LOSS OF COOLANT

This instruction presents the automatic actions, the immediate and subsequent operator actions and the diagnostic sequence which is to be followed in the identification of loss of coolant accidents or spurious safety injection initiation.

NOTE: The reactor automatic protection equipment is designed to safely shut down the reactor in the event of any of the above emergencies. The safety injection system is designed to provide emergency core cooling and boration to maintain the safe reactor shutdown condition. These plant safeguards systems operate with offsite electrical power or from onsite emergency diesel-electric power should offsite power not be available.

A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION

1.0 SYMPTOMS

NOTE: The process variables referred to in this Instruction are typically monitored by more than one instrumentation channel. The redundant channels should be checked for consistency while performing the steps of this Instruction.

1.1 The following symptoms are typical of those which may arise in a plant which is undergoing a loss of reactor coolant, loss of secondary coolant or steam generator tube rupture (one or more symptoms may appear in any order):

1.1.1 Low Pressurizer Pressure.

1.1.2 Low Pressurizer Water Level.

1.1.3 Letdown Isolation/Pressurizer Heater Cutout.

1.1.4 High Pressurizer Water Level.

1.1.5 High Containment Pressure.

1.1.6 High Containment Radiation.

1.1.7 High Containment Humidity.

1.1.8 High Containment Sump Water Level.

1.1.9 High Air Ejector Radiation.

1.1.10 High Steam Generator Blowdown Radiation.

1.1.11 Steam Flow/Feedwater Flow Mismatch.

1.1.12 Low Low Reactor Coolant System Average Coolant Temperature.

1.1.13 Rapidly Changing Reactor Coolant System Average Coolant Temperature.

1.1.14 Low Steamline Pressure.

1.1.15 Low Steam Generator Water Level.

1.1.16 Increasing Steam Generator Water Level.

1.1.17 High Steam Flow (one or all Steam lines).

1.1.18 Low Feedwater Pump Discharge Pressure.

A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION (Cond't)

1.0 SYMPTOMS (Cont'd)

1.1.19 Increased Charging Flow.

1.1.20 Decreasing Volumn Control Tank Level.

NOTE: The pressurizer water level indication should always be used in conjunction with other reactor coolant system indications such as the RCS subcooling recorder, T_{HOT}, pressure, core exit thermocouple temperatures, etc., to evaluate system conditions and to initiate manual operator actions.

NOTE: The pressurizer heaters must be re-energized within one hour of the initiation of loss of coolant, if pressurizer level permits. Close control group heaters ACB's locally if LOP lockout is in effect.

CAUTION: Be aware that loss of reactor coolant system pressure (loss of subcooling) can result in void formation within the reactor coolant system or reactor core.

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A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION (Cond't)

2.0 AUTOMATIC ACTIONS

NOTE: When the reactor has been operating at or above 1900 psig, the coincidence of two out of three pressurizer pressure channels <1685 psig and two out of three pressurizer level channels below 5%, will actuate safety injection. Except as required for surveillance testing, the pressurizer low level Bistables shall be in the tripped (safety injection) position.

2.1 Reactor/Turbine Trip.

2.2 Safety Injection Initiation.

2.3 Containment Isolation.

2.4 Possible Containment Spray.

NOTE: There shall be an operator stationed at the redundant auxiliary feedwater manual control valves (with no other assigned concurrent duties and in direct and continuous communication with the Control Room) to promptly initiate adequate auxiliary feedwater to the steam generator(s), in this event. In the event of a water hammer, the stationed operator, shall check the piping in the immediate area and report the water hammer, and any observed piping distress to the Control Operator.

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A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION (Cond't)

3.0 IMMEDIATE OPERATOR ACTIONS

CAUTION: During the performance of these immediate operator actions and subsequent operator actions, monitor refueling water storage tank level on LI-950 closely. Action must be taken under Subsequent Operator Actions of Parts B, C or D when RWST level reaches 21%.

3.1 Verify reactor/turbine trip.

3.2 If pressurizer pressure falls below 1685 PSIG on 2 of the 3 pressurizer channels, and automatic actuation of S.I.S. has not occurred; initiate S.I.S. manually.

3.3 Upon reactor trip and initiation of safety injection caused by low reactor coolant system pressure, immediately trip all operating reactor coolant pumps. RCP seal injection flow should be maintained.

3.4 Initiate auxiliary feedwater flow to the steam generators through the redundant feedwater header.

3.5 If it is determined that a void formation has occurred in the reactor coolant system or reactor core:

3.5.1 Attempt to reduce the void size by increasing reactor coolant system pressure.

3.5.2 Maintain reactor core cooling flow by continued safety injection or operation of the safety injection recirculation system, depending on RCS conditions.

3.6 Verify containment isolation has occurred by checking closed:

3.6.1 CS-1, CS-2, CS-3.

3.6.2 CV-534, CV-533, CV-535, CV-536 and CV-537.

3.6.3 CV-949, CV-957 and CV-992.

3.7 Operate Safety Injection block switches CS-1 and CS-2 to the "BLOCK" position.

3.8 Start Control Room air conditioning Fan A-33.

A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS

NOTE: If any of the following actions have not been initiated, do so manually.

4.1 Verify the following:

4.1.1 Safety injection system operating.

.1 East and west Feedwater Pumps and Safety Injection Pumps have started and the SIS valves are in the "Blue Light" position.

.2 Safety injection flow is being delivered to the reactor coolant system once system pressure goes below feed pump shut-off head ~1400 psig.

4.1.2 Auxiliary feedwater flow is being delivered to the steam generators in accord with directions of the Control Operator to the stationed operator at the redundant feedwater header.

4.1.3 Diesel generators 1 and 2 are running.

4.1.4 One (1) charging pump, salt water cooling pumps, and component cooling pumps are running.

4.1.5 4KV buses 1C and 2C and 480V buses 1, 2 and 3 are energized.

4.1.6 When containment pressure reaches 10 psi on any 2 of PIS 511, 512 or 513 in conjunction with SI, the following occurs:

.1 The refueling water pumps start and the spray header valves (CV-82 and CV-114) open to put the sprays in service. Spray flow ≥1080 gpm.

.2 Spray additive chemical injection pumps isolation valves (SV-600 and SV-601) open, pumps start. Hydrazine flow ≥.4 gpm on either pump.

4.1.7 Heat is being removed from the reactor plant via the steam generators by the following:

.1 Automatic steam dump to the condenser is occurring by placing Steam Dump Controller to Pressure Control-Condenser set at 930 psig.

.2 Reactor coolant average temperature is decreasing towards programed no-load temperature.

NOTE: After steam generator water level is established above the feed ring (>26%), the Auxiliary Feedwater System flow should be regulated to maintain ~50%.

A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

NOTE: If condenser steam dump has been blocked due to a control malfunction or loss of condenser vacuum, decay heat removal will be effected by automatic actuation of the main steam power-operated relief valves, or, if these prove ineffective, the main steam code safety valves. In this event, steam pressure will be maintained at the set pressure of the controlling valve(s) and reactor coolant average temperature will stabilize at approximately the saturation temperature for the steam pressure being maintained.

4.1.8 Upon a safety injection initiation, notify the "duty" station administrator and discuss the situation. If unable to contact any station administrator in the normal reporting chain within 15-20 minutes following the event, notify the NRC on the red phone.

4.2 Accident Determination.

4.2.1 Evaluate reactor coolant pressure to determine if it is low or decreasing in an uncontrolled manner. If it is low or decreasing, verify, by position switch indication, and/or alarms that:

.1 All pressurizer spray line valves are closed.

.2 All pressurizer relief valves are closed.

.3 All pressurizer safety valves are closed.

If not, where possible, manually close the valves from the Control Board.

4.2.2 If the RCS pressure is above 1840 psig and is stable or increasing, go to Step 4.2.6.

4.2.3 IF the condenser air ejector radiation (Channel R-1215) monitor or steam generator blowdown radiation (Channel 1216) monitor exhibt abnormally high readings, AND containment pressure, containment radiation and containment sump level exhibit normal readings; THEN go to Section D, "Steam Generator Tube Rupture."

A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.2.4 IF containment pressure, AND containment radiation, AND containment sump levels exhibit either abnormally high reading or increasing readings; THEN go to Section B "Loss of Reactor Coolant".

NOTE: For very small treaks inside the containment sphere, the containment pressure increase will be very small and possibly not recognizable by the operator. For very small breaks the containment sump water level will increase very slowly and early in the transient may not indicate a level increase.

4.2.5 IF steamline pressure is abnormally low and high steam flow or feedwater flow (prior to SI), AND containment radiation is in normal range; THEN go to Section C, "Loss of Secondary Coolant".

4.2.6 In the event of a spurious safety injection signal, the sequence of reactor trip, turbine trip and safeguards actuation will occur. The operator must assume that the safety injection signal is non-spurious unless the following are exhibited:

.1 Normal readings for containment pressure, radiation and sump level AND

.2 Normal readings for auxiliary building radiation and ventilation monitoring AND

.3 Normal readings for steam generator blowdown and condenser air ejector radiation.

IF all of the symptoms .1 through .3 above are met AND when the following .4 through .7 are exhibited:

.4 Reactor coolant pressure is greater than 2000 psig and increasing AND

.5 Pressurizer water level is greater than 15% AND

.6 The reactor coolant indicated subcooling is greater than 40°F AND

CAUTION: The T-Sat. recorder must be verified for accuracy for subcooling during natural circulation conditions. Core exit thermocouples should be used with pressurizer pressure and the backup curve for this verification.

A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

.7 Water level in at least one steam generator is stable and increasing as verified by level and by auxiliary feedwater flow to that steam generator. Total auxiliary feedwater flow to all steam generators should be greater then 200 gpm until indicated level is returned to within the narrow range level recorder.

.8 THEN Reset safety injection:

.1 Reset sequencers @ SLSS surveillance panels.

.2 Stop east and west feedwater pumps.

.3 Stop east and west safety injection pumps.

.4 Reset lockout switches if tripped.

.5 Maintain operable safety injection flowpaths.

CAUTION: Subsequent to this step, should loss of offsite power occur, manual action (e.g., manual safety injection initiation) will be required to load the safeguards equipment onto the diesel powered 4KV busses (1C and 2C).

4.2.7 Pressurizer water level should trend with reactor coolant system temperature, therefore, attempt to maintain adequate water level by operation of the charging system.

4.2.8 Re-establish operation of a normal and backup set of pressurizer heaters. If SISLOP occurred, the 480V bus lockout relays must be reset before the heaters can be energized.

