INDIAN POINT STATION

UNIT NO. 2

E-2 REV. 3

EMERGENCY CORE COOLING SYSTEM ACTUATION

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EMERGENCY CORE COOLING SYSTEM ACTUATION

1.0 INTRODUCTION

The Emergency Core Cooling System (Engineered Safeguards) is comprised of several sub-systems, namely:

Accumulators

High Head Injection

Low Head Injection

Containment Spray

Due to the complexity of these systems and the variance in the actions required of the operator depending upon the type of loss of coolant accident, five separate emergency procedures have been developed which deal with loss of coolant accidents.

This procedure describes the actions which automatically occur when the engineered safeguards are automatically actuated. These actions are independent of the nature of the cause. Further, it tells the operator how to verify proper occurences, remedy failures and ascertain what type of loss of coolant accident has occurred.

Emergency Procedures 2A, 2B, 2C and 2D describe the further actions to be taken following determination of the cause of the loss of coolant.

2.0 DESCRIPTION OF CONDITIONS

One of the following plant malfunctions has occurred requiring the initiation of the Engineered Safeguards:

A) LOSS OF COOLANT TO CONTAINMENT

B) STEAM GENERATOR TUBE RUPTURE

C) STEAM BREAK

3.0 INDICATIONS TO OPERATOR

Any one or more of the following can cause the automatic actuation of the engineered safeguards systems -

3.1 High Containment Pressure (2 psig).

3.2 Coincidence of Low Pressurizer Pressure and Level (1700 psig and 5%).

3.3 High Steam Line ΔP (100 psi).

3.4 High Steam Line flow (greater than 40% of full steam flow from zero load to 20% load and thereafter ramped to greater than 110% of full steam flow at 100% load coincident with low Tavg- $\leq$ 541°F or Low Steam Generator Pressure- $\leq$ 600 psig). 3

NOTE: Each condition is annunciated separately by the First Out Annunciator.

4.0 IMMEDIATE AUTOMATIC ACTION

4.1 Unit trip (refer to Emergency Procedure E-1).

4.2 Main feedwater isolation as follows:

A. Closure of main feedwater regulators (FCV-417, FCV-427, FCV-437 and FCV-447).

B. Closure of main boiler feed pump motor operated discharge valves (BFD-2-21 and BFD-2-22).

C. Tripping of main boiler feed pump turbines (due to item B).

4.3 Starting of the emergency diesel generators. Both of the service water bypass gates will open if an undervoltage condition exists on either bus 5A or 6A.

4.4 Stripping of all 480 volt load breakers except MCC 26A and MCC 26B. MCC 24 will also be excepted if outside power is not lost. In addition, all non-safeguards, automatic starting equipment fed by the 480 volt buses will be locked out and all the 480 volt tie breakers will be opened.

IF OUTSIDE POWER IS AVAILABLE (both 5A and 6A energized), the 480 volt bus supply breakers will remain closed and the diesel generators will just idle.

IF OUTSIDE POWER IS LOST (either 5A or 6A de-energized), the 480 volt bus supply breakers will trip and the diesel generator output breakers will close. The following interlocks must be satisfied for each diesel generator breaker to receive a closing signal:

A. No faults on the respective diesel generator output bus.

B. No faults on the respective 480 volt bus.

C. Respective 480 volt bus has received a load breaker stripping signal or an undervoltage condition exists on the bus.

D. Respective diesel generator has attained output voltage.

4.5 Containment "Phase A" isolation actuated.

4.6 Isolation valve seal water supply valves open (1410 and 1413).

4.7 Containment ventilation isolation actuated.

4.8 The following safeguards valves are sent opening signals:

A. Residual heat exchanger motor operated discharge valves (MOV-746 and MOV-747).

B. Residual heat exchanger component cooling discharge valves (MOV-822A and MOV-822B).

C. High head safety injection line branch valves (MOV-856A, MOV-856C, MOV-856D and MOV-856E; cold leg injection lines).

D. Boron injection tank discharge valves (MOV-1831, MOV-1822A, MOV-1822B and MOV-1821).

E. Accumulator discharge valves (MOV-894A, MOV-894B, MOV-894C and MOV-894D).

F. Fan cooler unit charcoal filter inlet valves (V-1294, V-1297, V-1300, V-1303, V-1306).

G. Fan cooler unit charcoal filter outlet valves (V-1293, V-1296, V-1299, V-1302, V-1305).

H. Service water for fan cooler units (TCV-1104 and TCV-1105).

I. Service water for the diesel generators (TCV-1176 and TCV-1176A).

4.9 The following valves are sent closing signals:

A. Fan cooler unit Normal flow path outlet valves (V-1295, V-1298, V-1301, V-1304, V-1307).

B. Service water to conventional plant (FCV-1111 and FCV-1112).

4.10 Starting of the component cooling booster pumps.

4.11 THE FOLLOWING EQUIPMENT WILL START IF:

A. 480 VOLT BUS 2A IS ENERGIZED:

1. No. 22 High Head Safety Injection Pump (if it fails to start, an alternate start signal will be initiated from bus 3A)

2. No. 23 Fan Cooler Unit

3. No. 22 Service Water Pump, if it is selected for the nuclear header (if it is selected but fails to start, an alternate start signal will be initiated from bus 3A).

*4. No. 22 Component Cooling Pump

B. 480 VOLT BUS 3A IS ENERGIZED:

1. No. 24 Fan Cooler Unit.

2. No. 21 Residual Heat Removal Pump.

3. No. 21 Auxiliary Feedwater Pump.

4. No. 25 Service Water Pump, if it is selected for the nuclear header (it it is selected but fails to start, an alternate start signal will be initiated from bus 2A).

*5. No. 23 Component Cooling Pump.

C. 480 VOLT BUS 5A IS ENERGIZED:

1. No. 21 High Head Safety Injection Pump (if it fails to start, the discharge valve (M.O. 851B) from No. 22 High Head Safety Injection Pump to the No. 23 high head header will close).

2. No. 21 or 24 Service Water Pump (whichever is selected for the nuclear header).

3. No. 21 Fan Cooler Unit.

4. No. 22 Fan Cooler Unit.

*5. No. 21 Component Cooling Pump.

D. 480 VOLT BUS 6A IS ENERGIZED:

1. No. 23 High Head Safety Injection Pump (if it fails to start, the discharge valve (M.O. 851A) from No. 22 High Head Safety Injection Pump to the No. 21 high head header will close).

2. No. 23 or 26 Service Water Pump (whichever is selected for the nuclear header.

3. No. 25 Fan Cooler Unit.

4. No. 23 Auxiliary Feedwater Pump.

5. No. 22 Residual Heat Removal Pump.

*THE COMPONENT COOLING PUMPS WILL ONLY RECEIVE AUTOMATIC START SIGNALS IF OUTSIDE POWER WAS NOT LOST.

