except only one loop shall be used when RPV temperature is >2ØØ°F. Reactor head spray can be used to cool the reactor head at an equal rate with reactor vessel cooldown. <2

If a LPCI signal occurs during the Shutdown Cooling mode the RHRS will automatically align itself to the LPCI injection mode except the pumps will not start since there is no suction path open from the Suppression Pool. The operator must close *MOV°s Ø32 A-D (Shutdown Cooling Suction) and open *MOV°s Ø31 A-D, upon which the pumps will automatically start.

CAUTION: The Shutdown Cooling mode is interlocked with the NSSSS system such that either reactor water level <+12.5 inches, drywell pressure >+1.69 psig or reactor vessel pressure >135 psig will terminate this mode by closing: the Suction Valves from the Reactor Vessel (*MOV-Ø47 and *MOV-Ø48), the Head Spray Valves (*MOV-Ø53 and *MOV-Ø54) and LPCI Inboard Isolation valves (*MOV-Ø37 A&B only if *MOV-Ø47 and *MOV-Ø48 were fully open). <2

This procedure presumes the RHRS to be initially in Standby Status.

8.1.6.1 Determine which RHR loop will be used for shutdown cooling.

NOTE: The "B" loop shall normally be used since "A" loop can then be simultaneously used to cool and/or reject water from the Suppression Pool.

8.1.6.2 Open heat exchanger Service Water Outlet valve 1P41 *MOV-Ø34B(A) on the selected loop and verify flow on *FI-ØØ6B(A). <2

8.1.6.3 Verify a source of reactor makeup is available and that the Condensate Transfer System in service.

8.1.6.4 Flush the selected loop per SPF 23.121.Ø1-3.

CAUTION If Shutdown Cooling is begun with single loop and it is later decided to use both loops, use care in selecting the flushing path preparatory to placing the second loop in operation. Errors in valve alignment could result in flushing suppression pool-water-filled lines into the reactor. Two loop mode shall not be used with RPV water >200°F. <2

CAUTION Observe tank levels during the flush to preclude overflow of the Waste Collector or Floor Drain Collector Tanks.

8.1.6.5 With *MOV-Ø48 fully closed, open Shutdown Cooling Suction valve *MOV-Ø47 and observe that RPV level does not drop excessively. K2

8.1.6.6 Open *MOV-Ø48, check *MOV-Ø47 open and observe that RPV level does not drop excessively.

8.1.6.7 Close Loop Fill to Shutdown Cooling Suction *Ø4V-ØØØ6.

NOTE: The loop is now lined up for Shutdown Cooling. Prior to starting the pump the following should be considered:

CAUTION: When the RHR pump is started the Operator must establish >4ØØ gpm flow to the RPV (observe *FI-ØØ1B(A)) within ten seconds. If this is not done the Minimum Flow valve *MOV-Ø45B(A) will open, discharging water from the RPV to the Suppression Pool at $\geq$ 4ØØ gpm. If flow cannot be established prior to ten seconds trip the RHR pump. If *MOV-Ø45B(A) opens and does not reclose, close *MOV-Ø47 and verify running RHR pump trips (the RHR pump, if running, will Auto-trip).

NOTE: Monitor conductivity cells CIS-Ø93 B&D (A&C). If conductivity is > 10 umhos/cm @ 25oC contact Radiochemistry personnel prior to discharging RHR into RPV.

CAUTION: RHR flow must be adjusted to avoid jet pump cavitation and dead heading the recirculation pumps if they are running.

8.1.6.8 Close LPCI Injection Valve *MOV-Ø36B(A) until it is approximately 25% open.

8.1.6.9 Open LPCI Outboard Isolation Valve *MOV-Ø37B(A).

8.1.6.10 Start the appropriate RHR pump by placing its CS to AUTO-AFTER-START.

CAUTION: At least one RHR pump should be operated at rated flow (7700 gpm) to avoid coolant thermal stratification. Cooldown rate can be controlled by service water flow or heat exchanger bypass flow.

8.1.6.11 Throttle LPCI Injection Valve *MOV-Ø36B(A) to desired flow. Start the second RHR pump if desired. (*MOV-Ø45B(A) will not open now since flow is >4ØØ gpm).

8.1.6.12 When desired flow is established, slowly close Heat Exchanger Bypass Valve *MOV-Ø34B(A) to establish required cooldown rate (not to exceed 1ØØ°F/hr.). Periodic adjustments of these valves will be required as RPV temperature decreases to maintain 1ØØoF/hr. cooldown rate.

CAUTION: Do not cool RPV below 70°F with head torqued down. K2

CAUTION: If loop A is being used for Shutdown Cooling and loop B is being used in a mode which takes a suction from the Suppression Pool or Fuel Pool, Head Spray shall not be initiated. This would cause Fuel Pool or Suppression Pool water to be sprayed into the RPV.

NOTE: Loop A/B crosstie *MOV-Ø5Ø must be opened prior to performing 8.1.6.13 if Loop A is to be used for head spray. However, *MOV-Ø5Ø must be closed whenever LPCI mode is required to be operational.

8.1.6.13 Open Head Spray valve *MOV-Ø54, then throttle open *MOV-Ø53 as required to decrease Reactor pressure and maintain even RPV cooldown rate (approximately 625 gpm, initially, on FI-ØØ4). Throttle LPCI Injection Valve *MOV-Ø36B(A), as necessary to limit flow to maximum allowable per pump. Monitor reactor vessel temperature recorder to maintain this rate as nearly equal as possible on all parts of the vessel - not to exceed 1ØØ°F/hr., nor to exceed 14Ø°F flange-to-shell ΔT.

8.1.6.14 When the Reactor is depressurized and cooled to desired temperature, close Head Spray Valves *MOV-Ø53 and *MOV-Ø54, and loop A/B Crosstie Valve *MOV-Ø5Ø (if opened for loop A spray).

CAUTION: Do not cause a negative pressure in RPV. Vent RPV when RPV water temperature decreases below 212oF.

8.1.6.15 As Reactor water temperature decreases to desired cold shutdown status the Heat Exchanger Bypass valve *MOV-Ø34B(A) will be opened to decrease heat transfer rate and the LPCI Injection Valve *MOV-Ø36B(A) will be throttled to reduce total flow. When total flow decreases to less than 77ØØ gpm for each pump that will be left running, an RHR pump should be stopped by placing the Control Switch to AUTO-AFTER-STOP, and observing amperage decrease to zero. K2

8.1.7 Return to Standby (From Shutdown Cooling)

8.1.7.1 When Shutdown Cooling is no longer needed, decrease flow in each loop to ≤7ØØ gpm (if Loops A/B crosstie *MOV-Ø5Ø is open, ≤77ØØ gpm total RHRS flow) and leave only one pump running. <2

CAUTION: Do not allow flow to decrease to 4ØØ gpm.

8.1.7.2 Throttle LPCI Injection Valve *MOV-Ø36B(A) to obtain 5ØØ gpm flow on *FI-ØØ1B(A).

8.1.7.3 Immediately stop the remaining pump, observing amps decrease to zero and ensure *MOV-Ø45B(A) remains closed.

8.1.7.4 When all pumps are stopped close Outboard Isolation valve *MOV-Ø37B(A), open Injection Valve *MOV-Ø36B(A) and close Loop A/B Crosstie *MOV-Ø5Ø.

8.1.7.5 Close Shutdown Cooling Suction valves *MOV-Ø47, *MOV-Ø48, and *MOV-Ø32 A-D. Verify shutoff to Suppression Pool Cooling and Spray *MOV-Ø4ØB(A) key locked closed, verify shell side drain sample *AOV-Ø61B(A) *AOV-Ø62B(A) closed. <2

NOTE: 1. If this shutdown precedes a refueling outage, and it is likely that the RHRS will be used for Fuel Pool Cooling Assist, leave the Condensate Transfer loop fill in service to the RHR discharge piping only by opening *04V-0016 and checking closed *04V-0006. The Loop Level Pumps 1E21*P-Ø49A&B should remain isolated from RHRS, by checking closed *01V-0015B(A) and the pump Suppression Pool Suction valves (*MOV's Ø31 A-D). If Suppression Pool Cooling is required during the interim, use the loop that will not be used for Fuel Pool Cooling. This should eliminate the need to repeat flushing prior to Fuel Pool Cooling Assist. <2

2. During low RHR discharge pressure conditions (<125 psig) it may be necessary to shut the Condensate Transfer Loop Fill valve *04V-0016 completely to preclude overfilling RPV or Fuel Pool Via Condensate Transfer.

8.1.7.6 Fully Open pump Suppression Pool Suction valves *MOV°s. Ø31 A-D and Heat Exchanger Bypass *MOV-Ø34A(B). <2

8.1.7.7 Secure Service Water to RHRS heat exchangers by closing 1P41*MOV-Ø34B(A).

8.1.7.8 Verify Loop Level Pumps are running.

8.1.7.9 Lock open Loop Fill valves *Ø1V-ØØ15A & B and open Loop Fill to Shutdown Cooling Line *Ø4V-ØØØ6.

8.1.7.10 Verify RHR in Standby Status by reviewing SPF 23.121.Ø1-2 for the Applicable loop(s).

8.1.8 Steam Condensing

The Steam Condensing mode is used when the reactor is isolated from the main condenser, and it is not desirable to use HPCI as a heat sink. In this case the RHRS heat exchangers are used to condense reactor steam and the RCIC turbine-driven pump is used as a reactor feed pump. In this way the reactor can be kept at or near operating pressure/temperature to facilitate return to power.

Reactor steam is supplied to the RHRS from the HPCI steam supply line. During the initial phase of operation steam is concurrently being released to the Suppression Pool through the Reactor Safety Relief valves, and condensate from the RHRS Heat Exchangers is sent to the Suppression Pool while warming up the system, flushing Suppression Pool water from RHRS lines and establishing water level in the heat exchangers.

After about 3Ø minutes, full decay heat steam flow can be accommodated in the two RHRS Heat Exchangers, during which RCIC turbine speed (flow rate) is controlled in manual or auto flow control to pump all condensate to the Reactor Feedwater Line. After about 1 1/2 hours operation in this mode, one RHR heat exchanger loop will be able to carry the heat load and the other exchanger loop may be placed in the Suppression Pool Cooling mode.

This procedure presumes a start from Standby Status. The RHRS should be placed in the Steam Condensing mode as soon as the reactor is isolated from the Main Condenser and the RCIC system is supplying makeup water to the Reactor from the Condensate Storage Tank in accordance with Reference 11.15. K2

8.1.8.1 Close the following valves:

*MOV-Ø33A(B) Heat Exchanger Shell Side Inlet
*MOV-Ø35A(B) Heat Exchanger Shell Side Outlet

8.1.8.2 Open the following valves:

*MOV-Ø55A(B), *MOV-Ø56A(B) Heat Exchanger Vent
*MOV-Ø44A(B), Heat Exchanger Drain to Suppression Pool
*AOV-Ø61A(B), *AOV-Ø62A(B) Heat Exchanger Shell Sample
1E41*MOV-Ø42, Reactor Steam to HPCIS
1E41*MOV-Ø41, Reactor Steam to HPCIS K2

8.1.8.3 Set heat exchanger level controllers LIC-ØØ2A(B) at 3/4 level in MANUAL and set RHRS to RCICS pressure controller PIC-ØØ5 at 45 psig in AUTO.

8.1.8.4 Open heat exchanger Service Water outlet valve 1P41*MOV-Ø34A(B), and verify flow.

CAUTION: Heat exchangers shell side shall not exceed 4ØØoF nor 45Ø psig at any time during this operational mode.

8.1.8.5 With steam traps open, slowly open RHRS Steam Inlet Valve *MOV-Ø49.

8.1.8.6 Place Steam Pressure Reducing Valve *PCV-ØØ3A(B) Control Switch A(B) in OPEN. K2

8.1.8.7 Using PIC-ØØ3A(B) in MANUAL to operate PCV-ØØ3A(B), slowly increase heat exchanger A(B) pressure to 2ØØ psig, then place PIC-ØØ3A(B) in AUTO.

8.1.8.8 Using LIC-ØØ2A(B), very slowly lower heat exchanger water level. (PCV-ØØ7A(B) is controlling flow to the Suppression Pool).

8.1.8.9 While lowering heat exchanger water level close vent valve *MOV-Ø56A(B). Partially reopen *MOV-Ø56A(B) to allow proper venting, by placing its CS to OPEN for three seconds, then return to NORM.

8.1.8.10 Continue lowering heat exchanger level as required to maintain amount of steam condensing necessary to maintain reactor pressure. (About 9 feet above tube sheet for 68,000 lbs./hr.) Hold desired level with LIC-ØØ2A(B) in MANUAL.

8.1.8.11 When heat exchanger outlet conductivity (CIS-Ø93A-D) <10umho/cm @25°C or chemistry sample indicate reactor grade water purity, heat exchanger effluent may be diverted from the Suppression Pool to the RCICS pump suction.

CAUTION: Condensate to RCICS pump suction must not exceed 14Ø°F nor 45 psig.

8.1.8.12 Start RCICS per Reference 11.15 if not already running. K2

8.1.8.13 Open RCICS pump supply valves *MOV-Ø43A(B).

8.1.8.14 Close *MOV's Ø44A(B). RHRS pressure will now force open the check valves to the RCICS and Condensate Storage Tank supply flow will diminish. RCICS turbine speed may have to be increased to maintain RHRS heat exchanger levels.

CAUTION: Do not overspeed RCIC turbine (Normal full speed 45ØØ RPM).

8.1.8.15 RHR Heat Exchanger level control can continue with RCIC flow control in manual or automatic, however there is no direct RHR Heat Exchanger level control signal to the RCIC turbine speed control and close surveillance of heat exchanger level is required. <2

8.1.8.16 Place heat exchanger level controllers LIC-ØØ2A(B) in AUTO.

8.1.8.17 PCV-ØØ3A(B) and PCV-ØØ7A(B) are now balancing to control RCICS inlet pressure. RHR heat exchanger level is being controlled in manual via manual or automatic RCIC Flow Control.

NOTE: If adjustment of water level is required, in order to balance heat exchangers, this may be done by manually operating the steam reducing valves. Open more to lower level. <2

NOTE: If a LPCI initiation signal occurs, the RHRS will revert to the LPCI mode of operation. RCIC auto initiation will occur at -38 inches reactor water level (LPCI: -132.5 inches). RCIC flow controller shall be increased to 400 gpm in AUTO. No other operator action is required.

CAUTION: If LPCI initiation occurs while in Steam Condensing Mode do not open Heat Exchanger Inlet and Outlet Valves *MOV-Ø33A(B) and *MOV-Ø35A(B) until Steps 8.1.8.20 through 8.1.8.31 are complete. To do so may result in water hammer and/or thermal stress damage to the affected RHR Heat Exchanger. <2

8.1.8.18 RPV level can be adjusted by regulating Reactor Reject to Hotwell via Reactor Water Cleanup System (Reference 11.19).

8.1.8.19 Changing one RHR Heat Exchanger from Steam Condensing to Suppression Pool Cooling is detailed in this and the following Steps. When Suppression Pool temperature approaches 120°F or the Reactor is cooled and depressurized sufficiently, one loop should be placed in Suppression Pool Cooling.

8.1.8.20 Verify Vent Valve *MOV-Ø55A(B) open and fully open *MOV-Ø56A(B).

8.1.8.21 With PIC-ØØ3A(B) in MANUAL, begin very slowly closing steam supply *PCV-ØØ3A(B). Observe water level begins to rise.

8.1.8.22 Slowly throttle close Heat Exchanger Vent valves *MOV-Ø55 A(B) and *MOV-Ø56A(B). Do not close fully. (Potential for pulling a vacuum on Hx.)

8.1.8.23 When *PCV-ØØ3A(B) is fully closed, close RCICS Supply valve *MOV-Ø43A(B) and Sample valves *AOV-Ø61A(B) and *AOV-Ø62A(B).

8.1.8.24 Place Steam Pressure Reducing Valve Control switch A(B) in CLOSE position.

8.1.8.25 Check Loop Fill valve *01V-ØØ15A(B) locked open for the loop to be used for Suppression Pool Cooling.

8.1.8.26 Open Heat Exchanger Outlet *MOV-Ø35A(B) to complete filling heat exchanger. <2

8.1.8.27 When LI-ØØ2A(B) shows 1ØØ% full, continue filling until temperature change can be felt on vent line.

8.1.8.28 Fully close Heat Exchanger Vent valves *MOV-Ø55A(B) and *MOV-Ø56A(B). <2

8.1.8.29 Verify that annunciators LINE FILL PUMP A/B DISC PRESS LOW and LINE FILL PUMP A/B FLOW HIGH are not illuminated.

8.1.8.30 Open Heat Exchanger Inlet *MOV-Ø33A(B). Verify Bypass *MOV-Ø34A(B) open.

8.1.8.31 Place the loop prepared in Steps 8.1.8.19 through 8.1.8.30 in the Suppression Pool Cooling mode as specified in Section 8.1.4.

8.1.9 Return to Standby Status (from Steam Condensing)

NOTE: This procedure can be used for one or both heat exchangers in the Steam Condensing operation.

8.1.9.1 Monitoring Reactor water level, place pressure controller(s) PIC-ØØ3A(B) in MANUAL and slowly throttle *PCV-ØØ3A(B) to obtain approximately 1Ø psig in RHR Heat Exchanger. Verify that RCICS continues to maintain Reactor water level from the Condensate Storage Tank. (Do not fully close *PCV-ØØ3A(B).)

8.1.9.2 Verify Heat Exchanger Vent *MOV-Ø55A(B) open, and fully open *MOV-Ø56A(B).

8.1.9.3 Adjust RCICS flow controller and/or RWCU reject as necessary to maintain Reactor water level.

8.1.9.4 Slowly Close *PCV-ØØ3A(B). <2

8.1.9.5 Close *MOV-Ø49 (HPCI steam to RHR) if only one heat exchanger is being utilized for steam condensing.

8.1.9.6 Close RHRS-to-RCICS valve(s) *MOV-Ø43A(B).

8.1.9.7 Check Loop Level valve(s) *ØIV-ØØ15A(B) locked open.

8.1.9.8 Close Sample valves *AOV-Ø61A(B) and *AOV-Ø62A(B).

8.1.9.9 Place Steam Pressure Reducing Valve Control switch(es) A(B) in the CLOSE position.

8.1.9.10 Raise heat exchanger level controller setting(s) to maximum.

8.1.9.11 Open Heat Exchanger Outlet valve(s) *MOV-Ø35A(B) to fill Heat Exchanger. <2

8.1.9.12 When cool water flow is evident in the vent line(s) close heat exchanger vent valves *MOV-Ø55A(B) and *MOV-Ø56A(B).

8.1.9.13 Open Heat Exchanger Inlet *MOV-Ø33A(B) and verify open Bypass valve *MOV-Ø34A(B). <2

8.1.9.14 Verify annunciators LINE FILL PUMP A/B DISCH PRESS LOW and LINE FILL PUMP A/B FLOW HIGH are not illuminated.

8.1.9.15 Secure Service Water System flow to RHRS Heat Exchangers by shutting 1P41*MOV-Ø34A(B).

8.1.9.16 Verify HX A and HX B level controllers *LIC-ØØ2A and B in MANUAL and set for 1ØØ% level.

8.1.9.17 Verify HPCIS steam to HX A and HX B Pressure Controller in MANUAL and set for zero psig.

8.1.9.18 Place HXs outlet to RCICS Inlet Pressure Controller in MANUAL and set for zero psig.

8.1.9.19 Return RCICS and HPCIS to standby per References 11.15 and 11.16.

8.1.9.20 Check for abnormal RHRS alarms, correct as required. Verify RHRS is in Standby Status by reviewing SPF 23.121.Ø1-2 for the applicable loop.

8.1.10 Fuel Pool Cooling Assist

The RHRS can be used to augment the Fuel Pool Cooling System when the heat load exceeds the capacity of the latter. This mode requires opening two manual valves in the RHRS and should be used only when in cold shutdown and when the LPCI mode is not required. The A RHRS loop should be used for Fuel Pool Cooling unless *MOV-Ø5Ø is not required to be closed per 6.1.6.

Initiation of this mode is presumed to proceed from Standby Status and with the Fuel Pool Cooling System in operation.

If a LPCI signal should occur while in this mode the system will revert to the LPCI mode, except, the operator must immediately close *MOVs Ø32A-D and open *MOVs Ø31A-D. The RHR pump will stop when *MOVs Ø32A-D are closed (in the loop being used for Fuel Pool Cooling Assist), then restart when *MOVs Ø31A-D are opened. K2

8.1.10.1 Unlock and open the FPC to RHR PP Supplies 1G41-1ØV-ØØØ8 A&B.

8.1.10.2 Verify that the FPC to RHR PP Suction 1G41-1ØV-ØØØ9 is open.

8.1.10.3 Unlock and open the FPC Returns from RHR 1G41-Ø6V-ØØØ7 A&B.

8.1.10.4 Open heat exchanger Service Water Outlet valve 1P41*MOV-Ø34A(B) and verify flow on *FI-ØØ6A(B).

8.1.10.5 Complete RHR Flush Checklist SPF23.121.Ø1-3 on the selected loop.

8.1.10.6 Open Fuel Pool Supply manual valve *HV-Ø73 (1ØV-ØØØ7). K2

CAUTION: When the RHR pump is started the operator must establish >4ØØ gpm flow to the RPV (on *FI-ØØ1A(B)) within ten seconds by opening *HV-Ø72 (Ø8V-ØØ32). If this is not done the Minimum Flow Valve *MOV-Ø45A(B) will open, discharging water from the Fuel Pool to the Suppression Pool at ≥4ØØ gpm. If *MOV-Ø45A(B) opens and does not reclose, close the appropriate Shutdown Cooling Suction *MOV-Ø32A-D (the RHR Pump, if running, will AUTO-TRIP).

NOTE: Monitor conductivity cells CIS-Ø93A&C (B&D). Do not discharge to fuel pool if conductivity is >1Ø umho/cm @ 25°C unless acceptable to Radiochemistry personnel.

8.1.10.7 Have operator standby to open *HV-Ø72 then start selected RHR pump.

8.1.10.8 Allow inrush current to drop to running current, then immediately open *HV-Ø72 to establish desired flow of greater than 4ØØ gpm.

8.1.10.9 When desired flow is established, slowly close Heat Exchanger Bypass *MOV-Ø34A(B) to establish desired cooling rate.

8.1.10.10 As spent fuel decay heat is diminished, Heat Exchanger Bypass *MOV-Ø34A(B) will be opened to decrease heat transfer rate. When this valve is fully open, *HV-Ø72 may be throttled until 5ØØ gpm is reached. At this time (or earlier) the Fuel Pool Cooling System capacity should be adequate to manage spent fuel heat generation.

8.1.11 Return to Standby Status (From Fuel Pool Cooling Assist)

8.1.11.1 Reduce RHRS flow rate to 5ØØ gpm and immediately STOP the RHR pump by placing its Control Switch in AUTO-AFTER-STOP position. Verify amps decrease to zero and ensure *MOV-Ø45A(B) remains closed. K2

8.1.11.2 Close Fuel Pool Outlet valve *HV-Ø73 and Fuel Pool Inlet valve *HV-Ø72.

8.1.11.3 Verify Loop Fill Pump running, then open Loop Fill valve *Ø1V-ØØ15A(B).

8.1.11.4 Close Shutdown Cooling Suction Valves *MOV-Ø32A&C (B&D).

8.1.11.5 Open Pump Suction *MOV-Ø31A&C (B&D), and Heat Exchanger Bypass *MOV-Ø34A(B).

8.1.11.6 Secure Service Water to RHRS heat exchanger(s) by shutting 1P41-Ø34A(B).

8.1.11.7 Verify RHR Standby Status by reviewing SPF 23.121.Ø1-2 for the appropriate loop.

8.1.11.8 Close and Lock the FPC Returns from RHR 1G41-Ø6V-ØØØ7A&B.

8.1.11.9 Close and lock the FPC to RHR PP Supplies 1G41-1ØV-ØØØ8A&B.

8.1.12 Reactor Pressure Vessel Draining

The RHRS can be used to reject water from the Reactor. This requires caution to avoid excessive draining which will initiate ECCS or trip the NSSSS. This should only be used if RWCU reject is unavailable or inadequate (pump down after refuel).

CAUTION: Fission Product gases may be present and could be released to the Radwaste Building Ventilation System.

8.1.12.1 Ensure adequate radwaste storage capacity for the volume of Reactor coolant to be drained.

8.1.12.2 Initiate the Shutdown Cooling mode in the A loop as detailed in Section 8.1.6. (If B loop must be used, open loop cross-connect valve *MOV-Ø5Ø consistant with 6.1.6).

