TRANSIENT WITH FAILURE TO SCRAM

A. SYMPTOMS

1. The following true signal(s) due to a Reactor transient are indicated by alarm or indication and the required full scram does not insert control rods as indicated on the full core display, rod position printout on the computer, or four rod display:

   a. Reactor Low Water Level 3 (12.5").

   b. High Drywell Pressure 1.69 psig.

   c. Scram Discharge Volume High Water Level (Scram Alarm).

   d. Main Steam Line High Radiation (later*).

   e. Turbine Stop Valve Closure.

   f. Control Valve Closure (Turbine Generator Load Reject).

   g. High Power Thermal Trip (flow biased APRM).

   h. High Neutron Flux (120% in RUN, 15% in Startup).

   i. MSIV Closure (less than 90% open in Run).

   j. High Reactor Pressure above 1043 psig.

2. Reactor pressure and/or neutron flux indication increases abruptly, and may go off-scale on recorders and meters. This is the key indication to recognizing an ATWS event.

3. Safety-Relief Valves may Lift.

4. Other Indications:

   a. Increasing Drywell Pressure and Temperature.

   b. Increasing Suppression Pool Temperature.

   c. Possible increase in containment radiation levels.

d. Possible High Stack and Off-Gas release rates.

e. Recirculation Pumps trip with jet pump and core flow decreasing.

B. AUTOMATIC ACTIONS

1. Reactor Recirculation Pumps trip off at 1135 psig Reactor Pressure or Reactor Water Level 2 (-50").

2. The following automatic actions are possible:

a. HPCS Auto Initiation.

b. RCIC Auto Initiation.

c. LPCS Auto Initiation.

d. LPCI Auto Initiation.

e. ADS Auto Initiation.

f. Division I, II, III Diesel Generators Auto Start.

g. Primary Containment and Reactor Vessel Isolation.

h. Standby Gas Treatment System Auto Start and Reactor Building Ventilation Isolation.

i. Off Gas System Isolation.

C. IMMEDIATE OPERATOR ACTIONS

1. MANUALLY SCRAM the Reactor as follows:

a. ARM and DEPRESS Manual Scram Pushbuttons.

b. PLACE Reactor Mode Switch to Shutdown.

c. CHECK that Reactor Power is decreasing with normal neutron decay and all rods are fully inserted.

2. If the Reactor Scrams, REFER to LGP 3-2, Reactor Scram. If the Reactor Scrams, DO NOT CONTINUE this Procedure.

3. VERIFY the following automatic actions:

   a. Reactor Recirculation Pumps trip.

   b. Safety-Relief Valves open to maintain Reactor pressure below 1250 psig.

4. CHECK whether the Backup Scram Valves cause the Reactor to scram. If a scram still is not indicated:

   a. START the Standby Liquid Control System, using both pumps to achieve a flow of 86 gpm within ONE MINUTE of the start of the event.

   b. VERIFY isolation of the Reactor Water Cleanup System.

5. MAINTAIN Feedwater flow to the Reactor Vessel, if possible, to maintain normal Reactor level as follows:

   a. OPERATE Turbine Driven Reactor Feed Pumps if the MSIV's are OPEN.

   b. OPERATE the Motor Driven Reactor Feed Pump if the MSIV's are CLOSED.

   c. OPERATE the Reactor Level Control System per LOP-RL-01 to maintain normal Reactor level.

6. VERIFY the following if Reactor Water Level 2 (-50") is exceeded:

   a. HPCS Auto Start Sequence.

   b. RCIC Auto Start Sequence.

7. VERIFY the following if 1.69 psig in Drywell is exceeded or Reactor level decreases to Level 1 (-130"):

   a. HPCS Auto Start Sequence.

   b. LPCS Auto Start Sequence.

   c. LPCI Auto Start Sequence.

d. Diesel Auto Start Sequence.

8. STARTUP Suppression Pool Cooling using both RHR Heat Exchangers within 10 minutes of the start of the event as follows:

   a. START RHR Service Water in accordance with LOP-RH-05, RHR Service Water Operation.

   b. PLACE A and B RHR Systems in the Suppression Pool Cooling Mode and REFER to LOP-RH-13, Suppression Pool Cooling Operation.

