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November 10, 1980
OG-44

Mr. D. F. Ross, Director
Division of Systems Integration
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20014

Dear Mr. Ross:

INADEQUATE CORE COOLING GUIDELINES

Enclosed are copies of the following guidelines:

1. E^2OI-1 Instructions to mitigate Inadequate Core Cooling (ICC) resulting from a loss of reactor coolant coincident with loss of all high head safety injection.

2. E^2OI-2 Instructions to mitigate Inadequate Core Cooling (ICC) resulting from a loss of auxiliary feedwater in plants with safety grade charging flow.

3. E^2OI-2 Instructions to mitigate Inadequate Core Cooling (ICC) resulting from a loss of auxiliary feedwater in plants with low pressure SI pumps.

These guidelines for recovery from inadequate core cooling were developed by the Westinghouse Owners Group utilizing WCAP-9753, WCAP-9744 and WCAP-9762 (UHI Plants) as analytical bases.

The proposed schedule for training and implementation of the Inadequate Core Cooling Instructions is as follows:

1. Late January, 1981 - Training session for utility site representatives.

2. February to June, 1981 - Preparation of plant specific instructions by site personnel and training of plant operators.

3. July 1, 1981 - Target date for implementation of Inadequate Core Cooling guidelines.

Very truly yours,

R. W. Jurgensen

Robert W. Jurgensen, Chairman
Westinghouse Owners Group

/pab
Attachment
cc: Steven S. Hanauer, NRC

INSTRUCTIONS TO MITIGATE INADEQUATE CORE COOLING (ICC) RESULTING FROM A LOSS OF REACTOR COOLANT COINCIDENT WITH LOSS OF ALL HIGH HEAD SAFETY INJECTION(1) (LOW HEAD SAFETY INJECTION IS AVAILABLE)

I. Purpose

The objectives of these instructions are to specify required operator actions and precautions necessary to:

1. Depressurize the primary system to establish low head safety injection flow and restore core cooling;

2. Determine when conditions are acceptable to return to the Emergency Operating Instructions.

II. Symptoms

1. Five core exit thermocouples are reading greater than 1200°F.

   OR

2. Abnormal containment conditions (pressure, radiation, or sump level) are indicated and either a. or b. below exist:(2)

(1) This instruction is applicable to all plants regardless of the shutoff head of the high head safety injection pumps.
(2) Not applicable to plants without vessel level instrumentation.

a. With any reactor coolant pump running, reactor vessel level is reading less than 100 percent in the narrow range.(1)

b. With no reactor coolant pumps running, two or more core exit thermocouples are reading greater than 700°F and reactor vessel level is reading less than (plant specific value which is 3 1/2 feet above the bottom of the active fuel in the core with zero void fraction, plus uncertainties).(1)

III. Immediate Actions

Refer to section on Immediate Actions of E-0, Immediate Actions and Diagnostics, if not already performed.

IV. Subsequent Actions

CAUTION: While in the injection mode, if the refueling water storage tank level approaches the low level alarm during the subsequent actions of this instruction, immediately terminate those actions and do not resume them until the transfer to cold leg recirculation has been accomplished. The instructions for switchover to cold leg recirculation begin with step 7 of E-1 ("Loss of Reactor Coolant").

NOTE: During the conduct of this instruction, closely monitor the core exit thermocouples (and vessel level gauge (1) if available) to determine the effectiveness of the subsequent actions.

(1) Not applicable to plants without vessel level instrumentation.

1. Establish power sources necessary to operate all cold leg accumulator isolation valves and verify that all valves are open; if not, open the valves. While doing so, immediately proceed with the subsequent actions.

2. Attempt to establish the necessary conditions for running reactor coolant pumps.

3. Attempt to establish makeup flow to the reactor coolant system by operation of any available equipment.

4. Continue efforts, throughout these instructions, to provide high head centrifugal charging and/or high head safety injection. Attempt to operate equipment manually or locally.

5. Regulate the auxiliary feedwater to restore and/or maintain an indicated narrow range steam generator water level.

   NOTE: Monitor the primary water supply (condensate storage tank) for the auxiliary feedwater pumps and upon reaching a low level (plant specific value), switch over to an alternate water supply source.

6. If the low head safety injection pumps have been shut down restart these pumps.

7. If all reactor coolant pumps are running and core exit thermocouples are reading less than 1200°F; then trip the reactor coolant pump in the loop connected to the pressurizer surge line.

CAUTION: The subsequent sections A, B and C must be executed sequentially, unless instructed otherwise in the procedure.

SECTION A

REACTOR COOLANT SYSTEM DEPRESSURIZATION VIA STEAM GENERATOR SECONDARY DEPRESSURIZATION

A-1. Close any open pressurizer PORV's. Also verify the open status and availability of power to all pressurizer PORV backup isolation valves.

A-2. Rapidly depressurize the steam generator secondary side of all available steam generators to X psig (plant specific value which is 200 psig plus instrument uncertainty) by dumping steam:

a. to the condenser, if the condenser is available, by manual control of the steam generator header pressure controller

OR

b. through the steam generator power operated relief valves, if the condenser is not available.

CAUTION: If depressurization of the steam generator secondaries to X psig cannot be accomplished, continue efforts to depressurize the steam generator secondaries and go to step B-1.

A-3. If at least two wide range hot leg RTD's do not read less than 400°F, then go to step B-1. Otherwise, proceed with the subsequent instructions.

A-4. If any cold leg accumulator isolation valve is open and the associated accumulator has not been vented, then trip all operating reactor coolant pumps.

A-5. Isolate the cold leg accumulators by closing the cold leg accumulator isolation valves.

NOTE: If the accumulator isolation valves cannot be closed vent the accumulator nitrogen gas to less than Y psig (plant specific value to be calculated in Appendix A). Do not proceed to step A-6 until the accumulators have been depressurized.

CAUTION: If core exit thermocouples should exceed 1200°F while venting the accumulator gas, then restart all operable reactor coolant pumps and proceed immediately to step A-6.

A-6. Rapidly depressurize the steam generator secondaries to atmospheric pressure.

A-7. Verify low head safety injection by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps.

A-8. Trip all operating reactor coolant pumps.

A-9. When core exit thermocouple readings are below 400°F (and the vessel level gauge (1), if available) indication is greater than ____ percent (plant specific value which is top of core plus uncertainties) then go to step 7 of E-1 ("Loss of Reactor Coolant") or, if safety injection switchover to cold leg recirculation has been accomplished, go to step 8 of E-1 ("Loss of Reactor Coolant").

CAUTION: If the core exit thermocouples should exceed 1200°F before all of the above conditions are satisfied then the instructions of section B should be executed.

(1) Not applicable to plants without vessel level instrumentation.

SECTION B

REACTOR COOLANT SYSTEM DEPRESSURIZATION VIA RESTARTING/RUNNING REACTOR COOLANT PUMPS

NOTE: If the steam generator secondaries have not been fully depressurized AND if the capability to rapidly depressurize the steam generator secondaries is restored during the conduct of steps B-1 through B-5 THEN return immediately to step A-1 and complete the subsequent steps of the A section.

NOTE: If normal conditions for starting reactor coolant pumps cannot be met in section B, the reactor coolant pumps must be started regardless.

B-1. If all reactor coolant pumps are not running and core exit thermocouples are reading greater than 1200°F, then start a shutdown reactor coolant pump. If core exit thermocouples remain above 1200°F, start another reactor coolant pump. Continue this action until either core exit thermocouples drop below 1200°F or all operable reactor coolant pumps are running.

If core exit thermocouples remain above 1200°F go to step C-1.

CAUTION: If at any time during the conduct of steps B-2 through B-6 core exit thermocouple readings exceed 1200°F return immediately to step B-1.