4.2.9 Re-establish normal makeup and letdown (if unaffected) to maintain pressurizer water level at 25% and to maintain reactor coolant pressure at 2085 psig. Ensure that water addition during this process does not result in dilution of the reactor coolant system boron concentration.

4.2.10 When reactor coolant pressure can be controlled by pressurizer heaters alone, place pressurizer level control on AUTO-MAN SET at ~25%.

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A. GENERAL CONDITIONS AND ACCIDENT DETERMINATION (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.2.11 IF, after securing safety injection and attempting to transfer to normal pressurizer pressure and level control:

.1 Reactor coolant pressure drops below 1685 psig OR

.2 Pressurizer water level drops below 10% of span, OR

.3 Reactor coolant subcooling becomes less than 40°F,

.4 THEN, REINITIATE SAFETY INJECTION MANUALLY.

.5 Rediagnose plant conditions and proceed to the appropriate Emergency Procedure.

CAUTION: Stopping and starting of the feedwater and safety injection pumps can cause pump motor overheating or reduced motor life. Hence, if the pumps are restarted once after termination, an additional 15°F of subcooling should be added to the required subcooling prior to the second termination of the pump(s).

4.2.12 IF after securing safety injection and transferring the plant to normal pressurizer pressure and level control:

.1 Reactor coolant pressure does not drop below 1685 psig AND

.2 Pressurizer water level remains above 10% span AND

.3 Reactor coolant indicated subcooling is greater than 40°F,

.4 THEN, go to Emergency Procedure S-3-5.1, "Emergency Trip," Part 4 Subsequent Operator Actions.

B. LOSS OF REACTOR COOLANT

These instructions specify required operator actions and precautions necessary to:

A. Establish and verify short term core cooling to prevent or minimize damage to the fuel cladding and release of excessive radioactivity.

B. Maintain long term shutdown and cooling of the reactor by recirculation of spilled reactor coolant, injected water and containment spray system drainage.

B. LOSS OF REACTOR COOLANT (Cond't)

1.0 SYMPTOMS

1.1 Low Pressurizer Level.

1.2 Letdown Isolation/Pressurizer Heater Cutout.

1.3 Low Pressurizer Pressure.

1.4 High Containment Pressure.

1.5 High Containment Radiation.

1.6 High Containment Sump Water Level.

1.7 High Containment Humidity.

1.8 Increased Charging Flow.

CAUTION: Loss of reactor coolant system pressure (loss of subcooling) may result in void formation within the reactor coolant system or reactor core.

NOTE: The operator should verify that the instrumentation necessary to monitor post accident conditions is operating and recording. These instruments include wide range RCS temperature and pressure, RCS subcooling, steam pressure, steam generator water level, containment pressure, RWST water level, condensate storage tank water level, pressurizer water level, and boric acid storage tank water level.

NOTE: The pressurizer heaters must be re-energized within one hour of the initiation of loss of coolant, if pressurizer level permits. Close control group heaters ACB's locally if LOP lockout is in effect.

NOTE: The process variables referred to in this Instruction are typically monitored by more than one instrumentation channel. The redundant channels should be checked for consistency while performing the steps of this Instruction.

NOTE: The pressurizer water level indication should always be used in conjunction with other reactor coolant system indications such as the RCS subcooling recorder, T_{HOT}, pressure, etc., to evaluate system response and to initiate manual operator actions.

B. LOSS OF REACTOR COOLANT (Cond't)

2.0 AUTOMATIC ACTIONS

2.1 The automatic actuations were discussed in Part A of this Procedure. They include:

2.1.1 Reactor/Turbine Trip.

2.1.2 Safety Injection Initiation.

2.1.3 Containment Isolation.

2.1.4 Possible Containment Spray.

3.0 IMMEDIATE OPERATOR ACTIONS

3.1 The immediate actions have already occurred under "Immediate Actions" of Part A of this Procedure.

4.0 SUBSEQUENT OPERATOR ACTIONS

CAUTION: Monitor "Refueling Water Storage Tank" Level (LI-950) closely. If RWST level decreases rapidly such that the RWST low level alarm (<21%) appears imminent, go directly to Step 4.11 (Page 18).

4.1 As the water level in the refueling water storage tank decreases, check that the containment sump water level instrumentation (LI-951) indicates an increase in water level in the sump. If a sump water level increase is not evident then a re-evaluation of the symptoms in Part A must be conducted.

4.2 Regulate the auxiliary feedwater flow to the steam generators to restore and/or maintain an indicated narrow range water level of ~50%. If narrow range water level increases in an unexplained manner in one steam generator, go to Part D "Steam Generator Tube Rupture."

4.3 Monitor the water supply (Condensate Storage Tank) for the auxiliary feedwater pumps and upon reaching a low level (<4'), switch over to an alternate water supply source. Refer to S-2-13 "Auxiliary Feedwater System Operation".

4.4 Close, and verify closed, by position switch indication, the pressurizer power operated relief valves (CV-545 and CV-546) and the backup isolation valves (CV-530 and CV-531).

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.5 Close the following containment isolation valves:

4.5.1 Reactor Coolant Pump seal return (CV-527 and CV-528).

4.5.2 Excess letdown (CV-287).

4.5.3 Reactor Coolant System Letdown (CV-525 and CV-526).

4.6 Verify again, all required sphere isolation valves are closed.

NOTE: The conditions given below for termination of safety injection should be continuously monitored throughout this Instruction.

4.7 IF reactor coolant pressure is above the shutoff head of the feedwater pumps (>1400 psig).

AND safety injection flow to the Reactor Coolant System is zero (FI-913, 914 and 915 for loops A, B and C).

THEN attempt to reestablish the reactor coolant pressure to greater than 2000 psig and pressurizer water level to greater than 50% of span.

BY

4.7.1 Resetting the sequencers at the SLSS surveillance panels and,

4.7.2 Establishing full charging flow (start standby charging pump).

4.7.3 Resetting lockout switches if tripped.

CAUTION: Subsequent to this step, should loss of offsite power occur, manual action (e.g., manual safety injection initiation) will be required to load the safeguards equipment onto the diesel powered 4KV busses (1C and 2C).

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.8 Safety Injection can be terminated IF:

4.8.1 Reactor coolant pressure is >2000 psig and increasing AND

4.8.2 Pressurizer water level is greater than 50% of span, AND

4.8.3 Water level in at least one steam generator is stable and increasing as verified by level and by auxiliary feedwater flow to that steam generator. Total auxiliary feedwater flow to all steam generators should be greater then 200 gpm until indicated level is returned to within the narrow range level recorder AND

4.8.4 Reactor coolant indicated subcooling is greater than 40°F.

CAUTION: The T-Sat. recorder must be verified for accuracy for subcooling during natural circulation conditions. Core exit thermocouples should be used with pressurizer pressure and the backup curve for this verification.

THEN

4.8.5 Terminate safety injection as follows:

.1 Stop east and west feedwater pumps.

.2 Stop east and west safety injection pumps.

.3 Maintain operable safety injection flowpaths.

4.8.6 If the conditions for resetting safety injection can not be met, go to 4.10.

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.9 After securing safety injection:

4.9.1 IF, reactor coolant pressure decreases below 1685 psig, OR

4.9.2 Pressurizer water level decreases below 20% or span, OR

4.9.3 Reactor coolant subcooling is <40°F,

4.9.4 THEN, MANUALLY INITITATE SAFETY INJECTION to ensure core cooling. Refer to Step 4.2 of Part A of this procedure to re-evaluate the event.

CAUTION: Stopping and starting of the feedwater and safety injection pumps can cause pump motor overheating or reduced motor life. Hence, if the pumps are restarted once after termination, an additional 15°F of subcooling should be added to the required subcooling prior to the second termination of the pump(s).

CAUTION: If inadequate core cooling is suspected (core exit TC >1200°F or T_H >700°F and SI and auxiliary feed flows are not effective) go to S-3-4.2, "Inadequate Core Cooling" for direction, then proceed with this procedure.

4.9.5 Re-establish normal charging and letdown (if unaffected) to maintain pressurizer water level at 25% and to maintain reactor coolant pressure at 2085 psig. Ensure that water addition during this process does not result in dilution of the reactor cooant system boron concentration.

4.9.6 Re-establish operation of a normal and backup set of pressurizer heaters. If SISLOP occurred, the 480V bus lockout relays must be reset before the heaters can be energized.

4.9.7 When reactor coolant pressure can be controlled by pressurizer heaters alone, place pressurizer level control on AUTO-MAN SET at ~25%.

4.9.8 Monitor the temperature indication of core exit thermocouples and all reactor coolant temperature T_H channels to verify that RCS temperature is at least 40°F less than saturation temperature at RCS indicated pressure.

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.9.9 If 40°F indicated subcooling is not present, then attempt to establish 40°F indicated subcooling by steam dump from the steam generators to the condenser or the atmosphere.

CAUTION: If steam dump is necessary, reduce steam generator pressure to 785 psig and maintain a reactor coolant cooldown rate of no more than 50°F/HR, consistent with plant make-up capability.

4.9.10 If 40°F indicated subcooling cannot be established or maintained, THEN, MANUALLY REINITIATE SAFETY INJECTION. Go to Step 4.2 (Page 7) of Part A to re-evaluate the event, unless this re-evaluation has already been performed.

4.9.11 Perform a controlled cooldown to cold shutdown conditions using Normal Cooldown Procedures (S-3-1.5) if required to affect repairs. Maintain subcooled conditions (at least 50°F indicated subcooling) in the reactor coolant system. If subcooled conditions cannot be maintained, go to Step 4.10.

4.10 If the conditions for terminating safety injection in Step 4.8 are not met, maintain necessary safety injection pumps operating. If any safeguards equipment is not operating, attempt to operate the equipment from the control room or locally. Effect repairs if necessary.

4.11 In the case of a break characterized by reactor coolant pressure quickly decreasing below steam generator pressure (985 psig), go to Step 4.11. In the case of a break characterized by a slowly decreasing reactor coolant pressure or stabilized reactor coolant system pressure above the lowest steam system safety valve setpoint, (985 psig), the following additional manual actions should be taken to aid the cooldown and depressurization of the reactor coolant system:

4.11.1 Reduce steam generator pressure to 785 psig and maintain a reactor coolant cooldown rate of 50°F/hr or less, consistant with plant makeup capabilities.

4.11.2 If the main condenser is in service, verify or transfer the steam dump control to steam pressure control and dump steam to the condenser to lower the reactor coolant temperature and consequently the reactor coolant pressure.

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.11.3 If the main condenser is not is service, dump steam to the atmosphere with the steam dump to atmosphere relief valves to lower the reactor coolant temperature and consequently the reactor coolant pressure.