8.1.12.3 Open Radwaste Drain Isolation *MOV-Ø51.

CAUTION: Either there must be a positive Reactor steam pressure throughout the procedure (< 135 psig); the RPV head must be removed; or adequate venting established to prevent a negative pressure in the RPV. Negative pressure can damage or decalibrate instrumentation. Take into account the weight of water on pressure instruments when assessing Reactor pressure.

8.1.12.4 Throttle open Radwaste Drain *MOV-Ø52 to obtain the desired Reactor level decrease rate.

8.1.12.5 When Reactor draining is complete, shut *MOV-Ø51, then shut *MOV-Ø52.

8.1.12.6 Proceed with Shutdown Cooling Operation or return to Standby as specified in Section 8.1.7.

8.1.13 Suppression Pool Draining

8.1.13.1 Ensure adequate radwaste storage capacity for the water to be drained from the Suppression Pool.

8.1.13.2 Initiate Suppression Pool Cooling in the A loop as detailed in Section 8.1.4. (If B loop must be used, open loop cross connect *MOV-Ø5Ø consistant with 6.1.6. If cooling is not required leave Service Water to Hx secured.)

8.1.13.3 Open Radwaste Drain Isolation *MOV-Ø51.

CAUTION:

1. Very large level drop in the Suppression Pool may result in negative pressure in the Suppression Pool. To prevent this, the Suppression Pool should be vented to the RBNVS. Health Physics shall be notified and appropriate precautions taken. (Check Technical Specificaton limitations before proceeding.)

2. Monitor Suppression Pool level, do not decrease level below 26 feet during normal operation or downscale on level instrumentation to preclude running RHR pumps with inadequate suction head. <2

3. Fission Gases may be present in the Suppression Pool water and may be released to the Radwaste Building Ventilation System.

8.1.13.4 Throttle open Radwaste Drain *MOV-Ø52 and establish Suppression Pool level decrease rate. Monitor Suppression Pool pressure and level indicators. Do not exceed Technical Specification level criteria. If negative chamber pressure occurs, immediately stop draining.

8.1.13.5 When desired Suppression Pool level is attained close Drain valve *MOV-Ø51, then close *MOV-Ø52.

8.1.13.6 Proceed with Suppression Pool Cooling or Return to Standby as specified in Section 8.1.5.

8.2 Abnormal Performance

8.2.1 Suppression Pool Cooling & Spray (with LPCI signal present) <2

The Suppression Pool Cooling mode is manually initiated and consists of a loop from and to the Suppression Pool through the RHRS pumps and heat exchangers. Either loop can be used for this mode. During accident conditions it may become necessary to cool the Suppression Pool which will require bypassing the interlocks that prevent opening of the Shutoff to Suppression Pool Cooling and Spray *MOV-Ø4ØA&B and Inlet to Suppression Pool *MOV-Ø42A&B.

8.2.1.1 Ascertain which Reactor recirculation loop does not require full flow LPCI injection. (This will be the loop containing the break.) Use this loop for Suppression Pool Cooling.

CAUTION: If the Reactor Core is not at least 2/3 covered (> -48 inches on 1B21*LITS-ØØ7A&B) it must be determined that no feasible alternative exists for Step 8.2.1.2. Do not perform this step unless it is absolutely necessary to maintain suppression pool temperature less than 170°F. <2

8.2.1.2 (If the Core is at least 2/3 covered do not perform this step; proceed with Step 8.2.1.3.).

Place Containment Spray Valve <2/3 Core Coverage Bypass Control key switch S-18A or S-18B (for the loop which is to be used for Suppression Pool Cooling) in MANUAL OVERRIDE position. Annunciator SYSTEM I (SYSTEM II) RHR CONTAINMENT SPRAY VALVE SELECTOR IN OVERRIDE will illuminate.

8.2.1.3 Hold Containment Spray Valve Accident Bypass Control switch S-17A or S-17B, as appropriate, in MANUAL position until white light above the switch is illuminated, then release. <2

NOTE: After the initial LPCI one minute interlock which holds Heat Exchanger Bypass valves *MOV-Ø34A and B fully open, and the five minute interlock which holds LPCI Injection valve *MOV-Ø36A and B open, the operator may, at his discretion, throttle these two valves to control Suppression Pool cooldown rate and to prevent RHR pump runout when a path is opened to the Suppression Pool.

8.2.1.4 Open heat exchanger Service Water Outlet valve 1P41*MOV-Ø34A(B) and verify flow on FI-ØØ6A(B). K2

8.2.1.5 Open Suppression Pool Keylock shutoff valve *MOV-Ø4ØA(B).

8.2.1.6 Simultaneously begin to open Suppression Pool Cooling Inlet valve *MOV-Ø42A(B) to establish desired flow rate while throttling LPCI Injection valve *MOV-Ø36A(B) taking care to not exceed 136 amps on either RHR pump. Depending upon whether or not it is desired to completely shut off LPCI flow to this recirculation loop, continue this procedure until *MOV-Ø36A(B) is fully closed and *MOV-Ø42A(B) is fully open (or some median value of divided flow). K2

8.2.1.7 If needed, throttle open Suppression Pool Spray *MOV-Ø41A(B) to give 500 gpm spray.

8.2.1.8 Operate Heat Exchanger Bypass valve *MOV-Ø34A(B) to establish cooldown rate or to maintain constant Suppression Pool temperature.

8.2.1.9 Depending upon operational/LPCI requirements, as flow requirements decrease, total flow may be diminished by throttling Suppression Pool Inlet valve *MOV-Ø42A(B) and/or LPCI Injection valve *MOV-Ø36A(B). When total flow in a given RHR loop has been decreased to 7700 gpm or less, and it is not intended to increase flow to greater than this, one RHR pump may be stopped.

CAUTION: Do not stop a pump when total flow is greater than rated flow (7700 gpm/pump) for the pump(s) that will still be running. (In any case in which loop A/B crosstie valve *MOV-Ø5Ø is open, this may involve more than two pumps).

8.2.1.10 When Suppression Pool Cooling & Spray is no longer required the loop that is operating in this mode can be returned to LPCI operation by opening LPCI Injection valve *MOV-Ø36A(B) while closing Suppression Pool Inlet valve *MOV-Ø42A(B) and Suppression Pool Spray *MOV-Ø41A(B), then closing Suppression Pool Keylock Shutoff valve *MOV-Ø4ØA(B). Throttle Heat Exchanger Bypass *MOV-Ø34A(B) as required for LPCI temperature control. K2

8.2.1.11 To return the loop to Standby Status proceed to Section 8.1.5.

NOTE: If step 8.2.1.2 was performed, Containment Spray Valve <2/3 Core Coverage Bypass Control Keyswitch S-18A or S-18B will have to be returned to OFF position. K2

8.2.2 Steam Supply Isolation (Steam Condensing)

8.2.2.1 Maintain Reactor water level with RCICS.

8.2.2.2 Open main steam relief valves or operate HPCI as necessary to control RPV pressure.

8.2.2.3 Maintain heat exchanger levels to the extent possible. Do not allow sudden level changes.

8.2.2.4 If possible, reset steam isolation and open steam supply valves; refer to Reference 11.16, Section 8.1.1 to warm up steam lines. <2

8.2.2.5 If steam supply cannot be reestablished shutdown the Steam Condensing mode as detailed in Section 8.1.9.

8.2.3 Heat Exchanger Trouble

The two RHR Heat Exchangers (*E-Ø34A and B) are supplied with Service Water from separate headers (A header supplies *E-Ø34A and B header supplies *E-Ø34B). In the event of loss of one Service water header, the RHRS loop in which the heat exchanger is affected loses its function in Shutdown Cooling, Fuel Pool Cooling Assist, Steam Condensing and Suppression Pool Cooling.

The LPCI and Drywell Spray modes of operation are not affected; therefore the entire RHRS does not become inoperable.

A heat exchanger tube leak of such severity as to result in off-site releases of radioactivity in excess of limits necessitates shutdown and isolation of that heat exchanger. This does not preclude operation of the LPCI or Drywell Spray modes, since flow can be bypassed through *MOV-Ø34A(B). (Radiation monitors 1D11-RE-Ø23A and 1D11-RE-Ø23B monitor service water through the respective heat exchangers whenever service water is flowing through their discharge lines).

Heat exchanger problems in the LPCI mode are dealt with in Reference 11.14. <2

8.2.3.1 If a high radiation alarm occurs on the service water outlet, immediately close Hx Discharge Valve 1P41*MOV-Ø34A(B) and Hx Inlet valve 1P41*MOV-Ø33A(B). This results in the same condition as loss of Service Water.

8.2.3.2 If Service Water is lost in a cooling mode of an RHRS loop, shut down the loop in accordance with the appropriate Return to Standby Status procedure for the mode in which it was operating.

8.2.4 Alarm Response Procedures

The following alarm response procedure (ARPs) are associated with this procedure:

1. ARP 1120 RHR HX A/B DISCH COOL WTR TEMP HI <2
2. ARP 1121 RHR A/B INLET WTR TEMP HI
3. ARP 1122 RHR SYS A DISCH HDR/SDC SUCT PRESS HI
4. ARP 1123 RHR SYS B DISCH HDR/SDC SUCT PRESS HI
5. ARP 1126 RX SYS A PRESS LO
6. ARP 1127 RX SYS B PRESS LO
7. ARP 1128 DRYWELL SYS A PRESS HI
8. ARP 1129 DRYWELL SYS B PRESS HI
9. ARP 1130 RHR SYS A RX LO LEVEL INIT
10. ARP 1131 RHR SYS B RX LO LEVEL INIT
11. ARP 1132 RHR SYS A MAN INIT SW ARMED
12. ARP 1133 RHR SYS B MAN INIT SW ARMED
13. ARP 1134 RHR PUMP A TRIP
14. ARP 1135 RHR PUMP B TRIPPED
15. ARP 1136 RHR PUMP C TRIPPED
16. ARP 1137 RHR PUMP D TRIPPED
17. ARP 1138 RHR PUMP A MOTOR OVLD
18. ARP 1139 RHR PUMP B MOTOR OVLD
19. ARP 1140 RHR PUMP C MOTOR OVLD
20. ARP 1141 RHR PUMP D MOTOR OVLD
21. ARP 1142 RHR SYS A LOGIC POWER FAIL
22. ARP 1143 RHR SYS B LOGIC POWER FAIL
23. ARP 1144 RX SYS A LEVEL LOW
24. ARP 1145 RX SYS B LEVEL LOW

25. ARP 1146 RHR SYS A DEGRADED

26. ARP 1147 RHR SYS A INOP

27. ARP 1148 RHR HX B OULTET CNDCT HI

28. ARP 1149 RHR HX A OUTLET CNDCT HI

29. ARP 1150 RHR SYS B CNTMT SP VV MAN OVERRIDE

30. ARP 1151 RHR SYS B CNTMT SP VV MAN OVERRIDE

31. ARP 1152 RHR SYS A IN TEST

32. ARP 1153 RHR SYS B IN TEST

33. ARP 1154 RHR SYS B DEGRADED

34. ARP 1155 RHR SYS B INOP

35. ARP 1370 RHR SYSTEM COMMON VALVE TROUBLE

36. ARP 1379 RHR SYS CROSSTIE VV SW IN OPEN POSN

9.0 ACCEPTANCE CRITERIA

N/A

10.0 FINAL CONDITIONS

Ensure that all documentation has been completed and signed.

11.0 REFERENCES

11.1 Technical Specifications, Section 3.3.3

11.2 Technical Specifications, Section 3.4.6.1

11.3 Technical Specifications, Section 3.4.9.1

11.4 Technical Specifications, Section 3.4.9.2

11.5 Technical Specifications, Section 3.5.1

11.6 Technical Specifications, Section 3.5.2

11.7 Technical Specifications, Section 3.6.2.1

11.8 Technical Specifications, Section 3.6.2.2

11.9 Technical Specifications, Section 3.6.2.3

11.10 FM 20B-13, (S&W) RHR Flow Diagram, Loop A, (M-1Ø112-13) <2

11.11 FM 20A-13, (S&W) RHR Flow Diagram, Loop B, (M-1Ø111-13)

11.12 FE-1B-10, (S&W) 4160 Emergency Buses 101, 103 (M-11Ø86-1Ø)

11.13 FE-1C-11, (S&W) 4160 Emergency Bus 102 (M-11Ø87-11)

11.14 SP23.2Ø4.Ø1, Low Pressure Cooling Injection (LPCI)

11.15 SP23.119.Ø1, Reactor Core Isolation Cooling

11.16 SP23.2Ø2.Ø1, High Pressure Coolant Injection

11.17 SP23.2Ø3.Ø1, Core Spray

11.18 SP23.1Ø5.Ø1, Condensate Storage and Transfer

11.19 SP23.7Ø9.Ø1, Reactor Water Cleanup

11.20 GEK-63Ø4Ø, Volume VII, Part 2, RHR System

12.0 APPENDICES

12.1 SPF23.121.Ø1-1, RHRS Prerequisite Checklist

12.2 SPF23.121.Ø1-2, RHRS Standby Status Checklist

12.3 SPF23.121.Ø1-3, RHR Flush Checklist

12.4 SPF23.121.Ø1-4A and 4B, Valve Lineup Checklist <2

12.5 SPF23.121.Ø1-5, System Component Power Supplies Checklist

RHRS PREREQUISITE CHECKLIST

	Signature	Initials	Time	Date
Authorization for Start	(Watch Engineer)			
Initiated by				
Completed by				
Reviewed by	(Watch Engineer)			

Step No.	Procedure	Initials	
5.1	Tagging log and Lifted Lead and Jumper Log reviewed.		K2
5.2	Manual Valve Lineup Checklist, SPF23.121.Ø1-4A, completed and signed off.		
5.3	Following electrical systems in operation:		K2
5.3.1	Normal and emergency AC power to: 46ØV*Buses 1Ø1, 1Ø2. 1Ø3 48ØV*MCCs 1111, 111X, 1117, 1113, 1118, 1119, 1121, 112Y, 1127, 1129, 1128, 1122, 1112 DC 125V power to: *MCC-ØA1 and ØB2 Power to 12Ø V AC instrument buses		K2
5.4	Prior to any breaker operations, place the control switch in STOP or PULL-TO-LOCK position.		
5.5	System Component Power Supply Checklist, SPF23.121.Ø1-5, completed and signed off.		
5.6	Control room Motor Operated Valve Lineup Checklist SPF23.121.Ø1-4B, completed and signed off.		
5.7	Suppression pool and reactor vessel water level normal.		
5.8	System filled and vented and Loop Fill Pumps running. If not filled and vented use Procedure 8.1.1 (normal) or 8.1.2 (Condensate Transfer fill and vent).		

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RHRS PREREQUISITE CHECKLIST

Step No.	Procedure	Initials
5.9	Service Water System available for RHR use.	_____
5.10	Diesel Generators available for emergency power (to support LPCI mode).	_____
5.11	Reactor Building and Drywell floor and equipment drain systems in service and adequate volume available in Radwaste System for flushing.	_____
5.12	RBCLCW System in service and supplying RHR pump seal coolers.	_____ K2
5.13	Process Radiation Monitoring system in service.	_____
5.14	Control air system in service for air operated valves.	_____
5.15	RCIC system (for Steam Condensing mode) ready for service.	_____

RHRS STANDBY STATUS CHECKLIST

	Signature	Initials	Time	Date
Authorization for Start	(Watch Engineer)			
Initiated by				
Completed by				
Reviewed by	(Watch Engineer)			

Step No.	Procedure	Initials	
8.1.3.1	Verify Prerequisite Checklist, SPF23.121.Ø1-1, completed.		
8.1.3.2	Verify Manual Initiation pushbutton switches A and B are in the DISARMED - NORMAL positon.		
8.1.3.3	Verify Containment Spray Valve Control Switches S17A and S17B, 2 psig Drywell or low Rx level interlock Bypass in OFF position and white lights extinguished.		
8.1.3.4	Verify Containment Spray Valve Control switches S18A and S18B, ≤2/3 core coverage bypass in OFF position and annunciator SYS I (and SYS II) RHR CONTAINMENT SPRAY VALVE SELECTOR ON OVERRIDE are not illuminated.		
8.1.3.5	Verify Steam Condensing Mode switch in RCIC FLOW position.		
8.1.3.6	Depress *MOV-Ø37A and *MOV-Ø37B (Inboard LPCI Isolation MOVs) Shutdown Control switches and verify white lights extinguished.		<2
8.1.3.7	Verify all white lights on 1H11*PNL-617 and 1H11*PNL-618 are extinguished and that test plugs and test switch keys are removed.		
8.1.3.8	Depress Initiation Reset pushbuttons A and B and verify white lights extinguished.		
8.1.3.9	Place RHR pumps *P-Ø14 A, B, C, D Control switches in AUTO-AFTER-STOP position.		<2

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RHRS STANDBY STATUS CHECKLIST

Step No.	Procedure	Initials
8.1.3.10	Place RHR System Inoperative switches I and II in NORMAL position and verify annunciators RHR SYSTEM I (and SYSTEM II) INOPERATIVE are not illuminated.	_____
8.1.3.11	Check all RHRS lights and annunciators for abnormal conditions. If required, refer to Alarm Response Procedures to clear alarms.	_____
8.1.3.12	Place HX A and HX B Level Controllers *LIC-ØØ2A and *LIC-ØØ2B in MANUAL and set for 1ØØ% level.	_____
8.1.3.13	Place HPCI steam-to-HX A and HX B Pressure Controllers *PIC-ØØ3A and *PIC-ØØ3B in MANUAL and set for zero psig.	_____
8.1.3.14	Remove the thermal overloads from the 1E11-MOV-Ø5Ø panel (loop A/B crosstie shutoff) and store the thermal overloads in the panel. Danger tag the thermal overloads removed and control the thermal overloads per SP 12.Ø35.Ø1 (Control of Lifted leads and Jumpers).	_____
8.1.3.15	Danger tag the 1E11-MOV-Ø5Ø handwheel in the closed position.	_____
8.1.3.16	Place HXs outlet to RCIC Inlet Pressure Controller *P1C-ØØ5 in MANUAL and set for zero psig. The RHRS is now in Standby and ready for automatic operation in the LPCI mode. (For operation in the LPCI Mode see Reference 11.13.)	_____

RHR FLUSH CHECKLIST

	Signature	Initials	Time	Date
Authorization for Start	(Watch Engineer)			
Initiated by				
Completed by				
Reviewed by	(Watch Engineer)			

Step No.	Procedure	Initials
1.	Operate the selected loop in Suppression Pool Cooling mode (Section 8.1.4) for approximately ten minutes to flush gross particulates to the Suppression pool, then return the loop to Standby Status.	
2.	Unlock and close Loop Fill Valves *Ø1V-ØØ15A and B.	
3.	Open Condensate Transfer Loop Fill valve *Ø4V-ØØ16.	
4.	Close Suppression Pool level Suction valves *MOV-Ø31A&C (B&D) for pumps to be used.	
5.	Open Shutdown Cooling Suction valves *MOV-Ø32A&C (B&D) for the pumps to be used.	
	CAUTION: The following steps may result in spillage of radioactive water. Use appropriate radiological precaustions to prevent personnel and equipment contamination.	
6.	Unlock and open Pump Suction Strainer Drain valves *Ø4V-3ØØØA&C (B&D) and Floor Drain Stop-Check valves *Ø4V-3ØØ2A&C (B&D), as appropriate.	
	NOTE: Notify Radwaste Control Room before opening drains and minimize water drained to Radwaste; in general one to two pipe volumes should be adequate.	
	CAUTION: Do not exceed flow capacity of the Floor Drain Sump Pumps.	
7.	Open Pump Casing Drain valves *Ø1V-3ØØ3A&C (B&D) and *Ø1V-3ØØ4A&C (B&D), as appropriate for approximately 2 minutes, then close.	

RHR FLUSH CHECKLIST

Step No.	Procedure	Initials
8.	Close and lock *Ø4V-3ØØØA&C (B&D).	
9.	Close Condensate Fill to LPCI Injection Line *Ø4V-ØØ12A(B).	
10.	Throttle open Pump Discharge Line Drains *Ø4V-3ØØ1A&C (B&D), as appropriate.	
11.	If Loop B is to be flushed, open Loop Fill Crosstie *Ø4V-ØØ14.	
12.	After 3 minutes, open Condensate Fill to LPCI Injection Line *Ø4V-ØØ12A(B) and close Condensate Fill to Shutdown Cooling Line *Ø4V-ØØØ6.	
13.	Close RHR Heat Exchanger Bypass *MOV-Ø34A(B).	
14.	After about 1Ø minutes, open Heat Exchanger Bypass *MOV-Ø34A(B) and close Heat Exchanger Inlet *MOV-Ø33A(B).	
15.	After about 5 minutes, open Heat Exchanger Inlet *MOV-Ø33A(B).	
16.	Close and lock Pump Discharge Line Drains *Ø4V-3ØØ1A&C (B&D) and close stop-check valves.	
17.	Unlock and open Suppression Pool Cooling and Spray Isolation *MOV-Ø4ØA(B) and Suppression Pool Inlet *MOV-Ø42A(B); for no longer than 1Ø minutes, then close.	
18.	Open Loop Fill to Shutdown Cooling Line *Ø4V-ØØØ6.	
19.	Verify the Shutdown Cooling Suction line has been pressurized by the Condensate Transfer System by observing pressure >5Ø psig.	
20.	Connect a hose to drain/vent connections located just upstream of RHR Isolation Valve *MOV-Ø37A(B), for Loop A open drain valves *Ø1V-3166 & *Ø1V-3167, for Loop B open vent valves *Ø1V-3122 & *Ø1V-3123, flush for approximately 5 minutes then close valves & remove hose.	
21.	Close Condensate Transfer Loop Fill valve *Ø4V-ØØ16.	
22.	Verify CIS-Ø93A(B) $\leq$ 10 umho/cm @25oC or accepted by Radio Chemistry personnel.	
23.	Close Loop Fill Crosstie *Ø4V-ØØ14 if open. The Shutdown Cooling Loop is now flushed.	

VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
	Reactor Building., El. 8°Ø" A RHR PP			
1E11* Ø1V-3ØØ5A	RHR PP A CASING VENT RT	CLOSED		
1E11* Ø1V-3ØØ6A	RHR PP A CASING VENT ISOL	CLOSED		
1E11* Ø1V-3ØØ3A	RHR PP A CASING DRAIN RT	CLOSED		
1E11* Ø1V-3ØØ4A	RHR PP A CASING DRAIN ISOL	CLOSED		
1E11* Ø1V-7Ø58A	RHR PP A SUCT STRAINER PDI-141A RT	OPEN		
1E11* Ø1V-7Ø59	RHR PP A SUCT STRAINER PDI-141A RT	OPEN		
1E11* Ø4V-3ØØØA	RHR PP A SUCT STRAINER DRAIN	LOCKED CLOSED		
1E11* Ø4V-3ØØ2A	RHR PP A SUCT STRAINER DRAIN STOP CHECK	CLOSED		
1E11* Ø1V-7Ø6ØA	RHR PP A SUCT PI-131A RT	OPEN		
1E11* Ø1V-7Ø61A	RHR PP A DISCH PI-133A, PS-134A, PS-135A RT	OPEN		
1E11* Ø1V-3ØØ7A	RHR PP A MINIMUM FLOW LEAK TEST RT	CLOSED		
1E11* Ø1V-3ØØ8A	RHR PP A MINIMUM FLOW LEAK TEST ISOL	CLOSED		
1E11* Ø3V-ØØØ1A	RHR PP A MINIMUM FLOW SHUTOFF	LOCKED OPEN		
1E11* Ø1V-3Ø14A	RHR PP A MINIMUM FLOW TEST RT	CLOSED		
1E11* Ø1V-3Ø15A	RHR PP A MINIMUM FLOW TEST ISOL	CLOSED		
1E11* Ø4V-3ØØ1A	RHR PP A DISCH LINE TO FLOOR DRAIN	LOCKED CLOSED		
1E11* 16V-ØØØ2A	RHR PP A DISCH ISOL TO LOOP A	LOCKED OPEN		
1E11* Ø4V-ØØØ9A	HX A TO RCIC SUCTION	LOCKED OPEN		
1E11* Ø1V-31ØØA	PCV-ØØ7A DRAIN RT	CLOSED		
1E11* Ø1V-31Ø1A	PCV-ØØ7A DRAIN ISOL	CLOSED		
1E11* Ø1V-3Ø16A	RT TEST ON SYSTEM A TO RCIC	CLOSED		
1E11* Ø3V-3Ø17A	2ND VV TEST CONN SYSTEM A TO RCIC	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
	RX 8'0" A RHR PP			
1E11* Ø1V-31Ø9A	RHR PP A SUPP POOL SUCT VENT	CLOSED		
1E11* Ø1V-311ØA	RHR PP A SUPP POOL SUCT VENT	CLOSED		
1E11* Ø1V-3213A	MOV-Ø31A DRAIN	CLOSED		
1E11* Ø1V-3214A	MOV-Ø31A DRAIN	CLOSED		
	RX EL. 8' 0" RHR C PP			
1E11* Ø1V-3ØØ4C	RHR PP C CASING DRAIN ISOL	CLOSED		
1E11* Ø1V-7Ø58C	RHR PP C SUCT STRAINER PDI-141C RT	OPEN		
1E11* Ø1V-7Ø59C	RHR PP C SUCT STRAINER PDI-141C RT	OPEN		
1E11* Ø4V-3ØØØC	RHR PP C SUCT STRAINER DRAIN	LOCKED CLOSED		
1E11* Ø4V-3ØØ2C	RHR PP C SUCT STRAINER DRAIN STOP CHECK	CLOSED		
1E11* Ø1V-7Ø6ØC	RHR PP C SUCT PI-131C RT	OPEN		
1E11* Ø1V-7Ø61C	RHR PP C DISCH PI-133A, PS-134A, PS-135A, RT	OPEN		
1E11* Ø1V-3ØØ7C	RHR PP C MIN FLOW LEAK TEST RT	CLOSED		
1E11* Ø1V-3ØØ8C	RHR PP C MIN FLOW LEAK TEST ISOL	CLOSED		
1E11* Ø3V-ØØØ1C	RHR PP C MIN FLOW SHUTOFF	LOCKED OPEN		
1E11* Ø4V-3ØØ1C	RHR PP C DISCH LINE TO FLOOR DRAIN	LOCKED CLOSED		
1E11* 16V-ØØØ2C	RHR PP C DISCH ISOL TO LOOP A	LOCKED OPEN		
1E11* Ø1V-31Ø9C	RHR PP C SUPP POOL SUCT VENT	CLOSED		
1E11* Ø1V-311ØC	RHR PP C SUPP POOL SUCT VENT	CLOSED		
1E11* Ø1V-3213C	MOV-Ø31C DRAIN	CLOSED		
1E11* Ø1V-3214C	MOV-Ø31C DRAIN	CLOSED		
1E11* Ø1V-3ØØ5C	RHR PP C CASING VENT RT	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3ØØ6C	RHR PP C CASING VENT ISOL	CLOSED		
1E11* Ø1V-3ØØ3C	RHR PP C CASING DRAIN RT	CLOSED		
1E11* Ø1V-3111C	RHR PP C DISCHARGE VENT	CLOSED		
1E11* Ø1V-3112C	RHR PP C DISCHARGE VENT	CLOSED		
	RX EL.8'0" HX A			
1E11* Ø1V-7Ø54A	RHR HX A LT-ØØ2A RT	OPEN		
1E11* Ø1V-7Ø55A	RHR HX A LT-ØØ2A RT	OPEN		
1E11* Ø1V-7Ø51A	RHR HX A OUTLET CE-Ø93A RT	OPEN		
1E11* Ø2V-3Ø12A	HX A DRN RT	CLOSED		
1E11* Ø2V-3Ø13A	HX A DRAIN ISOL	CLOSED		
1E11* Ø1V-7Ø51C	RHR HX A OUTLET CE-Ø93C RT	OPEN		
Ø1V-3156	MOV-Ø57A DRAIN	CLOSED		
Ø1V-3157	MOV-Ø57A DRAIN	CLOSED		
1P41 Ø1V-7Ø11A	SW FROM HX A 1P41- PI-Ø13A RT	OPEN		
1P41 Ø1V-7Ø1ØA	SW TO HX A 1P41- PI-Ø12A RT	OPEN		
	RX BLDG. EL 40' WEST			
1E11* Ø1V-ØØ5Ø	SUPP POOL COOLING TO ACCIDENT SAMPLE	OPEN		
1E11* Ø1V-3Ø09A	HX A VENT RT	CLOSED		
1E11* Ø1V-3Ø1ØA	HX A VENT ISOL	CLOSED		
1E11* Ø1V-3Ø5Ø	LOOP FILL INLET LINE DRAIN	CLOSED		
1E11* Ø1V-3Ø51	LOOP FILL INLET LINE DRAIN ISOL	CLOSED		
1E11* Ø1V-ØØ15A	LOOP LEVEL A PUMP INLET TO RHR	LOCKED OPEN		
1E11* Ø1V-3146	HPCI SUPPLY VALVES STEAM TRAP RETURN	LOCKED OPEN		
1E11* Ø1V-32Ø9	HPCI STEAM VALVE STEAM TRAP VENT	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-321Ø	HPCI STEAM VALVE STEAM TRAP VENT	CLOSED		
1E11* Ø1V-3211	HPCI STEAM VALVE STEAM TRAP DRAIN	CLOSED		
1E11* Ø1V-3212	HPCI STEAM VALVE STEAM TRAP DRAIN	CLOSED		
1E11* Ø1V-7Ø53A	RHR HX A PIC-ØØ3A RT	OPEN		
1E11* Ø1V-31Ø2	LOOP FILL CROSSTIE VENT RT	CLOSED		
1E11* Ø1V-31Ø3	LOOP FILL CROSSTIE VENT ISOL	CLOSED		
1E11* Ø1V-3199	LOOP FILL CROSSTIE DRAIN	CLOSED		
1E11* Ø1V-32ØØ	LOOP FILL CROSSTIE DRAIN	CLOSED		
1E11* Ø1V-3141	RELIEF LINE VACUUM BREAKER VENT	CLOSED		
1E11* Ø1V-3151	RELIEF LINE VACUUM BREAKER VENT	CLOSED		
	REACTOR BLDG. EL.63' 0" WEST			
1E11* Ø1V-7Ø66A	RHR SYS ILPCI INJ PS-136A RT	OPEN		
1E11* Ø4V-ØØ12A	SYS I LPCI INJ LINE FILL	OPEN		
1E11* Ø1V-3166	LPCI INJ DRAIN	CLOSED		
1E11* Ø1V-3167	LPCI INJ DRAIN	CLOSED.		
1E11* Ø1V-3Ø22A	LPCI INJ LINE TEST RT	CLOSED		
1E11* Ø1V-3Ø23A	LPCI INJ LINE TEST ISOL	CLOSED		
1E11* Ø1V-3214	LPCI INJ LINE DRAIN RT	CLOSED		
1E11* Ø1V-3215	LPCI INJ LINE DRAIN ISOL	CLOSED		
1E11* Ø1V-3174	LOOP LEVEL DRAIN	CLOSED		
1E11* Ø1V-3175	LOOP LEVEL 2ND DRAIN	CLOSED		
1E11* 1ØV-ØØ17A	SYS I *PCV-ØØ3A INLET ISOL	LOCKED OPEN		
1E11* Ø1V-7Ø56A	RHR SYS I LPCI/SUPP POOL COOL FR-ØØ1 FI-ØØ1, PDS-ØØ1A RT	OPEN		
1E11* Ø1V-7Ø57A	RHR SYS I LPCI/SUPP POOL COOL FR-ØØ1 FI-ØØ1A, PDS-ØØ1A, ISOL	OPEN		

<2

VALVE LINEUP CHECKLIST

*** A Second Qualifed Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3Ø38A	LPCI A LEAK TEST CONN RT	CLOSED		
1E11* Ø1V-3Ø39A	2ND FFT HDR A LEAK TEST CONN	CLOSED		
1E11* Ø1V-3Ø4ØA	LOOP A SUPP POOL INLET TEST RT	CLOSED		
1E11* Ø1V-Ø3Ø41A	LOOP A SUPP POOL INLET TEST ISOL	CLOSED		
1E11* Ø1V-3Ø54	CROSS TIE VALVE DRAIN RT	CLOSED		
1E11* Ø1V-3Ø55	CROSS TIE VALVE DRAIN ISOL	CLOSED		
1E11* Ø1V-31Ø7	LOOP CROSSTIE VENT	CLOSED		
1E11* Ø1V-31Ø8	LOOP CROSSTIE VENT	CLOSED		
1E11* Ø4V-ØØ16	COND TRANSFER FILL TO RHR	CLOSED		
1E11* Ø1V-3115A	SUPPRESSION POOL SPRAY VENT	CLOSED		
1E11* Ø1V-3116A	SUPPRESSION POOL SPRAY VENT	CLOSED		
1E11* Ø1V-3192	RV-153A VENT	CLOSED		
1E11* Ø1V-3193	RV-153A VENT	CLOSED		
1E11* Ø4V-ØØØ6	LOOP FILL TO RHR PP SUCT	OPEN		
1E11* 1ØV-ØØØ7	FUEL POOL COOLING ASSIST SUCT	LOCKED CLOSED		
1E11* Ø1V-3172	S/D COOLING SUCT DRAIN	CLOSED		
1E11* Ø1V-3173	S/D COOLING SUCT DRAIN	LOCKED CLOSED		
1E11* Ø1V-3124	S/D COOLING SUCT VENT	CLOSED		
1E11* Ø1V-3125	S/D COOLING SUCT VENT	LOCKED CLOSED		
1E11* Ø1V-3Ø36	S/D COOLING SUCT TEST RT	CLOSED		
1E11* Ø1V-3Ø37	S/D COOLING SUCT TEST ISOL	CLOSED		
1E11* Ø1V-7Ø33	S/D COOLING SUCT PS-137 RT	OPEN		
1E11* Ø1V-3194	LOOP LEVEL HEADER DRAIN	CLOSED		
1E11* Ø1V-3195	LOOP LEVEL HEADER DRAIN	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-7Ø62A	PS-138 A&C ROOT	OPEN		
1E11* Ø1V-7Ø62B	1C71*PS-ØØ2B ROOT	OPEN		
	EL 60' SUPPRESSION POOL			
1E11* Ø1V-3158A	SUPP POOL SPRAY VENT	CLOSED		
1E11* Ø1V-3159A	SUPP POOL SPRAY VENT	CLOSED		
	REACTOR BLDG. EL. 78' 7"			
1E11* Ø8V-ØØ32	RHR PP DISCH TO FUEL POOL COOLING	LOCKED CLOSED		
1E11* Ø1V-3Ø24A	RT VV A LPCI TEST CONN DW	CLOSED		
1E11* Ø1V-3Ø25A	2ND VV A LPCI TEST CONN DW	CLOSED		
1E11* 24V-ØØØ4A	RHR SYS I RETURN TO RX ISOL	LOCKED OPEN		
1E11* Ø1V-3134A	LPCI A INJECTION LINE DRAIN	CLOSED		
1E11* Ø1V-3135A	LPCI A INJECTION LINE DRAIN	CLOSED		
	EL. 100'			
1E11* Ø1V-3Ø82	SYS I DRYWELL SPRAY LINE LEAK TEST RT	CLOSED		
1E11* Ø1V-3Ø83	SYS I DRYWELL SPRAY LINE LEAK TEST ISOL	CLOSED		
1E11* Ø1V-3Ø28A	SYS I DRYWELL SPRAY LINE AIR TEST RT	CLOSED		
1E11* Ø1V-3Ø29A	SYS I DRYWELL SPRAY LINE AIR TEST ISOL	CLOSED		
1E11* Ø1V-3152A	SYS I DRYWELL SPRAY DRAIN	LOCKED CLOSED		
1E11* Ø1V-3153A	SYS I DRYWELL SPRAY DRAIN	CLOSED		
1E11* Ø1V-3Ø88	SYS I DRYWELL SPRAY DRAIN	CLOSED		
1E11* Ø1V-3Ø89	SYS I DRYWELL SPRAY DRAIN	CLOSED		
1E11* Ø1V-3113A	SYS I DRYWELL SPRAY VENT	CLOSED		
1E11* Ø1V-3114A	SYS I DRYWELL SPRAY VENT	CLOSED		

VALVE LINEUP CHECKLIST

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3190A	RHR TO HYDROGEN RECOMBINER "A" DRAIN	CLOSED		
1E11* Ø1V-3191A	RHR TO HYDROGEN RECOMBINER "A" DRAIN	CLOSED		
	REACTOR BLDG. EL. 8' 0" B RHR PP			
1E11* Ø1V-3ØØ5B	RHR PP B CASING VENT RT	CLOSED		
1E11* Ø1V-3ØØ6B	RHR PP B CASING VENT ISOL	CLOSED		
1E11* Ø1V-3ØØ3B	RHR PP B CASING DRAIN RT	CLOSED		
1E11* Ø1V-3ØØ4B	RHR PP B CASING DRAIN ISOL	CLOSED		
1E11* Ø1V-7Ø58B	RHR PP B SUCT STRAINER PDI-141 B RT	OPEN		
1E11* Ø1V-7Ø59B	RHR PP B SUCT STRAINER PDI-141B RT	OPEN		
1E11* Ø4V-3ØØØB	RHR PP B SUCT STRAINER DRAIN	LOCKED CLOSED		
1E11* Ø4V-3ØØ2B	RHR PP B SUCT STRAINER TO DRAIN STOP CHECK	CLOSED		
1E11* Ø1V-7Ø6ØB	RHR PP B SUCT PI-131B RT	OPEN		
1E11* Ø1V-7Ø61B	RHR PP B DISCH PI-133B, PS-134B AND PS-135B RT	OPEN		
1E11* Ø1V-3ØØ7B	RHR PP B MIN FLOW LEAK TEST RT	CLOSED		
1E11* Ø1V-3ØØ8B	RHR PP B MIN FLOW LEAK TEST ISOL	CLOSED		
1E11* Ø3V-ØØØ1B	RHR PP B MIN FLOW SHUTOFF	LOCKED OPEN		
1E11* Ø1V-3Ø14B	RHR PP B MIN FLOW TEST RT	CLOSED		
1E11* Ø1V-3Ø15B	RHR PP B MINIMUM FLOW TEST ISOL	CLOSED		
1E11* Ø1V-32Ø5	RHR PP B DISCH DRN RT	CLOSED		
1E11* Ø1V-32Ø6	RHR PP B DISCH DRN ISOL	CLOSED		
1E11* Ø4V-3ØØ1B	RHR PP B DISCH LINE TO FLOOR DRAIN	LOCKED CLOSED		
1E11* 16V-ØØØ2B	RHR PP B DISCH ISOL TO LOOP B	LOCKED OPEN		
1E11* Ø1V-3213B	MOV-Ø31B DRAIN	CLOSED		

VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3214B	MOV-Ø31B DRAIN	CLOSED		
1E11* Ø1V-31Ø9B	RHR PP B SUPP POOL SUCT VENT	CLOSED		
1E11* Ø1V-311ØB	RHR PP B SUPP POOL SUCT VENT	CLOSED		
	RX BLDG. EL. 8' 0" D RHR PP			
1E11* Ø1V-3ØØ5D	RHR PP D CASING VENT RT	CLOSED		
1E11* Ø1V-3ØØ6D	RHR PP D CASING VENT ISOL	CLOSED		
1E11* Ø1V-3ØØ3D	RHR PP D CASING DRAIN RT	CLOSED		
1E11* Ø1V-3ØØ4D	RHR PP D CASING DRAIN ISOL	CLOSED		
1E11* Ø1V-7Ø58D	RHR PP D SUCT STRAINER PDI-141D RT	OPEN		
1E11* Ø1V-7Ø59D	RHR PP D SUCT STRAINER PDI-141D RT	OPEN		
1E11* Ø4V-3ØØØD	RHR PP D SUCT STRAINER DRAIN	LOCKED CLOSED		
1E11* Ø4V-3ØØ2D	RHR PP D SUCT STRAINER TO DRAIN STOP CHECK	CLOSED		
1E11* Ø1V-7Ø6ØD	RHR PP D SUCT PI-131D RT	OPEN		
1E11* Ø1V-7Ø61D	RHR PP D DISCH PI-133D, PS-134D, PS-135D RT	OPEN		
1E11* Ø1V-3ØØ7D	RHR PP D MINIMUM FLOW LEAK TEST RT	CLOSED		
1E11* Ø1V-3ØØ8D	RHR PP D MINIMUM FLOW LEAK TEST ISOL	CLOSED		
1E11* Ø3V-ØØØ1D	RHR PP D MINIMUM FLOW SHUTOFF	LOCKED OPEN		
1E11* Ø1V-32Ø7	RHR PP DISCH DRN	CLOSED		
1E11* Ø1V-32Ø8	RHR PP DISCH DRN ISOL	CLOSED		
1E11* Ø4V-3ØØ1D	RHR PP D DISCH LINE TO FLOOR DRAIN	LOCKED CLOSED		
1E11* 16V-ØØØ2D	RHR PP D DISCH ISOL TO LOOP B	LOCKED OPEN		
1E11* Ø4V-ØØØ9B	HX B TO RCIC SUCT	LOCKED OPEN		
1E11* Ø1V-31ØØB	PCV-ØØ7B DRN RT	CLOSED		

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VALVE LINEUP CHECKLIST

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-31Ø1B	RCV-ØØ7B DRN RT	CLOSED		
1E11* Ø1V-3Ø16B	RT TST ON SYS B TO RCIC	CLOSED		
1E11* Ø1V-3Ø17B	2ND VV TST CONN SYS B TO RCIC	CLOSED		
1E11* Ø1V-3213D	MOV-Ø31D DRAIN	CLOSED		
1E11* Ø1V-3214D	MOV-Ø31D DRAIN	CLOSED		
1E11* Ø1V-31Ø9D	RHR PP D SUPP POOL SUCT VENT	CLOSED		
1E11* Ø1V-311ØD	RHR PP D SUPP POOL SUCT VENT	CLOSED		
1E11* Ø1V-3111D	RHR PP D DISCHARGE LINE VENT RT	CLOSED		
1E11* Ø1V-3112D	RHR PP D DISCHARGE LINE VENT ISOL	CLOSED		
	RX BLDG EL. 8' 0" RCIC SKID			
1E11* Ø1V-7Ø32	RHR SYS TO RCIC PT-ØØ5 RT	OPEN		
1E11* Ø1V-3Ø74	RCIC SUCT LINE VENT RT	CLOSED		
1E11* Ø1V-3Ø75	RCIC SUCT LINE VENT ISOL	CLOSED		
	RX BLDG. EL. 8' 0" HX B			
1E11* Ø2V-3Ø12B	HX B DRN RT	CLOSED		
1E11* Ø2V-3Ø13B	HX B DRN ISOL	CLOSED		
1P41* Ø1V-7Ø11B	SW FROM HX B 1P41-PI-Ø13B	OPEN		
1P41* Ø1V-7Ø1ØB	SW TO HX B 1P41-PI-Ø12B	OPEN		
1E11* Ø1V-7Ø51D	RHR HX B OUTLET CE-Ø93D RT	OPEN		
1E11* Ø1V-7Ø51B	RHR HX B OUTLET CE-Ø93B RT	OPEN		
Ø1V-7Ø48	C61 -CE - Ø16 RT	OPEN		
	RX BLDG EL. 40' 0" EAST			
1E11* Ø1V-3ØØ9B	HX B VENT RT	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3Ø1ØB	HX B VENT ISOL	CLOSED		
1E11* Ø1V-7Ø53B	RHR HX B PIC-ØØ3B RT	OPEN		
1E11* Ø4V-ØØ14	LOOP A TO B LOOP FILL CROSSTIE ISOL	LOCKED CLOSED		
1E11* Ø1V-31Ø4	LOOP FILL CROSSTIE DRAIN RT	CLOSED		
1E11* Ø1V-31Ø5	LOOP FILL CROSSTIE DRAIN ISOL	CLOSED		
1E11* Ø1V-ØØ15B	LOOP LEVEL B PUMP INLET TO RHR	LOCKED OPEN		
	RX BLDG. EL.63' Ø" EAST			
1E11* Ø1V-3Ø4ØB	LOOP B SUPP POOL INLET TEST RT	CLOSED		
1E11* Ø1V-3Ø41B	LOOP B SUPP POOL INLET TEST ISOL	CLOSED		
1E11* Ø1V-7Ø66B	RHR SYS II LPCI INJ PS-136B RT	OPEN		
1E11* Ø1V-7Ø54B	RHR HX B LT-ØØ2B RT	OPEN		
1E11* Ø1V-7Ø55B	RHR HX B LT-ØØ2B RT	OPEN		
1E11* Ø1V-7Ø56B	RHR SYS II LPCI/SUPP POOL COOL FR-ØØ1, FI-ØØ1B, PDS-ØØ1B RT	OPEN		
1E11* Ø1V-7Ø57B	RHR SYS II LPCI/SUPP POOL COOL FR-ØØ1, FI-ØØ1B, PDS-ØØ1B RT	OPEN		
1E11* Ø1V-3Ø38B	LOOP B SUPP POOL INLET TEST RT	CLOSED		
1E11* Ø1V-3Ø39B	LOOP B SUPP POOL INLET TEST ISOL	CLOSED		
1E11* Ø1V-3128	LOOP FILL TO B LOOP VENT RT	CLOSED		
1E11* Ø1V-3129	LOOP FILL TO B LOOP VENT ISOL	CLOSED		
1E11* Ø1V-313Ø	LOOP FILL TO B LOOP VENT RT	CLOSED		
1E11* Ø1V-3131	LOOP FILL TO B LOOP VENT ISOL	CLOSED		
1E11* Ø4V-ØØ12B	LPCI INJ LINE SYS II FILL ISOL	OPEN		
1E11* Ø1V-3Ø7Ø	LOOP B FILL TO LPCI INJ LINE DRN RT	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3122	LOOP B INJECTION LINE VENT	CLOSED		
1E11* Ø1V-3123	LOOP B INJECTION LINE VENT	CLOSED		
1E11* Ø1V-3Ø71	LOOP B FILL TO LPCI INJ LINE DRAIN ISOL	CLOSED		
1E11* Ø1V-3148	LPCI INJ TEST RT	CLOSED		
1E11* Ø1V-3149	LPCI INJ TEST ISOL	CLOSED		
1E11* Ø1V-3Ø22B	LPCI INJ LINE TEST RT	CLOSED		
1E11* Ø1V-3Ø23B	LPCI INJ LINE TEST ISOL	CLOSED		
1E11* Ø1V-7Ø62C	1C71*PS-ØØ2C ROOT	OPEN		
1E11* Ø1V-7Ø62D	*PS-138D ROOT	OPEN		
1E11* Ø1V-3138	PCV-ØØ3A DRAIN	CLOSED		
1E11* Ø1V-3139	MOV-Ø49 DRAIN	CLOSED		
1E11* Ø1V-ØØ17B	PCV-ØØ3B INLET ISOL	LOCKED OPEN		
1E11* Ø1V-3132B	LPCI INJECTION LINE VENT	LOCKED CLOSED		
1E11* Ø1V-3133B	LPCI INJECTION LINE VENT	CLOSED		
1E11* Ø1V-3168	LPCI INJECTION LINE DRAIN	CLOSED		
1E11* Ø1V-3169	LPCI INJECTION LINE DRAIN	CLOSED		
1E11* Ø1V-314Ø	PCV-ØØ3 B DRAIN	CLOSED		
1E11* Ø4V-ØØ11	LOOP LEVEL TO LPCI CROSSTIE BYPASS	CLOSED		
1E11* Ø4V-ØØ42	LPCI CROSSTIE VALVE BYPASS	LOCKED CLOSED		
1E11* Ø4V-ØØ43	LPCI CROSSTIE VALVE BYPASS	LOCKED CLOSED		
1E11* Ø1V-317Ø	LPCI CROSSTIE VENT	CLOSED		
1E11* Ø1V-3171	LPCI CROSSTIE VENT	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3126	LPCI CROSSTIE DRAIN	CLOSED		
1E11* Ø1V-3127	LPCI CROSSTIE DRAIN	CLOSED		
1E11* Ø1V-3119	LPCI CROSSTIE TO RADWASTE DRAIN	CLOSED		
1E11* Ø1V-312Ø	LPCI CROSSTIE TO RADWASTE DRAIN	CLOSED		
1E11* Ø1V-3121	LPCI CROSSTIE TO RADWASTE VENT	CLOSED		
1E11* Ø1V-3115B	MOV-Ø4ØB DOWNSTREAM VENT	CLOSED		
1E11* Ø1V-3116B	MOV-Ø4ØB DOWNSTREAM VENT	CLOSED		
	EL 60' SUPPRESSION POOL			
1E11* Ø1V-3158B	SUPP POOL SPRAY VENT	CLOSED		
1E11* Ø1V-3159B	SUPP POOL SPRAY VENT	CLOSED		
	RX BLDG. EL.78'			
1E11* 24V-ØØØ4B	RHR SYS II RETURN TO RX ISOL	OPEN		
1E11* Ø1V-3Ø24B	B LPCI INJECT LINE VENT RT	CLOSED		
1E11* Ø1V-3Ø25B	B LPCI INJECT INJECT LINE VENT ISOL	CLOSED		
1E11* 2ØV-ØØØ5	S/D COOLING SUCT RX ISOL	LOCKED OPEN		
1E11* Ø1V-3Ø42	S/D COOLING SUCT LINE TEST RT	LOCKED CLOSED		
1E11* Ø1V-3Ø43	S/D COOLING SUCT LINE TEST ISOL	CLOSED		
1E11* Ø1V-3Ø66	S/D COOLING SUCT LINE TEST RT	LOCKED CLOSED		
1E11* Ø1V-3Ø67	S/D COOLING SUCT LINE TEST ISOL	CLOSED		
1E11* Ø1V-3134B	B LPCI INJECTION LINE DRAIN	LOCKED CLOSED		
1E11* Ø1V-3135B	B LPCI INJECTION LINE DRAIN	CLOSED		
1E11* Ø4V-ØØ13	HEAD SPRAY FILL LINE	OPEN		
1E11* Ø1V-3176	RHR SYS II TO H_2 RECOMBINER VENT	CLOSED		

VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3177	RHR SYS II TO H_2 RECOMBINER VENT	CLOSED		
1E11* Ø1V-3178	RHR SYS II TO H_2 RECOMBINER DRAIN	CLOSED		
1E11* Ø1V-3179	RHR SYS II TO H_2 RECOMBINER DRAIN	CLOSED		
1E11* Ø1V-318Ø	RHR SYS II TO H_2 RECOMBINER VENT	CLOSED		
1E11* Ø1V-3181	RHR SYS II TO H_2 RECOMBINER VENT	CLOSED		
1E11* Ø1V-3182	RHR SYS II TO H_2 RECOMBINER DRAIN	CLOSED		
1E11* Ø1V-3183	RHR SYS II TO H_2 RECOMBINER DRAIN	CLOSED		
1E11* Ø1V-3184	RHR SYS II TO H_2 RECOMBINER VENT	CLOSED		
1E11* Ø1V-3185	RHR SYS II TO H_2 RECOMBINER VENT	CLOSED		
1E11* Ø1V-3186	RHR SYS II TO H_2 RECOMBINER DRAIN	CLOSED		
1E11* Ø1V-3187	RHR SYS II TO H_2 RECOMBINER DRAIN	CLOSED		
1E11* Ø1V-7Ø54B	RHR HX B LT-ØØ2B RT	OPEN		
1E11* Ø1V-7Ø55B	RHR HX B LT-ØØ2B RT	OPEN		
	RX BLDG. EL 86' EAST			
1E11* Ø1V-3Ø28B	SYS II CNMT SPRAY LINE AIR TEST RT	CLOSED		
1E11* Ø1V-3Ø29B	SYS II CNMT SPRAY LINE AIR TEST ISOL	CLOSED		
1E11* Ø1V-3113B	SYS II CNMT SPRAY VENT	CLOSED		
1E11* Ø1V-3114B	SYS II CNMT SPRAY VENT	CLOSED		
1E11* Ø1V-3152B	MOV-Ø39B 1st SEAT DRAIN	LOCKED CLOSED		
1E11* Ø1V-3153B	MOV-Ø39B 2nd SEAT DRAIN	CLOSED		
1E11* Ø1V-3Ø72	HEAD SPRAY LINE VENT RT	CLOSED		
1E11* Ø1V-3Ø73	HEAD SPRAY LINE VENT ISOL	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* Ø1V-3Ø3Ø	HEAD SPRAY LINE DRAIN RT	CLOSED		
1E11* Ø1V-3Ø31	HEAD SPRAY LINE DRAIN ISOL	LOCKED CLOSED		
1E11* Ø1V-7Ø34	HEAD SPRAY FI-ØØ4 RT	OPEN		
1E11* Ø1V-7Ø35	HEAD SPRAY FI-ØØ4 RT	OPEN		
1E11* Ø1V-3Ø84	HEAD SPRAY LINE TEST	CLOSED		
1E11* Ø1V-3Ø85	HEAD SPRAY LINE TEST	CLOSED		
	RX BLDG 100' EL.			
1E11* Ø1V-3Ø32	HEAD SPRAY LINE TEST RT	CLOSED		
1E11* Ø1V-3Ø33	HEAD SPRAY LINE TEST ISOL	CLOSED		
1E11* Ø1V-3190B	RHR TO HYDROGEN RECOMBINER "B" DRAIN	CLOSED		
1E11* Ø1V-3191B	RHR TO HYDROGEN RECOMBINER "B" DRAIN	CLOSED		

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VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
	1H11*PNL-6Ø1			
1E11* MOV-Ø44B	RHR HX B DRAIN TO SUPP POOL	CLOSED		
1E11* MOV-Ø43B	RHR HX B TO RCIC	CLOSED		
1E11* MOV-Ø5Ø	RHR SYSTEMS DISCH X-CONN	KEYLOCKED CLOSED		
1E11* MOV-Ø38B	RHR SYS II OUTBD DRYWELL SPRAY	KEYLOCKED CLOSED		
1E11* MOV-Ø39B	RHR SYS II INBD DRYWELL SPRAY	CLOSED		
1E11* MOV-Ø4ØB	RHR SYS II TEST TO SUPP POOL	KEYLOCKED CLOSED		
1E11* MOV-Ø42B	RHR SYS II TEST TO SUPP POOL	CLOSED		
1E11* MOV-Ø41B	RHR SYS II SUPP POOL SPRAY	CLOSED		
1E11* MOV-Ø36B	LPCI SYS II OUTBD INJECTION	OPEN		
1E11* MOV-Ø37B	LPCI SYS II INBD INJECTION	CLOSED		
1E11* AOV-Ø81B	LPCI SYS II ISOL (CHECK)	CLOSED		
1E11* MOV-Ø81B	LPCI SYS II ISOL (CHECK) BYPASS	CLOSED		
1E11* MOV-Ø31B	RHR PP B SUPP POOL SUCTION	KEYLOCKED OPEN		
1E11* MOV-Ø31D	RHR PP D SUPP POOL SUCTION	KEYLOCKED OPEN		
1E11* MOV-Ø32B	RHR PP B RPV SUCT	CLOSED		
1E11* MOV-Ø32D	RHR PP D RPV SUCT	CLOSED		
1E11* MOV-Ø34B	RHR HX B BYPASS	OPEN		
1E11* MOV-Ø33B	RHR HX B INLET	KEYLOCKED OPEN		
1E11* MOV-Ø45B	RHR PP SYS II MIN FLOW	CLOSED		
1E11* MOV-Ø35B	RHR HX B OUTLET	KEYLOCKED OPEN		
1E11* MOV-Ø55B	RHR HX B VENT ISOL	CLOSED		
1E11* MOV-Ø56B	RHR HX B VENT	CLOSED		
1E11* PCV-ØØ3B	HPCI STEAM TO RHR HX B	CLOSED		
1E11* PCV-ØØ7B	RCIC SUCT ROM RHR HX B	CLOSED		

VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* MOV-Ø49	HPCI STEAM TO RHR HX A AND B	CLOSED		
1E11* MOV-Ø55A	RHR HX A VENT ISOL	CLOSED		
1E11* MOV-Ø56A	RHR HX A VENT	CLOSED		
1E11* MOV-Ø35A	RHR HX A OUTLET	KEYLOCKED OPEN		
1E11* MOV-Ø34A	RHR HX A BYPASS	OPEN		
1E11* MOV-Ø33A	RHR HX A INLET	KEYLOCKED OPEN		
1E11* MOV-Ø45A	RHR PP SYS I MIN FLOW	CLOSED		
1E11* MOV-Ø32A	RHR PP A RPV SUCT	CLOSED		
1E11* MOV-Ø32C	RHR PP C RPV SUCT	CLOSED		
1E11* MOV-Ø31A	RHR PP A SUPP POOL SUCT	KEYLOCKED OPEN		
1E11* MOV-Ø31C	RHR PP C SUPP POOL SUCT	KEYLOCKED OPEN		
1E11* MOV-Ø36A	LPCI SYS I OUTBD INJECTION	OPEN		
1E11* MOV-Ø37A	LPCI SYS I INBD INJECTION	CLOSED		
1E11* AOV-Ø81A	SYS I ISOL (CHECK)	CLOSED		
1E11* MOV-Ø81A	LPCI SYS I ISOL (CHECK) BYPASS	CLOSED		
1E11* MOV-Ø4ØA	RHR SYS I TEST TO SUPP POOL	KEYLOCKED CLOSED		
1E11* MOV-Ø42A	RHR SYS I TEST TO SUPP POOL	CLOSED		
1E11* MOV-Ø41A	RHR SYS I SUPP POOL SPRAY	CLOSED		
1E11* MOV-Ø38A	RHR SYS I OUTBOARD DRYWELL SPRAY	KEYLOCKED CLOSED		
1E11* MOV-Ø39A	RHR SYS I INBD DRYWELL SPRAY	CLOSED		
1E11* MOV-Ø44A	RHR HX A DRAIN TO SUPP POOL	CLOSED		
1E11* MOV-Ø43A	RHR HX TO A RCIC	CLOSED		
1E11* PCV-ØØ3A	HPCI STEAM TO RHR HX A	CLOSED		

K2

VALVE LINEUP CHECKLIST

*** A Second Qualified Operator Should Verify Proper Alignment

VALVE NUMBER	DESCRIPTION	REQUIRED POSITION	*** INITIALS	
1E11* PCV-ØØ7A	RCIC SUCT FROM RHR HX A	CLOSED		
1E11* MOV-Ø48	RPV TO RHR OUTBD ISOL	CLOSED		
1E11* MOV-Ø52	RHR SYS TO RW ISOL	CLOSED		
1E11* MOV-Ø53	RHR (SYS II) OUTBD HEAD SPRAY ISOL	CLOSED		
	1H11*PNL-6Ø2			
1E11* MOV-Ø47	RPV TO RHR INBD ISOL	CLOSED		
1E11* MOV-Ø51	RHR SYS TO TW ISOL	CLOSED		
1E11* MOV-Ø54	RHR (SYS II) INBD HEAD SPRAY ISOL	CLOSED		
1E11* AOV-Ø61A	RHR HX A SAMPLE ROOT	CLOSED		
1E11* AOV-Ø62A	RHR HX A SAMPLE ISOL	CLOSED		
1E11* AOV-Ø61B	RHR HX B SAMPLE ROOT	CLOSED		
1E11* AOV-Ø62B	RHR HX B SAMPLE ISOL	CLOSED		
	1T48*PNL-ACH ATMOSPHERIC CONTROL PANEL			
1E11* MOV-Ø57A	RHR SYS I TO H_2 RECOMBINER A	KEYLOCKED CLOSED		
1E11* MOV-Ø57B	RHR SYS II TO H_2 RECOMBINER B	KEYLOCKED CLOSED		
	POST ACCIDENT SAMPLE PANELS 1 (1H11*PNL-AC1) & 2 (1H11*PNL-AC2)			
1E11* SOV-167A	HX B INLET ACCIDENT SAMPLE INBD	CLOSED		
1E11* SOV-167B	HX B INLET ACCIDENT SAMPLE OUTBD	CLOSED		
1E11* SOV-166A	HX A INLET ACCIDENT SAMPLE INBD	CLOSED		
1E11* SOV-166B	HX A INLET ACCIDENT SAMPLE OUTBD	CLOSED		
1E11* SOV-168	LOOP A POST ACCIDENT SAMPLE RETURN	CLOSED		
1E11* SOV-169	LOOP B POST ACCIDENT SAMPLE RETURN	CLOSED		

SYSTEM COMPONENT POWER SUPPLIES CHECKLIST

CAUTION: Place Control Switch to OFF or PULL-TO-LOCK before breaker operations.

COMPONENT NUMBER	COMPONENT DESCRIPTION	POWER SUPPLY/ BREAKER NUMBER	REQUIRED POSITION	INITIALS
1E11* P-Ø14B	RHR PUMP B	1R22*SWG-1Ø2/6	RCP	
1E11* P-Ø14C	RHR PUMP C	1R22*SWG-1Ø3/7	RCP	
1E11* P-Ø14D	RHR PUMP D	1R22*SWG-1Ø3/6	RCP	
1E11* MOV-Ø41A	INLET TO SUPP POOL SPRAY	1R24*MCC-111X/4EH	ON	
1E11* MOV-Ø44A	HEAT EXCHANGER DRAIN TO SUPPRESSION POOL	1R24*MCC-1111/4AD	ON	
1E11* MOV-Ø36A	LPCI INJECTION TO RX VESSEL	1R24*MCC-111X/2JM	ON	
1E11* MOV-Ø37A	OUTBOARD LPCI ISOLATION TO RX VESSEL	1R24*MCC-111X/1CI	ON	
1E11* MOV-Ø35A	HX A SHELL SIDE OUTLET	1R24*MCC-1117/3AD	ON	
1E11* MOV-Ø57A	RHR TO H_2 RECOMBINER	1R24*MCC-1117/3EH	ON	
1E11* MOV-Ø4$_9$	HPCI STEAM TO RHR HEAT EXCHANGER	1R24*MCC-1117/4AD	ON	
1E11* MOV-Ø42A	RHR TO SUPPRESSION POOL	1R24*MCC-1119/3EH	ON	
1E11* MOV-Ø55A	HX A VENT	1R42*MCC-1119/2AD	ON	

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SYSTEM COMPONENT POWER SUPPLIES CHECKLIST

CAUTION: Place Control Switch to OFF or PULL-TO-LOCK before breaker operations.

COMPONENT NUMBER	COMPONENT DESCRIPTION	POWER SUPPLY/ BREAKER NUMBER	REQUIRED POSITION	INITIAL
1E11* MOV-Ø32C	SHUTDOWN COOLING TO *P-Ø14C	1R24*MCC1113/3IL	ON	
1E11*AOV-Ø81A & 1E11*MOV-Ø81A	LPCI INJECTION TESTABLE CHECK CHECK VALVE AND BYPASS MOV	1R24*MCC-1113/8IL	ON	
1E11* MOV-Ø31A	*P-Ø4A SUCTION	1R24*MCC-1113/3AD	ON	
1E11* MOV-Ø31C	*P-Ø14C SUCTION	1R24*MCC-1113/3EH	ON	
1E11* MOV-Ø47	SHUTDOWN COOLING SUCTION (INSIDE DRYWELL)	1R24*MCC-1118/3EH	ON	
1E11* MOV-Ø54	HEAD SPRAY (INSIDE DRYWELL)	1R24*MCC-1118/4IL	ON	
1E11* MOV-Ø38A	OUTBOARD CONTAINMENT SPRAY	1R24*MCC-1118/6AD	ON	
1E11* MOV-Ø39A	INBOARD CONTAINMENT SPRAY	1R24*MCC-1118/6EH	ON	
1E11* MOV-Ø4ØA	SHUTOFF TO DRYWELL SPRAY AND SUPPRESSION POOL	1R24*MCC-1112/5CJ	ON	
1E11* MOV-Ø34A	HX A SHELL SIDE BYPASS	1R24*MCC-1112/2IL	ON	
1E11* MOV-Ø45A	RHR PUMPS A & C MIN FLOW	1R24*MCC-111X/2EI	ON	
1E11* P-Ø14A	RHR PUMP A	1R22*SWG-1Ø1/7	RCP	

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SYSTEM COMPONENT POWER SUPPLIES CHECKLIST

CAUTION: Place control switch to OFF or PULL-TO-LOCK before breaker operations.

COMPONENT NUMBER	COMPONENT DESCRIPTION	POWER SUPPLY/ BREAKER NUMBER	REQUIRED POSITION	INITIALS
1E11* MOV-Ø56A	HX A VENT	1R24*MCC-1119/2EH	ON	
1E11* MOV-Ø33A	HX A SHELL SIDE INLET	1R24*MCC-1119/3AD	ON	
1E11* MOV-Ø43A	HX A TO RCIC	1R24*MCC-1119/5AD	ON	
1E11* MOV-Ø32A	SHUTDOWN COOLING TO *P-Ø14A	1R24*MCC-1112/2AD	ON	
1E11* SOV-Ø61A	HX A SHELL SIDE DRAIN SAMPLE	120V AC RPS BUS A	ON	
1E11* SOV-Ø62A	HX A SHELL SIDE DRAIN SAMPLE	120V AC RPS BUS A	ON	
1E11* MOV-Ø52	RHR DISCHARGE TO RADWASTE	1R24*MCC-1121/2AD	ON	
1E11* MOV-Ø41B	INLET TO SUPP POOL SPRAY	1R24*MCC-1121/4EH	ON	
1E11* MOV-Ø44B	HX B DRAIN TO SUPPRESSION POOL	1R24*MCC-1121/5AD	ON	
1E11* MOV-Ø36B	LPCI INJECTION TO RX VESSEL	1R24*MCC-112Y/1JM	ON	
1E11* MOV-Ø37B	OUTBOARD LPCI ISOLATION TO RX VESSEL	1R24*MCC-112Y/2CI	ON	
1E11* MOV-Ø35B	HX B SHELL SIDE OUTLET	1R24*MCC-1127/3DC	ON	
1E11* MOV-Ø42B	INLET TO SUPPRESSION POOL	1R24*MCC-1129/4EH	ON	

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SYSTEM COMPONENT POWER SUPPLIES CHECKLIST

CAUTION: Place control switch to OFF or PULL-TO-LOCK before breaker operations.

COMPONENT NUMBER	COMPONENT DESCRIPTION	POWER SUPPLY/ BREAKER NUMBER	REQUIRED POSITION	INITIALS
1E11* MOV-Ø57B	RHR TO H_2 RECOMBINER	1R24*MCC-1129/5IL	ON	
1E11* MOV-Ø43B	HX B DRAIN TO RCIC	1R24*MCC-1129/2EH	ON	
1E11* MOV-Ø33B	HX B SHELL SIDE INLET	1R24*MCC-1129/2IL	ON	
1E11* MOV-Ø55B	HX B SHELL SIDE VENT	1R24*MCC-1129/5EH	ON	
1E11* MOV-Ø56B	[illegible] B SHELL SIDE VENT	1R24*MCC-1129/5AD	ON	
1E11*AOV-Ø81B 1E11*MOV-Ø81B	[illegible] INJECTION TESTABLE CHECK [illegible] AND BYPASS MOV	1R24*MCC-1118/3IL	ON	
1E11* MOV-Ø5Ø	LOOP A/B CROSSTIE SHUTOFF	1R24*MCC-1128/8FH	OFF	
1E11* MOV-Ø38B	CONTAINMENT SPRAY OUTBOARD	1R24*MCC-1128/3EH	ON	
1E11* MOV-Ø39B	CONTAINMENT SPRAY INBOARD	1R24*MCC-1128/3IL	ON	
1E11* MOV-Ø4ØB	SHUTOFF TO DRYWELL SPRAY AND SUPPRESSION POOL	1R24*MCC-1122/1GJ	ON	
1E11* MOV-Ø45B	RHR PUMPS B&D MIN FLOW	1R24*MCC-112Y/1FI	ON	
1E11* MOV-Ø31B	*P-Ø14B SUCTION	1R24*MCC-1122/3AD	ON	

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SYSTEM COMPONENT POWER SUPPLIES CHECKLIST

CAUTION: Place control switch to OFF or PULL-TO-LOCK before breaker operations

COMPONENT NUMBER	COMPONENT DESCRIPTION	POWER SUPPLY/ BREAKER NUMBER	REQUIRED POSITION	INITIALS
1E11* MOV-Ø31D	*P-Ø14D SUCTION	1R24*MCC-1122/3EH	ON	
1E11* MOV-Ø32D	SHUTDOWN COOLING TO *P-Ø14D	1R24*MCC-1122/2AD	ON	
1E11* MOV-Ø32B	SHUTDOWN COOLING TO *P-Ø14B	1R24*MCC-1122/3IL	ON	
1E11* MOV-Ø34B	HX B SHELL SIDE BYPASS	1R24*MCC-1122/2EH	ON	
1E11* MOV-Ø48	SHUTDOWN COOLING SUCTION	1R42*MCC-ØB2/3M	ON	
1E11* MOV-Ø53	HEAD SPRAY	1R42*MCC-ØB2/2D	ON	
1E11* MOV-Ø51	RHR DISCHARGE TO RADWASTE	1R42*MCC-ØA1/4H	ON	
1E11* SOV-Ø61B	HX B SHELL SIDE SAMPLE	120V AC RPS BUS B	ON	
1E11* SOV-Ø62B	HX B SHELL SIDE SAMPLE	120V AC RPS BUS B	ON	
1E11*PCV-ØØ3A 1E11*PCV-ØØ7A	HPCI STEAM PRESSURE CONTROL TO AND WATER PRESSURE CONTROL FROM HX A	1R35*PNL-R1/Ø8	ON	
1E11*PCV-ØØ3B 1E11*PCV-ØØ7B	HPCI STEAM PRESSURE CONTROL TO AND WATER PRESSURE CONTROL FROM HX B	1R35*PNL-R1/Ø8	ON	
1E21* P-Ø49A	CORE SPRAY/RR LOOP LEVEL PUMP A	1R24*MCC-1117/4EG	ON	
1E21* P-Ø49B	CORE SPRAY/RHR LOOP LEVEL PUMP B	1R24*MCC-1127/3AC	ON	

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Attachment B to LILCO's
7/9/82 Testimony on
Water Hammer Procedures
and Training

INFORMATION COPY

LESSON PLAN

REACTOR CORE ISOLATION COOLING SYSTEM

(RCIC)

MASTER COPY

LILCO SYS 119

S&W SYS 1E51

Rev. 2 Date: April 26, 1982

Prepared By: Ken Rottsnp 5/7/82
(Training Specialist) (Date)

Approved By: [signature] 5/7/82
(Training Supervisor) (Date)

1.0 LESSON PLAN: Reactor Core Isolation Cooling System (RCIC)

2.0 LECTURE DURATION: 2 Hrs. 30 Min.

3.0 MATERIALS REQUIRED FOR STUDENT:

3.1 RCIC Lesson Plan.

4.0 MATERIALS REQUIRED FOR INSTRUCTOR:

4.1 Associated Graphics

5.0 REFERENCE MATERIAL:

5.1 RCIC System Description including references therein - 1020.119

5.2 RCIC Operation Procedure 23.119.01

5.3 FSAR Sections 5.5.6 and 7.4.1.1

5.4 Technical Specifications sections 3.7.5, 4.7.5

5.5 Flow Diagram FM-22A & B

6.0 SCOPE OF LECTURE

To teach the student the piping arrangement, major components, instrumentation, system operation and system interrelations of the Reactor Core Isolation Cooling System (RCIC)

7.0 STUDENT SYNOPSIS:

At the end of this lecture the student should know:

7.1 The purpose of the system

7.2 The operating flow & range of the RCIC turbine.

7.3 Auto actions associated with system initiation & isolation.

7.4 The operation and flow path of the system during normal surveillance & emergency operation.

8.0 LESSON OUTLINE:

8.1 Theory

FIG. 1

8.1.1 Purpose of the system

1. To protect the core following a loss of normal feedwater flow.

   Figure 1 illustrates the sequence of events when the RCIC system is actuated without HPCI. The RCIC turbine pump system begins pumping in approximately thirty seconds, as the HPCI does, but because the flow capacity of the RCIC is much smaller than the HPCI, the pressure does not drop as it does for HPCI operation. The pressure rises to the relief valve setting after the isolation valves are closed. The RCIC pump makes up the relief valve losses and maintains the water level well above the top of the core at all times. RCIC provides ≈ 3% heat reject capability so it may be necessary to manually actuate relief valves for up to 30 minutes to maintain pressure.

2. Maintain the reactor in a hot standby condition following plant shutdown. (In conjunction with the RHR system in the steam condensing mode.)

3. Allows for complete plant shutdown following loss of normal feedwater until reactor is

depressurized to where the RHR system is in the shutdown cooling mode.

8.1.2 Design Basis of the System

1. The system operates automatically in time to maintain sufficient coolant in the reactor vessel so that the integrity of the radioactive material barrier is not compromised following the loss of normal feedwater flow.
2. SEISMIC, CAT. I., Testable during operation.
3. Allows complete plant shutdown under conditions of loss of normal feedwater by maintaining a sufficient water inventory until reactor is depressurized to where shutdown cooling mode of RHR system is placed in operation.
4. Provides a high degree of assurance that the system will operate when necessary by:
   a) Utilizing main steam for the turbine. Taps off prior to the MSIV's.
   b) Only requires Div. 125 V DC power for auto. start.