4.12 The main turbine-generator DC emergency bearing oil and seal oil pumps and the boiler feed pump turbine DC emergency bearing oil pump will start.

4.13 IF THE CONTAINMENT HIGH-HIGH PRESSURE (28 PSIG) SIGNAL IS INITIATED, THE FOLLOWING WILL OCCUR:

A. No. 21 Containment Spray Pump will start (480 volt bus 2A) and its associated discharge valves will open (MOV-866A and MOV-866B).

B. No. 22 Containment Spray Pump will start (480 volt bus 6A) and its associated discharge valves will open (MOV-866C and MOV-866D). 3

C. Containment "Phase B" isolation actuation.

D. Steam line isolation valve closure (MS-1-21, MS-1-22, MS-1-23 and MS-1-24).

E. IF NOT CANCELLED WITHIN TWO MINUTES OF SIGNAL INITIATION, NaOH WILL BE ADDED TO THE SPRAY FLUID VIA VALVES 876A AND 876B.

4.14 If high steam line flow exists, a steam line isolation valve closure will be initiated (MS-1-21, MS-1-22, MS-1-23 and MS-1-24).

4.15 The Unit No. 2 Central Control Room air conditioner swaps to the "Incident - Outside Air Filtered Mode" and the Unit No. 1 Central Control Room air conditioner swaps to the "Internal" mode of operation (dampers A and E close and dampers B, C and D open for the Unit No. 2 Air Conditioner).

5.0 IMMEDIATE OPERATOR ACTION

5.1 Verify that all required automatic actions have occurred. The list provided by items 4.1 to 4.15 should be used as a check list for this verification and it should be conducted as described by the following:

A. Bus voltage and electrical distribution is checked at the electrical panel. Diesel operation may be checked at either the electrical panel or the safeguards panel.

B. Correct valve status is determined as follows: Review the Bright-Dim status light panels (5). ALL LIGHTS SHOULD BE BRIGHT. If any lights are dim, ascertain the valve title and required position (by reading status light name plate), go to the corresponding valve switch and operate the switch in direction required.

C. Correct pump, fan/breaker operation is verified by the red-green lights located either above the control switch or provided on the safeguards panel. The light indications on the safeguards panel should be reviewed as they provide a localized status of the entire system. If any pump, fan/breaker fails to operate as required in section 4.1 to 4.15 of this procedure, go to its corresponding control switch and initiate proper action.

D. The Central Control Room Air Conditioner status can be verified at the air conditioner damper panel in the rear of the control room. All damper lights should be bright.

5.2 If a quick review of the process instrumentation indicates a true loss of coolant accident has occured (as opposed to an instrument or power supply failure caused SI signal), sound the emergency evacuation signal (rapid pulsing sound) as follows:

A. 30 second blast.

B. Announce over the P.A. System:

"This is a Site Emergency. All non-watch personnel report to the assembly areas." 3

C. 30 second blast.

NOTE: If time does not practically permit performing this step at this time, it may be delayed. The main intent in performing this step early is to start moving plant personnel to a common location so that accountability procedures may start and so that personnel will be readily available to the Emergency Director.

5.3 Determine the type of emergency condition using the following indications:

A. LOSS OF COOLANT TO CONTAINMENT

1. Decreasing pressurizer pressure.
2. Decreasing pressurizer level.
3. Increasing Containment pressure.
4. Increasing Containment sump level.
5. Increasing Containment activity.
6. Rising or normal Steam Generator pressure.

B. STEAM GENERATOR TUBE RUPTURE

1. Decreasing pressurizer pressure.
2. Decreasing pressurizer level.
3. No change in Containment conditions.
4. Increasing level in one Steam Generator.
5. Increasing Steam Generator pressure.
6. High Steam Generator Blowdown activity.
7. High Air Ejector discharge activity.

C. STEAM BREAK

STEAM BREAK UP STREAM OF MAIN STEAM LINE ISOLATION VALVES

1. Decreasing pressurizer pressure.
2. Decreasing pressurizer level.
3. Low T-AVG.
4. Increasing Containment pressure if break is inside Containment.
5. No change in Containment activity.
6. Low pressure in the affected Steam Generator.
7. Low level in the affected Steam Generator.
8. Steam Flow-Feedwater Flow mismatch in the affected Steam Generator.

STEAM BREAK DOWN STREAM OF MAIN STEAM ISOLATION VALVES

1. Decreasing pressurizer pressure.
2. Decreasing pressurizer level.
3. Low T-AVG.
4. No change in Containment Conditions.
5. Abnormally high steam flows in all Steam Generators.
6. Low steam generator pressure in all Steam Generators.
7. Low level in all Steam Generators.

CAUTION

UNDER NO REAL LOSS OF REACTOR COOLANT TO CONTAINMENT CONDITION SHOULD THE CONTAINMENT SPRAY ADDITIVE (NAOH) ADDITION BE CANCELLED. THE NAOH IS REQUIRED FOR IODINE REMOVAL AS WELL AS TO NEUTRALIZE THE ACIDIC EFFECT OF THE BORATED WATER COMING FROM THE REFUELING WATER STORAGE TANK, BORON INJECTION TANK AND THE REACTOR COOLANT SYSTEM.

NOTE: IF THE NAOH ADDITION IS INADVERTENTLY CANCELLED, IT MAY BE INSTITUTED BY OPENING THE SPRAY ADDITIVE TANK OUTLET VALVES (876A-876B) BY USING THEIR CONTROL SWITCHES.

5.4 With regard to power supplies, the following should be done:

A. If outside power is supplying the 6900 volt and 480 volt buses:

1. Trip the reactor coolant pumps if the Reactor Coolant System pressure drops below 1000 psig or if a decrease in reactor coolant pump flow is noted.
2. Have the 480 volt supply breakers for the lighting transformers closed by the Conventional Plant NPO.
3. Have the 480 volt supply breakers for all the motor control centers closed by the Conventional Plant NPO.

4. Have the Conventional Plant NPO re-establish the main turbine-generator lube and seal oil systems from the AC pumps. Re-establish the boiler feed pump lube oil system from the AC pumps. Shutdown the DC emergency bearing and seal oil pumps. Re-energize the battery chargers. 3

5. Shutdown the emergency diesel generators. Have the NPO-Rover verify that they are aligned for subsequent automatic operation (refer to step 4.41 of procedure DP-11 of the Detailed Procedures Book, Part IV of the Operations Manual).

B. If the emergency diesel generators are supplying the 480 volt buses, extreme care must be exercised while adding loads. The normal maximum rating of each emergency diesel generator is 1750 KW. The loading may be increased to 2000 KW if the WF so approves (this is a 2000 hour rating). 3 Diesel loading is indicated on the safeguards panel.

