Pressurized Water Reactor
B&W Technology
Crosstraining Course Manual

Chapter 19.0

Transients and Instrument Failures

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19.0 TRANSIENTS AND INSTRUMENT FAILURES

Learning Objectives:

1. With the use of the Integrated Control System (ICS) block diagram, describe how the ICS and plant responds to the following transients and instrument failures:

    a. Loss of 1 RCP
    b. Load Rejection
    c. Reactor Trip
    d. Power Range Excore Nuclear Instrument Failure
    e. RCS Loop Temperature Instrument Failure
    f. RCS Loop Flow Instrument Failure
    g. Feedwater Loop Flow Instrument Failure
    h. Loss of 1 Main Feedwater Pump
    i. Dropped Control Rod Assembly

19.1 Introduction

As previously described in Chapter 9.0, the integrated control system (ICS) has as its basic requirement the matching of generated electrical megawatts with demanded electrical megawatts. The ICS accomplishes this requirement through four subassemblies: the unit load demand, the integrated master, the feedwater demand, and the reactor demand. The unit load demand functions as a megawatt electric setpoint generator for the ICS. The integrated master receives the megawatt setpoint from the unit load demand to control the electrical output of the turbine generator. In addition, the integrated master translates the megawatt demand into signals for feedwater and reactor control. In the feedwater demand subassembly, the megawatt demand signal, converted to a feedwater demand in the integrated master, controls the amount of feedwater supplied to the once-through steam generators. The reactor demand subassembly moves the reactor's control rods in or out in response to the megawatt demand signal, and also controls the average reactor coolant system temperature.

The purpose of this chapter is to further explain and reinforce the students' understanding of the response of the ICS and plant by adding transients and instrument failures to the explanations of ICS operations. Since the events in the ICS occur simultaneously, it would by impossible to write concurrent descriptions of subassembly actions. Therefore, the discussion of a particular transient will start with unit load demand (ULD) actions and continue through the integrated master, feedwater demand, and reactor demand actions. The instrument failure discussions will start with the subassembly most affected and continue through the remaining subassemblies.

19.2 Plant Transients and Instrument Failures

19.2.1 Loss of One Reactor Coolant Pump

Initial conditions: Unit load is at 90% power. Group 7 control rods are 90% withdrawn.

1. Unit Load Demand (ULD) Actions

   a. When the reactor coolant pump is lost, a runback signal is initiated.

   b. A load reduction at the rate of 50% per minute is set into motion.

2. Integrated Master (IM) Actions

   a. The rapidly decreasing megawatt demand signal closes the turbine governor valves by modifying the turbine header pressure setpoint to a value higher than the actual header pressure.

   b. The closing of the turbine governor valves increases actual steam pressure. If steam pressure exceeds its setpoint by 50 psi, the turbine bypass valves will open to relieve excess energy.

   c. The demand to feedwater and the reactor will be further reduced by the pressure-error-(modifier) difference unit (Δ) signal.

3. Reactor Demand Actions

   a. The reduced demand signal from the integrated master will cause inward regulating rod motion. T_{avg} error also will decrease this demand signal.

   b. Because the regulating rods are almost fully withdrawn, a large amount of rod motion occurs with little change in reactor power. This will send reactor cross limits to feedwater.

      Reactor Cross Limits cause a TRACK condition. Since the runback limits are inserted downstream of transfer relay T_1, the runback signal from the ULD is not affected. However, the TRACK condition causes transfer relay T_2 to bleed the pressure setpoint modification signal to zero over a 100-sec time constant. If cross limits persist, then the reduction of turbine load will be accomplished by the pressure error that results from the decrease in reactor power and feedwater flow.

4. Feedwater Demand Actions

   a. The reactor cross limits will limit the decrease in feedwater demand.

   b. The actions of the RC flow and ΔT_c circuits will proportion feedwater between the OTSGs.

5. Final Conditions

   a. The actions listed above will continue until the load is stabilized at 75%.

19.2.2 Load Rejection

Initial conditions: Unit load is at 100% power. Group 7 rods are 90% withdrawn. The load rejection is caused by the main generator output breaker opening. The main turbine does NOT trip.

1. ULD Actions

   When the main generator output breaker is opened, the ULD goes into TRACK. Generator load will be reduced to 0 MWe because of the configuration of the offsite power supply to the station transformers. This reduction in megawatt load becomes the new megawatt demand, and the ICS will track this reduction at 20% per minute. Also, the large reduction in turbine load will cause actuation of the overspeed protection control circuit, which will revert the control of the EHC system to manual, generating a second TRACK condition. Recall, during a TRACK condition, the low-load limit is ignored by ICS.

2. IM Actions

   a. Because the EHC has shifted to manual, the IM cannot control the turbine. However, the closing of the turbine valves by the acceleration limiter (in its effort to prevent turbine overspeed) results in a large increase in steam header pressure.

   b. A large header pressure error will be developed in the pressure-error-(valves) unit and cause actuation of the turbine bypass valves and atmospheric dump valves. The opening of these valves removes the excess energy from the RCS.

   c. When the ULD demand drops below 15%, the turbine trip bias values will be selected, and header pressure will be controlled at 1035 psia.