8.2 Physical Description

8.2.1 General Description FIG. 2

1. Steam driven turbine pump capable of delivering make-up water to the reactor vessel from Condensate Storage Tank as the primary source and suppression pool as a secondary source.

2. Includes barometric condenser, vacuum pump, condensate pump, automatic valves, control devices.

3. Initiation:

   Manual

   Reactor vessel low level (-38") (1 out of 2 twice logic)

4. Basic modes of operation:

   Standby mode (with normal reactor operation)

   Normal flow control (Start-up mode)

   Test

   Hot Standby (with RHR in Steam Cond. Mode)

5. Power Supplies - All system MOV's and auxiliaries are powered from the DIV I 125V DC system, except for inside primary containment steam line MOV's, which are AC powered. However, these AC valves are normally open, therefore only DC power is needed to allow system to operate. (In addition steam line isolation AOV & condensate pump discharge AOV are supplied by 125V DC from DIV II & steam line isolation valves inside containment are supplied by DIV II AC power.)

FIG. 3

8.2.2. Major Equipment Description

1. RCIC Turbine - one 100% capacity turbine, very ... inefficient but extremely reliable. Operates at variable speeds & variable steam inlet conditions & provides 425 gpm flow over the entire operating range. Reaches full speed and load within 30 seconds of initiation. Started and stopped from control room or remote shutdown panel (manual line-up valves). Rupture discs on the exhaust line from the turbine prevent over-pressurization. FIG. 4

2. RCIC Pump - Five stage single suction, double volute pump. Maintains 400 GPM against reactor pressure of 1135 psig. Provides this flow @ 100 psig above RPV pressure.

3. Turbine Auxiliary Systems FIG. 5

Turbine seals, trip and throttle valve and control valve steam leakoffs are exhausted to barometric condenser, which maintains vacuum to prevent steam leaking to RCIC area. Condenses steam using cool condensate (discharge from lube oil cooler) spray.

Condensate is removed by a pump, which sends it to RCIC pump suction or clean radwaste. Non-condensibles are removed by a vacuum pump which exhaust to the suppression pool.

4. Lube Oil System (Turbine)

Turbine shaft driven oil pump supplies actuating oil for turbine control valve, and turbine bearings. Each sleeve bearing is drilled and grooved to carry oil. Sleeve bearings contain oil ringsto provide lubrication during coas[illegible]own. Bearing boxes have sight glasses for level indications.

5. RCIC loop level pump (P-51)

Keeps RCIC piping full of water to minimize water hammer effects and injection time when starting up system. Location in Reactor Building (NE) El. 8' (outside drywell). Single stage motor driven centrifugal pump - maintains disch. line full.

- Power supplied by DIV I 480V MCC.
- Approximately 55# Discharge Pressure.

6. Condensate Pump (P-77)

To pump the RCIC turbine's exhaust steam and seal steam condensate from the barometric condenser to the RCIC pump suction line.

Location in Reactor Building (NE) El. 8' (outside drywell).

Power supplied by DIV I 125 V DC MCC.

7. Vacuum Pump (P-76)

Maintain vacuum in barometric condenser, discharge to suppression pool. Location in Reactor Building (NE) El. 8' (outside drywell). Power supplied by DIV I 125V DC MCC.

8. Major valves

a) Control switch location on 1H11*PNL-602, main control room panels.

b) Steam Supply Stop Valve (MOV-043)

Valve is normally closed against reactor pressure. Located near turbine and its Trip/Throttle valve (MOV-044) and Governor (Control) Valve (HOV-051) so that most of steam supply line can be maintained hot (at reactor pressure) and full of steam. Drain pot just above MOV-043 keeps steam line drained.

c) Turbine Trip and Throttle Valve (MOV-044) FIG.6

Primary function is to fast close on a turbine trip. Secondary function is to backup the governor (control) valve (HOV-051) by throttling capability if

control of governor valve is lost. Motor operator on MOV-044 also provides ability to reopen valve from control room following a trip. In order to reset turbine after a trip, the trip and throttle valve must be closed in order to relatch valve.

d) Turbine Governor Valve (HOV-051)
Valve is positioned by the Turbine Governor Control System, either in manual or auto, to control the RCIC pump flow by controlling the steam flow to the turbine.

8.3 Principles of Operation

8.3.1 System operational modes

1. Normal operation - standby FIG. 7

During normal reactor operation the RCIC system is maintained in a standby mode - ready for either automatic or manual initiation of the system. The steam supply line is maintained hot, pressurized and drained up to the Steam Supply Stop Valve (MOV-043) to minimize the thermal and hydraulic stresses from a rapid start (automatic) of RCIC.

a) Loop Level pump - maintain RCIC pump discharge line full to minimize water hammer and time

system starts injecting water.

b) Valve positions as shown in Fig. 7 MOV-031, closes if MOV-032 opens, AOV's-081, 082 open, LCV-091 closed; LCV-091 opens on high trap level; AOV-083 open, LCV-095 closed; LCV-095 opens on high level condenser.

c) Maximum flow (high speed) demand signal is present at turbine governor. More detail on governor in startup mode.

2. Startup mode (RCIC pump start - from automatic or manual initiation) FIG. 8

Starts automatically on vessel low water level (-38"). Manually initiated by arming and then depressing switch on panel 602.

Actions occurring on auto-manual initiation are as follows:

MOV's-041, 048 receive backup open signal

MOV's-042, 047 open

MOV-036 open @125 psig & 40 GPM, closes 80 GPM to maintain at least minimum flow (auto closes if either MOV-043 or 44 are fully closed)

MOV-043 opens, MOV-044 & HOV-051 are full open

MOV-035 opens, MOV-034 was open

MOV-031 receives backup open signal

AOV-081, 082 close

MOV-038 opens

AOV-083, LCV-095 close

MOV-037 receives backup close signal

Barometric condenser condensate pump cycles by level switch in condenser

Vacuum pump starts

Turbine goes to high speed due to maximum flow demand signal present

Basic turbine speed control - Opening of the turbine control valve is governed by by flow or speed controller. The speed controller compares a speed reference signal tc a speed feedback signal provided from an electric tachometer on the turbine shaft and the flow demand to the actual flow. The speed controller generates the least electrical error signal which is transformed into a hydraulic signal in a hydraulic actuator. This hydraulic signal then positions a servo valve which opens or closes the governing valve to increase or decrease the speed of the turbine to its reference. Since "Idle" speed signal is less its signal range speed control as valve opens ramp speed control takes over. Flow starts to increase to the point it is smallest error signal and takes control. FIG. 9

3. Testing Mode

A design flow functional test of RCIC is performed during plant operation by taking suction from CST, through pump, full flow test line back to CST. Discharge valve MOV-035, remains closed and reactor operation is undisturbed. (Test of RCIC should be done with a slow acceleration after 1000 RPM). Before functionally testing MOV-035 in the open direction, close MOV-034 first. Auto return from test to startup if initiation signal received. All motor operated valves can be tested full cycle during normal operation. Functional test except when auto start or auto isolation signal is present.

4. Hot Standby Mode (with RHR in Steam Condensing Mode)

The objective of the hot standby mode is to work with the RHR system to maintain reactor close to operating pressure and temperature so that the plant can be put on line with a minimum of delay, after the existing problem is resolved. The RCIC pump will pump the reactor steam, condensed in the RHR heat exchanger back to the reactor, thus minimizing any inventory lost from steam being rejected to maintain pressure. Level control in the RHR heat exchanger is very important. Too high a level could force water up the RCIC steam line and into the main steam line. Too low a water level will induce steam in the RCIC

pump supply and cause the pump to cavitate.

Two means of level control are used together. An automatic controller can be used to throttle the pressure control valve in the RCIC pump suction line. This controller controls on level in the heat exchanger, unless pump suction pressure drops too low (then it will control on pump suction pressure). To provide the additional control needed, the RCIC steam flow to the turbine can be varied - this will only be done in manual and will require an operator full time to monitor heat exchanger level and vary steam flow to vary pump speed and thus control heat exchanger level.

5) Technical Specifications 3/4.7.5 specify:

a. operability requirements

b. appropriate actions if RCIC is not operable and

c. surveillance requirements

8.3.2 Hazards and Precautions

1. Check cooling water supply valve (MOV-038 open when system actuates.
2. Trip/throttle valve (MOV-044) manually declutched for manual operation.
3. Minimum speed (turbine) 2000 RPM.
4. Water hammer in turbine exhaust line at low speed and flow.

5. Line fill pump (P-51) on.

6. Minimum flow bypass (MOV-036) closed in standby mode to prevent draining the condensate storage tank to the suppression pool through the 36 valve.

8.3.3 Instrumentation and Control

1. Control room instrumentation (1H11*PNL-602) MCB

RCIC Pump

Suction Pressure
Discharge Pressure
Flow

RCIC Turbine

Steam Inlet Pressure
Exhaust Pressure
Speed
Vibration

2. Control room controls and indications (1H11*PNL-602)

MCB all MOV's and AOV's and pumps associated with RCIC.

3. Local Panel Instrumentation (1H21*PNL-17) Reactor Building. Same as Panel 602 except addition of loop level pump (P-51) discharge pressure (PIS-098) and no RCIC turbine speed indications.

4. Interlocks

a) Auto/Manual initiation FIG. 12

Initiation Signals:

1. Low Reactor water level
   -38 (1 out of 2 twice logic)
2. Manual (armed, pushbutton)
   Upon initiation the following valves receiving open signals:

MOV-042 (opens only if no auto isolation signal present)

MOV-035

MOV-043

MOV-034

MOV-038

MOV-031 (only if MOV-032 is not fully open)

MOV-041 (only if no auto isolation signal present)

Auto start of barometric condenser vacuum pump

b) Auto/Manual Isolation

Isolation Signals:

1. High Turbine Exhaust Diaphragm Pressure 10 PSIG (Indicates leak in rupture disk), or
2. Reactor Pressure Low 57 PSIG
3. RCIC equipment area hi temperature 134° F

4. Suppression pool area high temperature 134° F

Steam line high Δ P 3 Sec. T.D. 327"

(290% rated steam flow)

Manual Isolation pushbutton (only in "A" logic, and only if an initiation signal is present).

Automatic Actions on a RCIC Isolation

"A" Logic closes out board steam supply isolation valves MOV-42 & MOV-48, and trips RCIC Turbine.

"B" Logic closes inboard steam supply isolation valves MOV-41 and MOV-47, and trips the turbine.

(NOTE: Manual isolation pushbutton does not feed the "B" logic).

c) Auto, Manual-RCIC Turbine Trip Signals

Any Of The Following:

Reactor water, ni level, 54.5" (Closes MOV-043 only)

Low pump suction, 15" Hg

High turbine exhaust line pressure, 25 psig

Overspeed, 110% elec.

125% mech.

Manual or Auto Isolation

Note: Rx High Level Closes MOV-043 only, so that it will be able to Auto Start on another subsequent low level.

Automatic actions on a turbine trip:

Trip and throttle valve (MOV-044) - closes

All turbine trips except electrical overspeed, can be reset by shutting MOV-044 and then reopening in. Electrical overspeed requires manual reset by locally operating the control valve trip lever.

d) Steam Supply Valve (MOV-043)

Valve MOV-043 will not open if the turbine exhaust line isolation valve (MOV-045) is not full open.

e) Pump Suction Valves

If the pump suction valve from the suppression pool (MOV-032) is "full open", it will send a closed signal to the suction valve from the CST (MOV-031, which will prevent it from opening in response to an auto initiation signal. MOV-032 being full open will also send a closed signal to Test Bypass Valve to CST.. (MOV 37)

f) Pump Discharge Valve (MOV-034)

Auto opens on an initiation and has no auto

close signals. Is Normally Open.

g) Pump Discharge Valve (MOV-035)

Auto opens on an initiation if

1) steam line stop valve (MOV-043) not fully closed,

2) turbine stop valve (MOV-044) not fully closed.

5. System Interrelations

The RCIC system requires support of the following systems:

DIV I Emergency Power

1. 125 V DC for system MOV's & Auxiliaries. Also supplies 1 of the series isolation valves on the steam line drain & condensate pump discharge.

DIV II Emergency Power

1. 125 V DC is used to power one of the series isolation valves on the steam line drains and condensate pump discharge.

2. 480 V AC is used to supply MOV's inside containment.

8.4 Summary

The purpose of the RCIC system is to protect the core following a loss of normal feedwater flow, by injecting water into the reactor to maintain an adequate level of coolant, thus assuring adequate core cooling and preventing the fuel from overheating.

The RCIC system is also used to maintain the reactor in hot standby condition following plant shutdown and to allow for complete shutdown by maintaining sufficient water inventory until the reactor is depressurized to a level where the RHR system, in shutdown mode, can be placed into operation.

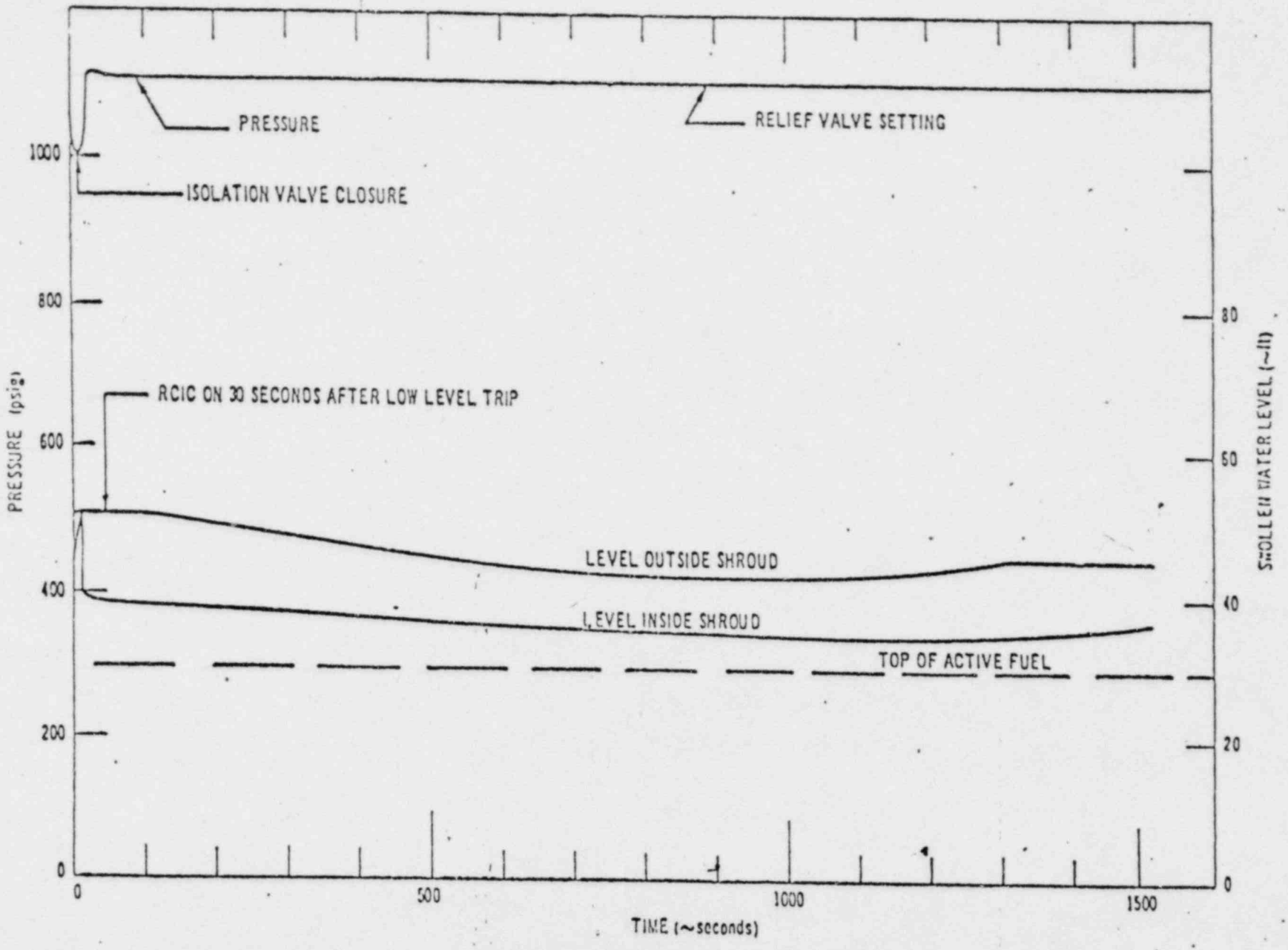
The RCIC system is initiated by low reactor vessel level (-38") or manually by the operator. System is designed to deliver 425 GPM to vessel within 30 sec.

The RCIC system has testable power operated valves and the capability of full flow test of pump while operating.

RCIC loop level pump maintains the RCIC system filled with water to prevent water hammer and reduces the time for water injection to vessel.

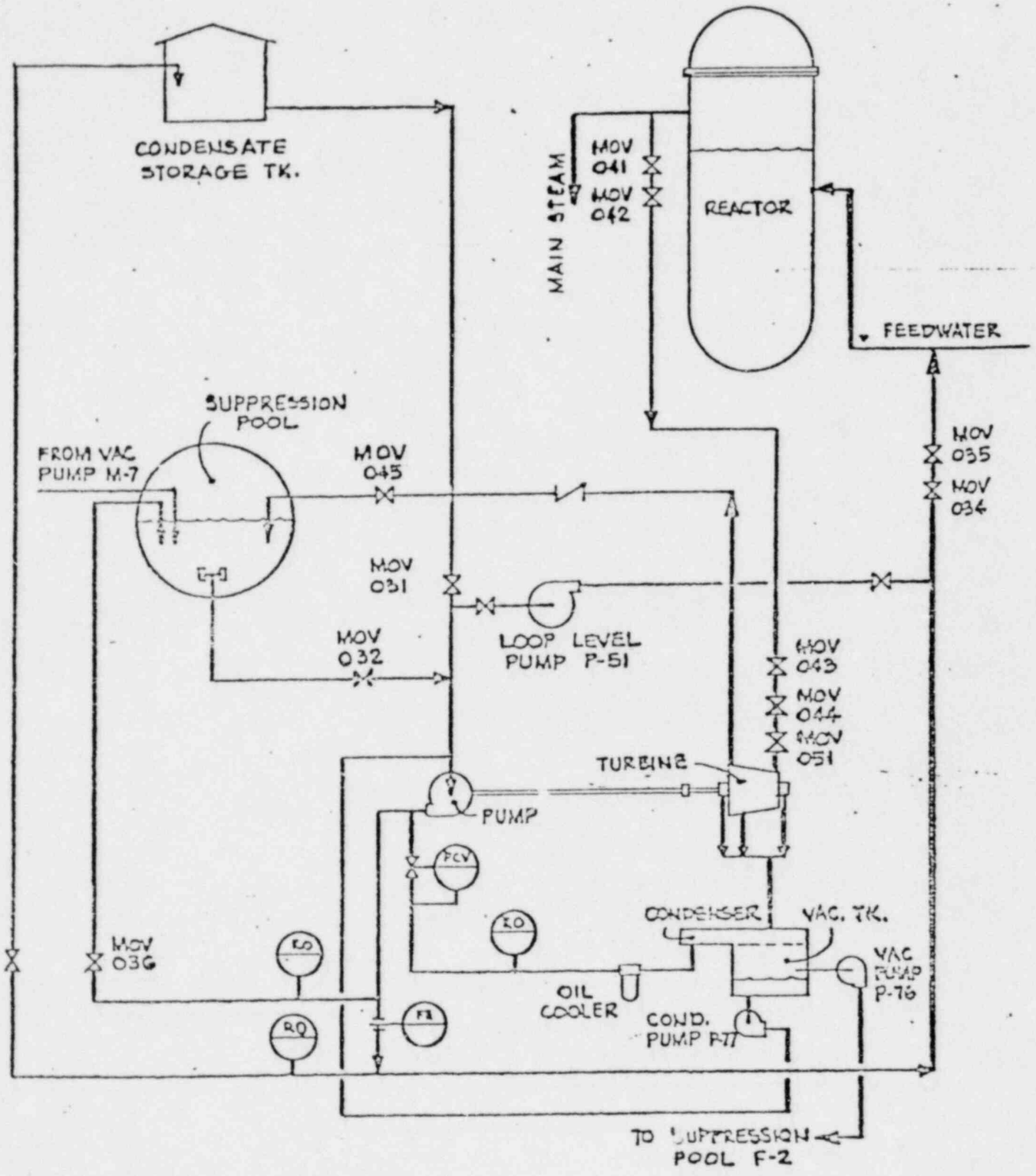
9.0 TRANSPARENCIES CONTAINED IN THIS LESSON PLAN INCLUDE:

Fig. No.	Description
1	Pressure-Level Transient Curve
2	Basic RCIC Flow Path
3	Power Distribution
4	RCIC Main Flow Path
5	Loop Level and Aux. Flow Paths
6	Turbine Trip & Throttle Valve
7	RCIC System - Standby Mode
8	RCIC System - Startup Mode
9	Turbine Governor Startup Function & Speed Characteristics
10	RCIC System Test Mode
11	RCIC System Hot Standby Mode
12	Initiation Logic
13	Isolation Logic
14	RCIC Turbine Trip Logic