NOTE: If at any time during the conduct of the subsequent instruction an operating reactor coolant pump fails, replace the lost pump by any remaining operable reactor coolant pumps.

B-2. Attempt to fully depressurize the secondary side of all available steam generator secondaries by any means possible. Regulate the auxiliary feedwater to restore and/or maintain an indicated narrow range steam generator water level.

B-3. Monitor the RCS depressurization. When evidence of low head safety injection flow is determined by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps, THEN proceed with the subsequent steps.

NOTE: Low head safety injection may be intermittent but this is sufficient and the next steps of this procedure should be executed.

B-4. If the cold leg accumulators have not already been isolated, isolate the cold leg accumulators by closing the cold leg accumulator isolation valves.

NOTE: If the cold leg accumulator isolation valves cannot be closed THEN vent the accumulator gas to less than Y psig (plant specific value to be calculated in Appendix A). Do not proceed to step B-5 until the accumulators have been depressurized.

B-5. WHEN:

a. Steam generator secondaries have been fully depressurized.

AND

b. At least two wide range hot leg RTD's are reading less than 350°F.

THEN

Trip all operating reactor coolant pumps.

B-6. Verify CONTINUOUS delivery of low head safety injection by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps. If continuous delivery of low head safety injection cannot be verified return immediately to step B-1.

B-7. When core exit thermocouple readings are less than 400°F (and the vessel level gauge (1), if available) is indicating _____ percent (plant specific value which is top of core plus uncertainties) THEN go to step 7 of E-1 ("Loss of Reactor Coolant") of, if safety injection switchover to cold leg recirculation has been established go to step 8 of E-1 ("Loss of Reactor Coolant").

(1) Not applicable to plants without vessel level instrumentation.

SECTION C

REACTOR COOLANT SYSTEM DEPRESSURIZATION VIA OPENING PRESSURIZER POWER OPERATED RELIEF VALVES

NOTE: If the steam generator secondaries have not been fully depressurized AND if the capability to rapidly depressurize the steam generator secondaries is restored during the conduct of steps C-1 through C-6 THEN return immediately to step A-1 and complete the subsequent steps of the A section.

NOTE: If the capability to operate additional reactor coolant pumps is restored during the conduct of steps C-1 through C-6 THEN return immediately to step B-1 and complete the subsequent steps of the B section.

C-1. Open all operable pressurizer power operated relief valve (PORV's).

C-2. If core exit thermocouples remain above 1200°F, open any other available vent paths from the reactor coolant system to the containment.

C-3. Attempt to fully depressurize the secondary side of all available steam generators by any means possible. Regulate auxiliary feedwater to restore and/or maintain an indicated narrow range steam generator water level.

C-4. Monitor the RCS pressure. When evidence of low head safety injection flow is determined by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps, THEN proceed with the subsequent steps.

NOTE: Low head safety injection maybe intermittent but this is sufficient and the next steps of this procedure should be executed.

C-5. If the cold leg accumulators have not already been isolated, isolate the cold leg accumulators by closing the cold leg accumulator isolated valves.

NOTE: If the cold leg accumulator isolation valves cannot be closed THEN vent the accumulator gas to less than Y psig (plant specific value to be calculated in Appendix A). DO NOT PROCEED to step C-6 until the accumulators have been depressurized.

C-6. When:

a. Steam generator secondaries have been fully depressurized.

AND

b. At least two wide range hot leg RTD's are reading less than 350°F.

THEN

Trip all operating reactor pumps.

C-7. Verify CONTINUOUS delivery of low head safety injection by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps. If continuous low head safety injection cannot be verified return immediately to section B step B-1 and complete the subsequent steps of the B, section.

C-8. When core exit thermocouples are reading less than 400°F (and the vessel level gauge (1), if available) is indicating ____percent (plant specific value which is top of core plus uncertainties) THEN go to step 7 of E-1 ("Loss of Reactor Coolant") OR, if safety injection switchover to cold leg recirculation has been accomplished, go to step 8 of E-1 ("Loss of Reactor Coolant").

CAUTION: If core exit themocouples should exceed 1200°F before all of the above conditions are satisfied then immediately return to section B.

(1) Not applicable to plants without vessel level instrumentation.

Appendix A

Accumulator Isolation via Gas Venting to the Containment

In several steps of the $E^2$0I-1 procedure accumulator isolation is to be accomplished by venting the gas if the isolation valves could not be closed. Specifically, the instructions state that the gas should be vented to Y PSIG before the next steps can be executed. The value Y should be calculated as;

Y(PSIG) = Low Head Safety Injection Pump shut off head (PSIG) - 100 psi

INSTRUCTIONS TO MITIGATE INADEQUATE CORE COOLING (ICC) RESULTING FROM A LOSS OF AUXILIARY FEEDWATER IN PLANTS WITH SAFETY GRADE CHARGING FLOW

I. PURPOSE

The purpose of this instruction is to specify the required operator actions and precautions necessary to:

1. Establish alternate core decay heat removal capability when main and auxiliary feedwater is unavailable.

2. Prevent or minimize damage to the fuel cladding and release of excessive radioactivity.

3. Establish stable reactor conditions which are amendable to long term cooling.

II. SYMPTOMS

1. The Auxiliary Feedwater System is not available for decay heat removal, and

2. The Main Feedwater System is not available for decay heat removal.

III. IMMEDIATE ACTIONS

Refer to the section on Immediate Actions of the appropriate operating instruction for the initiating event, if not already performed.

IV. SUBSEQUENT ACTIONS

CAUTION: If during the conduct of steps 5 through 9 the Reactor Coolant System pressure and core exit thermocouples or wide range RTD temperature are increasing due to loss of heat removal capability of the secondary system, then immediately proceed to step 10.

1. If a Loss of Reactor Coolant is also in progress, monitor wide range reactor coolant system pressure, and

   a. If the wide range reactor coolant system pressure is ABOVE any steam generator pressure, then perform the actions through step 2 in EOI-1, Loss of Reactor Coolant, while continuing with step 5 of this instruction.

   b. If the wide range reactor coolant system pressure is BELOW the steam pressure in ALL steam generators, then immediately return to EOI-1, Loss of Reactor Coolant.

2. If a Loss of Secondary Coolant is also in progress, then perform the actions through step 5 in EOI-2, Loss of Secondary Coolant, while continuing with step 5 of this instruction.

3. If a Steam Generator Tube Rupture is also in progress, then perform the actions through step 10 in EOI-3, Steam Generator Tube Rupture, while continuing with Step 5 of this instruction.

4. If any other event is in progress, follow the appropriate procedure while continuing with the subsequent steps of this instruction.

5. Attempt to operate the auxiliary feedwater system by performing the following actions.

a. Verify that auxiliary feedwater pumps are running. If not, check breaker position and restore if necessary.

b. Verify that auxiliary feedwater valves are in the proper alignment as indicated by the MCB status lights.

c. Verify that the water supply to the suction at the auxiliary feedwater pump is available.

d. Locally verify open valve positions and attempt to manually start all auxiliary feedwater pumps.

e. Verify that the valves in the steam supply to the turbine driven auxiliary feedwater pump are open.

NOTE: Monitor pump discharge pressure and auxiliary feedwater flow indicators to determine auxiliary feedwater availability.

6. If auxiliary feedwater cannot be restored, attempt to restore main feedwater.

7. If auxiliary feedwater or main feedwater flow becomes available as a result of manual actions and Z (flow equivalent to at least one motor driven auxiliary feedwater pump at design pressure) gpm is being injected into the non-faulted steam generators, immediately proceed to the appropriate abnormal operating instructions. If safety injection has been initiated, immediately proceed to EOI-0, Immediate Actions and Diagnostics.

8. If only the condensate system is available, then perform the following actions:

a. Rapidly depressurize all non-faulted steam generators to a pressure below the shutoff head of the condensate pumps.