9. If Reactor level could not be controlled normally with Feedwater and HPCS or RCIC were initiated, when Reactor Level approaches Level 8 (55"):

   a. CLOSE HPCS Injection Valve.

   b. CONTROL Reactor Water Level above Level 2 (-50") manually, using RCIC.

10. VERIFY AUTO START of Standby Gas Treatment System if applicable limits were reached as follows:

    a. Reactor level decreased to Level 2 (-50").

    b. High Drywell pressure (1.69 psig).

    c. High Reactor Building Ventilation Exhaust Radiation.

    d. High Fuel Pool Ventilation Exhaust Radiation.

11. VERIFY Primary Containment Group Isolations occur if any applicable limits are exceeded.

12. CHECK whether the Main Condenser is available. Control Reactor pressure with bypass Valves if the Main Condenser is available and Stack Gas activity levels are normal.

D. SUBSEQUENT OPERATOR ACTIONS

1. VERIFY the following indications:

a. Reactor power is decreasing.

b. Reactor pressure is below 1075 psig.

c. Reactor level is above Level 2 (-50"). CONTROL Reactor level with RCIC, HPCS, or Feedwater flow, if possible.

d. Core flow decreases to natural circulation level, consistant with operating map.

e. If containment pressure reaches or exceeds 50 psig, USE wetwell spray to CONTROL containment pressure.

f. Both Standby Liquid Control Pumps are running and Standby Liquid Control Solution Tank level is decreasing.

CAUTION

1. De-energizing RPS busses will result in a loss of neutron monitoring instrumentation.

2. The following attempts to scram the Reactor are to be performed concurrently if manpower is sufficient.

2. CHECK Control Rod Position Indication. If the control rods have not fully inserted, PROCEED to scram the Reactor in the following order:

a. DE-ENERGIZE RPS Subchannel Logic by opening breakers from control room panels 1H13-P609 and 1H13-P611 (2H13-P609 and 2H13-P611).

b. TRIP RPS Scram Logic Breakers CB-2A and CB-2B at the RPS Distribution Bus in the Auxiliary Electric Room.

c. OPEN the following RPS Power Supply breakers for 2 minutes locally at the RPS Power Supply Buses and MG Set control panels and then RECLOSE:

1) RPS MG Set "A" output breaker.

2) RPS MG Set "B" output breaker.

3) CB-1, RPS Alternate Power Supply Breaker from MCC 1328-1.

d. INDIVIDUALLY SCRAM Control Rods at Local Hydraulic Control Units (HCU's) by placing Branch Junction Module Switches to the Scram-Test position.

e. ISOLATE air from the scram air system by closing 1C11-F095 (2C22-F095); Scram Air Supply Valve.

f. MANUALLY INSERT Control Rods from Control Room Panel 1H13-P603 (2H13-P603) using the Reactor Manual Control System.

3. CHECK Stack Gas Release Rate and Off-Gas Release Rate. INITIATE GSEP if necessary.

4. AFTER the Reactor is shutdown to the level where the only source of power is decay heat, PROCEED to stabilize Plant Condition in HOT SHUTDOWN as follows:

CAUTION

Do not shutdown SBLC injection once it has been started until the SBLC Solution Tank is verified to be empty.

a. SAMPLE Reactor Coolant frequently to VERIFY Boron concentration is above the level determined to maintain the plant shutdown (above 750 ppm with all rods out).

b. PERFORM either step D.4.b.1 or D.4.b.2 as follows:

1) MAINTAIN Reactor at 1000 to 1050 psig by operating a Relief Valve and removing heat from the containment using Suppression Pool Cooling.

2) MAINTAIN Reactor at 1000 to 1050 psig as follows:

a) VERIFY that Boron concentration in the Reactor will be sufficient to maintain the Reactor shutdown after

accounting for a normal startup of the Steam Condensing Mode of RHR.

b) STARTUP the Steam Condensing Mode of RHR in accordance with LOP-RH-09, Steam Condensing Startup and Operation.