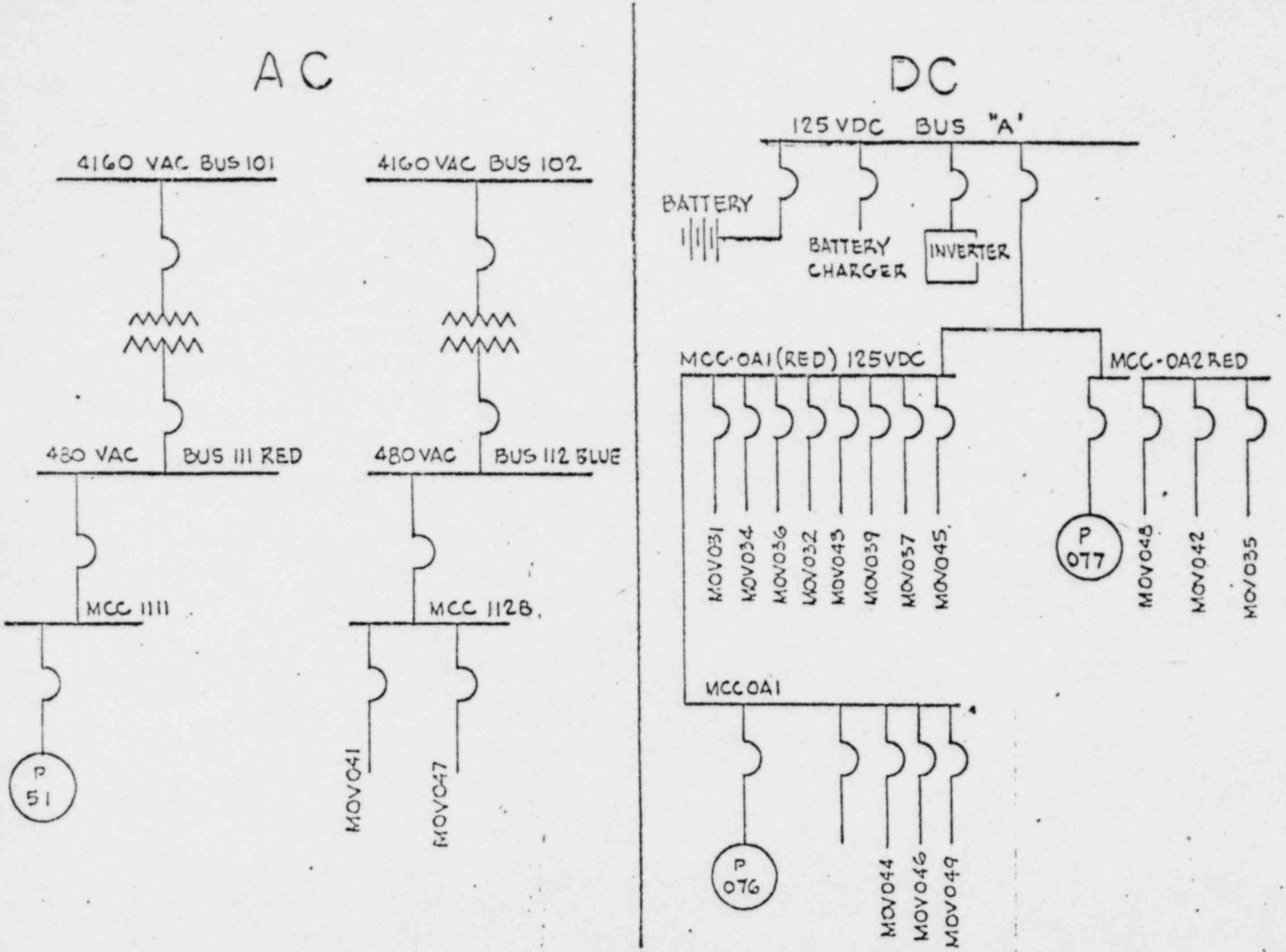
PRESSURE-LEVEL WITH RCIC ONLY & COMPLETE ISOLATION AT 10 SECONDS

Fig. 1



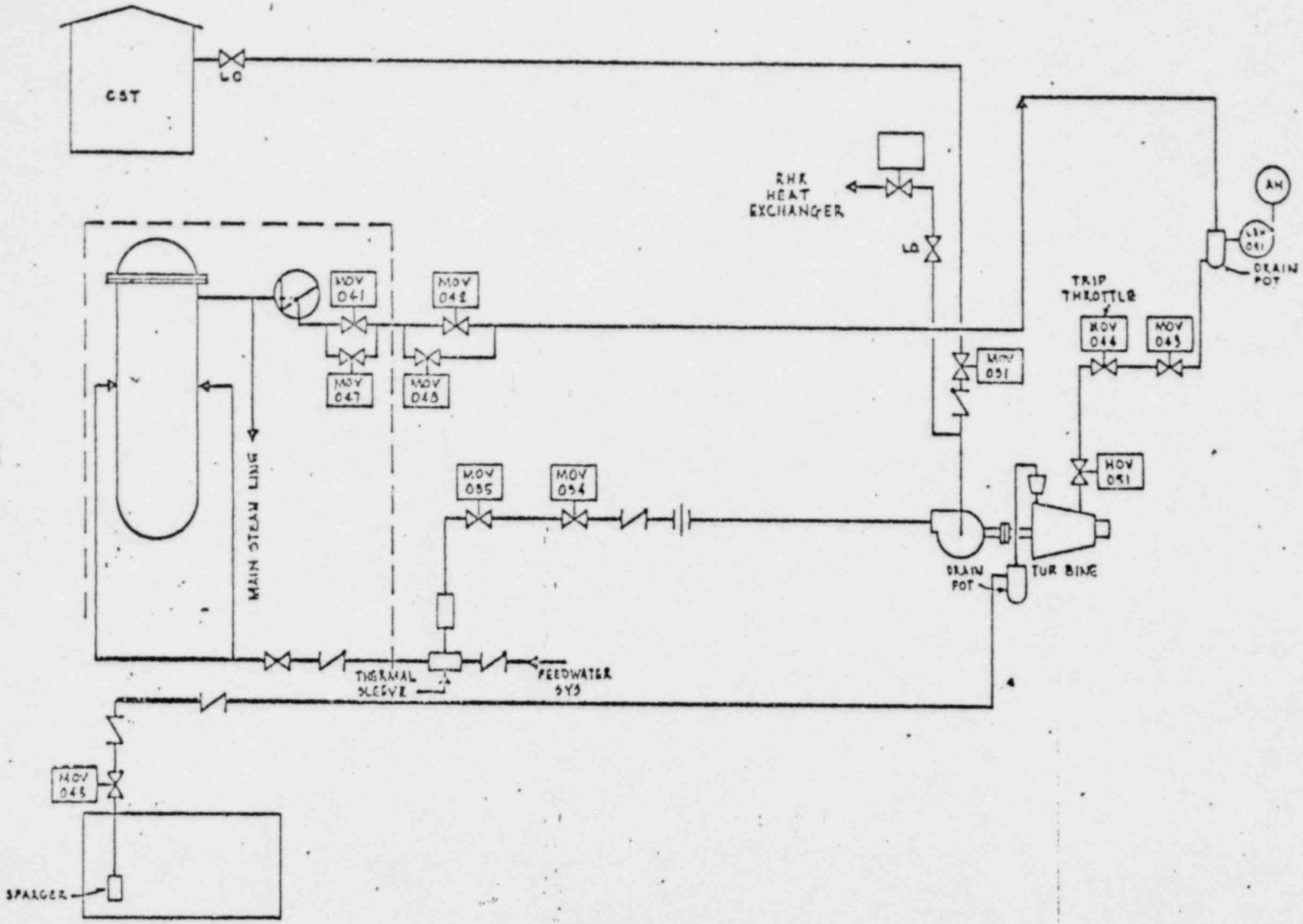
BASIC RCIC FLOW PATHS

Fig. 2



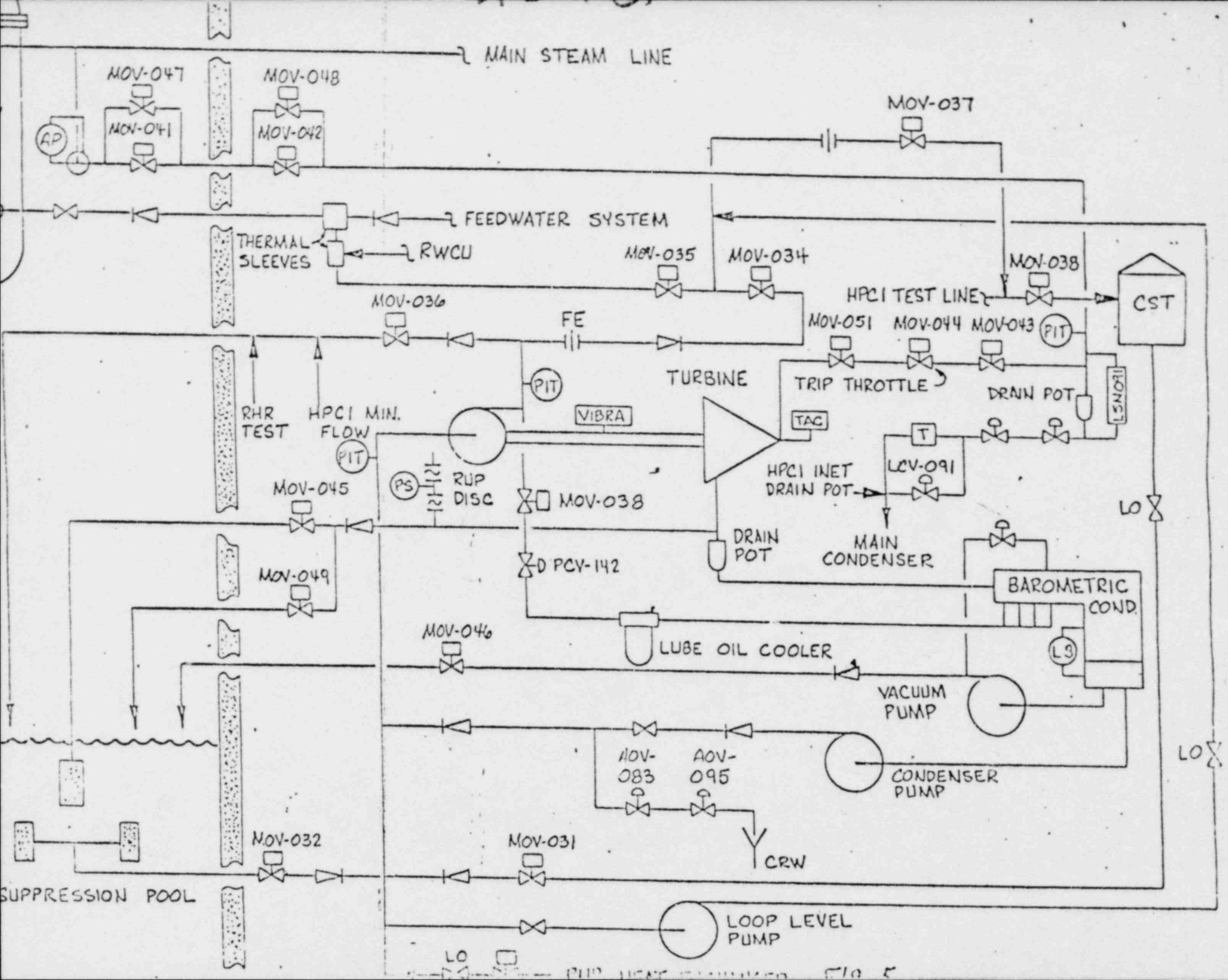
POWER DISTRIBUTION

Fig. 3



RCIC Main Flow Path

Fig. 4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MOV-048
MOV-041
MOV-042
AP
MOV-037
FEEDWATER SYSTEM
THERMAL SLEEVES
RWCU
MOV-035
MOV-034
MOV-038
HPCI TEST LINE
CST
MOV-036
FE
MOV-051
MOV-044
MOV-043
PIT
TURBINE
TRIP THROTTLE
DRAIN POT
LSNO11
RHR TEST
HPCI MIN. FLOW
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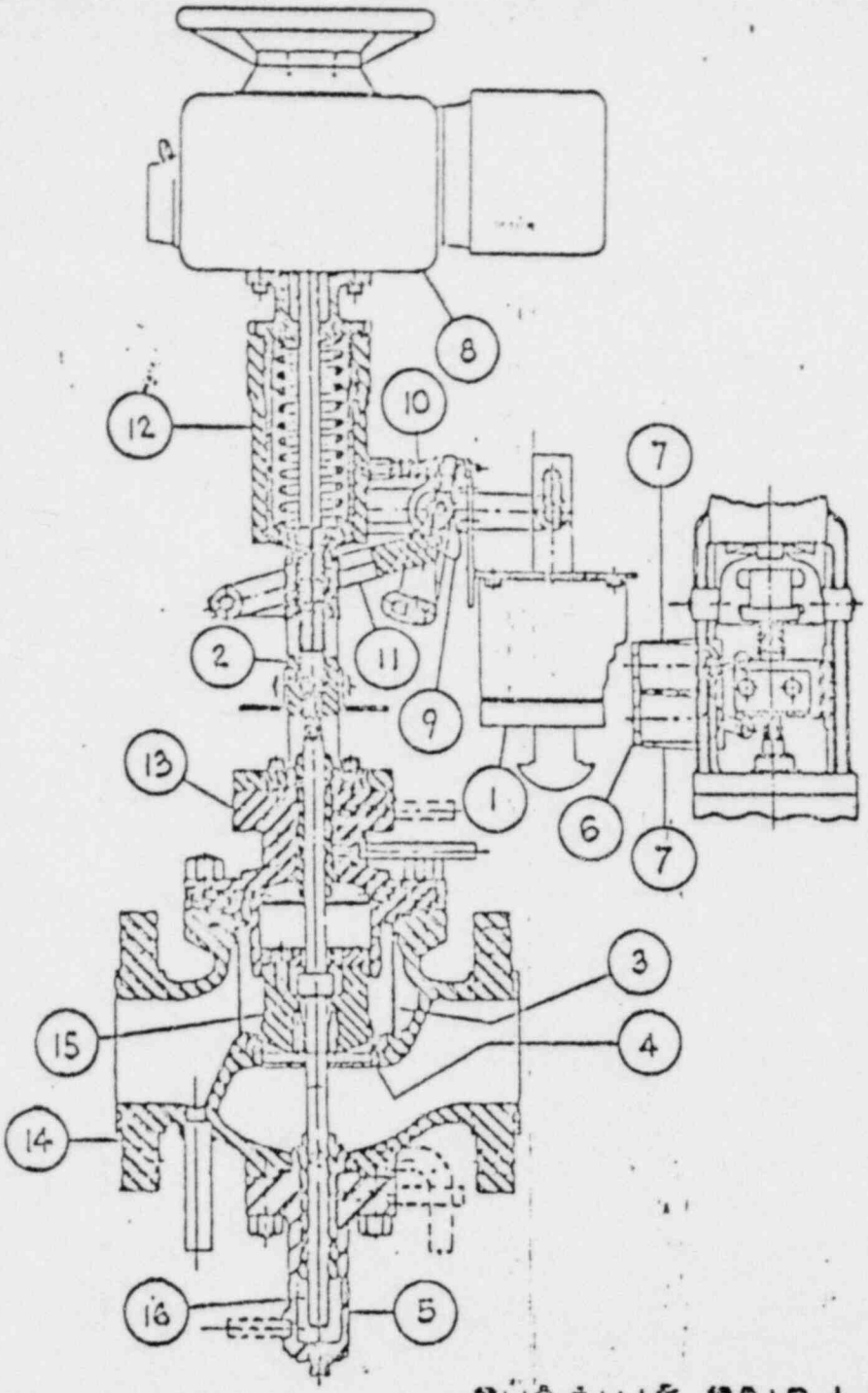
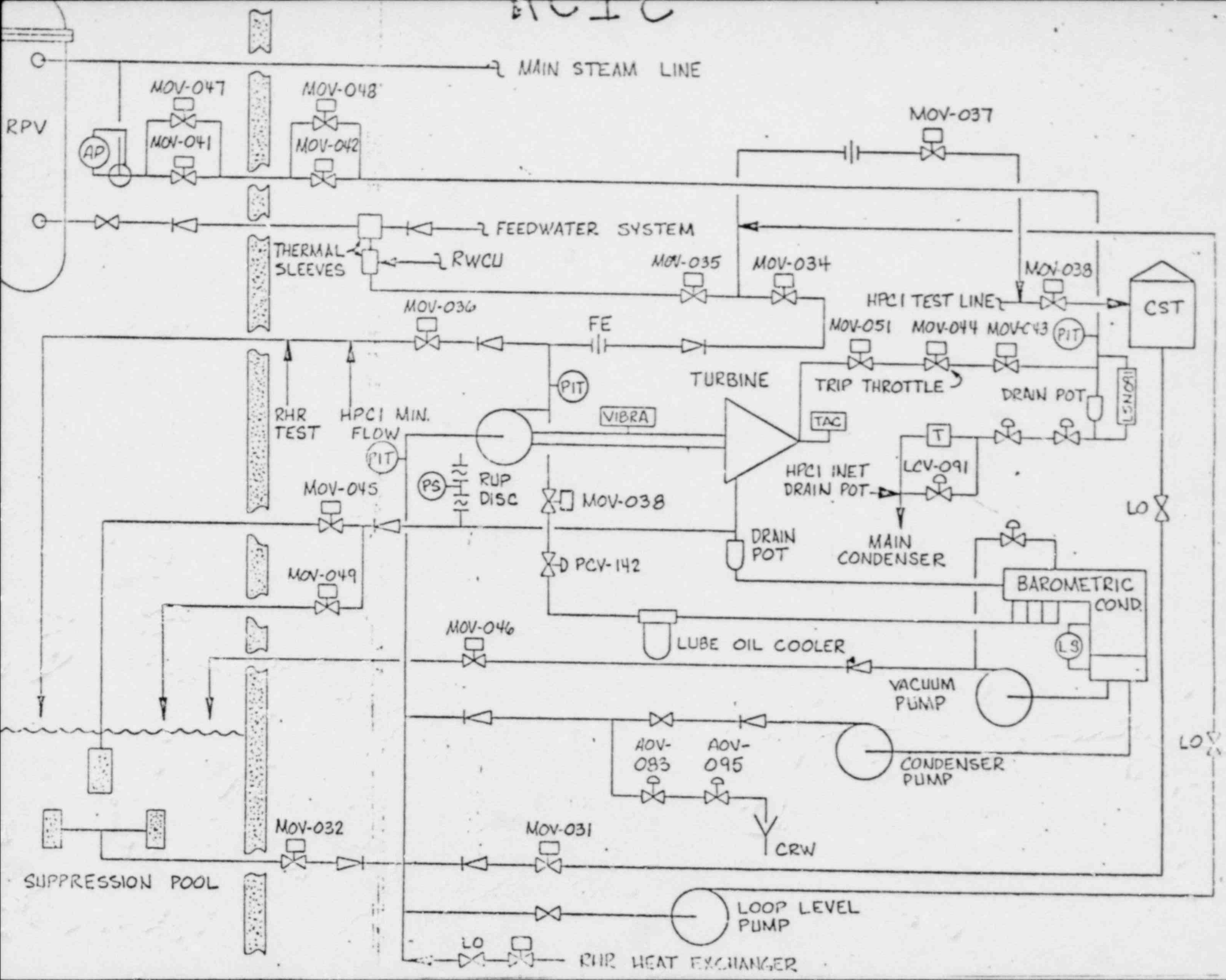
HPCI INET DRAIN POT
LCV-091
MOV-045
PS
RUP DISC
MOV-038
LO
DRAIN POT
MAIN CONDENSER
D PCV-142
MOV-049
BAROMETRIC COND.
MOV-046
LUBE OIL COOLER
L9
VACUUM PUMP
AOV-083
AOV-095
CONDENSER PUMP
LO
CRW
MOV-032
MOV-031
SUPPRESSION POOL
LOOP LEVEL PUMP
LO



PART Nº	DESCRIPTION
1	SOLENOID ASSEMBLY
2	HALF COUPLING (TWO)
3	STRAINER BASKET
4	SEAT
5	BOTTOM STUFFING BOX
6	SWITCH MOUNTING PLATE
7	SWITCH ASSEMBLY
8	LIMITORQUE MOTOR OPER.
9	TRIP HOOK
10	COMPRESSION SPRING
11	LATCHING UPPER LEVER
12	COMPRESSION SPRING
13	COVER WITH CYLINDER
14	BODY
15	DISC
16	PILOT VALVE WITH STEM

TURBINE TRIP & THROTTLE VALVE

Fig. 6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MOV-047
MOV-048
RPV
AP
MOV-041
MOV-042
MOV-037
FEEDWATER SYSTEM
THERMAL SLEEVES
RWCU
MOV-035
MOV-034
MOV-038
HPCI TEST LINE
CST
MOV-036
FE
MOV-051
MOV-044
MOV-043
PIT
TURBINE
TRIP THROTTLE
DRAIN POT
LSH-091
RHR TEST
HPCI MIN. FLOW
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T
HPCI INET DRAIN POT
LCV-091
MOV-045
RUP DISC
MOV-038
LO
DRAIN POT
MAIN CONDENSER
PCV-142
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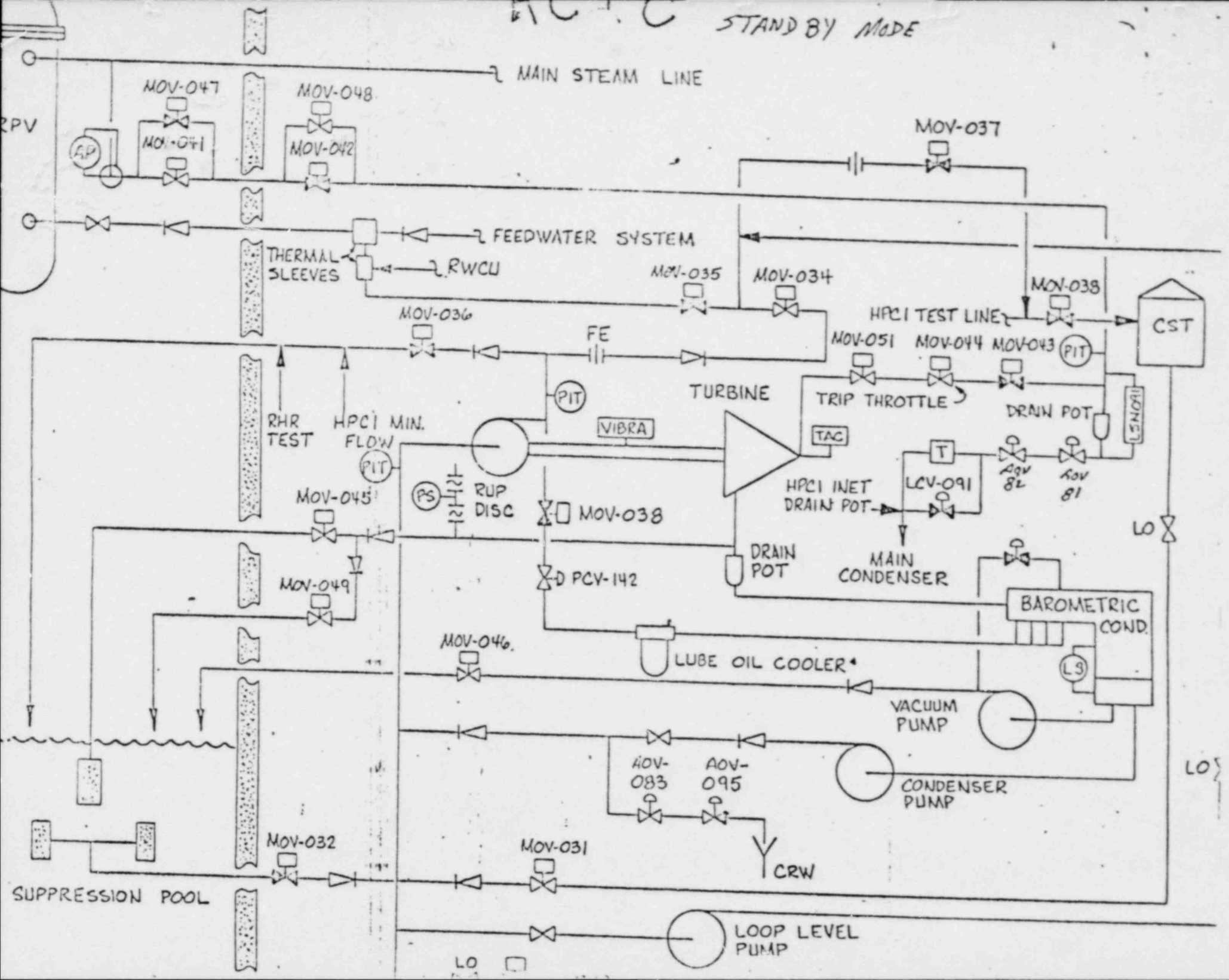
BAROMETRIC COND.
MOV-046
LUBE OIL COOLER
LS
VACUUM PUMP
AOV-083
AOV-095
CONDENSER PUMP
LO
CRW
MOV-032
MOV-031
SUPPRESSION POOL
LOOP LEVEL PUMP
LO
RHR HEAT EXCHANGER