CAUTION: Do not attempt to block safety injection.

b. If safety injection occurs, reset safety injection and feedwater isolation and open the feedwater control and isolation valves to feed the depressurized steam generators while continuing the steam generator depressurization.

c. Begin injecting condensate flow to the depressurized steam generator.

9. a. If reactor coolant system pressure and core exit thermocouples or wide range RTD temperature are increasing, due to loss of heat removal capability of the secondary system, go to step 10.

b. If flow greater than Z (flow equivalent to at least one motor-driven auxiliary feedwater pump at desing pressure) gpm is being injected into the non-faulted steam generator(s), AND if an indicated narrow range water level in at least one depressurized steam generator is greater than (insert plant specific value which includes an allowance for normal channel accuracy, post accident transmitter errors and reference leg errors) precent of span, then immediately return to the appropriate EOI or AOI. Otherwise return to step 5.

10. Manually initiate safety injection if not already actuated.

CAUTION: Monitor RWST level closely. If RWST level reaches a low level immediately proceed to Cold Leg Recirculation Switchover Instructions, Table E-1.1 of EOI-1. Following the implementation of cold leg recirculation return and continue with step 11.

11. Initiate an RCS depressurization by performing the following actions:

a. Establish power sources necessary to operate the pressurizer PORV's.

b. Ensure that pressurizer PORV isolation valves are in the OPEN position.

c. Manually open ALL Pressurizer PORV's.

NOTE: If pressurizer PORV's are opened, an increase in pressurizer level is expected.

12. Verify at least two PORV flow paths are open by checking the MCB status lights and temperature indicators in each PORV discharge line. If 2 PORV flow paths are verified to be open, proceed to step 14.

13. If at least TWO pressurizer PORV flow paths are not verified to be open, perform the following actions:

a. Attempt to restart one reactor coolant pump (preferably in a non-faulted steam generator loop) if not already running.

b. Depressurize at least one non-faulted steam generator secondary side to atmosphere pressure by opening the steam generator PORV's

NOTE: If the steam generator PORV's cannot be opened from the MCB, manually open at least one steam generator PORV.

c. Align a low pressure water source to the depressurized non-faulted steam generator(s).

NOTE: Sources of low pressure water may include fire water, service water, or condensate water.

d. Proceed to step 15.

14. Stop all reactor coolant pumps if not already tripped.

CAUTION: If the reactor coolant pumps are stopped, the seal injection flow should be maintained.

15. If

a. Secondary cooling capability has not been restored

OR

b. Secondary cooling capability has been restored and core exit thermocouples and wide range RTD's readings are not trending downward.

THEN, maintain the pressurizer PORV's in the open position. Maintain safety injection flow and go to step 7 in EOI-1, Loss of Reactor Coolant. If secondary cooling capability has been restored as verified by core exit thermocouples and wide range RTD's, then continue on with step 16.

16. WHEN

a. the indicated narrow range water level in at least one non-faulted steam generator is greater than (insert plant specific value which includes an allowance for normal channel accuracy, post-accident transmitter errors and reference leg process errors) percent of span AND

b. the reactor coolant indicated subcooling based upon the incore thermocouples is greater than (insert plant specific value which is the sum of the errors for the temperature measurement system used and the pressure measurement system translated into temperature using the saturation tables)

THEN

c. monitor the core exit thermocouples to record baseline readings, and then close the pressurizer PORV's.

CAUTION: If after closing of the pressurizer PORV's, a rapid increase in core exit thermocouple temperatures (greater than 15°F) occurs, immediately reopen the pressurizer power operated relief valves and proceed to step 7 in EOI-1, Loss of Reactor Coolant.

17. After the pressurizer PORV's are closed, monitor the conditions given below for termination of safety injection.

WHEN

a. Reactor coolant system pressure has increased by at least 200 psi (after closure of the pressurizer PORVs), AND

b. Pressurizer water level is greater than 50 percent of span, AND

c. The reactor coolant sytem indicated subcooling BASED ON HOT LEG WIDE RANGE TEMPERATURE IN THE NON-FAULTED LOOPS OR THE CORE EXIT THERMOCOUPLES is greater than (insert plant specific valve which is the sum of the errors for the temperature measurement system used, and the pressure measurement system translated into temperature using the saturation tables).

THEN:

d. Reset safety injection and stop all operating safety injection pumps not needed for normal charging and reactor coolant pump seal injection flow.

CAUTION: Automatic reinitiation of safety injection will not occur since the reactor trip breakers are not reset.

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 emergency busses.

e. Establish normal charging flow and then isolate safety injection flow to RCS Cold Legs via Boron Injection Tank.

CAUTION: IF reactor coolant pressure decreases by 200 psi OR pressurizer water level decreases by 10 percent of span following termination of safety injection flow OR the reactor coolant sub-cooling drops below (insert plant specific value which is the sum of the errors for the temperature measurement system used and for the pressure measurement system translated into temperature using the saturation tables), MANUALLY REINITIATE safety injection to establish reactor coolant pressure and pressurizer water level and go to section D EOI-0.

CAUTION: If the pumps are restarted once after termination, an additional 15°F of sub-cooling should be added to the required sub-cooling prior to the second termination of the high head pumps. This can be achieved by terminating SI at 200 psi higher pressure.

f. Reestablish normal makeup and letdown to maintain pressurizer water level in the normal operating range and to maintain reactor coolant pressure at values reached when safety injection is terminated. Ensure that water addition during this process does not result in dilution of the reactor coolant system boron concentration.

g. Reestablish operation of the pressurizer heaters. When reactor coolant pressure can be controlled by pressurizer heaters alone, return makeup and letdown t pressurizer water level control only.

h. After the water level in the non-faulted steam generator(s) has been restored to the narrow range span, regulate the auxiliary feedwater flow to those steam generator(s) to maintain an indicated narrow range water level.

NOTE: Monitor the primary water supply (Condensate Storage Tank) for the auxiliary feedwater pumps and upon reaching a low level, switch over to an alternate water supply source.

18. Monitor either the average temperature indication of core exit thermocouples (if available) or all wide range reactor coolant temperature T_H to verify that RCS temperature is at least 50°F less than saturation temperature at RCS indicated pressure.

If 50°F indicated subcooling is not present, then attempt to establish 50°F indicated subcooling by steam dump from the steam generators to the condenser or the atmosphere.

CAUTION: If steam dump is necessary, reduce the steam generator pressure to maintain a reactor coolant cooldown rate of no more than 50°F/hr, consistent with plant make-up capability, until 50°F subcooling is established.

If 50°F indicated subcooling cannot be established or maintained, then MANUALLY REINITIATE SAFETY INJECTION. Go to EOI-0.

19. Perform a controlled cooldown to cold shutdown conditions using Normal Coolant Procedures if required to affect repairs. Maintain subcooled conditions (at least 50°F indicated subcooling) in the reactor coolant system.

E²OI-2

INSTRUCTIONS TO MITIGATE INADEQUATE CORE COOLING (ICC) RESULTING FROM A LOSS OF AUXILIARY FEEDWATER IN PLANTS WITH LOW PRESSURE SI PUMPS

I. PURPOSE

The purpose of this instruction is to specify the required operator actions and precautions necessary to:

1. Establish alternate core decay heat removal capability when main and auxiliary feedwater is unavailable.

2. Prevent or minimize damage to the fuel cladding and release of excessive radioactivity.

3. Establish stable reactor conditions which are amendable to long term cooling.

II. SYMPTOMS

1. The auxiliary feedwater system is not available for decay heat removal, and

2. The main feedwater system is not available for decay heat removal.

III. IMMEDIATE ACTIONS

Refer to the Section on Immediate Actions of the appropriate operating instruction for the initiating event, if not already performed.