1. Re-establish component cooling to protect the Reactor Coolant Pump seals if the emergency is due to anything but a major loss of coolant to containment accident.
2. Have the 480 volt supply breakers for the lighting transformers closed by the Conventional Plant NPO.
3. Have the 480 volt supply breakers for all the motor control centers closed by the Conventional Plant NPO.
4. Have the Conventional Plant NPO re-establish the main turbine-generator lube and seal oil systems from the AC pumps. Re-establish the boiler feed pump lube oil system from the AC pumps. Shutdown the DC emergency bearing and seal oil pumps. Re-energize the battery chargers. 3
5. Have the NPO-Rover report to the Diesel Generator Room to monitor diesel-generator operation. He should pay particular attention to the fuel inventory. 3

CAUTIONS

1. THE DIESEL FUEL OIL SUPPLY PUMPS ARE POWERED FROM MCC'S 27 AND 29. THEY MUST BE RESTORED WITHIN ONE-HALF HOUR FROM THE TIME THEY WERE STRIPPED FROM THE BUS IF THE EMERGENCY DIESEL GENERATORS ARE RUNNING.
2. THE BORIC ACID STORAGE TANK HEATERS ARE SUPPLIED FROM MCC 27. IT MUST BE RESTORED WITHIN TWO HOURS FROM THE TIME IT WAS STRIPPED FROM THE BUS.
3. THE DC EMERGENCY BEARING AND SEAL OIL PUMPS MUST BE SHUTDOWN WITHIN TWO HOURS OF THEIR STARTING TIME IN ORDER TO PRESERVE THE BATTERIES. IF AT ALL POSSIBLE, THE AC MAIN AND BOILER FEED PUMP TURBINE OIL SYSTEMS SHOULD BE ENERGIZED PRIOR TO SHUTTING DOWN THE DC PUMPS. MCC'S 22, 23, 24 AND 25 ARE REQUIRED TO SUPPORT THE AC OIL SYSTEMS.
4. WHILE INSTRUMENT AIR IS NOT REQUIRED FOR 24 HOURS (TO SUPPORT THE WELD CHANNEL AND CONTAINMENT PENETRATION PRESSURIZATION SYSTEM) IT IS DESIRABLE TO HAVE IT FOR SUPPORT OF MISCELLANEOUS VALVE AND INSTRUMENT OPERATIONS. MCC'S 24 AND 29 ARE REQUIRED TO POWER THE INSTRUMENT AIR SYSTEM.
5. IF DIESEL NO. 22 IS IN SERVICE, BOTH OF ITS OUTPUT BREAKERS (EG2A AND EG2B) MUST BE CLOSED IN ORDER FOR ALL SAFEGUARDS EQUIPMENT SERVICED BY DIESEL NO. 22 TO OPERATE. IF ONLY ONE OUTPUT BREAKER HAS CLOSED IT IS PERMISSIBLE TO CLOSE THE 2AT3A TIE BREAKER FROM THE ELECTRICAL PANEL.

6.0 SUBSEQUENT ACTION

6.1 If the control board indications (as per step 5.2) indicate:

A. A loss of coolant to containment - refer to Emergency Procedure 2A.

B. A steam generator tube rupture - refer to Emergency Procedure 2B.

C. A steam break up stream of the main steam line isolation valves - refer to Emergency Procedure 2C.

D. A steam break down stream of the main steam line isolation valves - refer to Emergency Procedure 2D.

INDIAN POINT STATION

UNIT NO. 2

E-2A REV. 3

LOSS OF COOLANT TO CONTAINMENT

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E-2A

LOSS OF COOLANT TO CONTAINMENT

1.0 INTRODUCTION

Following actuation of the engineered safeguards, the operator followed Emergency Procedure E-2.

After verifying all automatic actuations, he proceeded to determine the nature of the emergency. If the conclusion is that the emergency was due to a failure of the Reactor Coolant System (either large or small) the following subsequent operator action is required.

Unless specifically noted as being otherwise, all indicators requiring observation and switches requiring manipulation are located on the safeguards panel.

For the purpose of this procedure, it has been assumed that either the GWF or the WF has reported to the Control Room and has undertaken the role of Emergency Director. Additionally, it is assumed that the emergency evacuation signal has been sounded. 3

2.0 OPERATOR ACTION FOLLOWING A LOSS OF COOLANT ACCIDENT TO CONTAINMENT

2.1 INJECTION PHASE

3

2.1.1 Prior to resetting the Engineered Safeguards signal:

1. Set the control switches for the Containment Fan Cooler units' charcoal filter valves, inlet and outlet, to the "OPEN" position (V-1294, V-1293, V-1297, V-1296, V-1300, V-1299, V-1303, V-1302, V-1306, V-1305).

2. Set the control switches for the Containment Fan Cooler units' normal flow path inlet valves to the "CLOSE" position (V-1295, V-1298, V-1301, V-1304, V-1307).

3. Set the control switches for the Containment Fan Cooler units' service water by-pass outlet temperature control valves to the "OPEN" position (TCV-1104 and TCV-1105).

4. Set the control switches for the service water flow control valves to the Conventional Plant to the "CLOSED" position (FCV-1111 and FCV-1112).

5. Have the Nuclear Plant or Rover NPO set the control switches for the service water flow control valves to the diesels (FCV-1176 and 1176A) to the open position. These switches are located in the Diesel Building. | 3

These actions will prevent the valves from moving out of their required position when the Engineered Safeguards Signal is reset.

6. Place all three high containment pressure safety injection bistable trip switches (located in protection racks B1, B9 and A9) in the tripped position.

This action will prevent inadvertant reactuation of the injection phase of the engineered safeguards following the Engineered Safeguards Signal being reset.

2.1.2 Reset the Engineered Safeguards signal by pressing both of the "SI RESET" buttons. This action can only be successfully accomplished after two minutes have elapsed since signal initiation.

CAUTION

IF SUBSEQUENT TO RESETTING THE ENGINEERED SAFEGUARDS SIGNAL OUTSIDE POWER IS LOST, THE REQUIRED EQUIPMENT MUST BE MANUALLY RESTARTED BY ITS CONTROL SWITCHES.

2.1.3 Compare the flows in the four high head safety injection cold leg injection lines. If any one flow is approximately twice the others, this is indicative of a break in that injection line. Isolate that injection line by closing its motor operated stop valve (Loop 21 - MOV-856A, Loop 22 - MOV-856D, Loop 23 - MOV-856E or Loop 24 - MOV-856C).