4.12 Monitor delivery of refueling water to the reactor coolant system. As level approaches 21% in the RWST (LI-950), anticipate receipt of the following indications/alarms. Upon receipt of any two, reset and terminate safety injection as per Step 4.13 below.

CAUTION: Safety injection flow should be terminated within 30 seconds following receipt of the second indication to insure sufficient inventory for containment spray.

4.12.1 Containment sphere sump level above -4' as indicated by LI-951.

4.12.2 Containment sphere sump water level at -3' as indicated by the sphere sump high-high level alarm.

4.12.3 Refueling water storage tank level at 21% as indicated on LI-950.

4.12.4 Refueling water tank low-low level alarm.

4.13 Reset Safety Injection.

4.13.1 Terminate Safety Injection flow.

.1 Reset sequencers at SLSS surveillance panels.

.2 Stop east and west feedwater pumps.

.3 Stop east and west safety injection pumps.

4.13.2 Isolate Safety Injection lines.

.1 Close MOV-850 A, B and C.

.2 Close HV-851 A and B.

.3 Close HV-853 A and B.

.4 Verify CV-875 A and B close automatically.

4.14 Stop automatic make-up or dilution.

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.15 Re-establish cold leg injection within 3 minutes of terminating safety injection flow:

4.15.1 Place MOV-1100B and 1100D control out-of-auto and open.

4.15.2 Place MOV-1100C control out-of-auto and close.

4.15.3 Place FC-1115A, B and C on manual and close FCV-1115A, B, C, D, E and F.

4.15.4 Open MOV-356, 357, 358, 18 and 19.

4.15.5 Start the second charging pump.

4.15.6 Close FCV-1112.

4.15.7 Open FCV-1115D, E and F to establish 110 gpm to each of Loop A, Loop B and Loop C. If flow cannot be estalbished in one line, set the flow to each of the other two loops at 165 gpm. Do not exceed a total charging pump flow of 330 gpm because of potential damage to charging pumps.

4.15.8 If instrument air is lost to FCV-1115D, E and F, place back-up manual controllers in service.

.1 Place Position Control Switch in "ON".

.2 Place Auxiliary Air Control Switch in "ON".

.3 Adjust flow as described in 4.15.7 above using the Manual Control Station.

.4 After flow has been set, place Position Control Switch in "OFF" position. This will lock valve in position and reduce nitrogen requirement.

.5 To charge flow, again place Position Control Switch in "ON", make flow change and place switch in "OFF".

4.16 Open the safety switch to the inlet MOV of the inservice residual heat exchanger(s) to prevent inadvertent operation due to flooding.

4.16.1 East HX MOV-822A (42-1164).

4.16.2 West HX MOV-822B (42-1266).

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.17 Begin alignment of the safety injection recirculation system when the RWST level is less than 12% as indicated on LI-950 or sphere sump level is at/or above -2' as indicated on sphere water level grade indicating lights, LI-951.

CAUTION: Complete switchover to S.I. recirculation before RWST level reaches 7% on LI-950. This insures that adequate NPSH to the refueling water and charging pumps will be maintained. RWST level will drop from 12% to 7% in about 6 minutes.

4.17.1 Start east and west S.I. recirc. pumps.

NOTE: Pumps should be run for at least 2 minutes against closed discharge valves to insure air is vented from system.

4.17.2 Verify that at least two component cooling water pumps are running.

4.17.3 Verify that at least one salt water cooling pump is running.

4.17.4 Open the recirc. heat exchanger cooling water valves CV's 737 A and B.

4.17.5 Override and close CV's 517 and 518, reducing containment spray.

4.17.6 Stop one refueling water pump if both pumps are running.

4.17.7 Open MOV's 866 A and B, thus establishing recirc. flow.

4.17.8 Close MOV-883, refueling water tank outlet valve.

4.18 Periodically check auxiliary building area radiation monitors for detection of leakage from ECCS during recirculation. If significant leakage has been identified in the ECCS, attempt to isolate the leakage. The operator MUST maintain recirculation flow to the RCS at all times.

4.19 If off-site power is available, stop Diesel Generators No. 1 and No. 2.

4.20 One hour after initiation of safety injection, reduce injection flow via MOV-356, 357 and 358 to 70 gpm to each loop. If flow is to two loops only, set flow at 105 gpm to each loop. Do not exceed 210 gpm total flow.

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B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.21 In the event hydrogen gas generation is evident or suspected, refer to S-3-2.37, "Post Accident Hydrogen Gas Control" Operating Instruction for methods of control.

4.22 Nineteen hours after the emergency, establish hot leg injection to provide dual recirculation.

4.22.1 Reduce cold leg injection flow to 102 gpm.

.1 Set flow to 34 gpm to each of the three cold legs or:

.2 If only two loops are available, set flow at 51 gpm to each of the available cold legs.

4.22.2 Establish hot leg injection flow at approximately 110 gpm, as indicated by FI-1112.

.1 Verify or align pressurizer auxilairy spray system as follows:

(1) CV-304 closed.

(2) CV-305 open

(3) PCV-430C closed

(4) PCV-430H closed

.2 Open FCV-1112 to establish 110 gpm as indicated.

4.22.3 If hot leg injection via the auxiliary sprays is determined to be ineffective because of lack of adequate flow or diversion of part of the flow due to CV-304, PCV-430C or PCV-430H failing to close, use the alternate hot leg injection flow path.

.1 Open the residual heat removal loop inlet MOV's 813 and 814 and de-energize their power supplies; MOV-813 (42-1169) and MOV-814 (42-1271).

.2 Verify that either refueling water pump is in operation.

CAUTION: Use portable radiation suvey instrumentation to assess local radiation levels while performing following steps.

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

.3 Open the downstream manual crosstie valve between the spray supply line and the letdown line.

.4 The upstream manual block valve has been preset and locked in a throttled position to establish approximately 100 gpm which can be verified by substracting the total measured supply flows (FIS-522 and FI's 1114 A, B and C) from the total measured return flow (recirc. pump FIS's 520 and 521).

4.23 When containment pressure is less than 2 psig and maximum reduction in radiation levels has been achieved, discontinue sprays.

4.23.1 RLR 1200 and 1201 can be used for trend indication of decreasing radiation levels.

4.23.2 Test Panel CSAS Train A and B must be reset before sphere spray valves CV-82 and 114 can be closed.

4.24 If it becomes necessary to reset the containment isolation system, first obtain approval of the Plant Manager or his designee, then:

4.24.1 Place following valves in the "After Close" position:

.1 Sampling System Sphere Isolation SV-949

.2 Sampling System Sphere Isolation SV-957

.3 Sampling System Sphere Isolation SV-992

.4 Sphere Isolation Valves, CS-3 (Pull to Close)

.5 Sphere Purge POV-9, 10; CS-1

.6 Sphere Equalization Pressure, CV-116; CS-2

4.24.2 If containment pressure is less than 2 psig and SI is reset:

.1 Depress PS-23 reset push button

.2 Depress PS-117 reset push button

B. LOSS OF REACTOR COOLANT (Cond't)

4.0 SUBSEQUENT OPERATOR ACTIONS (Cond't)

4.24.3 Containment isolation valves are now reset and may be opened individually as needed.

NOTE: Containment isolation valves shall remain closed unless needed for operations and then shall be reclosed after use.

C. LOSS OF SECONDARY COOLANT

1.0 SYMPTOMS

1.1 Steam-feedwater flow mismatch trip.

1.2 Reactor overpower trip.

1.3 Steam flow abnormally high.

1.4 Steam pressure abnormally low.

1.5 Steam generator low level alarm.

1.6 Safety injection initiation.

2.0 AUTOMATIC ACTION

2.1 Reactor/turbine trip.

2.2 Safety Injection initiation.

3.0 IMMEDIATE OPERATOR ACTION

3.1 Immediate actions have already occurred under "Immediate Operator Action" of Part A of this procedure.

4.0 SUBSEQUENT OPERATOR ACTION

4.1 Determine which steam generator is affected by observing steam generator water level.

4.1.1 A low water level compared to the others denotes the faulted loop.

4.1.2 Terminate auxiliary feedwater to that loop.

4.1.3 Maintain level in other steam generators within range of narrow range instrumentation if possible.

CAUTION: Indicated water level may increase as much as 10% above the normally indicated value as the containment temperature approaches 271°F, due to reference leg heat up.

CAUTION: Depressurization of a steam generator may cause boiling in the reference leg causing a major bias for a short time.

C. LOSS OF SECONDARY COOLANT (Con't)

4.0 SUBSEQUENT OPERATOR ACTION (Con't)

4.2 Monitor the water supply (Condensate Storage Tank) for the auxiliary feedwater pumps and upon reaching a low level (<4'), switch over to an alternate water supply source. Refer to S-2-13, "Auxiliary Feedwater System Operation."

4.3 Initiate auxiliary feedwater to the steam generators using the redundant flow path.

NOTE: There shall be an operator stationed at the redundant auxiliary feedwater manual control valves (with no other assigned concurrent duties and in direct and continuous communications with the Control Room) to promptly initiate adequate auxiliary feedwater to the steam generator(s) in this event. In the event of a water hammer, the stationed operator, shall check the piping in the immediate area and report the water hammer, and any observed piping distress to the Control Operator.

4.4 If auxiliary feedwater is ineffective in removing core heat due to total loss of the feedwater system:

4.4.1 Align charging pump dishcarge to the reactor coolant system through MOV-356, MOV-357 and MOV-358.

4.4.2 Operate the reactor coolant pump seal supply FCV-1115 A, B, C, D, E and F to maintain maximum flow to the core with consideration to charging pump capability.

4.4.3 Maintain reactor coolant pressure at ~2000 psig by opening the power operated relief valves.

4.5 If containment spray has been actuated (break inside containment), reset spray when containment pressure has been reduced to <2 psig.

4.6 Reset safety injection only if ALL the requirements 1 to 5 are met:

1. Safety inject has been operating for twenty (20) minutes.

2. Reactor coolant indicated subcooling is >40°F.

3. Reactor Coolant pressure is ~2000 psig.

4. Pressurizer water level is >15% and increasing.

C. LOSS OF SECONDARY COOLANT (Con't)

4.0 SUBSEQUENT OPERATOR ACTION (Con't)

5. Water level in at least one steam generator is stable and increasing as verified by auxiliary feedwater flow to that steam generator. Total auxiliary feedwater flow to all steam generators should be greater then 200 gpm until indicated level is returned to within the narrow range level recorder.