IV. SUBSEQUENT ACTIONS

CAUTION: The operator must proceed to step 10 before the secondary liquid inventory is depleted. Steps 1 through 9 should also be performed concurrently.

1. If a loss of reactor coolant is also in progress, monitor wide range reactor coolant system pressure, and

   a. IF the wide range reactor coolant system pressure is ABOVE any steam generator pressure, then perform the actions through Step 2 in EOI-1, Loss of Reactor Coolant, while continuing with Step 5 of this instruction.

   b. IF the wide range reactor coolant system pressure is BELOW the steam pressure in ALL steam generators, then immediately return to EOI-1, Loss of Reactor Coolant.

2. If a Loss of Secondary Coolant is also in progress, then perform the actions through Step 5 in EOI-2, Loss of Secondary Coolant, while continuing with Step 5 of this instruction.

3. If a Steam Generator Tube Rupture is also in progress, then perform the actions through Step 10 in EOI-3, Steam Generator Tube Rupture, while continuing with step 5 of this instruction.

4. If any other event is in progress, follow the appropriate procedure while continuing with the subsequent steps of this instruction.

5. Attempt to operate the auxiliary feedwater system by performing the following actions.

a. Verify that auxiliary feedwater pumps are running. If not, check breaker position and restore if necessary.

b. Verify that auxiliary feedwater valves are in the proper alignment as indicated by the MCB status lights.

c. Verify that the water supply to the suction of the auxiliary feedwater pumps is available.

d. Locally verify open valve positions and attempt to manually start all auxiliary feedwater pumps.

e. Verify that the valves in the steam supply to the turbine driven auxiliary feedwater pump are open.

NOTE: Monitor pump discharge pressure and auxiliary feedwater flow indicators to determine auxiliary feedwater availability.

6. If auxiliary feedwater cannot be restored, attempt to restore main feedwater, if possible.

7. If auxiliary feedwater or main feedwater flow becomes available as a result of manual actions and Z (flow equivalent to at least one motor driven auxiliary feedwater pump at design pressure) gpm is being injected into the non-faulted steam generators, immediately proceed to the appropriate abnormal operating instructions. If safety injection has been initiated, immediately proceed to EOI-0, Immediate Actions and Diagnostics.

8. If only the condensate system is available, then perform the following actions:

a. Rapidly depressurize all non-faulted steam generators to a pressure below the shutoff head of the condensate pumps.

CAUTION: Do not attempt to block safety injection.

b. If safety injection occurs, reset safety injection and feedwater isolation and open the feedwater control and isolation valves to feed the depressurized steam generators while continuing the steam generator depressurization.

c. Begin injecting condensate flow to the depressurized steam generator.

9. If flow greater than Z (flow equivalent to at least one motor-driven auxiliary feedwater pump at design pressure) gpm is being injected into the non-faulted steam generator(s), AND if an indicated narrow range water level in at least one depressurized steam generator is greater than (insert plant specific value which includes an allowance for normal channel accuracy, post accident transmitter errors and reference leg errors) percent of span, then immediately return to the appropriate EOI. Otherwise continue to Step 10.

10. Manually initiate safety injection if not already actuated.

CAUTION: Monitor RWST level closely. If RWST level reaches a low level, immediately proceed to Cold Leg Recirculation Switchover Instructions, Table E-1.1 in EOI-1, Loss of Reactor Coolant. Following implementation of cold leg recirculation, return and continue with step 11.

11. Initiate an RCS depressurization by performing the following actions:

a. Establish power sources necessary to operate the pressurizer PROV's.

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b. Ensure that pressurizer PORV's isolation valves are in the OPEN position.

c. Manually open ALL Pressurizer PORV's.

NOTE: If pressurizer PORV's are opened, an increase in pressurizer level is expected.

12. Verify at least two PORV flow paths are open by checking the MCB status lights and temperature indicators in each PORV discharge line. If 2 PORV flow paths are verified to be open, proceed to step 14.

13. If at least TWO pressurizer PORV flow paths are not verified to be open, perform the following actions:

a. Attempt to restart one reactor coolant pump (preferably in a non-faulted steam generator loop) if not already running.

b. Depressurize at least one non-faulted steam generator secondary side to atmosphere pressure by opening the steam generator PORV's

NOTE: If the steam generator PORV's cannot be opened from the MCB, manually open at least one steam generator PORV.

c. Align a low pressure water source to the depressurized non-faulted steam generator(s).

NOTE: Sources of low pressure water may include fire water, service water, or condensate water.

d. Proceed to Step 15.

14. Stop all reactor coolant pumps if not already tripped.

CAUTION: If the reactor coolant pumps are stopped, the seal injection flow should be maintained.

15. If

a. Secondary cooling capability has not been restored

OR

b. Secondary cooling capability has been restored and core exit thermocouples and wide range RTD's readings are not trending downward.

THEN, maintain the pressurizer PORV's in the open position. Maintain safety injection flow and go to Step 7 in EOI-1, Loss of Reactor Coolant. If secondary cooling capability has been restored as verified by core exit thermocouples and wide range RTD's, then continue on with step 16.

16. WHEN:

a. the indicated narrow range water level in at least one non-faulted steam generator is greater than (insert plant specific value which includes an allowance for normal channel accuracy, post-accident transmitter errors and reference leg process errors) percent of span AND

b. the reactor coolant indicated subcooling based upon the core exit thermocouples is greater than (insert plant specific value which is the sum of the errors for the temperature measurement system used and the pressure measurement system translated into temperature using the saturation tables)

THEN:

c. monitor the core exit thermocouples to record base line readings, and then close the pressurizer PORV's.

CAUTION: If after closing of the pressurizer PORV's, a rapid increase in core exit thermocouple temperatures (greater than 15°F) occurs, immediately reopen the pressurizer power operated relief valves and proceed to Step 7 in EOI-1, Loss of Reactor Coolant.

17. After the pressurizer PORV's are closed, monitor the conditions given below for termination of safety injection.

WHEN:

a. reactor coolant system pressure has increased by at least 200 psi (after closure of the pressurizer PORVs), AND

b. pressurizer water level is greater than 50 percent of span, AND

c. the reactor coolant sytem indicated subcooling BASED ON HOT LEG WIDE RANGE TEMPERATURE IN THE NON-FAULTED LOOPS OR THE CORE EXIT THERMOCOUPLES is greater than (insert plant specific valve which is the sum of the errors for the temperature measurement system used, and the pressure measurement system translated into temperature using the saturation tables).

THEN:

d. reset safety injection and stop all operating safety injection pumps not needed for normal charging and reactor coolant pump seal injection flow.

CAUTION: Automatic reinitiation of safety injection will not occur since the reactor trip breakers are not reset.

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 emergency busses.

e. establish normal charging flow and then isolate safety injection flow to RCS Cold Legs via Boron Injection Tank.

CAUTION: IF reactor coolant pressure decreases by 200 psi OR pressurizer water level decreases by 10 percent of span following termination of safety injection flow OR the reactor coolant sub-cooling drops below (insert plant specific value which is the sum of the errors for the temperature measurement system used and for the pressure measurement system translated into temperature using the saturation tables), MANUALLY REINITIATE safety injection to establish reactor coolant pressure and pressurizer water level and go to Section D EOI-0.

CAUTION: If the pumps are restarted once after termination, an additional 15°F of sub-cooling should be added to the required sub-cooling prior to the second termination of the high head pumps. This can be achieved by terminating SI at 200 psi higher pressure.

f. Reestablish normal makeup and letdown to maintain pressurizer water level in the normal operating range and to maintain reactor coolant pressure at values reached when safety injection is terminated. Ensure that water addition during this process does not result in dilution of the reactor coolant system boron concentration.

g. Reestablish operation of the pressurizer heaters. When reactor coolant pressure can be controlled by pressurizer heaters alone, return makeup and letdown to pressurizer water level control only.

h. After the water level in the non-faulted steam generator(s) has been restored to the narrow range span, regulate the auxiliary feedwater flow to those steam generator(s) to maintain an indicated narrow range water level.