5. When the Reactor is to be shutdown to COLD SHUTDOWN, PROCEED using the following considerations:

a. Sufficient negative reactivity has been inserted to the Reactor to account for the positive reactivity effects temperature and dilution.

NOTE

Carryover should not significantly affect Reactor Boron concentration.

b. If the plant is not contaminated and the Reactor is not isolated, a normal shutdown and cooldown in accordance with LGP 2-1 can be performed.

c. CAUTION must be taken that the unborated water in the RHR Shutdown Cooling lines does not temporarily dilute the Boron in the core to allow criticality as follows:

1) ESTABLISH an excess Boron concentration to accomodate for the effect of RHR dilution (30% excess is required above the 750-1000 PPM concentration).

2) STARTUP the Reactor Recirculation Pumps in SLOW speed in order to homogenize vessel Boron concentration. If the Primary Containment is isolated, the isolation signal must be reset in order to supply RBCCW to the Recirc. Pumps.

3) START RHR Shutdown Cooling flow to the Reactor Vessel gradually by throttling OPEN the Shutdown Cooling Injection Valve (The RHR Pump Minimum Flow Valve must be overridden in the closed position to prevent the loss of borated water).

d. Do not exceed a 100°F/hr cooldown rate (TS).

e. When flooding the Reactor Vessel up to the steam dome, use a source of water borated to the same concentration as the water in the Reactor to prevent Reactor Boron concentration dilution. The SBLC Solution Tank can be used. However, if using the SBLC Pumps, Reactor flooding will require one to two days. An alternate pump can be used.

f. Concentration levels of Boron in the Reactor Vessel will be 750-1000 ppm. The minimum solubility of Boron in water at 32°F is greater than 5000 ppm.

g. If a fuel element failure is suspected, refer to LGA-16, Fuel Element Failure.

E. DISCUSSION

An ATWS (Anticipated Transient without scram) is extremely unlikely but will require prompt operator action to mitigate the consequences. Operator concerns are as follows: 1) VERIFY that Recirculation pumps trip. 2) Shutdown of Reactor. 3) Limit Reactor peak pressure 4) Maintain the core covered. 5) Limit the temperature of the Suppression Chamber, and 6) Long-term cooldown.

The operator must attempt to scram the Reactor with the most readily available means. Upon recognizing that the Reactor does not scram, the operator should INITIATE STANDBY LIQUID CONTROL (SBLC) WITHIN TWO MINUTES OF THE EVENT to minimize Reactor power production, which would heat-up the containment. HPCS or RCIC operation is necessary to maintain the core covered if feed flow is stopped, and should be initiated if Level 2 (-50 inches) is approached. Suppression Pool Cooling using two RHR Heat Exchangers must be initiated to ensure that Suppression Chamber temperature limits are not exceeded.

Subsequently, the operator must insert enough negative reactivity into the Reactor so that an uncontrolled restart will not occur. Thus, a cooldown must not be initiated until Control Rods are inserted or Boron concentration is determined satisfactory. The consequences of this accident to the containment and environment must be evaluated. GSEP should be initiated if necessary.

Assuming 100% Reactor power and a two minute time delay to the start of Boron injection, Suppression Pool temperature will peak at 177°F after 28 minutes with the MSIV's closed or 105°F after two minutes with Bypass Valve capability. Containment pressure will peak at 3.5 psig with MSIV closure or .4 psig with bypass Valve capability. Hot shutdown should be achieved within 18 minutes of Boron injection. However, once Boron injection is started, it must be run to completion: DO NOT SHUTDOWN SBLC UNTIL POSITIVE VERIFICATION THAT THE SBLC SOLUTION TANK IS EMPTY.

It must be noted that FAILURE OF A MANUAL SCRAM WITHOUT AN ABNORMAL TRANSIENT REQUIRES THAT REACTOR RECIRCULATION PUMPS REMAIN OPERATING TO EXPEDITE BORON MIXING. The release limits of 10 CFR 100 apply to the ATWS event.