4.7 If ALL the requirements 1 to 5 listed in step 4.6 are met, then reset safety injection:

4.7.1 Stop east and west feedwater pumps.

4.7.2 Stop east and west safety injection pumps.

4.7.3 Reset lockout switches if tripped.

4.7.4 Maintain operable safety injection flowpaths.

CAUTION: If 40°F subcooling cannot be maintained after terminating safety injection, then re-initiate safety injection until the required subcooling is regained.

4.8 In the vent hydrogen gas generation is evident or suspected, refer to S-3-2.37, "Post Accident Hydrogen Gas Control," Operating Instruction for methods of control.

4.9 Complete RCS cooldown per Operating Instruction S-3-1.5, "Plant Hot Shutdown to Cold Conditions."

4.10 If a steam line break has occurred inside the containment and the residual heat removal pumps are inoperable, complete the following operations:

4.10.1 Maintain maximum charging and letdown. Hold pressurizer level constant.

4.10.2 Terminate feedwater addition.

CAUTION: If steam or feedwater line break has occurred inside containment, cooldown by use of natural circulation.

C. LOSS OF SECONDARY COOLANT (Con't)

4.0 SUBSEQUENT OPERATOR ACTION (Con't)

4.10.3 Align Safety Injection and Feedwater pumps to take suction from the RWST.

.1 Open Hydraulic Valves 853A, 853B, 852A and 852B.

.2 Close Hydraulic Valves 851A, 851B, 854A, and 854B.

.3 Start a safety injection pump and its corresponding feedwater pump.

.4 Maintain steam generator level above the tube bundle.

4.10.4 As the contents of the RWST are exhausted, return water from the sump to the RWST as follows:

.1 Close MOV-883

.2 Close MOV-1100B and MOV-1100D if not already closed and place the switches in the manual position.

.3 Establish component cooling water to the recirculation heat exchanger by opening CV-737A and CV-737B.

NOTE: Containment sump level should be at least to the grade -3' level prior to operating the recirculation pumps.

.4 Start the recirculation pumps, operate for one (1) minute to purge discharge line then open MOV-866A and MOV-866B.

.5 Open the 4" manual return valve to the RWST from the refueling water pump discharge header.

.6 Start a refueling water pump.

.7 Continue their operation until there is no boiling in the steam generator.

4.11 Inspect safety injection, steam and feedwater lines for piping integrity.

D. STEAM GENERATOR TUBE FAILURE

1.0 SYMPTOMS

1.1 Radiation Monitoring System channel high activity alarm.

1.1.1 Main condenser air ejector (Channel 1215) high activity alarm.

1.1.2 Steam generator blowdown (Channel 1216) high activity alarm.

NOTE: A high activity alarm followed by low indicated CPM may indicate a saturated detector.

1.2 Increased makeup flow to Reactor Coolant System.

1.3 Pressurizer level decreasing.

1.4 Pressurizer pressure decreasing (backup heaters on).

1.5 Main stack (Channel 1214) high activity alarm.

1.6 Automatic start of standby charging pump.

1.7 Charging pump suction transferred to refueling water storage tank on low-low level of the volume control tank.

1.8 Safety injection initiation.

2.0 AUTOMATIC ACTION

2.1 Safety Injection Initiation

2.2 Reactor/turbine trip

3.0 IMMEDIATE OPERATOR ACTION

3.1 Immediate actions have already accurred under "Immediate Operator Actions" Part A of this procedure.

D. STEAM GENERATOR TUBE FAILURE (Con't)

4.0 SUBSEQUENT OPERATOR ACTION

4.1 Transfer the steam dump pressure control to condenser only to minimize atmospheric steam dump.

4.2 Attempt to maintain the water level in the leaking steam generator at the minimum allowable level (26%)

4.3 If the main steam safety valves and/or atmospheric steam dump valves are open, operate the pressurizer power relief valves to depressurize the reactor coolant system.

CAUTION: Maintain 40°F subcooling in the reactor coolant system.

4.4 Safety injection may reset only if ALL the requirements 1 to 5 are met:

1. Safety Injection System has been operating for twenty (20) minutes.

2. Reactor Coolant indicated subcooling is >40°F.

3. Reactor Coolant System pressure is >2000 psig.

4. Pressurizer water level is >15% and increasing.

5. Water level in at least one steam generator is stable and increasing as verified by auxiliary feedwater flow to that steam generator. Total auxiliary feedwater flow to all steam generators should be greater then 200 gpm until indicated level is returned to within the narrow range level recorder.

4.5 If ALL the requirements 1 to 5 listed in step 4.4 are met, then reset safety injection:

4.5.1 Stop east and west feedwater pumps.

4.5.2 Stop east and west safety injection pumps.

4.5.3 Reset lockout switches if tripped.

4.5.4 Maintain operable safety injection flowpaths.

CAUTION: If 40°F subcooling cannot be maintained after terminating Safety Injection, then re-initiate safety injection until the required subcooling is regained.

D. STEAM GENERATOR TUBE FAILURE (Con't)

4.0 SUBSEQUENT OPERATOR ACTION (Con't)

4.6 If pressurizer level cannot be maintined using charging pumps only, periodically open MOV's 850A, B, and C with the safety injection and feedwater pumps running to maintain pressurizer level.

4.7 Initiate plant cooldown at maximum rate as per Operating Instruction S-3-1.5, "Plant Hot Shutdown to Cold Conditions." Maintain >40°F subcooling in the reactor coolant system.

4.8 To minimize release of contaminants:

4.8.1 Verify that steam generator blowdown is closed to the outfall and blowdown tank.

4.8.2 Close the steam generator 5 gpm continuous blowdowns.

4.8.3 Avoid the use of the steam driven auxiliary feedwater pump.

4.8.4 Close the hotwell drawoff valve and the auxiliary feedwater pumps flush water valves.

4.8.5 Verify that the air ejector after condenser drains are aligned to the condenser and close the steam to the ammonia strippers.

4.8.6 Close all unnecessary chem-lab samples and align the chem-lab drain header to rad waste.

4.8.7 Do not pump hotwells overboard.

4.9 Conduct radiation and smear surveys to determine contaminated areas due to atmospheric release of steam dump and/or safety valves. All outside areas should be considered contaminated until proven otherwise. Use proper health physics procedures at all times.

4.10 Have Chemical Radiation Technician perform analysis of steam generator blowdown, hotwells, condensate system and other systems as necessary to determine extent of radioactive material release to various systems and to the enviornment.

D. STEAM GENERATOR TUBE FAILURE (Con't)

4.0 SUBSEQUENT OPERATOR ACTION (Con't)

4.11 In the event hydrogen gas generation is evident or suspected, refer to S-3-2.37, "Post Accident Hydrogen Gas Control," Operating Instruction for methods of control.

4.12 After completing cooldown drain reactor coolant system to midloop.

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EMERGENCY SHUTDOWN

1.0 SYMPTOMS

NOTE: If shutdown is due to loss of offsite power refer to Emergency Operating Instruction S-3-5.30.

1.1 Reactor plant first-out trip alarm.

1.2 Turbine-generator first-out trip alarm.

1.3 Plant electrical protection trip alarm.

1.4 Manual reactor and/or turbine trip.

2.0 AUTOMATIC ACTION

2.1 Reactor trip.

2.2 Turbine trip.

2.3 Automatic steam dump actuation (if trip occurs above 30% reactor power).

2.4 Turbine stop valves and control valves close.

2.5 Unit 1, PCB 412 and PCB 612 open (one (1) minute after turbine stop valves close).

2.6 At 40% nominal generator terminal voltage (7200 volts) on generator coastdown, which takes ∿ four (4) minutes following the trip, the following occurs:

2.6.1 Reactor coolant pumps A, B and C trip.

2.6.2 Exciter motor breaker opens.

2.6.3 Exciter field breaker opens.

2.7 If the trip is from electrical protection or from remote turbine trip push button, there is no generator coastdown. The following occurs:

2.7.1 Unit 1 PCB 412 and PCB 612 open immediately.

2.7.2 Exciter field breaker opens immediately.

2.7.3 Auxiliary transformer A feeder ACB 11A04 opens.

2.7.4 Auxiliary transformer B feeder ACB 11B04 opens.

2.7.5 Reactor coolant pumps A, B and C trip.

EMERGENCY SHUTDOWN (Con't)

2.0 AUTOMATIC ACTION (Con't)

2.8 If the voltage regulator is on manual control at the time of the trip:

2.8.1 Field breaker trips open.

2.8.2 18KV voltage decays.

2.8.3 Generator inertia coastdown is not effective.

2.9 When Tavg < 545°F, steam generator feedwater valves position to pass 5% of full load flow.

2.10 When turbine lube oil pressure <10 psig, auxiliary lube oil pump starts automatically.

2.11 When turbine speed reaches "0", turbine is automatically placed on the turning gear operation.

3.0 IMMEDIATE OPERATOR ACTION

3.1 Verify the following:

3.1.1 Reactor trip.

3.1.2 Control rods fully inserted into the core.

3.1.3 Turbine stop and control valves closed.

3.1.4 Unit 1 PCB 412 and PCB 612 open.

3.1.5 Exciter field breaker open.

3.2 Observe operation of feedwater control system.

3.2.1 Assume manual control, if steam generator level is abnormally low or high.

3.2.2 Slowly re-establish normal water level to approximately 50%.

3.3 Observe steam dump system operation, transfer to "Atmos-Condenser" when Tavg approaches 535°F.

3.4 Transfer NIS recorder to intermediate range channels.

EMERGENCY SHUTDOWN (Con't)

4.0 SUBSEQUENT OPERATOR ACTION

NOTE: List pre-trip and first-out alarms before resetting annunciators.

4.1 Verify termination of generator coastdown at 40% of nominal terminal voltage (7200 volts).

4.2 Restore power to 4KV buses 1A and 1B (from Auxiliary Transformer C).

4.1.1 Open auxiliary transformer A feeder ACB 11A04.

4.1.2 Open auxiliary transformer B feeder ACB 11B04.

4.1.3 Close bus 1A-1C tie ACB 11C01.

4.1.4 Close bus 1B-1C tie ACB 12C02.

4.3 Immediately within one (1) minute following the reactor coolant pumps' trip, start pumps A and C, or B for recirculation and pressurizer sprays.

CAUTION: If all three pumps are tripped for more than one (1) minute, no pump may be restarted until thrity (30) minutes after reactor coolant temperature has stabilized and all feedwater flow has been secured.

CAUTION: Allow two (2) minutes between the start of additional pumps.