2.1.4 If the break is small (RCS pressure $\geqslant$ 400 psig), then:

1. Cool the Reactor Coolant System by Steam Dump to the condenser or atmosphere in case of a blackout.

2. If after 15 minutes the Reactor Coolant System pressure is above 170 psig and no low head flow injection is indicated, shutdown one Residual Heat Removal Pump (ACS panel) if both are running.

3. If after two hours the Reactor Coolant System pressure is above 170 psig and no low head flow is indicated shutdown the operating Residual Heat Removal pump (ACS panel).

4. Periodically check, by Residual Heat Removal pump starts, to see if low head injection is possible.

2.1.5 If Accumulator pressures are less than 250 psig close their isolation valves (this will require re-energization of the valve motor operators) when time permits. | 3

2.1.6 If the Engineered Safeguards Signal is accompanied by a High-High Containment Pressure Signal, the Containment Spray Signal must be reset, by means of the two reset buttons.

CAUTION

IF THE ENGINEERED SAFEGUARDS SIGNAL IS NOT ACCOMPANIED BY A HIGH-HIGH CONTAINMENT PRESSURE SIGNAL, THE OPERATOR MUST REMAIN ALERT FOR A DELAYED RISE IN THE CONTAINMENT PRESSURE. IF THE CONTAINMENT PRESSURE REACHES THE HIGH-HIGH SIGNAL ACTUATION LEVEL AFTER THE ENGINEERED SAFEGUARDS SIGNAL IS RESET OR IF HIGH RADIATION, ON MONITOR R-10, IS DETECTED IN CONTAINMENT (REGARDLESS OF THE CONTAINMENT PRESSURE), THE OPERATOR MUST START THE SPRAY PUMPS AND OPEN THE MOTOR OPERATED DISCHARGE VALVES MANUALLY BY USING THEIR RESPECTIVE SWITCHES.

CONT. SPRAY PUMP NO. 21 - MOV-866A AND MOV-866B
CONT. SPRAY PUMP NO. 22 - MOV-866C AND MOV-866D

IF NaOH IS TO BE ADDED, THE SPRAY ADDITIVE TANK DISCHARGE VALVES (876A AND 876B) MUST BE OPENED.

IF PHASE "B" CONTAINMENT ISOLATION IS ALSO DESIRED IT CAN BE INITIATED BY CLOSING, FROM THE ISOLATION VALVE PANEL:

A. COMPONENT COOLING TO THE REACTOR COOLANT PUMPS (MOV-769 AND MOV-797).

B. COMPONENT COOLING FROM THE REACTOR COOLANT PUMP MOTOR BEARINGS (MOV-784 AND MOV-786).

C. COMPONENT COOLING FROM THE REACTOR COOLANT PUMP THERMAL BARRIERS (FCV-625 AND MOV-789).

D. REACTOR COOLANT PUMP NO. 1 SEAL COMMON RETURN (MOV-222).

| 3

2.1.7 Make a field survey of the Control Room as per Appendix A of this procedure. Start the Control Room air sampler to determine Iodine concentrations as per Appendix B of this procedure.

NOTES: 1. The IP1 Control Room Operator may be utilized to perform these tasks. 3

2. Anti-C clothing and self-contained breathing apparatus (Chemox and Air Paks), as well as full face pressure demand air masks are located in the emergency locker. The need for this equipment will be determined by the results of the analysis of the Control Room air samples.

2.1.8 Check out the two-way radio system with the Energy Control Center.

2.1.9 At the first low level alarm from the Refueling Water Storage Tank, it is desireable to start switching over to Recirculation Injection.

NOTE: If time permits prior to starting Recirculation phase have an NPO re-energize the valve motor operators for MOV-1810, MOV-744 and MOV-882 in preparation for valve re-alignment. Accumulator Isolation valves (MOV-894A through MOV-894D) should also be energized if not done in step 2.1.5 above. 3

2.2 RECIRCULATION PHASE

2.2.1 At the second low level alarm from the Refueling Water Storage Tank it is mandatory to commence and complete the change over to the Recirculation Phase (within 15 minutes) as follows. Verify each action by observing valve/breaker position lights on the safeguards panel. 3

1. Put Recirculation Switch No. 1 to ON position, it will then:

a) Trip High Head Safety Injection Pump No. 22 if all three (3) High Head Safety Injection Pumps were running.

b) Close High Head Safety Injection Pump No. 22's suction valves, MOV-887A and MOV-887B, if High Head Safety Injection Pump No. 22 is secured.

c) Trip Containment Spray Pump No. 22 if both Containment Spray Pumps are running.

d) Close Containment Spray Pump No. 22's discharge valves, MOV-866C and MOV-866D, if Containment Spray Pump No. 22 is shut down, or, close Containment Spray Pump No. 21's discharge valves, MOV-866A and MOV-866B, if Containment Spray Pump No. 21 is shut down.

NOTE: Item D will not take place unless the Containment Spray Signal has been reset. If the Containment Spray Signal was not reset, then, when it is reset, close the Containment Spray Pump discharge valves on the shutdown pumps.

e) Energize switch function complete light when above is complete.

NOTE: If the switch function complete light is not received, recheck all required actions and initiate manual actuation as required. This note applies to all recirculation switch operations.

2. Put Recirculation Switch No. 2 to ON position, it will then:

a) Start one Non-Essential Service Water Pump (No. 21 or No. 24 depending on which is selected to supply the non-essential header - header selection is determined by switch on safeguards panel).

b) Assures at least one Component Cooling Pump (No. 23, No. 22 or No. 21 in this order) is running.

c) Energize switch function complete light when above is complete.

3. Put Recirculation Switch No. 3 to ON position, it will then:

a) Trip Residual Heat Removal Pumps No. 21 and No. 22.

b) Close RHR pump suction, MOV-882, and discharge, MOV-744, valves. 3

c) Energize switch function complete light when above is complete.

NOTE: The switch completion light for Recirculation Switch No. 3 will not light as the power supplies for MOV-882 and 744 are de-energized. At this time, just verify that the RHR pumps are shutdown and proceed to complete the recirculation procedure. 3

4. Put Recirculation Switch No. 4 to ON position, it will then:

   a) Start Recirculation Pump No. 21.

   b) Open Recirculation Pumps header discharge valves, MOV-1802A and MOV-1802B.

   c) Energize switch function complete light when above is complete.

5. Put Recirculation Switch No. 5* to ON position, it will then:

   a) Start another Non-Essential Service Water Pump (No. 22 or 23, or, No. 25 or 26 depending on which are selected to supply the non-essential header).

   b) Assures a second Component Cooling Pump is running.

* The action of this switch will be nullified unless outside power or all three (3) diesels are available.

   c) Start Recirculation Pump No. 22 if a) and b) above are complete.

   d) Energize switch function complete light when above is complete.