NOTE: Monitor the primary water supply (Condensate Storage Tank) for the auxiliary feedwater pumps and upon reaching a low level, switch over to an alternate water supply source.

18. Monitor either the average temperature indication of core exit thermocouples (if available) or all wide range reactor coolant temperature T_H to verify that RCS temperature is at least 50°F less than saturation temperature at RCS indicated pressure.

If 50°F indicated subcooling is not present, then attempt to establish 50°F indicated subcooling by steam dump from the steam generators to the condenser or the atmosphere.

CAUTION: If steam dump is necessary, reduce the steam generator pressure to maintain a reactor coolant cooldown rate of no more than 50°F/hr, consistent with plant make-up capability, until 50°F subcooling is established.

If 50°F indicated subcooling cannot be established or maintained, then MANUALLY REINITIATE SAFETY INJECTION. Go to EOI-0.

19. Perform a controlled cooldown to cold shutdown conditions using Normal Coolant Procedures if required to affect repairs. Maintain subcooled conditions (at least 50°F indicated subcooling) in the reactor coolant system.

INSTRUCTIONS TO MITIGATE INADEQUATE CORE COOLING (ICC) RESULTING FROM A LOSS OF REACTOR COOLANT COINCIDENT WITH LOSS OF ALL HIGH HEAD SAFETY INJECTION(1) (LOW HEAD SAFETY INJECTION IS AVAILABLE)

I. Purpose

The objectives of these instructions are to specify required operator actions and precautions necessary to:

1. Depressurize the primary system to establish low head safety injection flow and restore core cooling;

2. Determine when conditions are acceptable to return to the Emergency Operating Instructions.

II. Symptoms

1. Five core exit thermocouples are reading greater than 1200°F.

   OR

2. Abnormal containment conditions (pressure, radiation, or sump level) are indicated and either a. or b. below exist:(2)

(1) This instruction is applicable to all plants regardless of the shutoff head of the high head safety injection pumps.
(2) Not applicable to plants without vessel level instrumentation.

a. With any reactor coolant pump running, reactor vessel level is reading less than 100 percent in the narrow range.(1)

b. With no reactor coolant pumps running, two or more core exit thermocouples are reading greater than 700°F and reactor vessel level is reading less than (plant specific value which is 3 1/2 feet above the bottom of the active fuel in the core with zero void fraction, plus uncertainties).(1)

III. Immediate Actions

Refer to section on Immediate Actions of E-0, Immediate Actions and Diagnostics, if not already performed.

IV. Subsequent Actions

CAUTION: While in the injection mode, if the refueling water storage tank level approaches the low level alarm during the subsequent actions of this instruction, immediately terminate those actions and do not resume them until the transfer to cold leg recirculation has been accomplished. The instructions for switchover to cold leg recirculation begin with step 7 of E-1 ("Loss of Reactor Coolant").

NOTE: During the conduct of this instruction, closely monitor the core exit thermocouples (and vessel level gauge (1) if available) to determine the effectiveness of the subsequent actions.

(1) Not applicable to plants without vessel level instrumentation.

1. Establish power sources necessary to operate all cold leg accumulator isolation valves and verify that all valves are open; if not, open the valves. While doing so, immediately proceed with the subsequent actions.

2. Attempt to establish the necessary conditions for running reactor coolant pumps.

3. Attempt to establish makeup flow to the reactor coolant system by operation of any available equipment.

4. Continue efforts, throughout these instructions, to provide high head centrifugal charging and/or high head safety injection. Attempt to operate equipment manually or locally.

5. Regulate the auxiliary feedwater to restore and/or maintain an indicated narrow range steam generator water level.

   NOTE: Monitor the primary water supply (condensate storage tank) for the auxiliary feedwater pumps and upon reaching a low level (plant specific value), switch over to an alternate water supply source.

6. If the low head safety injection pumps have been shut down restart these pumps.

7. If all reactor coolant pumps are running and core exit thermocouples are reading less than 1200°F; then trip the reactor coolant pump in the loop connected to the pressurizer surge line.

CAUTION: The subsequent sections A, B and C must be executed sequentially, unless instructed otherwise in the procedure.

SECTION A

REACTOR COOLANT SYSTEM DEPRESSURIZATION VIA STEAM GENERATOR SECONDARY DEPRESSURIZATION

A-1. Close any open pressurizer PORV's. Also verify the open status and availability of power to all pressurizer PORV backup isolation valves.

A-2. Rapidly depressurize the steam generator secondary side of all available steam generators to X psig (plant specific value which is 200 psig plus instrument uncertainty) by dumping steam:

a. to the condenser, if the condenser is available, by manual control of the steam generator header pressure controller

OR

b. through the steam generator power operated relief valves, if the condenser is not available.

CAUTION: If depressurization of the steam generator secondaries to X psig cannot be accomplished, continue efforts to depressurize the steam generator secondaries and go to step B-1.

A-3. If at least two wide range hot leg RTD's do not read less than 400°F, then go to step B-1. Otherwise, proceed with the subsequent instructions.

A-4. If any cold leg accumulator isolation valve is open and the associated accumulator has not been vented, then trip all operating reactor coolant pumps.

A-5. Isolate the cold leg accumulators by closing the cold leg accumulator isolation valves.

NOTE: If the accumulator isolation valves cannot be closed vent the accumulator nitrogen gas to less than Y psig (plant specific value to be calculated in Appendix A). Do not proceed to step A-6 until the accumulators have been depressurized.

CAUTION: If core exit thermocouples should exceed 1200°F while venting the accumulator gas, then restart all operable reactor coolant pumps and proceed immediately to step A-6.

A-6. Rapidly depressurize the steam generator secondaries to atmospheric pressure.

A-7. Verify low head safety injection by eitner direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps.

A-8. Trip all operating reactor coolant pumps.

A-9. When core exit thermocouple readings are below 400°F (and the vessel level gauge (1), if available) indication is greater than ____ percent (plant specific value which is top of core plus uncertainties) then go to step 7 of E-1 ("Loss of Reactor Coolant") or, if safety injection switchover to cold leg recirculation has been accomplished, go to step 8 of E-1 ("Loss of Reactor Coolant").

CAUTION: If the core exit thermocouples should exceed 1200°F before all of the above conditions are satisfied then the instructions of section B should be executed.

(1) Not applicable to plants without vessel level instrumentation.

SECTION B

REACTOR COOLANT SYSTEM DEPRESSURIZATION VIA RESTARTING/RUNNING REACTOR COOLANT PUMPS

NOTE: If the steam generator secondaries have not been fully depressurized AND if the capability to rapidly depressurize the steam generator secondaries is restored during the conduct of steps B-1 through B-5 THEN return immediately to step A-1 and complete the subsequent steps of the A section.

NOTE: If normal conditions for starting reactor coolant pumps cannot be met in section B, the reactor coolant pumps must be started regardless.

B-1. If all reactor coolant pumps are not running and core exit thermocouples are reading greater than 1200°F, then start a shutdown reactor coolant pump. If core exit thermocouples remain above 1200°F, start another reactor coolant pump. Continue this action until either core exit thermocouples drop below 1200°F or all operable reactor coolant pumps are running.

If core exit thermocouples remain above 1200°F go to step C-1.

CAUTION: If at any time during the conduct of steps B-2 through B-6 core exit thermocouple readings exceed 1200°F return immediately to step B-1.