4.4 Open turbine drain valves.

4.5 Close reheater steam supply MOV's.

4.6 Verify start of turbine auxiliary oil pump.

4.7 Align backup station power (220KV/18KV System).

4.7.1 Open generator motor operated disconnect switch.

4.7.2 If trip was not from transformer protection:

.1 Reset lockup bus.

.2 Close Unit 1 PCB 412 and PCB 612.

.3 Notify Mira Loma Switching Center as soon as practical.

EMERGENCY SHUTDOWN (Con't)

4.0 SUBSEQUENT OPERATOR ACTION (Con't)

4.8 Upon a unit trip, notify the "duty" station administrator and discuss the situation. If unable to contact any station administrator in the normal reporting chain within 15-20 minutes following the trip, notify the NRC via the red phone.

4.9 Verify proper operation of automatic turbine turning gear engagement.

4.10 Determine cause of the emergency shutdown and initiate the necessary corrective actions.

4.11 As soon as possible following a unit trip and prior to return to criticality, conduct a containment inspection to check for any fluid system leakage including RCP oil leakage.

4.12 Establish Hot Standby (S-3-1.4), Hot Shutdown (S-3-1.13) or Cold Shutdown (S-3-1.5) as conditions warrant.

4.13 Isotopic analysis for iodine in the reactor coolant must be made between 2 and 6 hours following a thermal power change exceeding 15% within a one hour period.

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AUXILIARY FEEDWATER SYSTEM OPERATION

1. OBJECTIVE

To provide instruction on the method of alignment for operation of the auxiliary feedwater system including auxiliary feedwater pumps, valves and pump suction supply.

2. REFERENCES

2.1 S-3-2.39 "Safety Related Valve Alignment"

2.2 S-2-19 "Auxiliary Feedwater System Testing"

2.3 DPR-13 Appendix A Part 3.4

2.4 S-0-111 "Equipment Testing Before and after Maintenance"

3. PREREQUISITES

3.1 Condensate make-up system is in service to the point where suction is available to the auxiliary feedwater pumps.

3.2 Steam is available to the turbine driven auxiliary feedwater pump.

3.3 Pump(s) are primed, flush water on and service water available.

3.4 Auxiliary feedwater pumps are aligned per S-3-2.38 "Safety Related Valve Alignment" Part I.

3.5 Auxiliary feedwater MOV-1204 operable and on automatic.

4. PRECAUTIONS

4.1 The reactor shall not be pressurized above 500 psig unless both auxiliary feedwater pumps are operable, or the steam driven pump is in continuous operation when the residual decay heat levels are greater than the natural heat losses from the reactor coolant system.

4.2 After criticality, one auxiliary feedwater pump may be removed from service for a period not to exceed 24 consecutive hours.

4.3 T average temperature changes must be anticipated when using the auxiliary feedwater pumps to supply the steam generator.

4. PRECAUTIONS (Cont'd)

4.4 To assure reliability, the steam turbine and exhaust lines must be drained after use of the turbine driven pump.

4.5 The auxiliary feedwater pumps shall not be used for pumping through their normal discharge valves with open discharge valves on the main feedwater pumps when the safety injection system is operable.

4.6 The electric auxiliary feedwater pump discharge valve MOV-1204 shall have its electric disconnect switch open and fuses removed and its valve handwheel chained and locked when the safety injection system is operable.

4.7 Equipment requires testing before and after maintenance, per Station Order S-V-111.

4.8 The automatic auxiliary feedwater system shall be operable and in the ENABLE mode when the reactor coolant system pressure is >500 psig unless there is an operator stationed at the redundant auxiliary feedwater manual control valves (with no other assigned concurrent duties and in direct and continuous communication with the control room) to promptly initiate adequate auxiliary feedwater to the steam generator(s) if required.

5. CHECK OFF LIST/FORMS

5.1 Not applicable

6. PROCEDURES

6.1 Unit Startup Operation.

	Important Step		Key Point
6.1.1	Verify pump(s) discharge valves closed to main feedwater header.		
6.1.2	Verify main and auxiliary feedwater regulators closed.		
6.1.3	Start motor driven pump.	6.1.3	Verify bearing and seal water established.
6.1.4	Slowly open the pump discharge valve to the main feedwater header.	6.1.4	Pressurize slowly to avoid pressure shock. MOV-1204 need not be opened.

6. PROCEDURES (Cont'd)

	Important Step		Key Point
6.1.5	Adjust flow as required on the auxiliary regulators.	6.1.5	Observe pump amps - do not exceed red line.
6.1.6	Upon completion of pumping, close the pump discharge valve.		
6.1.7	Stop motor driven pump.		
	NOTE: If steam is available, the turbine driven pump may be used as follows:		
6.1.8	Start turbine driven pump by performing or verifing:		
6.1.8.1	Overspeed trip latched.		
6.1.8.2	Crack open steam supply bypass valve.		
6.1.8.3	Close turbine and exhaust drains when steam flows.	6.1.8.3	Total of three drain valves.
6.1.8.4	Slowly open main steam supply valve.	6.1.8.4	Observe turbine speed and pump discharge pressure increasing by action of turbine governor. If discharge pressure >1350 psig, verify proper turbine speed using portable RPM indicator (4400 RPM)
6.1.8.5	Close steam supply bypass valve.	6.1.8.5	Observe steam control valve regulating downstream pressure at ~610 psig.
6.1.9	Slowly open the steam driven pump discharge valve to main feedwater header.	6.1.9	Pressurize slowly to avoid pressure shock.
6.1.10	Adjust flow as required on the auxiliary regulators.		

6. PROCEDURES (Cont'd)

	Important Step		Key Point
6.1.11	Upon completion of pumping, close pump discharge valve.		
6.1.12	Stop turbine driven pump.		
6.1.12.1	Slowly close main steam supply valve.		
6.1.12.2	Open turbine and exhaust drain when pump has stopped.	6.1.12.2	Total of three drain valves.

6.2 Automatic System Operation

NOTE: The automatic auxiliary feedwater system shall remain out-of-service with all pertinent leads lifted to prevent inadvertent operation. This condition shall remain until its use is approved.

NOTE: There shall be an operator stationed at the redundant auxiliary feedwater manual control valves (with no other assigned concurrent duties and in direct and continuous communications with the Control Room) to promptly initiate adequate auxiliary feedwater to the steam generator(s) whenever the automatic auxiliary feedwater system is not in the ENABLE mode and the reactor coolant system pressure is >500 psig.

6.2.1	Upon low level (<26%) in 2/3 steam generators, verify:		
6.2.1.1	Electric auxiliary feedwater pump starts.		
6.2.1.2	MOV-1204 opens after 20 sec. TD.	6.2.1.2	Discharge valve to 1st point heater outlet.
6.2.1.3	Establish flow to all steam generators through auxiliary regulators.	6.2.1.3	Auxiliary regulators (CV-142, 143 and 144) manually positioned except on SI when they close.

NOTE: On a unit trip, or other conditions causing low steam generator level (except safety injection), feedwater flow will be through the auxiliary and main feedwater regulators from both the main feedwater pumps and the electric auxiliary feedwater pump. Upon safety injection the auxiliary feedwater pump alone will feed the steam generators through the redundant feedwater header.

6. PROCEDURES (Cont'd)

	Important Step		Key Point
6.2.2	Adjust flow to maintain steam generator level within the narrow range instrumentation (>26%).	6.2.2	Upon unit trip establish 50% level.
6.2.3	If the main and/or auxiliary feedwater regulators are unavailable, initiate flow through the redundant feed header.	6.2.3	Emergency redundant feed header ties into main feed line downstream of main/and auxiliary regulators.
6.2.3.1	Verify running or start the electric and/or steam driven pump.	6.2.3.1	See 6.1.8 for starting steam driven pump.
6.2.3.2	Open the inlet block valves to each steam generator feed line.	6.2.3.2	Valves located in Controlled Area, just south of containment sphere.

NOTE: Maintain communications with Control Room to assure flow is within capability of pump(s).

6.3 Loss of Suction from Condensate Storage Tank.

6.3.1	Place auxiliary feedwater system in DISABLE mode. See Precaution 4.8	6.3.1	Insure integrity of of electric auxiliary feedwater pump.

NOTE: The automatic auxiliary feedwater system shall remain out-of-service with all pertinent leads lifted to prevent inadvertent operation. This condition shall remain until its use is approved.

6.3.2 Initiate unit shutdown to cold conditions.

6.3.3 Initiate repair and/or return to service of suction from Condensate Storage Tank.

6.3.4 Verify alignment of the permanently installed suction hose between hose connection at fire pump suction piping and suction connection at the electric auxiliary feedwater pump inlet.

6.3.5 Open valve to the suction of the electric auxiliary feedwater pump <u>if</u> it is needed during shutting down of the unit.

6. PROCEDURES (Cont'd)

6.3 (continued)

6.3.6 Upon return to service of normal suction, perform weekly test of auxiliary feedwater pumps. The unit shutdown may be terminated.

6.4 Alternate Auxiliary Feedwater Pumps and/or Condensate Storage Tank (CST) Supply Operation.

	Important Step		Key Point
6.4.1	Primary Makeup Tank to Condensate Storage Tank.		
6.4.1.1	Verify primary makeup pump running.		
6.4.1.2	Open pump discharge valve to condensate tank approx. 2-3 turns.	6.4.1.2	Located at CST. Second primary makeup pump may auto start.

NOTE: Primary makeup pumps have a design flow of 100 gpm. If the auxiliary feedwater pumps are in service, this flow rate may not be adequate to maintain or increase level in the condensate storage tank.

6.4.1.3	Upon completion of pumping, close isolation valve at CST.		
6.4.2	Unit 2 Condensate Tank to Unit 1 Condensate Storage Tank.		
6.4.2.1	Align 2 1/2" fire hose between Unit 2 CST and Unit 1 CST inlet connection.	6.4.2.1	Contact Unit 2 and 3 Operations to assist in this.
6.4.2.2	Request Unit 2 and 3 Operations start transfer pump and charge line.		
6.4.2.3	Open inlet block valve at Unit 1 CST.	6.4.2.3	Do not exceed transfer pump capability, Contact Unit 2 and 3 Operations.

NOTE: Unit 2 condensate transfer pump is rated at 1000 gpm.

NOTE: Under normal operations, verify water chemistry within acceptable limits prior to initiating transfer. In an emergency, obtain Watch Engineers approval prior to transfer.