RCIC STAND BY MODE
MAIN STEAM LINE
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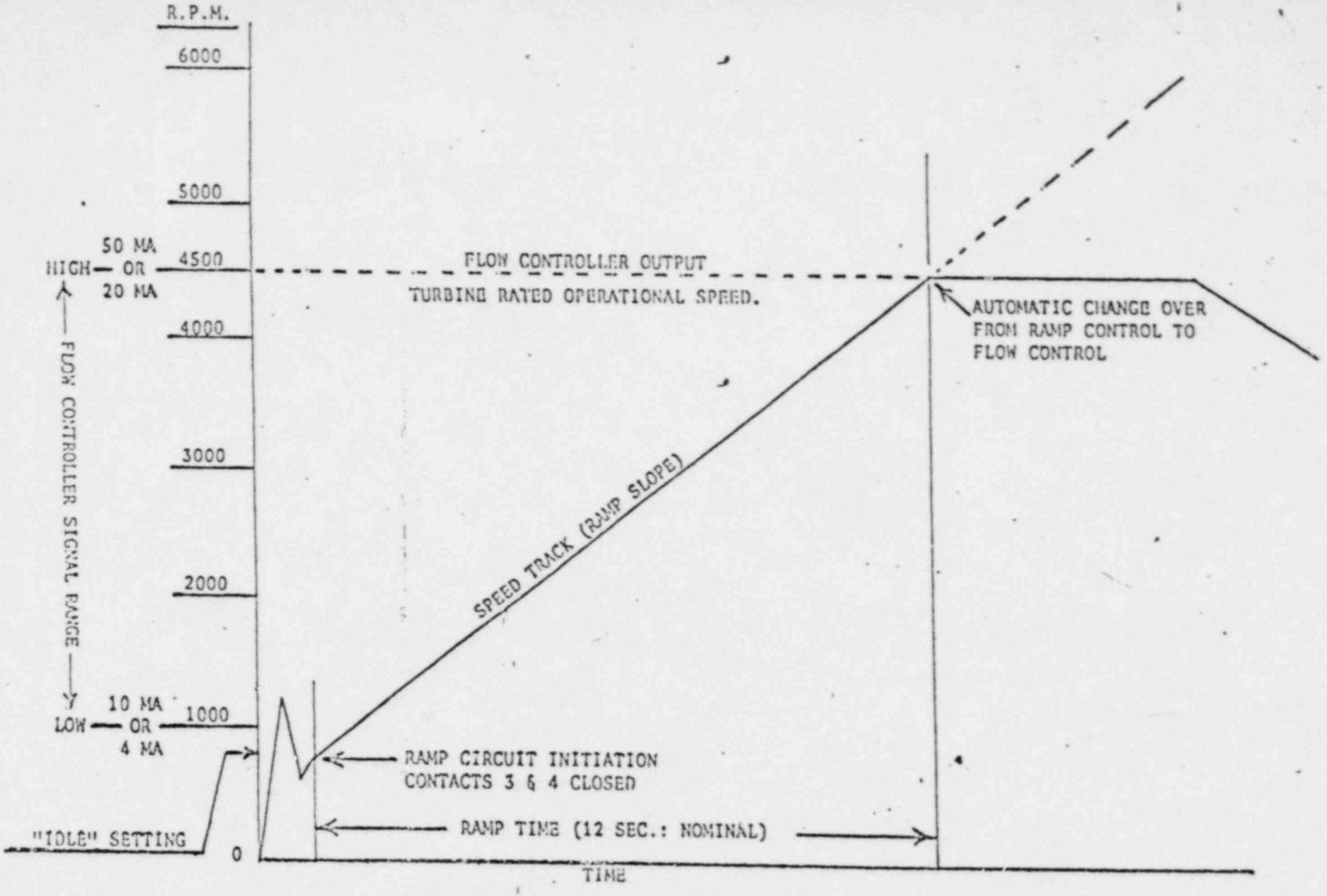
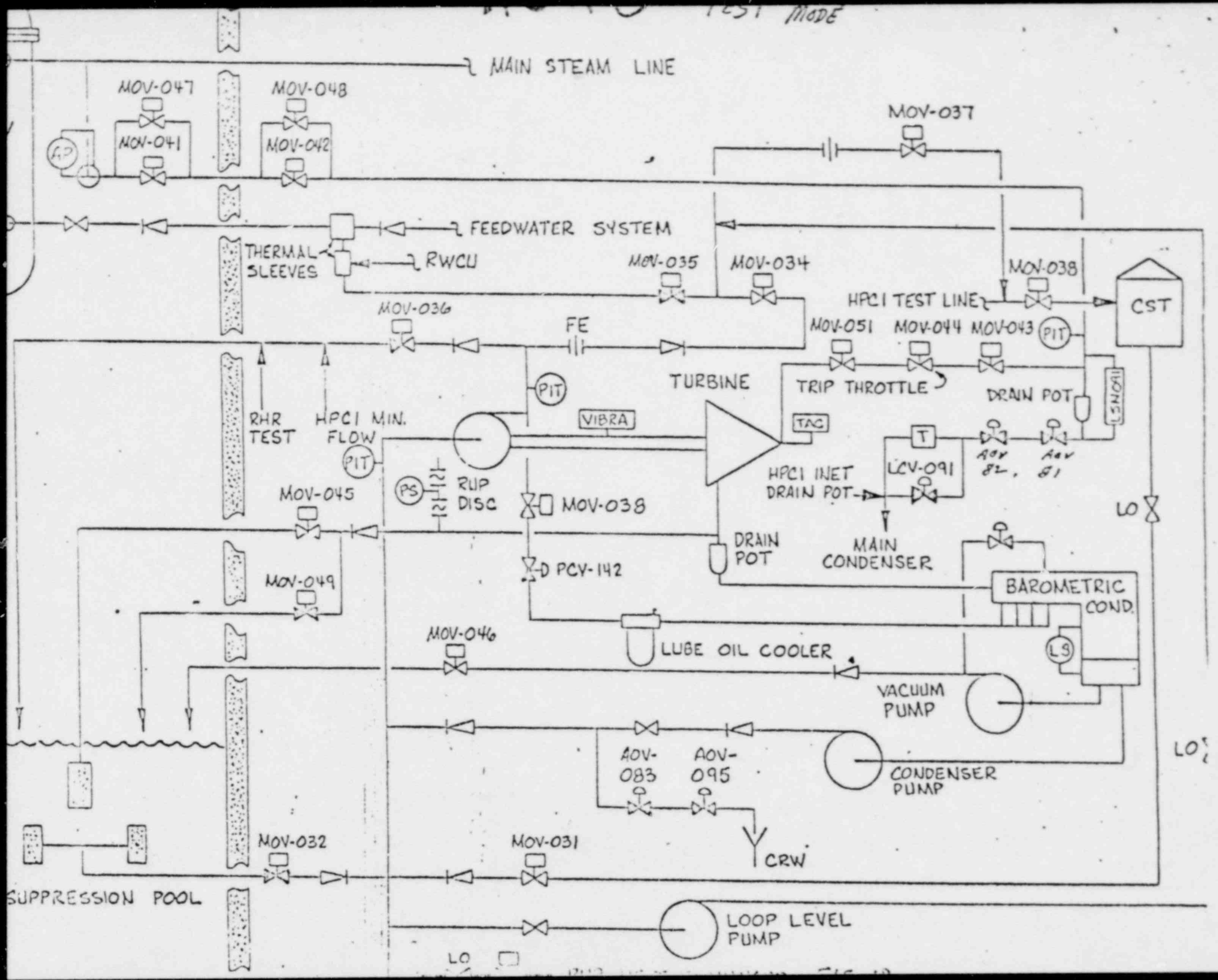
MOV-048
MOV-037
RPV
ΔP
MOV-041
MOV-042
FEEDWATER SYSTEM
THERMAL SLEEVES
RWCU
MOV-035
MOV-034
MOV-038
HPCI TEST LINE
CST
MOV-036
FE
MOV-051
MOV-044
MOV-043
PIT
TRIP THROTTLE
DRAIN POT
TURBINE
VIBRA
TAC
RHR TEST
HPCI MIN. FLOW
PIT
PS
RUP DISC
MOV-045
MOV-038
HPCI INET DRAIN POT
LCV-091
T
AOV 82
AOV 81
LO
DRAIN POT
MAIN CONDENSER
PCV-142
MOV-049
BAROMETRIC COND.
MOV-046
LUBE OIL COOLER
L3
VACUUM PUMP
AOV-083
AOV-095
CONDENSER PUMP
LO
MOV-032
MOV-031
CRW
SUPPRESSION POOL
LOOP LEVEL PUMP
LO



R.C.I.C. TURBINE GOVERNOR STARTUP FUNCTION & SPEED TRACK CHARACTERISTICS

Fig. 9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MOV-048
MOV-041
MOV-042
MOV-037
FEEDWATER SYSTEM
THERMAL SLEEVES
RWCU
MOV-035
MOV-034
MOV-038
HPCI TEST LINE
CST
MOV-036
FE
MOV-051
MOV-044
MOV-043
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TURBINE
TRIP THROTTLE
DRAIN POT
LSHONSI
RHR TEST
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T
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AOV 81
HPCI INET DRAIN POT
LCV-091
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MOV-038
DRAIN POT
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D PCV-142
MOV-049
BAROMETRIC COND.
MOV-046
LUBE OIL COOLER
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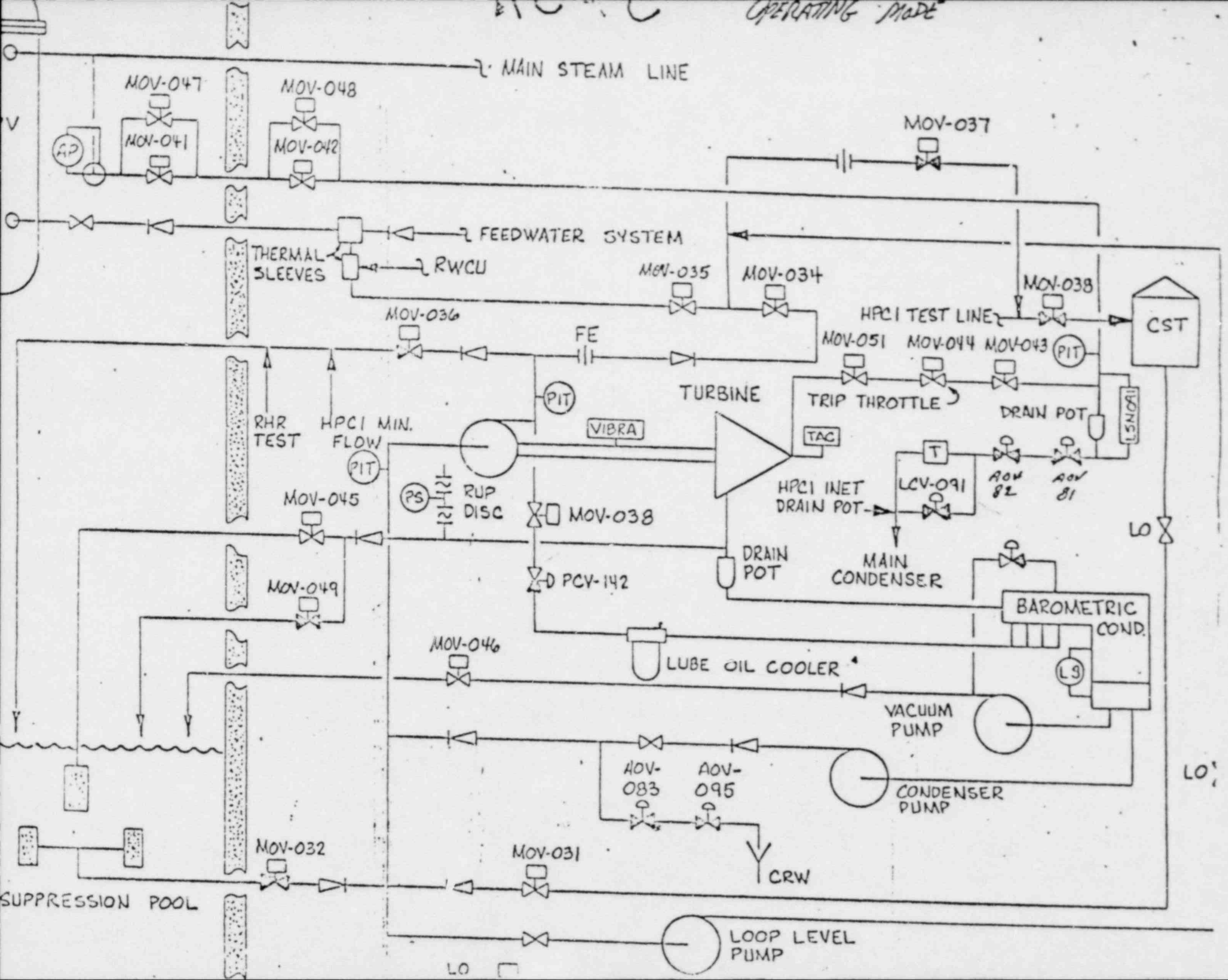
VACUUM PUMP
AOV-083
AOV-095
CONDENSER PUMP
MOV-032
MOV-031
CRW
SUPPRESSION POOL
LOOP LEVEL PUMP
LO


OPERATING MODE
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MOV-048
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MOV-042
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MOV-037
FEEDWATER SYSTEM
THERMAL SLEEVES
RWCU
MOV-035
MOV-034
MOV-038
HPCI TEST LINE
CST
MOV-036
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MOV-051
MOV-044
MOV-043
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DRAIN POT
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RHR TEST
HPCI MIN. FLOW
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LCV-091
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AOV 81
HPCI INET DRAIN POT
MOV-045
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MOV-038
LO
DRAIN POT
MAIN CONDENSER
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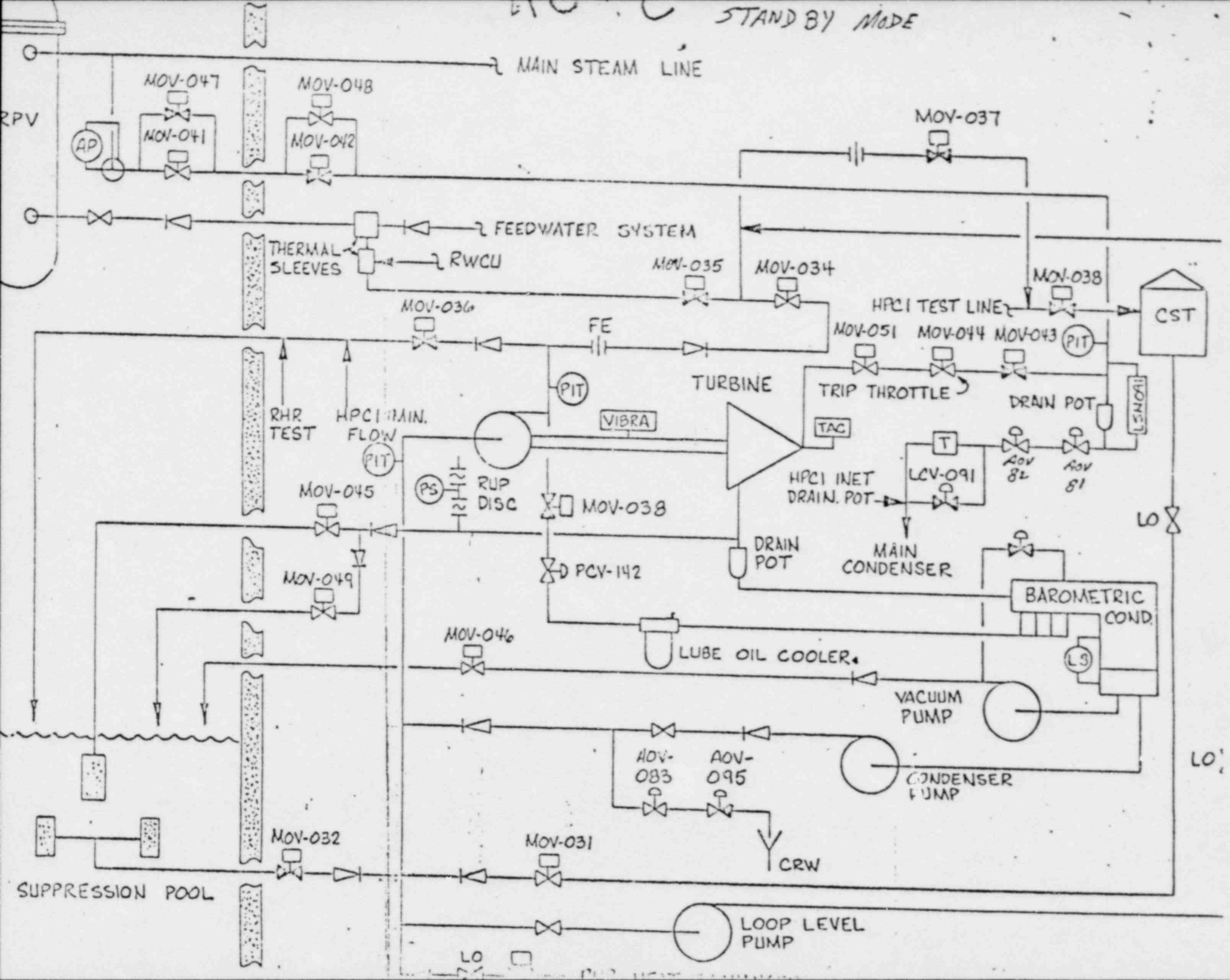
MOV-049
BAROMETRIC COND.
MOV-046
LUBE OIL COOLER
L9
VACUUM PUMP
AOV-083
AOV-095
CONDENSER PUMP
LO
MOV-032
MOV-031
CRW
SUPPRESSION POOL
LOOP LEVEL PUMP
LO


STAND BY MODE
MAIN STEAM LINE
MOV-047
MOV-048
MOV-041
MOV-042
RPV
AP
MOV-037
FEEDWATER SYSTEM
THERMAL SLEEVES
RWCU
MOV-035
MOV-034
MOV-038
HPCI TEST LINE
CST
MOV-036
FE
MOV-051
MOV-044
MOV-043
PIT
TURBINE
TRIP THROTTLE
DRAIN POT
LSH
RHR TEST
HPCI MIN. FLOW
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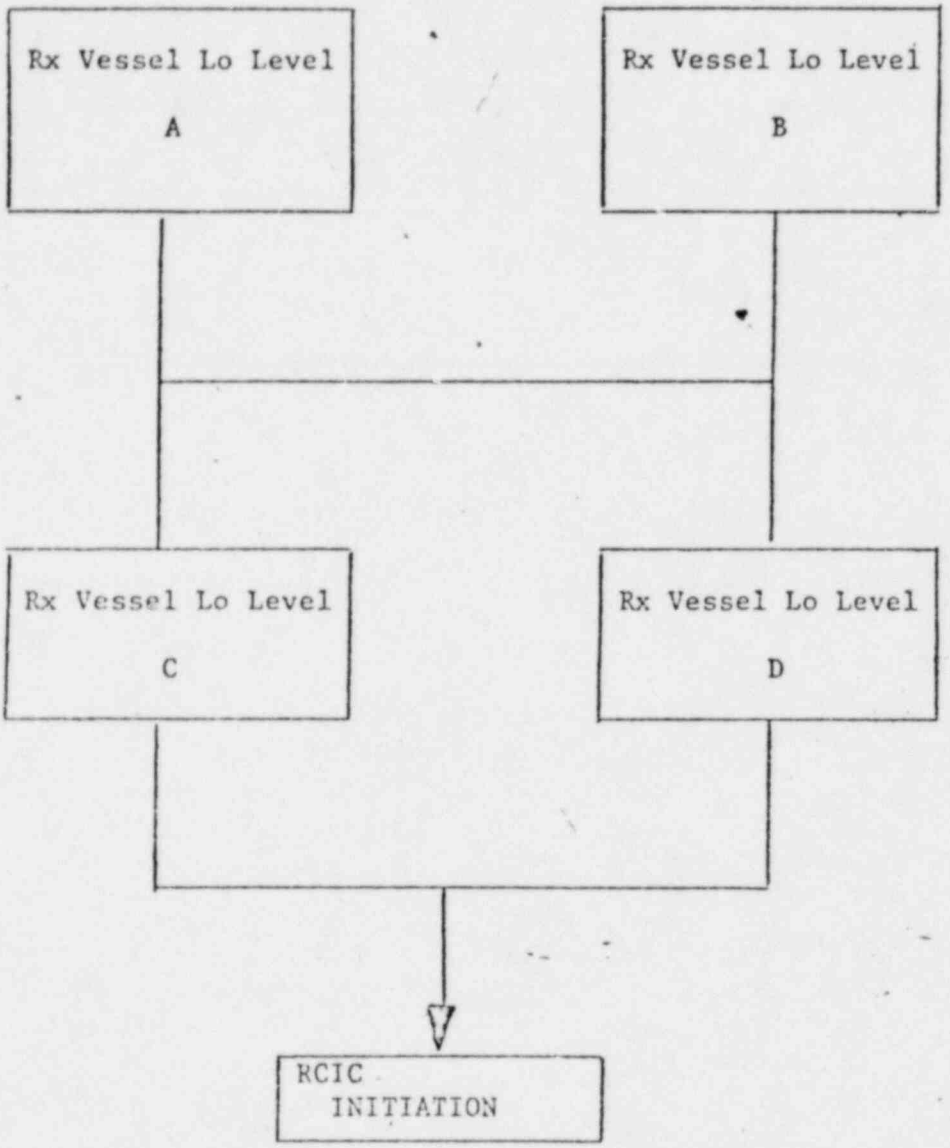
TAC
T
LCV-091
AOV 82
AOV 81
HPCI INET DRAIN. POT
MOV-045
PS
RUP DISC
MOV-038
DRAIN POT
MAIN CONDENSER
LO
PCV-142
MOV-049
BAROMETRIC COND.
MOV-046
LUBE OIL COOLER
LS
VACUUM PUMP
AOV-083
AOV-095
CONDENSER PUMP
LO
MOV-032
MOV-031
CRW
SUPPRESSION POOL
LOOP LEVEL PUMP
LO

125 V DC logic energize to operate.



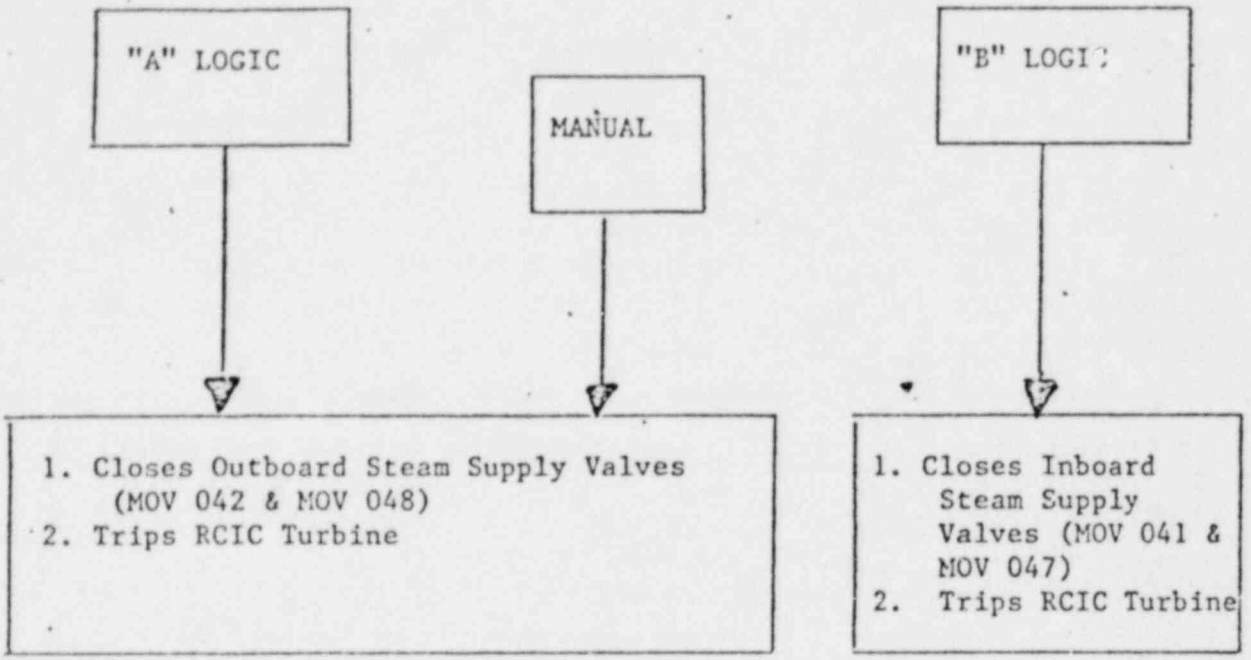
Level Instruments Are Part Of Wide Range Vessel Instrumentation.

A&C Instruments Come Off 1 Condensing Chamber.

B&D Instruments Come Off 1 Condensing Chamber

Therefore Leak in Variable Leg Will Cause Auto Initiation

RCIC INITIATION LOGIC FIG. 12



Above Logic Schemes Insure Redundant Isolation & Trip Signals Are Generated Due To An Isolation Signal Being Received.

ISOLATION SIGNALS

1. High Rx Water Level
2. Low Rx Pressure
3. High ΔP On Steam Supply Line
4. Turbine Exhaust Diaphragm Press High
5. RCIC Area High Temp. (Or Cooler T)
6. Suppression Pool Area High Temp. (Or Cooler T)

RCIC ISOLATION LOGIC FIG. 13

DATA SHEET

Data

Initiates on 1 out of 2 twice reactor low level (-38")

425 gpm, 2800 ft. head

80 gpm closes

40 gpm at pump discharge 125 psig for minimum flow opening

Rated injection within 30 sec.

Isolates on - High turb. exh. diaph. press.	10 psig	
Reactor Pressure Low	60 psig	
RCIC equipment area high temp	(LATER)	
Suppression pool high temp	(LATER)	
Steam line hi Δ P or inst line break	290%	3 sec. time delay
Manual Isolation P.B.		
Heat Removal Capacity 3%		
Turbine Trips - Reactor Water Level High	54.5"	(TT & T MOV-043 Only)
Low Pump Suction	15" Hg	
High Turbine Exh. Pressure		
Overspeed	110% electrical, 125% mechanical	
Manual Trip P.B.		
Auto Isolation Signal		

The turbine governor system consists of seven components:

Resistor Box - reduces 125V DC input to a 48V DC output to the EG-M box

Ramp Generator and Signal Convertor Box - provides the speed reference voltage to the speed reference section of the EG-M box.

Consists of the following:

Low signal selector - select the lowest (least positive) signal from either Ramp Generator or Signal Convertor and sends it to speed reference section of EG-M box.

Ramp Generator - provides two functions:

A continuous (low voltage) Idle output signal to hold turbine at low speed setting until the ramp function is initiated.

A ramp function is initiated by closing the ramp circuit switch contacts (3&4). Produces a positive linear increasing D.C. voltage to speed reference section of EG-M box.