6. Observe the flow indicators for the Low Head Injection paths. If 3 of the 4 indicators each show 300 gpm or more, then low head recirculation is indicated. If 2 of the 4 indicators each show less than 300 gpm, then high head recirculation is indicated.

   NOTE: If low head recirculation is appropriate, proceed as defined below; if high head recirculation is appropriate, proceed to step 8 on page E-2A-10. 3

7. LOW HEAD RECIRCULATION

   7.1 COMPLETION OF RECIRCULATION SWITCH SEQUENCE

      7.1.1 Put Recirculation Switch No. 7 to ON position, it will then:

         a) Trip the running High Head Safety Injection Pumps.

         b) Energize switch function complete light when above is complete.

7.1.2 Put Recirculation Switch No. 8 to ON position, it will then:

a) Close Containment Spray Pump test line valve 1813.

b) Close Safety Injection Pump suction valve from RWST, MOV-1810. 3

c) Energize switch function complete light when above is complete.

NOTE: The switch completion light for Recirculation Switch No. 8 will not light as the power supply for MOV-1810 is de-energized. At this time, just verify closure of valve 1813 and proceed to complete the recirculation procedure. 3

7.1.3 Close the Residual Heat Removal Loop miniflow test line valves, MOV-743 and MOV-1870.

7.1.4 Close the Safety Injection test line valves, MOV-842 and MOV-843, to the Refueling Water Storage Tank.

7.2 IF CONTAINMENT SPRAY WAS ACTUATED:

7.2.1 Stop the running Containment Spray Pump and close its discharge valves just prior to the Refueling Water Storage Tank being emptied.

Cont. Spray Pump No. 21 - MOV-866A and MOV-866B
Cont. Spray Pump No. 22 - MOV-866C and MOV-866D

NOTE: If the Containment Spray Signal has not been reset, place the control switch for the running Containment Spray Pump in the "PULL OUT" position. When the Containment Spray Signal is eventually reset, close the discharge valves.

7.2.2 It is necessary to set up the system for combined core cooling and containment spray recirculation.

a) Open spray header valve MOV-889B. The second spray header, MOV-889A, serves as an alternate.

b) Slowly close, at the ACS panel, the residual heat exchanger discharge flow control valves, HCV-638 and HCV-640, so as to direct flow to the spray header.

c) Continue to close the residual heat exchanger discharge flow control valves in small increments until the minimum acceptable flow directed to the core has been reached; i.e., three out of the four low-head flowmeters read at least 300 gpm.

d) Check the flow being directed to the spray header; if spray recirculation is at 1300 gpm or more, continue in this mode for 24 hours.

If spray recirculation is less than 1300 gpm proceed to align the system for high-head recirculation as follows:

1) Isolate the spray header by closing both MOV-889A and MOV-889B.

2) Open the low-head to high-head path by opening valves MOV-888A and MOV-888B.

3) Arm the High Head Safety Injection Pump suction header low pressure alarm by placing the manual toggle switch in the unblocked position.

4) Start two high-head pumps, preferable Nos. 21 and 23, and check the flow.

CAUTION

THE SUCTION VALVES TO HIGH HEAD SAFETY INJECTION PUMP NO. 22, MOV-887A AND MOV-887B, WILL BE CLOSED AT THIS TIME DUE TO PREVIOUS ACTIONS.

5) Isolate the low-head recirculation header by closing valves MOV-746 and MOV-747 at the ACS panel.

6) Open the spray header isolation valve MOV-889B and continue in this mode for 24 hours. The second spray header, MOV-889A, serves as an alternate.

CAUTION

CLOSELY MONITOR HIGH HEAD SAFETY INJECTION PUMP SUCTION PRESSURE. 3

e) After 24 hours the containment spray recirculation may be stopped and full recirculation flow directed to the core. Close the spray header isolation valves, MOV-889A and MOV-889B.

NOTE: The operator must remain alert for a rise in containment pressure; in the unlikely event that the containment pressure subsequently rises to 28 psig, recirculation spray should be reactivated.

7.3 IF CONTAINMENT SPRAY WAS NOT ACTUATED

The water being recirculated must have its pH adjusted to be within the range of 7.5 to 10.5 within the first 24 hours. This is accomplished by mixing sodium hydroxide in the CVCS boric acid batch tank and feeding it to the Reactor Coolant System with the Charging Pumps. Approximately 1300 gallons of 30% NaOH would be required.

7.4 DURING RECIRCULATION PHASE

Check the number of Recirculation Pumps operating and whether or not both heat exchanger flow paths are open, i.e. MOV's 746 and 747 (at the ACS panel). If only one pump is operating through the Residual Heat Exchangers the total pump discharge flow should be checked (sum of four individual loop flows). For long-term recirculation (beyond 24 hours) the maximum flow for one pump should be limited to 3000 gpm by adjustment of the residual heat exchanger discharge flow control valves HCV-640 and HCV-638 at the ACS panel.

NOTE: This flow limitation is imposed to avoid the possibility of long-term operation at or near cavitating conditions.

7.5 CONTAINMENT ISOLATION

Proceed directly to step 2.2.2 if on low head recirculation; disregard following section on high head recirculation.

8.1 COMPLETION OF RECIRCULATION SWITCH SEQUENCE

8.1.1 Put Recirculation Switch No. 6 to ON position, it will then:

a) Close Residual Heat Removal Heat Exchanger discharge valves MOV-746 and MOV-747.

b) Open Residual Heat Removal Heat Exchanger No. 21's discharge valves MOV-888A and MOV-888B to the High Head Safety Injection Pumps suction header.

c) Close Safety Injection test line valves MOV-842 and MOV-843.

d) Close Residual Heat Removal mini-flow line valves MOV-743 and MOV-1870.

e) Arm the High Head Safety Injection Pump suction header low pressure alarm.

f) Energize switch function complete light when above is complete.

8.1.2 Put Recirculation Switch No. 8 to ON position, it will then:

a) Close Containment Spray Pump test line valve 1813.

b) Close Safety Injection Pump suction valve from RWST, MOV-1810.

c) Energize switch function complete light when above is complete.

NOTE: The switch completion light for Recirculation Switch No. 8 will not light as the power supply for MOV-1810 is de-energized. At this time, just verify closure of valve 1813 and proceed to complete the recirculation procedure.

8.2 IF CONTAINMENT SPRAY WAS ACTUATED:

8.2.1 Stop the running Containment Spray Pump and close its discharge valves just prior to the Refueling Water Storage Tank being emptied.

Cont. Spray Pump No. 21 - MOV-866A and MOV-866B
Cont. Spray Pump No. 22 - MOV-866C and MOV-866D

NOTE: If the Containment Spray Signal has not been reset, place the control switch for the running Containment Spray Pump in the "PULL OUT" position. When the Containment Spray Signal is eventually reset, close the discharge valves.