6. PROCEDURES (Cont'd)

	Important Step		Key Point
6.4.3	Service Water Reservoir to Condensate Storage Tank.		
6.4.3.1	Align 2 1/2" fire hose between FH-7 and inlet connection of CST.	7.4.3.1	FH-7 located near Sulfuric Acid Tank.
	CAUTION: This alignment is for emergency conditions only and should never be utilized unless authorized by the Watch Engineer.		
6.4.3.2	Start a fire pump.		
6.4.3.3	Open inlet block valve at CST.		
6.4.3.4	Open hydrant valve.	6.3.3.4	If maximum pump amps are exceeded, start second fire pump.
	NOTE: This flow path is capable of 1000 gpm which exceeds the pumping capability of both auxiliary feedwater pumps combined.		
6.4.4	Service Water Reservoir to Auxiliary Feedwater Pump Suction.		
6.4.4.1	Stop auxiliary feedwater pump(s).		
6.4.4.2	Close auxiliary feedwater pump(s) normal suction valves.		
6.4.4.3	Verify alignment of the permanently installed suction hose between hose connection at fire pump suction piping and suction connection at the electric auxiliary feedwater pump inlet.		
	CAUTION: This alignment is for emergency conditions only and should never be utilized unless authorized by the Watch Engineer.		

6. PROCEDURES (Cont'd)

	Important Step	Key Point
6.4.4.4	Open block valve at fire pump suction and load hose.	
6.4.4.5	Start auxiliary feedwater pump.	
6.4.5	Domestic Water System to Condensate Storage Tank.	
6.4.5.1	Align 2 1/2" fire hose between outlet at domestic water filter and inlet connection at CST.	
	CAUTION: This alignment is for emergency condition only and should never be utilized unless authorized by the Watch Engineer.	
6.4.5.2	Open outlet valve at domestic water filter to charge hose.	
6.4.5.3	Open inlet block valve at CST.	
	NOTE: This flow path is capable of approximately 250 gpm.	

7. RECORDS

Not applicable.

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INADEQUATE CORE COOLING

1. OBJECTIVE

To provide a description of the conditions associated with inadequate core cooling and identify the actions necessary to restore adequate core cooling utilizing available control room instrumentation.

2. REFERENCES

2.1 S-3-5.5 "Loss of Coolant"

3. PREREQUISITES

3.1 This procedure is applicable to any condition such as a small LOCA, Unit trip with subsequent low pressure condition or any other condition where the margin to saturation is reduced to less than the alarm point (50°F).

4. PRECAUTIONS

4.1 Operational decisions shall not be based solely on a single plant parameter or instrument when more than one confirmatory indication is available.

4.2 The manual override of any emergency safety system shall not be initiated unless continued operation would result in unsafe plant conditions.

4.3 The Reactor coolant system must be borated to a Cold Shutdown condition before commencing cool down.

5. CHECK-OFF LIST/FORMS

5.1 Not Applicable

6. PROCEDURES

6.1 Recognizing Inadequate Core Cooling.

6.1.1 Inadequate core cooling is the condition where heat production exceeds heat removal to the point where the core exit temperature may exceed the saturation temperature for the existing pressure. Ability to remove heat may then be further reduced by the formation of voids in the vessel and up into the hot legs. Without forced cooling (Reactor Coolant Pump or Safety Injection flow depending on plant condition) natural circulation may then cease and serious core damage may occur.

6. PROCEDURES (Cont'd)

6.1.2 Inadequate core cooling (voiding and loss of margin to saturation in the extreme) may be recognized by use of the following instrumentation:

6.1.2.1 Saturation Recorder, indicating:
High or increasing loop temperature (T_{HOT}),
Decreasing margin to saturation, and
Decreasing saturation temperature.

6.1.2.2 System pressure decreasing.

6.1.2.3 Decreasing main steam pressure.

6.1.2.4 Core outlet temperature high or increasing as seen by core thermocouples.

6.1.2.5 Use of saturated temperature curve.

6.1.3 To help eliminate voiding and to enhance core cooling, forced flow provided by reactor coolant pumps, safety injection flow or recirculation pumps depending on plant status or under loss of power conditions, natural circulation must be in effect.

6.2 Natural Circulation.

6.2.1 Under loss of power conditions where natural circulation is required for core heat removal, verify or attempt to establish the following conditions:

6.2.1.1 Pressurizer pressure ≥ 2000 psi.

6.2.1.2 Pressurizer level ≥ 10%.

6.2.1.3 Auxiliary feedwater system suppling steam generators and levels being maintained on the narrow range recorders.

6.2.2 The following indications are indicative of heat removal having been established.

6.2.2.1 Loop ΔT indicating less than full load ΔT but greater than 0. Immediately following a reactor trip the ΔT should drop to approximately 15-25°F. The greater the ΔT, the greater the flow.

6.2.2.2 Core outlet thermocouples constant or decreasing. For printed core TC map, go to O.I. S-3-2.36 "Operation of Thermocouple Monitoring System". For instructions regarding continuous digital readout of thermocouples, go to 6.7.

6. PROCEDURES (Cont'd)

6.2.2.3 Steam generator pressure constant or decreasing at a rate equivalent to the rate of decrease of the reactor coolant system temperature (T_{COLD}).

6.2.3 Instrumentation available for monitoring natural circulation include:

6.2.3.1 Core outlet thermocouples.

6.2.3.2 Loop cold leg temperature.

6.2.3.3 Loop ΔT.

6.2.3.4 Reactor coolant system pressure.

6.2.3.5 Main steam pressure.

6.2.3.6 Steam generator narrow and wide range level indication.

6.2.3.7 Saturated temperature recorder.

6.2.3.7.1 Loop hot leg temperature.

6.2.3.7.2 Saturated temperature.

6.2.3.7.3 Margin to saturation.

6.3 Recognizing Voids.

6.3.1 If conditions have reached the point where the margin to saturation approaches zero, voiding will occur at the core outlet. Evidence of voiding will be:

6.3.1.1 Reactor coolant pump (if running).
Low amperes.
Low and/or fluctuating flow.
High vibration.

6.3.1.2 Increasing source range count rate.

6.3.1.3 Increasing sphere radiation levels.

6.3.2 The above conditions may be evident along with the following conditions:

6.3.2.1 Inadequate core cooling (voiding and loss of margin to saturation in the extreme) may be recognized by use of the following instrumentation:

6. PROCEDURES (Cont'd)

6.3.2.1.1 Saturation Recorder, indicating:
High or increasing loop temperature (T_{HOT}),
Decreasing margin to saturation and,
Decreasing saturated temperature.

6.3.2.1.2 System pressure decreasing.

6.3.2.1.3 Decreasing main steam pressure.

6.3.2.1.4 Core outlet temperature high or increasing as seen by core thermocouples.

6.3.2.1.5 Use of Saturated Temperature curve.

6.4 Operation During Transients.

6.4.1 The margin to saturation in the reactor coolant system is maintained by keeping or increasing system pressure to a point where the reactor coolant system is in a subcooled condition. This can be enhanced by:

6.4.1.1 Increasing pressurizer pressure by use of pressurizer heaters. If low pressurizer level exists, establish maximum charging to re-establish pressurizer level above the point where heater operation is allowed (>10%).

6.4.1.2 Decreasing reactor coolant temperature by steam dump to condenser and/or atmosphere. Maintain steam generator(s) level within the limits of the narrow range instrumentation.

CAUTION: Too rapid a cooldown may allow the margin to saturation to become too low from depressurization.

6.4.1.3 Increasing pressurizer pressure by use of charging at maximum rate. If pressure continues to fall and safety injection is initiated but pressurizer pressure remains above 1400 psig, continue charging at maximum rate and return pressurizer heaters to service as soon as pressurizer level allows (>10%). As long as pressure remains below 1900 psig, continue to fill the pressurizer. If level instrumentation indicates a full or solid pressurizer maintain pressurizer heaters on and charging flow to maintain system pressure such that an adequate margin to saturation is maintained. Refer to E.O.I. S-3-5.5 "Loss of Coolant".

6. PROCEDURES (Cont'd)

6.4.2 If any or all of the following conditions exist it is evidence of a loss of subcooled conditions in the reactor coolant system.

6.4.2.1 RCS T_{HOT} greater than pressurizer liquid temperature.

6.4.2.2 Margin to saturation approaching zero.

6.4.2.3 Pressurizer pressure equal to saturation pressure for Reactor Coolant T_{HOT} as indicated on recorder or by use of backup graph.

6.4.3 If subcooled conditions have been lost and safety injection has occured, refer to S-3-5.5 "Loss of Coolant" for further instructions. If safety injection has not occured and pressurizer pressure is low:

6.4.3.1 Establish maximum charging flow.

6.4.3.2 Insure pressurizer heaters are on, if level permits. After the RCS is borated to the Cold Shutdown conditions, initiate RCS cooldown by steam dumps to condense or atmosphere and by use of main or auxiliary feedwater addition.

6.4.4 If the condition is due to a loss of coolant type accident or loss of secondary coolant, initiate safety injection and refer to S-3-5.5 "Loss of Coolant" for further instructions.

6.4.5 If RCS pressure is re-established (> 2000 psig) and under control, forced circulation should be re-established by use of (1) RCP, preferable "B" RCP. After the RCS temperatures are stabilized, start the other RCP's.

NOTE: Close pressurizer spray valves 430C and 430H prior to starting initial RCP.

After forced circulation is restarted, place pressurizer spray valves on AUTO and obtain an RCS boron sample.

6.5 Inadequate Core Cooling.

6.5.1 During a small LOCA, the following symptoms will be evidence of inadequate core cooling.

6.5.1.1 Five (5) or more core exit thermocouples (TC) exhibit readings at or above 1200°F.

NOTE: TC printouts drop off the thousands digit, therefore 1200°F will appear as 200°F.

6. PROCEDURES (Cont'd)

6.5.1.2 If the high range readings from the core exit thermocouples are not available, a condition of inadequate core cooling exists when: the hot leg RTD's are pegged high and SI flow is not being delivered to the Reactor Coolant System and feedwater is not being delivered to the intact steam generators.

6.5.2 If the above conditions exist, perform the following:

6.5.2.1 Continue efforts to provide safety injection and/or charging flow to the RCS and/or feedwater flow to the steam generators. Attempt to operate equipment manually locally, if possible.

6.5.2.2 Continue monitoring of core exit thermocouples to determine effectiveness of subsequent actions.

6.5.2.3 Depressurize the RCS by:

6.5.2.3.1 Dumping steam to the condenser, or,

6.5.2.3.2 If the condenser is not available, dump steam through the atmospheric steam dump valves, or,

CAUTION
DEPRESSURIZATION THROUGH USE OF THE STEAM GENERATORS SHOULD ONLY BE ATTEMPTED IF THERE IS AN EFFECTIVE WATER LEVEL AND AUXILIARY OR MAIN FEEDWATER IS AVAILABLE.