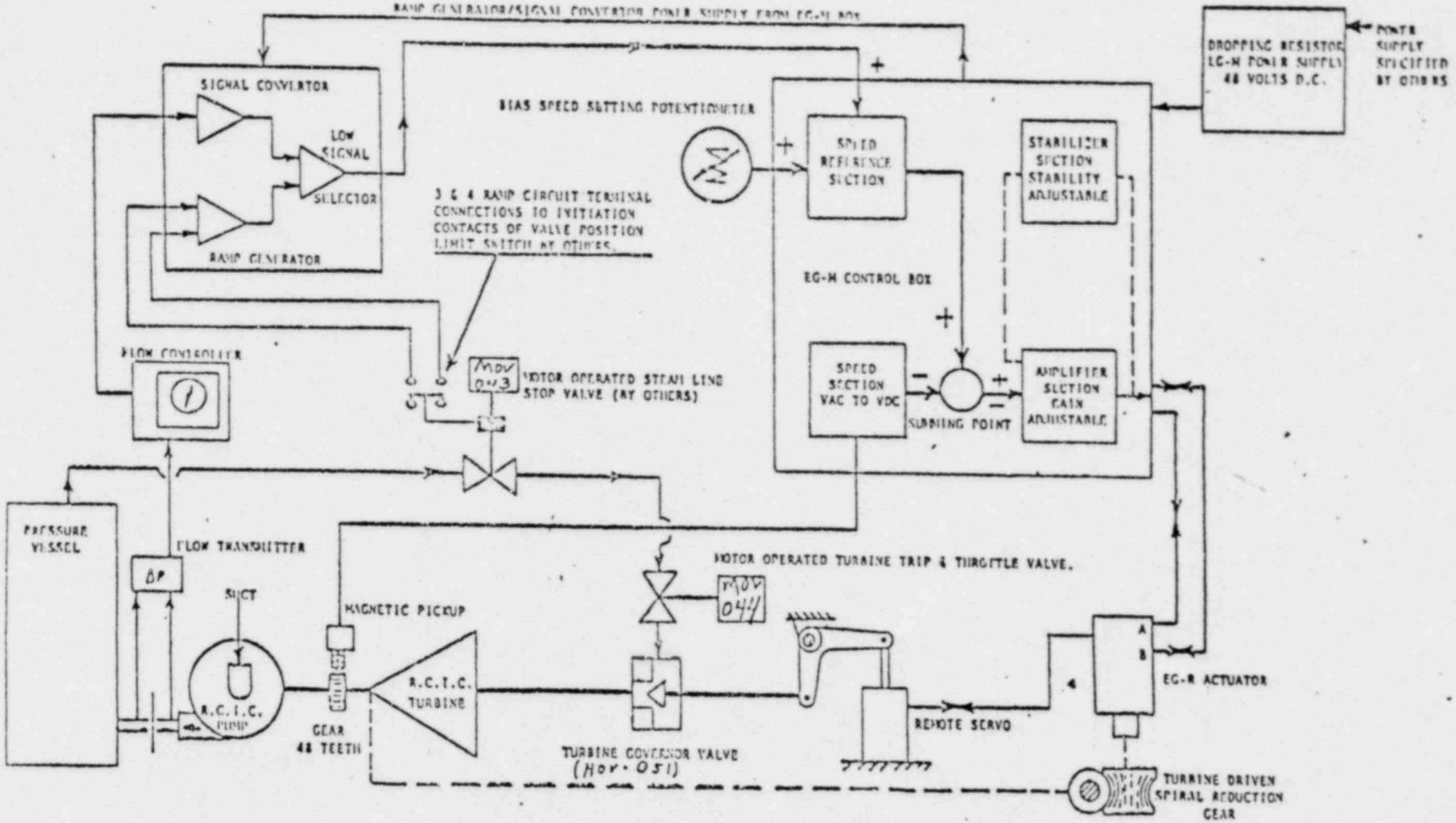
Signal Convertor - provides the pump flow versus speed voltage to the speed reference section of the EG-M box.

Bias speed setting potentiometer - used for local manual speed control.

Magnet pickup - produces signal to EG-R actuator.

EG-R Electro-Mechanical-hydraulic actuator - in conjunction with a remote servo adjust turbine speed.

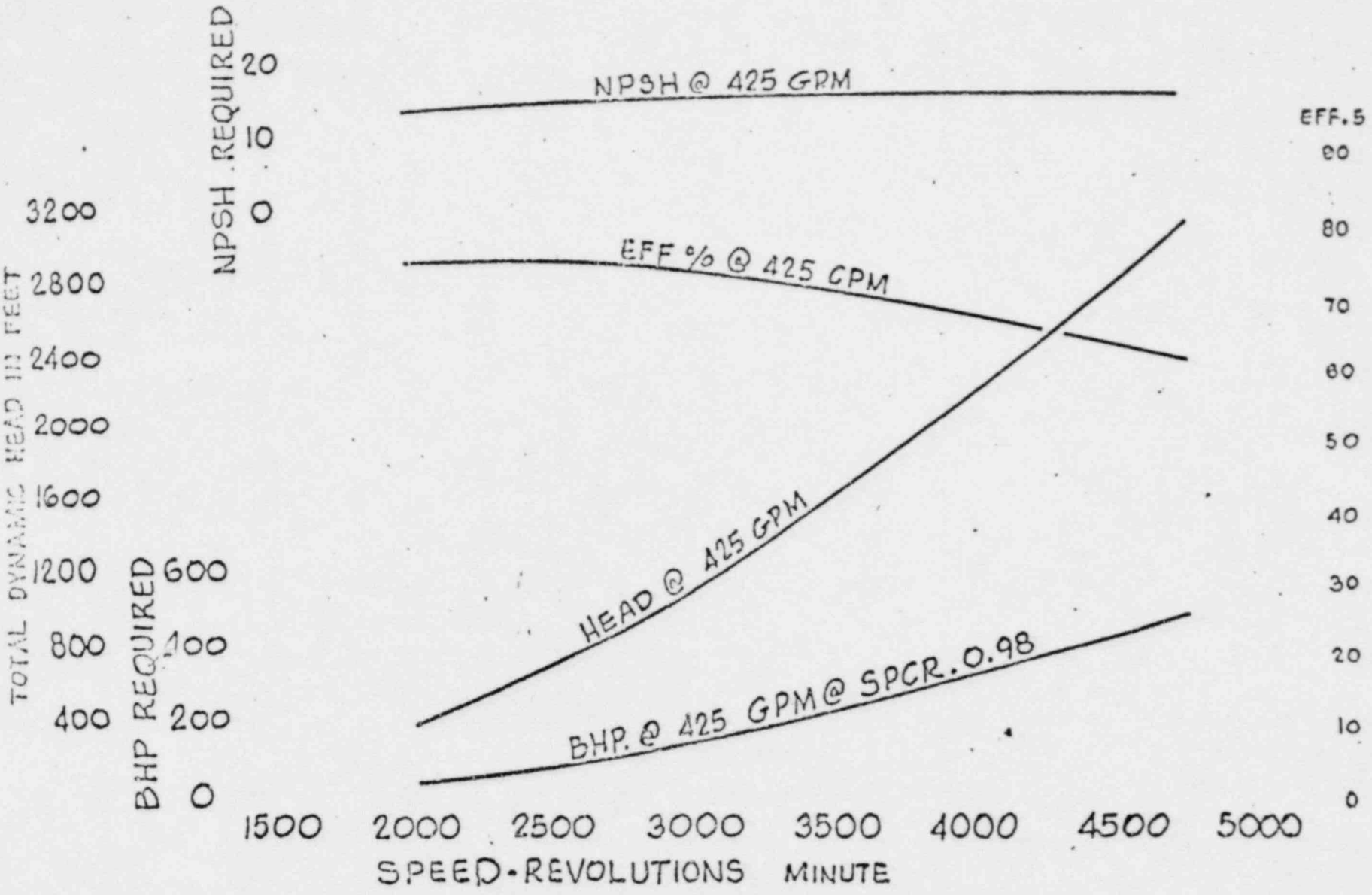
Remote Servo - pressure differential type with power piston connected to turbine governor valve by linkage.



TURBINE GOVERNOR CONTROL SYSTEM

DATA SHEET ATTACHMENT

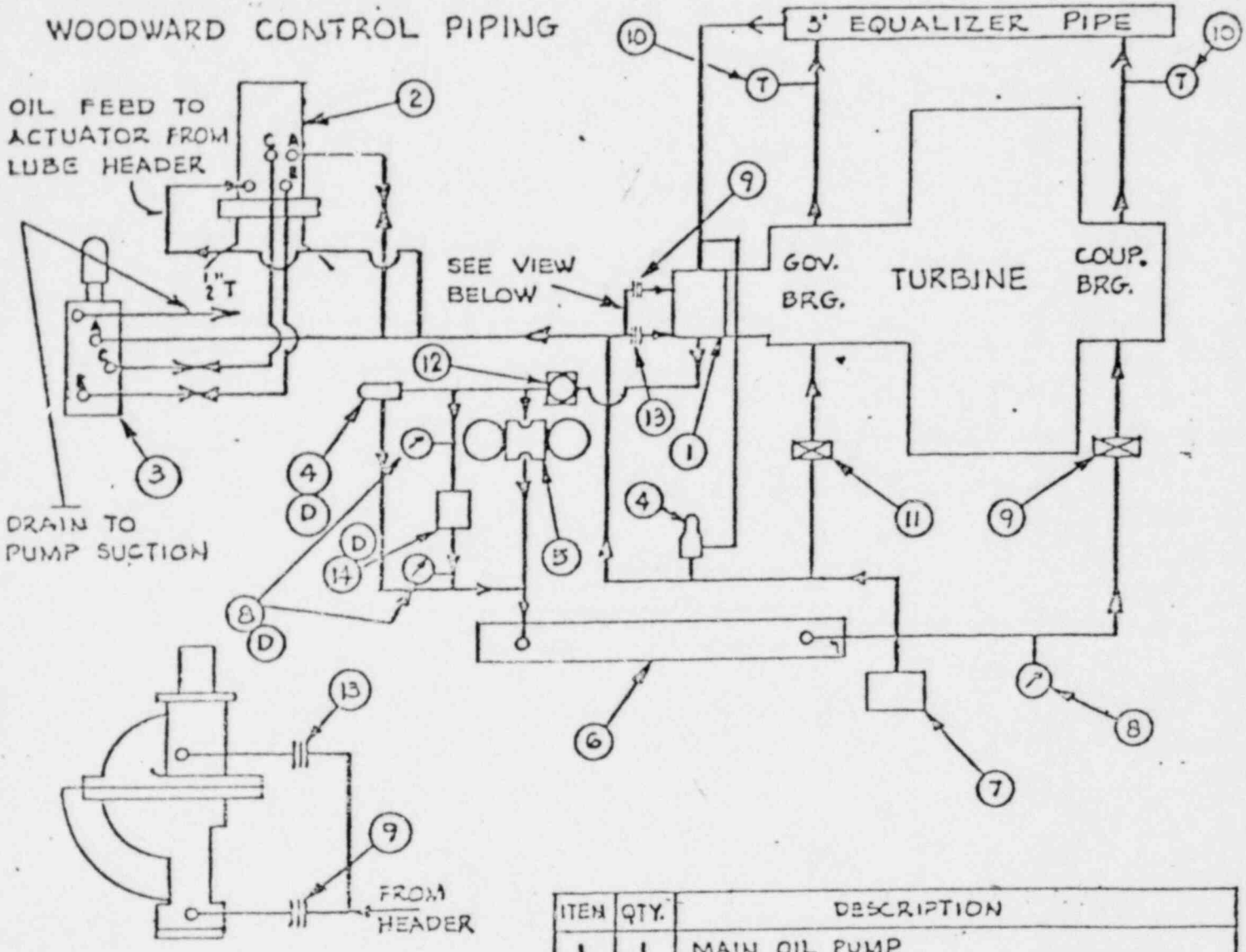
Turbine Governor Control System



RCIC PUMP CURVES

DATA SHEET ATTACHMENT

WOODWARD CONTROL PIPING



VIEW SHOWING GOV. DRIVE GEAR AND BUSHING LUBE

	ITEM	QTY.	DESCRIPTION
	1	1	MAIN OIL PUMP
	2	1	WOODWARD GOV. HYDRAULIC A
	3	1	WOODWARD SERVO
(D)	4	2	RELIEF VALVE
	5	1	DUPLEX STRAINER
	6	1	OIL COOLER
	7	1	LOW OIL PRESS. SW. ALARM
(D)	8	3	OIL PRESS. GUAGE 0-30#
	9	2	3/32 ORIFICE
	10	2	DIAL THERMOMETERS W/ ELECT. CONTACTS
	11	1	1/16 ORIFICE
	12	1	SIGHT FLOW INDICATOR
	13	1	#51 DRILL ORIFICE
(D)	14	1	DIFFERENTIAL PRESSURE SWITCH

Lube Oil System

NUCLEAR ENERGY PROJECTS DIVISION • SAN JOSE CALIFORNIA 95125

Attachment C to LILCO's
7/9/82 Testimony on
Water Hammer Procedures
and Training

June 15, 1976
File Tab E

SIL No. 175
Category 2

RHR/RECIRCULATION SYSTEM WATER HAMMER DURING PRIMARY SYSTEM COOLDOWN

Several operating BWRs recently experienced water hammer in the Residual Heat Removal (RHR)/Recirculation Systems piping. Water hammer occurred during primary system cooldown, in preparing for or while in the shutdown cooling mode. Subsequent inspection and evaulation of the piping in the drywell revealed no damage or significant pipe movement. However, although there is no cause for undue concern, measures should be taken to prevent future occurrences of the condition.

The purpose of this Service Information Letter (SIL) is to discuss the most probable causes for RHR/Recirculation Systems water hammer and to present corrective action recommendations.

DISCUSSION

Air and/or steam voids may form and accumulate in the RHR piping and create a potential water hammer situation when establishing pump flow or with the opening of valving during primary system cooldown. These voids can accumulate anywhere a piping hump exists or where there is a loop that cannot be vented due to inadequate or improper installation. Such loops exist at several operating BWRs and include a considerable amount of large diameter RHR piping. Moreover, air voids can accumulate during draining, flushing, and filling of the RHR piping if the venting installation provisions and/or procedures are inadequate.

Steam voids can be created in the RHR piping anytime the water pressure is allowed to fall below the saturation pressure. This can occur in several ways:

1. During a rapid reactor cooldown, water trapped in the insulated pipe on the outboard side of the injection check valve that has previously been heated by conduction may lag in temperature behind the cooler reactor water. The trapped hot water will then vaporize as required to equalize pressure across the check valve.

2. The flow in the one-inch line can easily reach critical (choked) flow for those plants with one-inch bypass valves and lines around the RHR isolation check valve in the drywell. This can occur during the warmup of the RHR injection piping when draining saturated reactor water back to the radwaste system through the one-inch bypass. Then, while the upstream flow is choked (the one-inch bypass flow can be choked as low as approximately 40 gpm, depending on conditions and piping configurations), a higher flow continues to be dumped to radwaste. The steam void that is formed may not condense rapidly, depending on its size and other conditions.

3. If saturated water is drained into the RHR piping during warmup and then the reactor is allowed to depressurize below the saturation temperature of the pocket of hot water in the RHR loop.

Voids, such as those described above, can produce water hammer upon establishing flow or by the opening of alternate flow paths. The severity of the water hammer depends upon the void size, flow velocity, and piping configuration.

RECOMMENDED ACTION

General Electric recommends a thorough review of the RHR System shutdown cooling mode of operation with special attention to the following considerations:

1. Review for adequacy the plant RHR system pipe venting provisions and procedures for draining, flushing, and filling to determine the potential for trapping voids.

2. Special attention should be given to flow rates that mitigate potential water hammer and to the RHR/Recirculation pipe tee thermal stresses as disussed below. This applies particularly to plants with the potential for trapping large air or steam voids when placing the RHR system into the shutdown cooling mode.

   (a) Flow Rates and Water Hammer

   For plants having piping humps or loops where large voids may be suspected, prior to starting the RHR pump, open the throttle valve to achieve approximately 3000 gpm. Then start the pump and hold 3000 gpm for 25-30 seconds. Next open the valve to achieve normal shutdown cooling flow.

This will more gently clear any void out of the hump and will then increase the flow to a high rate to reduce the cool down/warmup thermal transient on the recirc/RHR tee.

NOTE

The preceding is a compromise in lengthening the duration of the thermal transient on the tee to mitigate potential water hammer. Acceptable thermal stresses should be confirmed before implementing the above procedure.

(b) RHR/Recirculation Pipe Tee Thermal Stresses

The tee which joins the RHR injection line to the recirculation pump is subjected to a thermal transient upon initiation of the RHR system in the shutdown mode. The tee is initially at recirculation pipe temperature while the RHR water is as much as 250°F less. This slug of colder RHR water induces a transient as it clears the system, while another transient occurs when the hot water from the recirculation system follows the colder slug through the RHR system and reheats the tee.

Using the criterion of 120 cycles a B31.7 piping code fatigue analysis has shown that under some conditions the RHR to recirculation pipe tee can be overstressed.

3. Do not use the one-inch bypass lines solely for warmup in plants equipped with such lines since they do not have adequate capacity. There is no practical way to adequately control the flow through the one-inch bypass without the potential for a steam void forming. Even if the flow could be reduced to subcritical flow, say to about 40 gpm, the injection piping warmup alone would then take approximately an hour. If in conjunction with the one-inch bypass line, the check valve can be held part way open, then piping warmup could be accomplished without restricting flow.

4. Take special care to avoid allowing the pressure of any water in the RHR system to drop below its saturation pressure as a result of significant reactor depressurization at those plants using the RHR suction piping warmup procedure. This will prevent steam voids from forming in the suction piping and can be accomplished by slowing or stopping reactor depressurization during RHR piping warmup.

For additional information or clarification of the above recommendations contact your local General Electric service representative.

Prepared by: R.T. Reich/L.A. Gonzalez

Approved by: D L Layton
D.L. Layton, Manager
Product Service

Issued by: D L Allred
D.L. Allred, Manager
Utility Support Services

Product Reference:
E11- Residual Heat Removal System

BWR SERVICES Information Letter

September 30, 1976
File Tab E

CRF-110

SIL No. 31
Revision 2
Category 3

WARM-UP OF HPCI AND/OR RCIC STEAM SUPPLY LINES

This Service Information Letter (SIL) presents General Electric's recommendation for modifying the High Pressure Coolant Injection and Reactor Core Isolation Cooling (HPCI and RCIC) systems to allow for gradual warm-up of their respective steam supply lines. This SIL supersedes SIL No. 31, Revision 1, dated November 27, 1974, which should be discarded.

DISCUSSION

Whether the HPCI and RCIC steam isolation valves are closed automatically because of an isolation signal, or remote manually for some maintenance reason at reactor pressures up to 1000 psig, there is not any means of re-pressurizing and warming the line gradually to prevent thermal shock or water hammer. Also, after the valves have been closed, there is not any way of preventing them from automatically opening again before they can be manually sequenced open.

RECOMMENDED ACTION

A desirable mode of operation recommended by General Electric is, first, to open the outboard isolation valve (valve farthest from steam supply) to allow drainage and, then, to slowly open the inboard isolation valves, thus allowing the steam lines to heat up gradually. This would relieve any thermal shocking or water hammer to the steam lines, valve seats and discs which might occur when the lines are suddenly exposed to $\geq$ 100 psig reactor steam. Based on General Electric evaluations, the following action is recommended.

1. As noted in SIL 31, Revision 1, General Electric recommends removal of the inboard isolation valve opening seal-in circuits from the HPCI and/or RCIC systems, if seal-in circuits are being utilized. This change will allow the valve(s) to be throttled in the opening direction, permitting gradual pressurization and warming of the steam supply lines during all phases of the reactor operations. Unnecessary throttling of the valve should be avoided as this will result in increased valve seat wear. Seal-in in the closing direction must be retained for positive containment isolation.

2. In addition, General Electric recommends removal of the automatic initiation opening logic from the normally open HPCI and RCIC steam line isolation valves. This will help to prevent damage to the HPCI and RCIC systems from steam/water hammer and thermal shock due to the isolation valves being opened without proper steam line draining and prewarming. As a result, HPCI and RCIC system availability will be improved. General Electric has concluded that this will be permissable from a licensing and safety standpoint based upon the finding that proper administrative control of these valves is more preferable than the presently incorporated automatic initiation opening logic, and that this change does not unacceptably degrade system safety reliability.

3. General Electric also recommends that for proper administrative control annunciators and alarms be added to identify a "steam line isolation valve which is leaving the full open position." Keylock switches should also be installed for each system's steam isolation valves and for the isolation reset push button, through which the HPCI trips on low pressure.

   The changes for items 2 and 3 above will provide the following improvements:

   a. The valves can be opened according to a set procedure so that the steam lines can be properly drained and prewarmed.

   b. The annunciators will inform the operator when the valves are out of the normally open position as a protection against possible inadvertent closure.

   c. The keylock switches will provide positive administrative control of the system logic.

For additional information or assistance, contact your local General Electric service representative.

Prepared by: R.E. Kingston/D. Cagley

Approved by: D L Layton
D.L. Layton, Manager
Product Service

Issued by: D L Allred
D.L. Allred, Manager
Utility Support Services

Product Reference:
E41 - HPCI System
E51 - RCIC System

Submitted: [signature]

Approved: _____
(Plant Manager)

Effective Date: 12/7/81

Revision 1

ARP 1039 | MC-1 |
(Window Number)
1H11*PNL-601
(Panel Number)
A4/C-1 <1
(Panel Sub-Section)

HPCI LN FILL PP PRESS LO

Instr. No. *PIS-098

Set Point: Trip <40 psig
Reset > 40.8 psig

POSSIBLE CAUSE	IMMEDIATE ACTION
1. Pump tripped or stopped	1.1 Check pump running indication
	1.2 Restart pump
	1.3 Check discharge line pressure indicator
2.1 High flow	2.1 Check for high flow alarm. If present, start search for source of valve leakage.

SUBSEQUENT ACTION

1.1 If pump failed, valve in the supply from condensate transfer system and vent system pipework

1.2 Initiate maintenance work request

2.1 If high flow, carry out valve leak test procedure

REFERENCES

SP 23.202.01
BCN-1.61-130

<1

Attachment D to LILCO's
7/9/82 Testimony on
Water Hammer Procedures
and Training

Submitted: _____

Approved: _____
(Plant Manager)

Effective Date: 3/19/82

Revision: 1

ARP 1Ø9Ø
(Window Number)
1H11*PNL-6Ø2
(Panel Number)
A6/D-8
(Panel Sub-Section)

MC-1

<1

RCIC LINE FILL PUMP FLOW HIGH

Instr. No. *FS-Ø99

Set Point: Trip: ≥1Øgpm

Reset: <9.1gpm

	POSSIBLE CAUSE	IMMEDIATE ACTION
1.	System venting in progress	1.1 Verify alarm clears when venting complete.
2.	Incorrect valve lineup	2.1 Establish valve line-up per SP 23.119.Ø1
3.	System leak	3.1 Isolate leak

SUBSEQUENT ACTION

3.1 Dispatch an operator to check for system leakage. Use an alternate of loop fill (see procedures), if necessary.

3.2 Initiate a maintenance work request, if required.

REFERENCES

SP 23.119.Ø1
BCN-1.61-19Ø

MC-1

Submitted: _____

Approved: _____
(Plant Manager)

Effective Date: 6/11/82

Revision: 2

ARP 1112
(Window Number)
1H11*PNL-601
(Panel Number)
A2/A-3
(Panel Sub-Section)

CS SYS B DEGRADED

Instr. No. Various Relays

Set Point: Trip De-energized
Reset Energized

POSSIBLE CAUSE

1. Loss of control power or thermal overload trip of:
   a. Loop level pump *P-49B
   b. *MOV-034B Min Flow
   c. *MOV-031B Pump Suction
   d. *MOV-033B Injection valve not fully closed.
   e. *MOV-035B Test valve not fully closed.
   f. *MOV-081B Testable Check Bypass.

IMMEDIATE ACTION

1.1 Determine what failure caused the alarm by checking if the loop level pump is running, red running light illuminated, and if the blue power available light for all valves is illuminated.

SUBSEQUENT ACTION

1. If thermal overload, investigate cause and if clear reset the trip relay, continue to monitor equipment for signs of abnormal operation.
2. Manually place the valve in its proper position.
3. If the loop level pump failed, line up the core spray system to be supplied by the condensate transfer pump.
4. Adhere to applicable technical specifications.

REFERENCES

SP23.203.01
ESK-10AMB20

CONTROL COPY
JUN 2[illegible] 1982
NO. 13

In the Matter of
LONG ISLAND LIGHTING COMPANY
(Shoreham Nuclear Power Station, Unit 1)
Docket No. 50-322 (OL)

I certify that copies of the "Testimony of Johnny J. Kreps and Jack A. Notaro for the Long Island Lighting Company on Water Hammer Procedures and Training" were served upon the following by first-class mail, postage prepaid, on July 9, 1982, or by hand on July 9, 1982, as indicated by an asterisk:

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