8.2.2 It is necessary to set up the system for combined core cooling and containment spray recirculation.

a) Open spray header valve MOV-889B and verify that adequate flow is being diverted to the spray header. The second spray header, MOV-889A, serves as an alternate.

CAUTION

CLOSELY MONITOR HIGH HEAD SAFETY INJECTION PUMP SUCTION PRESSURE. 3

b) Continue in this mode for 24 hours.

c) After 24 hours the containment spray recirculation may be stopped and full recirculation flow directed to the core. Close the spray header isolation valves, MOV-889A and MOV-8889B.

NOTE: The operator must remain alert for a rise in containment pressure; in the unlikely event that the containment pressure subsequently rises to 28 psig, recirculation spray should be reactivated.

8.3 IF CONTAINMENT SPRAY WAS NOT ACTUATED

The water being recirculated must have its pH adjusted to be within the range of 7.5 to 10.5 within the first 24 hours. This is accomplished by mixing sodium hydroxide in the CVCS boric acid batch tank and feeding it to the Reactor Coolant System with the Charging Pumps. Approximately 1300 gallons of 30% NaOH would be required.

8.4 DURING RECIRCULATION PHASE

8.4.1 After a minimum of 24 hours of cold leg recirculation, combined cold and hot leg recirculation may be initiated as follows:

a) Energize both hot leg injection line motor operated valves (MOV-856B and MOV-856F).

b) Close either MOV-856A or MOV-856E and open MOV-856B.

c) Close either MOV-856C or MOV-856D and open MOV-856F.

Hot leg recirculation is required in order to quench the steam leaving the core.

8.4.2 The operator must make regular tests to see if the reactor coolant pressure has decreased sufficiently to permit internal low-head recirculation to be established. This is done as follows:

a) Close the residual heat exchanger discharge flow control valves; HCV-638 and HCV-640 at the ACS panel.

b) Open Residual Heat Exchanger No. 22's discharge stop valve; MOV-746 at the ACS panel.

c) Slowly open Residual Heat Exchanger No. 22's discharge flow control valve, MOV-640, to establish a low-head flow; during this procedure observe that the High Head Safety Injection Pump suction pressure is maintained.

d) If three out of four of the low-head flowmeters indicate 300 gpm or more proceed to establish low-head recirculation.

e) Stop the High-Head Safety Injection Pumps and close the low head to high head path, MOV-888A and MOV-888B.

f) Proceed to open Residual Heat Exchanger No. 21's discharge stop valve, MOV-747, and open both residual heat exchanger discharge flow control valves, HCV-640 and HCV-638. If only one pump is operating, HCV-638 and HCV-640 should be adjusted so that the flow does not exceed 3000 gpm. If both pumps are operating, HCV-638 and HCV-640 may be set to fully open; ascertain, however, that the fully open condition does not give a flow in excess of 6000 gpm. This operation is performed at the ACS panel.

2.2.2 With regard to containment isolation, the following must be initiated:

NOTES: 1) Whichever NPOs are available should be dispatched to do this valve lineup as a team rather than as individuals.

2) A check list is provided, as Appendix C to this procedure, for their use.

3) They should take portable survey equipment and high range dosimeters with them.

3

A) After the Charging Pumps are stopped, isolate the charging line by closing valves 205, 226 and 227 in the valve room and admit isolation valve seal water by opening 1402.

B) After Reactor Coolant Pump No. 21 is stopped, close its' injection water supply isolation valves (241A and 250A) in the valve room and admit isolation valve seal water by opening 1466.

C) After Reactor Coolant Pump No. 22 is stopped, close its' injection water supply isolation valves (241B and 250B) in the valve room and admit isolation valve seal water by opening 1467.

D) After Reactor Coolant Pump No. 23 is stopped, close its' injection water supply isolation valves (241C and 250C) in the valve room and admit isolation valve seal water by opening 1468.

E) After Reactor Coolant Pump No. 24 is stopped, close its' injection water supply isolation valves (241D and 250D) in the valve room and admit isolation valve seal water by opening 1469.

F) After all Reactor Coolant Pumps are stopped,

1. Isolate the No. 1 seal water return line (MOV-222).

2. Isolate the Reactor Coolant Pumps cooling water supply and return lines (MOV-769, MOV-797, MOV-786, MOV-784, MOV-789 and MOV-625).

NOTE: These valves are operated from the Containment Isolation panel and may already be closed as the result of a high-high containment pressure condition which generates a containment isolation Phase B signal. Automatic seal water injection to these valves will have been initiated by the earlier Containment "Phase A" Isolation signal.

G) If the safety injection test line is in service, close its' manual containment isolation valves (859A and 859C) in the valve room.

H) Following the shutting down of both Containment Spray Pumps, close the containment spray lines manual containment isolation valves (869A and 869B) in the valve room and introduce isolation valve seal water by opening 1405 and 1463.

I) If the Residual Heat Removal pumps are not in service, close their motor operated suction and discharge valves (MOV-882 and 744) and mini-flow valves (MOV-743 and 1870) and assure that the RHR sample valve (958) in the valve room is closed. Introduce isolation valve N_2 seal gas by opening 1401, 1446, 1449 and 1450.

NOTE: The power supplies for MOV-882 and 744 will have to be re-energized.

J) Assure that the Recirculation Pump sample valves (990B and 990C) in the valve room are closed and introduce isolation valve N_2 seal gas by opening 1420.

K) Close the Nitrogen supply lines to the Pressurizer Relief Tank and Reactor Coolant Drain Tank (550 and 1610) in the valve room.

L) IF ON LOW HEAD RECIRCULATION:

1. Close the Safety Injection pump suction valve from the RWST, MOV-1810. Close the manually operated High Head Safety Injection Pump Discharge valves (850A and 850B). Close the motor operated High Head Safety Injection Pump Discharge valves (MOV-851A and MOV-851B) and introduce isolation valve seal water by opening 1403, 1404, 1464 and 1465.

   NOTE: The power supply for MOV-1810 will have to be re-energized.

2. Assure that the valves from the low head to the high head path, MOV-888A and MOV-888B are closed and introduce isolation valve N_2 seal gas by opening 1447 and 1448.