6.5.2.3.3 Open the Pressurizer PORV's only if:

(a) SI or charging is available to deliver to the RCS.

(b) RCS depressurization cannot be accomplished by steam relief from the steam generators.

(c) Feedwater is not available to maintain the steam generator secondary water level at an effective level.

6. PROCEDURES (Cont'd)

6.5.2.3.4 If no means for RCS depressurization are available, or if the depressurization did not result in decreasing core exit thermocouple temperatures, then start a reactor coolant pump, if possible.

6.6 Saturation Recorder.

6.6.1 Description

6.6.1.1 The RCS Saturation Recorder is a 3-pen Foxboro recorder with inputs from (1) Pressurizer pressure and (2) RCS hot leg RTD's. The hot leg RTD may be from any loop as selected through a 3-way switch located on the J-console below the recorder.

6.6.1.2 The recorder is powered from a station vital bus.

6.6.1.3 The recorder will display (1) Hot leg temperature, (450-700°F), (2) Saturation temperature corresponsing to measured pressurizer pressure (450-700°F), (3) Margin to saturation (-100 to +100°F).

6.6.1.4 The recorder will also provide an alarm on decreasing margin to saturation.

6.6.2 Normal Operation.

6.6.2.1 The saturation recorder shall normally be in service aligned to the reactor coolant loop with the lowest margin to saturation.

6.6.2.2 Once per shift, preferable at the beginning, the two remaining loops shall be checked and correlated to the Backup Saturation Curve to verify operability, accuracy, and to determine the reactor coolant loop with the lowest margin to saturation. The loop being monitored shall be identified on the chart at the conclusion of this step.

6.6.2.3 Failure of this recorder shall be cause for having maintenance performed on it as soon as practical but no longer than sixteen hours following notice of failure.

6.7 Saturation Curve.

6.7.1 The attached saturation curve shall be used to:

6.7.1.1 Backup the saturation recorder during transients.

6. PROCEDURES (Cont'd)

6.7.1.2 Verify for accuracy the saturation recorder on a routine basis once per shift.

6.7.2 The saturation curve displays RCS Hot leg temperature (0-700°F) versus RCS pressure (0-2300 psig) to give:

6.7.2.1 Saturated temperature/pressure curve.

6.7.2.2 50°F subcooling curve.

6.7.2.3 Technical Specifications 0°F/Hr. heatup/cooldown curve.

6.8 Core Thermocouples.

6.8.1 For continuous digital readout of core thermocouples:

6.8.1.1 On Parrallel to Serial Converter, place switch to MANUAL SCAN.

6.8.1.2 On Master Scanner, depress CONT SCAN then START. Digital indicator should now be displaying TC for indicated channel.

NOTE: If single readout of core TC's is desired, depress SINGLE SCAN instead of CONT. SCAN.

6.8.2 To change rate (time delay) of display, on Master Scanner, adjust SCAN RATE.

6.8.3 To return system to normal, depress SINGLE SCAN, allow system to complete cycle, then place switch on Parallel to Serial Converter to AUTO.

6.8.4 This operation may be performed regardless of condition of core mapping computer.

7. RECORDS

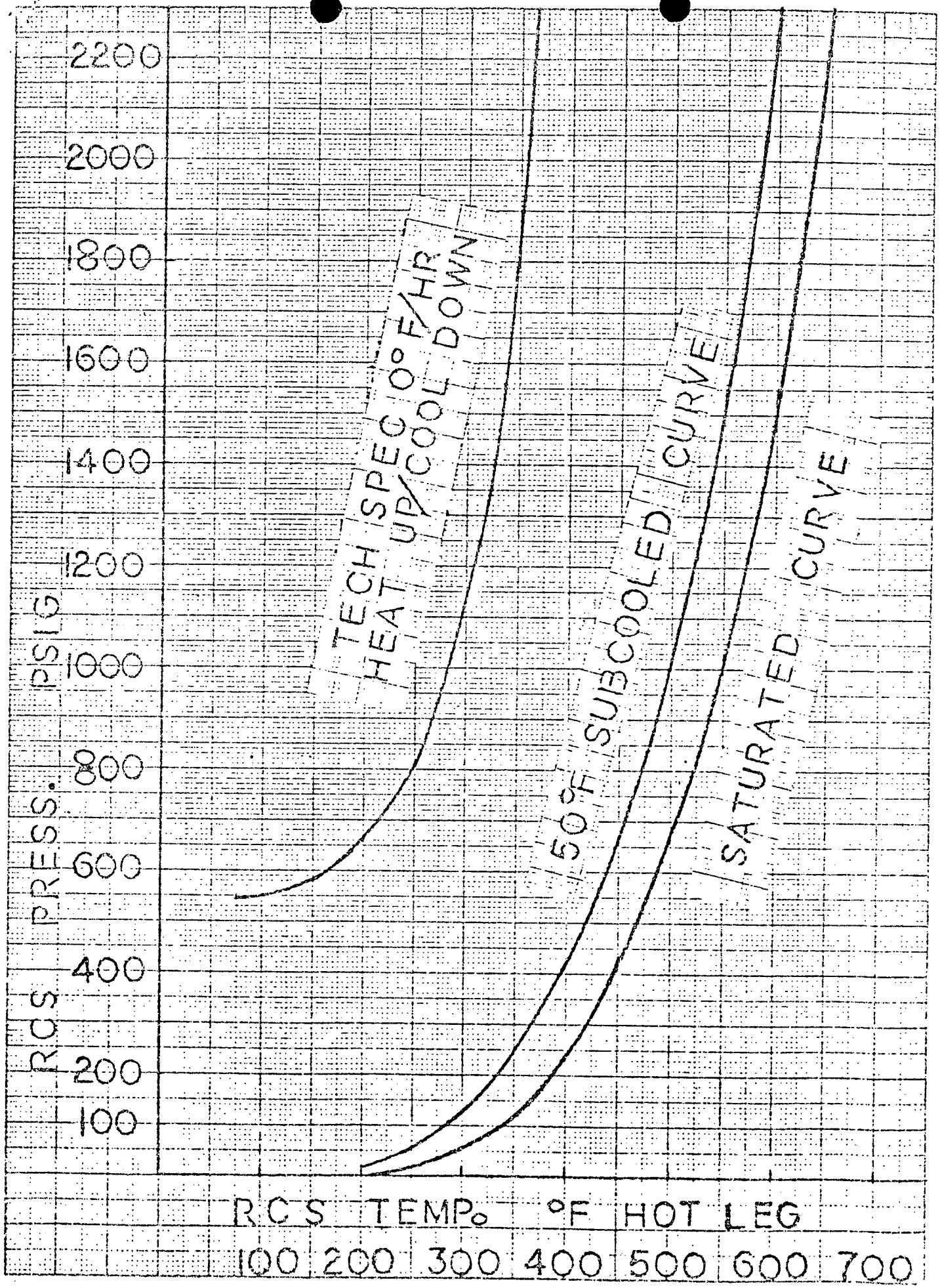
7.1 Not Applicable

R. R. Brunet

R. R. BRUNET
SUPERINTENDENT UNIT 1

APPROVED:
J. M. Curran / RRB
J. M. CURRAN
PLANT MANAGER

AJS:sf


RCS PRESS. PSIG
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
100
TECH SPEC 0°F/HR HEAT UP/COOL DOWN
50°F SUBCOOLED CURVE
SATURATED CURVE
RCS TEMP. °F HOT LEG
100 200 300 400 500 600 700

(7)

PLANT HOT SHUTDOWN TO COLD CONDITIONS

I. OBJECTIVE

This instruction describes a safe and efficient method of cooling down and depressurizing the reactor cycle from the hot shutdown to a cold or refueling condition in which the reactor coolant temperature is maintained less than 150°F.

II. CONDITIONS

A. The plant is in the hot shutdown condition. One shutdown group shall be withdrawn to the "cocked" position except for the conditions listed under "Precautions," Item III-A.

B. Primary Makeup Water and Boric Acid Systems have sufficient storage to compensate for reactor coolant shrinkage.

III. PRECAUTIONS

A. One shutdown group of control rods must be at the "cocked" position whenever positive reactivity is being inserted by boron dilution, xenon decay or cooldown. The following two exceptions to this rule may be applied:

1. The Reactor Coolant System has been borated to at least the hot, xenon free, boron concentration and is being maintained at hot shutdown conditions.

2. The Reactor Coolant System has been borated to the cold shutdown boron concentration and the primary plant is being cooled down.

B. The pressurizer spray valves shall be operated as necessary to maintain the pressurizer boron concentration within +150 ppm to -50 ppm of the main coolant boron concentration to minimize the amount of reactivity tied up in this manner.

C. The cooldown rate of the Reactor Coolant System shall not exceed 100°F/hr.

NOTE: The maximum allowable cooldown rate is subject to change during plant life as the observed or expected shift in design transition temperature (DTT) increases (refer to heatup and cooldown curve).

D. To limit the consequences of a steam line break establish 4% $\Delta K/K$ shutdown, hot, xenon free, all rods in, prior to removing the safety injection system from service.

E. Component cooling to the reactor coolant pumps must be supplied any time a reactor coolant pump is operating and must not be terminated to an idle pump until the reactor cycle has been cooled to the cold condition (< 200°F).

F. Do not maintain the pressurizer level above 80% unless required for system cooldown or startup operations.

G. The containment spray system, the refueling water storage tank, the associated valves and interlocks shall remain operable per Tech. Spec. 3.3 while above 200°F in the reactor coolant system.

H. During the solid water phase of cooldown, reactor coolant pumps must be run continuously. Should abnormal or unusual conditions cause securing of all reactor coolant pumps, restart is permitted only after evaluating RCS temperature gradients.

In addition, at the completion of cooldown the reactor coolant pump shall be run sufficient additional time to insure that all reactor coolant systems and steam generator metal temperatures have equalized with reactor coolant liquid temperatures.

I. Tests or maintenance activities that might affect reactor coolant system pressure shall not be performed during solid system operation.

IV. CHECK-OFF LIST

See PSSO-119

V. INSTRUCTIONS

Important Steps	Key Points
1. If the Reactor Coolant System is to be opened for repair or refueling, initiate degassing of the reactor coolant in accordance with Instruction S-3-1.12, Reactor Dissolved Gas Concentration Control.	
2. Borate the Reactor Coolant System to the cold shutdown concentration in accordance with Operating Instructions S-3-2.5 and S-3-1.3.	2. a. The reactor coolant system must be borated to the cold shutdown concentration and verified by sample analysis before a controlled cooldown is initiated.