NOTE: If at any time during the conduct of the subsequent instruction an operating reactor coolant pump fails, replace the lost pump by any remaining operable reactor coolant pumps.

B-2. Attempt to fully depressurize the secondary side o. all available steam generator secondaries by any means possible. Regulate the auxiliary feedwater to restore and/or maintain an indicated narrow range steam generator water level.

B-3. Monitor the RCS depressurization. When evidence of low head safety injection flow is determined by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps, THEN proceed with the subsequent steps.

NOTE: Low head safety injection may be intermittent but this is sufficient and the next steps of this procedure should be executed.

B-4. If the cold leg accumulators have not already been isolated, isolate the cold leg accumulators by closing the cold leg accumulator isolation valves.

NOTE: If the cold leg accumulator isolation valves cannot be closed THEN vent the accumulator gas to less than Y psig (plant specific value to be calculated in Appendix A). Do not proceed to step B-5 until the accumulators have been depressurized.

B-5. WHEN:

a. Steam generator secondaries have been fully depressurized.

AND

b. At least two wide range hot leg RTD's are reading less than 350°F.

THEN

Trip all operating reactor coolant pumps.

B-6. Verify CONTINUOUS delivery of low head safety injection by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps. If continuous delivery of low head safety injection cannot be verified return immediately to step B-1.

B-7. When core exit thermocouple readings are less than 400°F (and the vessel level gauge (1), if available) is indicating _____ percent (plant specific value which is top of core plus uncertainties) THEN go to step 7 of E-1 ("Loss of Reactor Coolant") of, if safety injection switchover to cold leg recirculation has been established go to step 8 of E-1 ("Loss of Reactor Coolant").

(1) Not applicable to plants without vessel level instrumentation.

SECTION C

REACTOR COOLANT SYSTEM DEPRESSURIZATION VIA OPENING PRESSURIZER POWER OPERATED RELIEF VALVES

NOTE: If the steam generator secondaries have not been fully depressurized AND if the capability to rapidly depressurize the steam generator secondaries is restored during the conduct of steps C-1 through C-6 THEN return immediately to step A-1 and complete the subsequent steps of the A section.

NOTE: If the capability to operate additional reactor coolant pumps is restored during the conduct of steps C-1 through C-6 THEN return immediately to step B-1 and complete the subsequent steps of the B section.

C-1. Open all operable pressurizer power operated relief valve (PORV's).

C-2. If core exit thermocouples remain above 1200°F, open any other available vent paths from the reactor coolant system to the containment.

C-3. Attempt to fully depressurize the secondary side of all available steam generators by any means possible. Regulate auxiliary feedwater to restore and/or maintain an indicated narrow range steam generator water level.

C-4. Monitor the RCS pressure. When evidence of low head safety injection flow is determined by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps, THEN proceed with the subsequent steps.

NOTE: Low head safety injection maybe intermittent but this is sufficient and the next steps of this procedure should be executed.

C-5. If the cold leg accumulators have not already been isolated, isolate the cold leg accumulators by closing the cold leg accumulator isolated valves.

NOTE: If the cold leg accumulator isolation valves cannot be closed THEN vent the accumulator gas to less than Y psig (plant specific value to be calculated in Appendix A). DO NOT PROCEED to step C-6 until the accumulators have been depressurized.

C-6. When:

a. Steam generator secondaries have been fully depressurized.

AND

b. At least two wide range hot leg RTD's are reading less than 350°F.

THEN

Trip all operating reactor pumps.

C-7. Verify CONTINUOUS delivery of low head safety injection by either direct flow indication or by low head SI pump discharge pressure less than the shutoff head of the low head SI pumps. If continuous low head safety injection cannot be verified return immediately to section B step B-1 and complete the subsequent steps of the B, section.

C-8. When core exit thermocouples are reading less than 400°F (and the vessel level gauge (1), if available) is indicating _____percent (plant specific value which is top of core plus uncertainties) THEN go to step . of E-1 ("Loss of Reactor Coolant") OR, if safety injection switchover to cold leg recirculation has been accomplished, go to step 8 of E-1 ("Loss of Reactor Coolant").

CAUTION: If core exit themocouples should exceed 1200°F before all of the above conditions are satisfied then immediately return to section B.

(1) Not applicable to plants without vessel level instrumentation.

Appendix A

Accumulator Isolation via Gas Venting to the Containment

In several steps of the E^2OI-1 procedure accumulator isolation is to be accomplished by venting the gas if the isolation valves could not be closed. Specifically, the instructions state that the gas should be vented to Y PSIG before the next steps can be executed. The value Y should be calculated as;

Y(PSIG) = Low Head Safety Injection Pump shut off head (PSIG) - 100 psi

INSTRUCTIONS TO MITIGATE INADEQUATE CORE COOLING (ICC) RESULTING FROM A LOSS OF AUXILIARY FEEDWATER IN PLANTS WITH SAFETY GRACE CHARGING FLOW

I. PURPOSE

The purpose of this instruction is to specify the required operator actions and precautions necessary to:

1. Establish alternate core decay heat removal capability when main and auxiliary feedwater is unavailable.

2. Prevent or minimize damage to the fuel cladding and release of excessive radioactivity.

3. Establish stable reactor conditions which are amendable to long term cooling.

II. SYMPTOMS

1. The Auxiliary Feedwater System is not available for decay heat removal, and

2. The Main Feedwater System is not available for decay heat removal.

III. IMMEDIATE ACTIONS

Refer to the section on Immediate Actions of the appropriate operating instruction for the initiating event, if not already performed.

IV. SUBSEQUENT ACTIONS

CAUTION: If during the conduct of steps 5 through 9 the Reactor Coolant System pressure and core exit thermocouples or wide range RTD temperature are increasing due to loss of heat removal capability of the secondary system, then immediately proceed to step 10.

1. If a Loss of Reactor Coolant is also in progress, monitor wide range reactor coolant system pressure, and

   a. If the wide range reactor coolant system pressure is ABOVE any steam generator pressure, then perform the actions through step 2 in EOI-1, Loss of Reactor Coolant, while continuing with step 5 of this instruction.

   b. If the wide range reactor coolant system pressure is BELOW the steam pressure in ALL steam generators, then immediately return to EOI-1, Loss of Reactor Coolant.

2. If a Loss of Secondary Coolant is also in progress, then perform the actions through step 5 in EOI-2, Loss of Secondary Coolant, while continuing with step 5 of this instruction.

3. If a Steam Generator Tube Rupture is also in progress, then perform the actions through step 10 in EOI-3, Steam Generator Tube Rupture, while continuing with Step 5 of this instruction.

4. If any other event is in progress, follow the appropriate procedure while continuing with the subsequent steps of this instruction.

5. Attempt to operate the auxiliary feedwater system by performing the following actions.

a. Verify that auxiliary feedwater pumps are running. If not, check breaker position and restore if necessary.

b. Verify that auxiliary feedwater valves are in the proper alignment as indicated by the MCB status lights.

c. Verify that the water supply to the suction at the auxiliary feedwater pump is available.

d. Locally verify open valve positions and attempt to manually start all auxiliary feedwater pumps.

e. Verify that the valves in the steam supply to the turbine driven auxiliary feedwater pump are open.

NOTE: Monitor pump discharge pressure and auxiliary feedwater flow indicators to determine auxiliary feedwater availability.

6. If auxiliary feedwater cannot be restored, attempt to restore main feedwater.

7. If auxiliary feedwater or main feedwater flow becomes available as a result of manual actions and Z (flow equivalent to at least one motor driven auxiliary feedwater pump at design pressure) gpm is being injected into the non-faulted steam generators, immediately proceed to the appropriate abnormal operating instructions. If safety injection has been initiated, immediately proceed to EOI-0, Immediate Actions and Diagnostics.