2.2.3 Sample the Containment atmosphere after the first 24 hours and periodically thereafter to determine the need for use of the Hydrogen Recombiner or the Post Accident Containment Ventilation System. Refer to procedures DP-10 and DP-47 of the Detailed Procedures Book, Part IV of the Operations Manual for operation of the recombiners and ventilation system, respectively. 3

CAUTION

OPERATION OF THE POST ACCIDENT CONTAINMENT VENTILATION SYSTEM SHOULD NOT BE INSTITUTED WITHOUT FIRST CONSULTING THE EMERGENCY DIRECTOR IN ORDER TO ASSURE THAT DOWNWIND OFF-SITE DOSES ARE NOT EXCESSIVE. 3

2.2.4 Periodically resurvey the Control Room and re-analyze the Control Room atmosphere for particulate and iodine concentrations. The periodicity of the surveys and atmosphere analysis is dependent upon plant conditions, radiation fields sensed by Control Room ARM (R-2) and changes thereto. 3

Appendix A

Control Room Field Survey

1.0 Purpose

To provide a procedure for radiation field survey of the Central Control Room using the RAD OWL, Model RO-1, portable ion chamber.

2.0 Procedure

2.1 Conduct a survey of the Unit No. 1 and 2 Central Control Room. Record fields at locations noted on attached sketch and also at any other locations where high fields are found. Measurements should be taken with the detector cover on (γ) and off ($\beta+\gamma$). Instructions for operation of the RAD OWL are contained in paragraph 3.0 below.

2.2 General area fields which register several mr/hr above background and where the $\beta+\gamma$ reading is double the γ reading or higher are indicative of airborne contamination in the Control Room atmosphere. The Health Physics Technician should be contacted to determine the particulate concentration involved for the purpose of deciding if protective clothing is required.

2.3 High γ fields are indicative of streaming from containment. Such areas should be determined and avoided if possible. If not, time in area should be limited to as short as practicable.

3.0 Operating Instructions for RAD OWL

3.1 Turn the function switch to the BATT position. The meter should read above the BATT cut-off line.

3.2 Turn the function switch to 500 R/hr position. Check that the meter reads zero (assuming the absence of a high radiation field).

NOTE: The zero setting of the instrument may be checked at any time on any range and in any radiation field by merely depressing the ZERO pushbutton. Since any zero offset will be most noticeable on the "5" range (5 R/hr. 5 mR/hr, 5 mR), adjusting the meter reading to zero with the ZERO SET knob should be done only on one of these three ranges. Once set, no adjustment should again be necessary when using the "500" or "50" ranges. Small re-adjustments may be necessary on the "5" ranges.

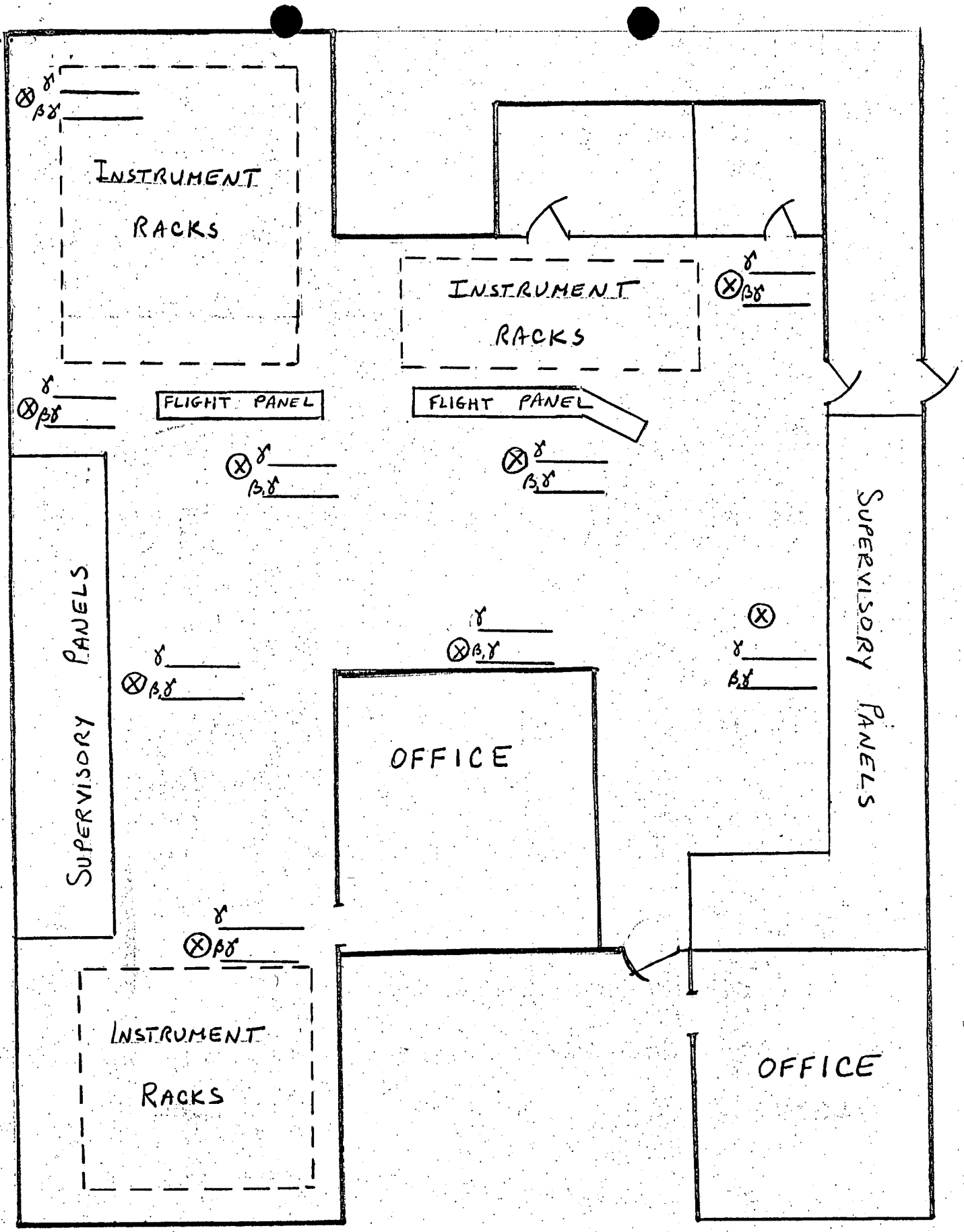
Depressing the ZERO pushbutton will erase the integrated reading when on one of the three integration ranges. To check for possible zero offset without losing the reading, switch to the 5 mR/hr (or 5 R/hr) position, depress the ZERO pushbutton and set to zero using the ZERO SET knob. Release the ZERO pushbutton. Return to the integrate position and read the meter or continue integrating, if desired.

3.3 To read dose rate, set the function switch to the desired range of operation. The switch position is the full scale reading of that range. Read the dose rate directly on the meter, keeping in mind what full scale reading represents.

NOTE: When selecting the most sensitive range, (5 mR/hr) switching transient noise, including releasing the ZERO pushbutton, may cause a temporary offscale reading on the meter. This can be avoided by first selecting 500 mR/hr, letting the needle settle, then repeating at 50 mR/hr, and then switching to 5 mR/hr.