Important Steps	Key Points
NOTE: The reactor shutdown will normally be 3% with all rods inserted. When the reactor coolant system is to be opened, a shutdown margin ≥ 5% will be maintained and ≥ 10% with the reactor head removed.	b. A minimum of one reactor coolant pump must be in operation during any boron concentration change. Pump A or B must be used for spray flow for equalizing boron concentrations.
NOTE: If a Chemical Technician is not on duty, operators will establish a main coolant sample line flush for 15 minutes and then draw a sample properly labeled for analysis as soon as Chemical Technician arrives on site.	c. During this operation, the pressurizer liquid level is allowed to increase above the no load programmed level. Place FCV-1112 on manual and set the flow for approximately 110 gpm until the boron addition is complete or the pressurizer level indication is near the upper limit. If possible, do not allow letdown diversion to radwaste or volume control system to makeup.
3. Prepare additional batches of boric acid to refill the boric acid storage tank.	
4. Set the reactor coolant makeup control for automatic makeup at the refueling or cold shutdown boron concentration, whichever is applicable.	4. a. Verify that a normal level in the volume control tank is maintained during the cooldown. b. Verify proper boron concentration at blend device outlet.
5. Periodically sample the reactor coolant and pressurizer liquid.	5. a. Confirm that the intended boron concentration change is accomplished. b. Check the reduction in coolant activity. c. Check the dissolved hydrogen concentration.

Important Steps	Key Points
9. Stop all reactor coolant pumps except B to reduce heating of the Reactor Coolant System.	9. a. Pump B must be operated for spray flow. If Pump B is not available, pumps A and C will be used.
10. Add additional boric acid as required if refueling concentration is to be achieved.	10. a. Sample the pressurizer liquid and reactor coolant for boron concentration.
11. Manually block the safety injection actuation circuit when the alert to block safety injection alarm is received or when pressure is approximately 1750 psig. (See Precaution D)	
12. As cooldown progresses, maintain the pressurizer liquid as high as possible.	12. a. Promotes better cooling of the metal in the upper steam space. b. Do not collapse the bubble at this time. Maintain approximately 90% level.
13. As the letdown flow decreases, open additional letdown orifices.	13. a. Maintain the purification flow rate at approximately 90 gpm.
14. Open reactor coolant pump seal bypass flow valve CV-276 when any one of the three seal leak-off flows is (1) gpm on a running pump and the pressure is 1500 psig.	
15. Continue to cooldown by periodically resetting the steam dump control.	
16. At 500 psig, establish two positive barriers between the feedwater and reactor coolant system.	16. a. Refer to O. I. S-3-2.21.
* 17. When system pressure decreases to 400 psi, arm the OMS by operating CS-3A and CS-6 to the enable position.	
18. When the reactor coolant pressure decreases to 400 psig, start preliminary alignment of the Residual Heat Removal System. See Operating Instruction S-3-2.12.	

Important Steps	Key Points
19. Break vacuum from the condenser when no longer needed.	19. a. Open the condenser vacuum breaker. b. Stop the condenser vacuum pumps and/or secure steam to the air ejectors. c. Stop both gland seal condenser exhauster blowers. d. When the condenser is at atmospheric pressure, shut off the steam to the Turbine Gland Seal System.
20. Place the residual heat removal loop in service in accordance with Operating Instruction S-3-2.12.	
21. When the residual heat removal loop is in service, increase the pressurizer level and collapse the bubble as indicated by LI-435.	21. a. Place FC-1112 on manual and increase the charging flow. Do not allow pressure to exceed 400 psig.
22. The reactor coolant system is filled and solid, therefore; * a. Assign a reactor operator to monitor the RCS pressure. b. Do not close MOV813 and 814, residual heat removal inlets or LCV1112, CV202, 203 and 204, normal letdown, except as required for RCS hydrostatic tests.	22. a. Operator monitoring is not required when the OMS is operational. b. To provide relief paths to RV206 and normal letdown by PCV1105.
23. Continue to operate reactor coolant pump "B" during the cooldown to obtain a uniform cooldown rate of all coolant loops and provide spray requirements to cool the pressurizer.	23. Do not reduce pressure below RC pump NPSH requirements.
24. When the main steam pressure reaches approximately atmospheric, apply a nitrogen blanket to the main steam lines and close the trap free blow valves as required.	
25. Raise the water level in the steam generators to approximately 120% of indicated level.	25. As steam generator levels increase, measure rate of change to calculate time to reach 120% level.

Important Steps	Key Points
26. Stop the last reactor coolant pump when the final cold shutdown temperature is reached. Hang caution tags on the RCP control switches indicating the RCS temperature at the time the last pump was stopped. Restart of the RCP's will only be affected after determining that RV-206 is available as a relief flow path and carefully assessing RCS temperature gradients or evaluating the potential for having developed temperature gradients.	26. a. Open auxiliary spray valve CV-305, close charging line CV-304 and spray valves CV-430C and H. b. Adjust the charging line flow controller FC-1112 to continue the desired cool-down rate of the pressurizer. c. Continue to circulate through the auxiliary spray line until the pressurizer temperature is approximately 150°F, indicated by TI-430A.
27. The Reactor Coolant System may be maintained at pressure as follows: a. Manually adjust FC-1112 to obtain a set charging flow. b. Control the pressure automatically with the letdown system pressure controller PC-1105.	
28. When the desired shutdown temperature is achieved and the reactor coolant pumps have been taken out of service, some auxiliary coolant system components may be taken out of service, dependent upon Cooling System heat load.	28. a. Residual heat removal pump. b. Component cooling pump. c. Residual heat exchanger. d. Component cooling heat exchanger.

VI. FINAL CONDITIONS

The unit is in the cold shutdown condition.

J. M. Curran
Plant Manager

* Indicates Revision

MHB:dh

POST ACCIDENT HYDROGEN GAS CONTROL

I. OBJECTIVE

This procedure provides information and action to be taken for the control and removal of hydrogen or other non-condensable gases in the reactor coolant system or released to the containment.

II. CONDITIONS

The reactor is in a post accident condition and significant quantities of hydrogen and/or other non-condensable gases have been generated.

III. PRECAUTIONS

A. Hydrogen gas in the presence of air is combustible, therefore, the removal of hydrogen gas should be to a system where air is not present or is at a minimum.

B. The release of hydrogen to the containment should be a last resort. The release should be accompanied by subsequent sampling of the containment atmosphere if possible for early detection of combustible mixtures.

IV. CHECK-OFF LIST

Not applicable.

V. INSTRUCTIONS

A. Preventing or Eliminating Voids.

1. Maintain pressurizer pressure above the hot leg saturation pressure by:

   a. Increased charging

   b. Pressurizer heater operation

V. INSTRUCTIONS

A. (continued)

2. Maintain reactor core cooling by:

a. Continued safety injection operation.

b. Operation of safety injection recirculation system

c. Use of auxiliary feedwater to the steam generators.

B. Removal of Hydrogen Gas from Reactor Coolant System

1. With a reactor coolant pump in operation:

a. Initiate pressurizer sprays.

b. Vent pressurizer vapor space to pressurizer relief tank using power operated relief valves (PORV).

c. Maintain pressurizer relief tank pressure below 100 psig. if possible to reduce hydrogen accumulation in the containment.

d. Initiate RCS letdown, when available to promote gas stripping in the volume control tank.

CAUTION
THE USE OF LETDOWN MAY CAUSE LOCAL HIGH RADIATION AREAS.

2. Without a reactor coolant pump in operation:

a. Place pressurizer in a water solid condition with the safety injection pumps running and the power operated relief valve(s) and/or sample valve open.

b. Depressurize RCS by judicious use of valves, lines and pumps available in the safety injection system and by adjusting the pressurizer relief valves and/or sample valve.

c. As pressure is reduced and the bubble grows, the gas will eventually reach the pressurizer surge line and hence to the pressurizer relief tank via the power operated relief valve(s).

V. INSTRUCTIONS

C. Sampling Containment Atmosphere

1. While containment pressure > 2 psig: During this time all sample points would be unavailable due to containment isolation.

2. While containment pressure < 2 psig:

a. Obtain pressurizer relief tank gas sample if available This may reflect sphere conditions if rupture diaphragm is not intact otherwise would reflect pressurizer conditions.

b. Obtain local sample (if radiological conditions permit) at suction to O.R.M.S. Channel 1211/1212.

VI. FINAL CONDITIONS

With a gas bubble located in the upper head, several methods of core cooling are unaffected. The steam generator can be used to remove decay heat using reactor coolant pump forced flow or natural circulation. The safety injection system can be used to cool the core while venting as described above through the pressurizer power operated relief valves. Core cooling by these methods can proceed indefinitely if the primary coolant pressure is held constant.

If a lower system pressure is desired, a controlled depressurization may be initiated and venting of hydrogen and non-condensable gases may be accomplished as described above.

VII. REFERENCES

SCE (J. H. Drake) letter to NRC (R. H. Engelken) dated May 3, 1979, Docket No. 50-206.

R. R. Brunet
R. R. BRUNET
SUPERINTENDENT, UNIT 1

APPROVED:

J. M. Curran
M. CURRAN
PLANT MANAGER

AJS/yc

Important Steps	Key Points
* 6. Switch off all pressurizer heaters. Pressurizer liquid and RCS liquid temperature and pressure readings will be taken every 30 minutes until cold shutdown condition is reached, unless recorder TR-430, Pressurizer Temperature is in service.	6. a. Use reading sheet included in check-off sheet form PSSO-119.
7. Begin cooldown of the Reactor Coolant System. Place steam dump controller 418A on manual control and if possible maintain steam dump to condenser only.	7. a. Slowly adjust the steam dump control to increase the dumping rate.
	b. Do not exceed a cooldown rate as shown on the pressure temperature curve. Caution: If cooldown exceeds 50°F/hr contraction of the reactor coolant may exceed the automatic makeup capacity.
8. Begin cooldown of the pressurizer and depressurization of the Pressurizer and Reactor Coolant System.	8. a. Transfer spray valves PC-430C and PC-430H to manual control.
	b. Slowly open a spray valve and maintain the reactor coolant pressure within the limits shown on the pressure-temperature curve.
	c. The spray flow must be controlled to limit the rate of pressurizer cooldown to 195°F/hr.
*	d. The temperature difference between the pressurizer and reactor coolant should not exceed a maximum of 200°F between TI-430C and TI-430B, or TR-402 depending on which reactor coolant pump is operating.