8. If only the condensate system is available, then perform the following actions:

a. Rapidly depressurize all non-faulted steam generators to a pressure below the shutoff head of the condensate pumps.

CAUTION: Do not attempt to block safety injection.

b. If safety injection occurs, reset safety injection and feedwater isolation and open the feedwater control and isolation valves to feed the depressurized steam generators while continuing the steam generator depressurization.

c. Begin injecting condensate flow to the depressurized steam generator.

9. a. If reactor coolant system pressure and core exit thermocouples or wide range RTD temperature are increasing, due to loss of heat removal capability of the secondary system, go to step 10.

b. If flow greater than Z (flow equivalent to at least one motor-driven auxiliary feedwater pump at desing pressure) gpm is being injected into the non-faulted steam generator(s), AND if an indicated narrow range water level in at least one depressurized steam generator is greater than (insert plant specific value which includes an allowance for normal channel accuracy, post accident transmitter errors and reference leg errors) precent of span, then immediately return to the appropriate EOI or AOI. Otherwise return to step 5.

10. Manually initiate safety injection if not already actuated.

CAUTION: Monitor RWST level closely. If RWST level reaches a low level immediately proceed to Cold Leg Recirculation Switchover Instructions, Table E-1.1 of EOI-1. Following the implementation of cold leg recirculation return and continue with step 11.

11. Initiate an RCS depressurization by performing the following actions:

a. Establish power sources necessary to operate the pressurizer PORV's.

b. Ensure that pressurizer PORV isolation valves are in the OPEN position.

c. Manually open ALL Pressurizer PORV's.

NOTE: If pressurizer PORV's are opened, an increase in pressurizer level is expected.

12. Verify at least two PORV flow paths are open by checking the MCB status lights and temperature indicators in each PORV discharge line. If 2 PORV flow paths are verified to be open, proceed to step 14.

13. If at least TWO pressurizer PORV flow paths are not verified to be open, perform the following actions:

a. Attempt to restart one reactor coolant pump (preferably in a non-faulted steam generator loop) if not already running.

b. Depressurize at least one non-faulted steam generator secondary side to atmosphere pressure by opening the steam generator PORV's

NOTE: If the steam generator PORV's cannot be opened from the MCB, manually open at least one steam generator PORV.

c. Align a low pressure water source to the depressurized non-faulted steam generator(s).

NOTE: Sources of low pressure water may include fire water, service water, or condensate water.

d. Proceed to step 15.

14. Stop all reactor coolant pumps if not already tripped.

CAUTION: If the reactor coolant pumps are stopped, the seal injection flow should be maintained.

15. If

a. Secondary cooling capability has not been restored

OR

b. Secondary cooling capability has been restored and core exit thermocouples and wide range RTD's readings are not trending downward.

THEN, maintain the pressurizer PORV's in the open position. Maintain safety injection flow and go to step 7 in EOI-1, Loss of Reactor Coolant. If secondary cooling capability has been restored as verified by core exit thermocouples and wide range RTD's, then continue on with step 16.

16. WHEN

a. the indicated narrow range water level in at least one non-faulted steam generator is greater than (insert plant specific value which includes an allowance for normal channel accuracy, post-accident transmitter errors and reference leg process errors) percent of span AND

b. the reactor coolant indicated subcooling based upon the incore thermocouples is greater than (insert plant specific value which is the sum of the errors for the temperature measurement system used and the pressure measurement system translated into temperature using the saturation tables)

THEN

c. monitor the core exit thermocouples to record baseline readings, and then close the pressurizer PORV's.

CAUTION: If after closing of the pressurizer PORV's, a rapid increase in core exit thermocouple temperatures (greater than 15°F) occurs, immediately reopen the pressurizer power operated relief valves and proceed to step 7 in EOI-1, Loss of Reactor Coolant.

17. After the pressurizer PORV's are closed, monitor the conditions given below for termination of safety injection.

WHEN

a. Reactor coolant system pressure has increased by at least 200 psi (after closure of the pressurizer PORVs), AND

b. Pressurizer water level is greater than 50 percent of span, AND

c. The reactor coolant sytem indicated subcooling BASED ON HOT LEG WIDE RANGE TEMPERATURE IN THE NON-FAULTED LOOPS OR THE CORE EXIT THERMOCOUPLES is greater than (insert plant specific valve which is the sum of the errors for the temperature measurement system used, and the pressure measurement system translated into temperature using the saturation tables).

THEN:

d. Reset safety injection and stop all operating safety injection pumps not needed for normal charging and reactor coolant pump seal injection flow.

CAUTION: Automatic reinitiation of safety injection will not occur since the reactor trip breakers are not reset.

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 emergency busses.

e. Establish normal charging flow and then isolate safety injection flow to RCS Cold Legs via Boron Injection Tank.

CAUTION: IF reactor coolant pressure decreases by 200 psi OR pressurizer water level decreases by 10 percent of span following termination of safety injection flow OR the reactor coolant sub-cooling drops below (insert plant specific value which is the sum of the errors for the temperature measurement system used and for the pressure measurement system translated into temperature using the saturation tables), MANUALLY REINITIATE safety injection to establish reactor coolant pressure and pressurizer water level and go to section D EOI-0.

CAUTION: If the pumps are restarted once after termination, an additional 15°F of sub-cooling should be added to the required sub-cooling prior to the second termination of the high head pumps. This can be achieved by terminating SI at 200 psi higher pressure.

f. Reestablish normal makeup and letdown to maintain pressurizer water level in the normal operating range and to maintain reactor coolant pressure at values reached when safety injection is terminated. Ensure that water addition during this process does not result in dilution of the reactor coolant system boron concentration.

g. Reestablish operation of the pressurizer heaters. When reactor coolant pressure can be controlled by pressurizer heaters alone, return makeup and letdown to pressurizer water level control only.

h. After the water level in the non-faulted steam generator(s) has been restored to the narrow range span, regulate the auxiliary feedwater flow to those steam generator(s) to maintain an indicated narrow range water level.

NOTE: Monitor the primary water supply (Condensate Storage Tank) for the auxiliary feedwater pumps and upon reaching a low level, switch over to an alternate water supply source.

18. Monitor either the average temperature indication of core exit thermocouples (if available) or all wide range reactor coolant temperature T_H to verify that RCS temperature is at least 50°F less than saturation temperature at RCS indicated pressure.

If 50°F indicated subcooling is not present, then attempt to establish 50°F indicated subcooling by steam dump from the steam generators to the condenser or the atmosphere.

CAUTION: If steam dump is necessary, reduce the steam generator pressure to maintain a reactor coolant cooldown rate of no more than 50°F/hr, consistent with plant make-up capability, until 50°F subcooling is established.

If 50°F indicated subcooling cannot be established or maintained, then MANUALLY REINITIATE SAFETY INJECTION. Go to EOI-0.

19. Perform a controlled cooldown to cold shutdown conditions using Normal Coolant Procedures if required to affect repairs. Maintain subcooled conditions (at least 50°F indicated subcooling) in the reactor coolant system.

INSTRUCTIONS TO MITIGATE INADEQUATE CORE COOLING (ICC) RESULTING FROM A LOSS OF AUXILIARY FEEDWATER IN PLANTS WITH LOW PRESSURE SI PUMPS

I. PURPOSE

The purpose of this instruction is to specify the required operator actions and precautions necessary to:

1. Establish alternate core decay heat removal capability when main and auxiliary feedwater is unavailable.

2. Prevent or minimize damage to the fuel cladding and release of excessive radioactivity.

3. Establish stable reactor conditions which are amendable to long term cooling.

II. SYMPTOMS

1. The auxiliary feedwater system is not available for decay heat removal, and

2. The main feedwater system is not available for decay heat removal.

III. IMMEDIATE ACTIONS

Refer to the Section on Immediate Actions of the appropriate operating instruction for the initiating event, if not already performed.