3.4 To read dose, set the function switch to one of the three integrating ranges (mR-INT). Momentarily depress the ZERO pushbutton to start the integration period. At the end of the period, read the total dose received directly on the meter, keeping in mind what full scale represents.

NOTE: The dose rate may be checked at any time during an integration period by merely switching to the desired range, reading the dose rate and then returning to the integrate range to continue integrating.



CENTRAL CONTROL ROOM SURVEY

Appendix B

Control Room Ambient Air Iodine-131 Determination

1.0 Purpose

To provide a method for the determination of Iodine-131 concentration in the Control Room ambient air during emergency conditions.

2.0 Procedure

2.1 Obtain an air sample of the Control Room as follows:

2.1.1 Set up the air sampler by inserting two millipore (0.8μ) particulate filters in the first holder (inlet), followed by a charcoal filter in the second holder.

2.1.2 Record the gas meter starting volume and the time.

Volume _____

Time _____

2.1.3 Start the sampler running.

2.2 Set up the MS-2 (analyzer, detector, pig) as follows:

2.2.1 Set the controls to the following settings:

High Voltage Adjust	3.71
Threshhold	3.64
Window	0.91
Window IN/OUT	OUT
Test Mode	ON

2.2.2 Place the Mode Switch in the "TIMED" position.

2.2.3 Set the timer for one minute and start the test mode count. Reading should be 3600 $\pm$ 60 counts.

2.2.4 Reset the controls to the following settings:

Window IN/OUT	IN
Test Mode	OFF
Timer count in minutes	10

2.2.5 Place the mock Iodine-131 check source under the crystal and adjust the high voltage for maximum count rate (source in petrie dish).

2.2.6 Remove the check source and do a 10 minute background check.

Background Reading _____

2.2.7 Place the check source beneath the crystal and do a 10 minute count. The check source should give a reading of 304,000 $\pm$ 15,000 counts above background.

2.3 At the end of one hour, turn off the sampler. Record:

Volume _____

Time _____

2.4 Remove the filters from the sampler and place the charcoal filter beneath the crystal and count the sample for 10 minutes. Record counts: _____

2.5 Calculate the Iodine Activity as follows:

$$\text{I-131 (uCi/cc)} = \frac{\text{Sample Counts - Background}}{\text{Final Volume-Initial Volume}} \times 1.34 \times 10^{-10}$$

Example: Sample Count = 1300
Background Count = 953
Initial Volume = 8444 ft^3
Final Volume = 8504 ft^3

$$\text{I-131} = \frac{(1300-953)}{(8504-8444)} \times 1.34 \times 10^{-10}$$

$$= \frac{347}{60} \times 1.34 \times 10^{-10}$$

$$= 7.7 \times 10^{-10} \text{ uCi/cc}$$

2.6 Control Room personnel should use air line respiratory equipment if the Iodine-131 concentration is 9×10^{-9} uCi/cc or greater.

2.7 Start another air sample as per step 2.1 above. Time of subsequent samples should be based upon results of first sample and recommendation of Health Physics Technician.

Appendix C

Containment Isolation Valve Lineup Sheet

	Permission* Granted	Valve Operation	Location	Valving** Completed
A.		Isolate Charging Line		
		A. Close 205	1	
		B. Close 226	1	
		C. Close 227	1	
		D. Open 1402 (IVSW)	2	
B.		Isolate 21 RCP Seal Injection		
		A. Close 241A	3	
		B. Close 250A	3	
		C. Open 1466 (IVSW)	2	
C.		Isolate 22 RCP Seal Injection		
		A. Close 241B	3	
		B. Close 250B	3	
		C. Open 1467 (IVSW)	2	
D.		Isolate 23 RCP Seal Injection		
		A. Close 241C	3	
		B. Close 250C	3	
		C. Open 1468 (IVSW)	2	
E.		Isolate 24 RCP Seal Injection		
		A. Close 241D	3	
		B. Close 250D	3	
		C. Open 1469 (IVSW)	2	
F.		Isolate RCP Seal Return		
		A. Close MOV-222	CCR	
		Isolate RCP Component Cool.Wtr.		
		A. Close MOV-769	CCR	
		B. Close MOV-797	CCR	
		C. Close MOV-786	CCR	
		D. Close MOV-784	CCR	
		E. Close MOV-789	CCR	
		F. Close MOV-625	CCR	
G.		Isolate SI Test Line		
		A. Close 859A	1	
		B. Close 859C	1	

Location: 1 - Piping Penetration Area
2 - Piping Penetration Area - Rack on Handrail
3 - Gallery above Piping Penetration Area
4 - HH SI Pump Room - PAB 59' Elevation

H.		Isolate Containment Spray Headers		
		A. Close 869A	3	
		B. Close 869B	3	
		C. Open 1405 (IVSW - 869B)	3	
		D. Open 1463 (IVSW - 869A)	3	
I.		Isolate RHR System		
		A. Close MOV-882	CCR	
		B. Close MOV-744	CCR	
		C. Close MOV-743	CCR	
		D. Close MOV-1870	CCR	
		E. Close 958 (Sample Line)	1	
		F. Open 1401(N_2 Gas-732)	1	
		G. Open 1446(N_2 Gas-MOV-744)	1	
		H. Open 1449 (N_2 Gas - Sample Line)	1	
		I. Open 1450 (N_2 Gas - Between MOV-743/1870)	1	
J.		Isolate Recirculation Sample Line		
		A. Close 990B	1	
		B. Close 990C	1	
		C. Open 1420 (N_2 Gas)	1	
K.		Isolate N_2 to PRT and RCDT		
		A. Close 550 (PRT)	1	
		B. Close 1610 (RCDT)	1	
L.	IF ON LOW HEAD RECIRC-ULATION	Isolate HHSI Pumps		
		A. Close MOV-1810	CCR	
		B. Close 850A	4	
		C. Close 850B	4	
		D. Close MOV-851A	CCR	
		E. Close MOV-851B	CCR	
		F. Close MOV-888A	CCR	
		G. Close MOV-888B	CCR	
		H. Open 1403 (IVSW - 850A)	4	
		I. Open 1404 (IVSW - 850B)	4	
		J. Open 1464 (IVSW - MOV-851A)	4	
		K. Open 1465 (IVSW - MOV-851B)	4	
		L. Open 1447(N_2 Gas - MOV-888A)	1	
		M. Open 1448(N_2 Gas - MOV-888B)	1	

* The SRO/WF should initial those lines which it is permissible to isolate.

** The NPO should initial each valve as he properly positions it. The SRO can previously position the MOVs. If he does so, he should initial the appropriate right hand column entry.