IV. SUBSEQUENT ACTIONS

CAUTION: The operator must proceed to step 10 before the secondary liquid inventory is depleted. Steps 1 through 9 should also be performed concurrently.

1. If a loss of reactor coolant is also in progress, monitor wide range reactor coolant system pressure, and

   a. IF the wide range reactor coolant system pressure is ABOVE any steam generator pressure, then perform the actions through Step 2 in EOI-1, Loss of Reactor Coolant, while continuing with Step 5 of this instruction.

   b. IF the wide range reactor coolant system pressure is BELOW the steam pressure in ALL steam generators, then immediately return to EOI-1, Loss of Reactor Coolant.

2. If a Loss of Secondary Coolant is also in progress, then perform the actions through Step 5 in EOI-2. Loss of Secondary Coolant, while continuing with Step 5 of this instruction.

3. If a Steam Generator Tube Rupture is also in progress, then perform the actions through Step 10 in EOI-3, Steam Generator Tube Rupture, while continuing with step 5 of this instruction.

4. If any other event is in progress, follow the appropriate procedure while continuing with the subsequent steps of this instruction.

5. Attempt to operate the auxiliary feedwater system by performing the following actions.

a. Verify that auxiliary feedwater pumps are running. If not, check breaker position and restore if necessary.

b. Verify that auxiliary feedwater valves are in the proper alignment as indicated by the MCB status lights.

c. Verify that the water supply to the suction of the auxiliary feedwater pumps is available.

d. Locally verify open valve positions and attempt to manually start all auxiliary feedwater pumps.

e. Verify that the valves in the steam supply to the turbine driven auxiliary feedwater pump are open.

NOTE: Monitor pump discharge pressure and auxiliary feedwater flow indicators to determine auxiliary feedwater availability.

6. If auxiliary feedwater cannot be restored, attempt to restore main feedwater, if possible.

7. If auxiliary feedwater or main feedwater flow becomes available as a result of manual actions and Z (flow equivalent to at least one motor driven auxiliary feedwater pump at design pressure) gpm is being injected into the non-faulted steam generators, immediately proceed to the appropriate abnormal operating instructions. If safety injection has been initiated, immediately proceed to EOI-0, Immediate Actions and Diagnostics.

8. If only the condensate system is available, then perform the following actions:

a. Rapidly depressurize all non-faulted steam generators to a pressure below the shutoff head of the condensate pumps.

CAUTION: Do not attempt to block safety injection.

b. If safety injection occurs, reset safety injection and feedwater isolation and open the feedwater control and isolation valves to feed the depressurized steam generators while continuing the steam generator depressurization.

c. Begin injecting condensate flow to the depressurized steam generator.

9. If flow greater than Z (flow equivalent to at least one motor-driven auxiliary feedwater pump at design pressure) gpm is being injected into the non-faulted steam generator(s), AND if an indicated narrow range water level in at least one depressurized steam generator is greater than (insert plant specific value which includes an allowance for normal channel accuracy, post accident transmitter errors and reference leg errors) precent of span, then immediately return to the appropriate EOI. Otherwise continue to Step 10.

10. Manually initiate safety injection if not already actuated.

CAUTION: Monitor RWST level closely. If RWST level reaches a low level, immediately proceed to Cold Leg Recirculation Switchover Instructions, Table E-1.1 in EOI-1, Loss of Reactor Coolant. Following implementation of cold leg recirculation, return and continue with step 11.

11. Initiate an RCS depressurization by performing the following actions:

a. Establish power sources necessary to operate the pressurizer PROV's.

b. Ensure that pressurizer PORV's isolation valves are in the OPEN position.

c. Manually open ALL Pressurizer PORV's.

NOTE: If pressurizer PORV's are opened, an increase in pressurizer level is expected.

12. Verify at least two PORV flow paths are open by checking the MCB status lights and temperature indicators in each PORV discharge line. If 2 PORV flow paths are verified to be open, proceed to step 14.

13. If at least TWO pressurizer PORV flow paths are not verified to be open, perform the following actions:

a. Attempt to restart one reactor coolant pump (preferably in a non-faulted steam generator loop) if not already running.

b. Depressurize at least one non-faulted steam generator secondary side to atmosphere pressure by opening the steam generator PORV's

NOTE: If the steam generator PORV's cannot be opened from the MCB, manually open at least one steam generator PORV.

c. Align a low pressure water source to the depressurized non-faulted steam generator(s).

NOTE: Sources of low pressure water may include fire water, service water, or condensate water.

d. Proceed to Step 15.

14. Stop all reactor coolant pumps if not already tripped.

CAUTION: If the reactor coolant pumps are stopped, the seal injection flow should be maintained.

15. If

a. Secondary cooling capability has not been restored

OR

b. Secondary cooling capability has been restored and core exit thermocouples and wide range RTD's readings are not trending downward.

THEN, maintain the pressurizer PORV's in the open position. Maintain safety injection flow and go to Step 7 in EOI-1, Loss of Reactor Coolant. If secondary cooling capability has been restored as verified by core exit thermocouples and wide range RTD's, then continue on with step 16.

16. WHEN:

a. the indicated narrow range water level in at least one non-faulted steam generator is greater than (insert plant specific value which includes an allowance for normal channel accuracy, post-accident transmitter errors and reference leg process errors) percent of span AND

b. the reactor coolant indicated subcooling based upon the core exit thermocouples is greater than (insert plant specific value which is the sum of the errors for the temperature measurement system used and the pressure measurement system translated into temperature using the saturation tables)

THEN:

c. monitor the core exit thermocouples to record base line readings, and then close the pressurizer PORV's.

CAUTION: If after closing of the pressurizer PORV's, a rapid increase in core exit thermocouple temperatures (greater than 15°F) occurs, immediately reopen the pressurizer power operated relief valves and proceed to Step 7 in EOI-1, Loss of Reactor Coolant.

17. After the pressurizer PORV's are closed, monitor the conditions given below for termination of safety injection.

WHEN:

a. reactor coolant system pressure has increased by at least 200 psi (after closure of the pressurizer PORVs), AND

b. pressurizer water level is greater than 50 percent of span, AND

c. the reactor coolant sytem indicated subcooling BASED ON HOT LEG WIDE RANGE TEMPERATURE IN THE NON-FAULTED LOOPS OR THE CORE EXIT THERMOCOUPLES is greater than (insert plant specific valve which is the sum of the errors for the temperature measurement system used, and the pressure measurement system translated into temperature using the saturation tables).

THEN:

d. reset safety injection and stop all operating safety injection pumps not needed for normal charging and reactor coolant pump seal injection flow.

CAUTION: Automatic reinitiation of safety injection will not occur since the reactor trip breakers are not reset.

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 emergency busses.

e. establish normal charging flow and then isolate safety injection flow to RCS Cold Legs via Boron Injection Tank.

CAUTION: IF reactor coolant pressure decreases by 200 psi OR pressurizer water level decreases by 10 percent of span following termination of safety injection flow OR the reactor coolant sub-cooling drops below (insert plant specific value which is the sum of the errors for the temperature measurement system used and for the pressure measurement system translated into temperature using the saturation tables), MANUALLY REINITIATE safety injection to establish reactor coolant pressure and pressurizer water level and go to Section D EOI-0.

CAUTION: If the pumps are restarted once after termination, an additional 15°F of sub-cooling should be added to the required sub-cooling prior to the second termination of the high head pumps. This can be achieved by terminating SI at 200 psi higher pressure.

f. Reestablish normal makeup and letdown to maintain pressurizer water level in the normal operating range and to maintain reactor coolant pressure at values reached when safety injection is terminated. Ensure that water addition during this process does not result in dilution of the reactor coolant system boron concentration.