3. Feedwater Demand Actions

   a. Feedwater flow will respond to the 20% per minute reduction in feedwater demand caused by the tracking condition. The reduction in feedwater flow will be tempered by reactor cross limits to feedwater from the reactor demand subassembly.

   b. The reduction in feedwater demand is the controlling signal until low-level limits become the controlling signal.

4. Reactor Demand Actions

   a. The reduction in the reactor demand causes insertion of the regulating rods. Due to the low rod worth at the upper end of group 7, the actual decrease in reactor power will not keep up with the decrease in reactor demand. This will result in reactor cross limits to feedwater.

   b. The reduction in reactor power continues until the reactor demand signal reaches 15%. After this occurs, the low limit supplied by the integrated master will maintain reactor demand at 15%.

5. Final Conditions

   a. Reactor power is being maintained at 15%.

   b. Turbine bypass valves are dissipating the reactor's energy to the condenser while controlling header pressure at 1035 psia.

   c. OTSGs are on low-level limits (~2 ft. on startup range).

19.2.3 Reactor Trip

Initial conditions: Prior to the trip, the Unit load was at 100% power and the Group 7 rods were 90% withdrawn. When the reactor tripped, the turbine also tripped. Therefore, the reactor demand subassembly does not control the regulating rods and the integrated master does not control the turbine.

1. ULD Actions

   The ULD is in TRACK and is reducing the megawatt demand signal to zero at a rate of 20% per minute.

2. IM Actions

   The reactor trip biases are chosen for the control of header pressure by all five valve groups. As the energy of the RCS is removed by the turbine bypass valves and atmospheric dump valves, the pressure error will decrease. At the end of the transient, header pressure will be 1200 psia, with the excess energy being dissipated to the condenser by the turbine bypass valves.

3. Feedwater Demand Actions

   a. When the reactor trip signal is received, the level error signal is transferred to the feedwater regulating valves by transfer relays T_{10} and T_{11}, causing a rapid reduction in feedwater flow.

   b. When the OTSGs reach the low-level limit, the feedwater regulating valves will be modulated to control at this setpoint.

4. Final Conditions

   a. Turbine bypass valves are dissipating reactor decay heat and reactor coolant pump heat to the condenser by controlling header pressure at 1200 psia (T_{avg} ~ 567°F).

   b. The OTSGs are on low-level limits (~2 ft. on startup range).

19.2.4 Power Range Excore Nuclear Instrument Fails High

Initial conditions: Unit load is at 100% power. Group 7 control rods are 76% withdrawn.

1. Reactor Demand Actions

   a. The failure produces a large negative neutron error signal which is sent to the rod control system. Group 7 rods begin to insert when the error signal exceeds 1%. Actual RCS Tave drops due to the negative reactivity added by the rods.

   b. The decrease in RCS Tave produces a Tave error signal. The Tave error signal is added to the megawatt demand signal from the Integrated Master and increases the Rx Demand signal in an attempt to restore Tave to its setpoint.

   c. The large negative neutron error also produces Rx Cross Limits to Feedwater and causes a TRACK condition. Because the NI signal (Rx power) is much greater than the Rx Demand signal, the Rx Cross Limits increase the FW Demand signal, which in turn increases FW flow. The additional FW flow further reduces RCS Tave.

d. The increasing Tave error signal continues to increase the Rx Demand signal and thus reduce the neutron error signal. The rod will insert less frequently and if the Tave error signal becomes large enough, the rods may begin to withdraw.

2. IM Actions

a. Because of the TRACK condition, the ICS will adjust the turbine governor valves to control turbine header pressure at setpoint. Since Tave is lowering, turbine header pressure is also lowering and the ICS will reduce turbine load (generator MWe) to restore header pressure to setpoint.

3. The transient resulting from the NI failure is a relatively slow moving event. The operators are expected to stabilize the plant and restore Tave to setpoint.

19.2.5 RCS Loop Temperature Instrument Failures

19.2.5.1 RCS Loop A Th Fails Low

Initial conditions: Unit load is at 100% power. Group 7 control rods are ~ 78% withdrawn. The Loop A Thot is selected as the Unit Thot. Note that Thot Avg is normally selected as the Unit Thot input for the ICS. Unit Tavg is selected as the input for the ICS. Note that Unit Tavg is normally selected as the input for the ICS.

1. Reactor Demand Actions

a. The Unit Thot is part of the Unit Tavg calculation. Since the Unit Thot was selected to Loop A Thot and it failed LOW, a lower Unit Tavg signal is generated. This creates a large Tavg error signal which increases the Rx Demand signal. Since the Rx Demand signal is greater than NI power (Rx power), a large positive neutron error is produced.

b. The large positive neutron error causes outward rod motion in an effort to restore Tavg to its setpoint. The outward rod motion adds positive reactivity, which briefly increases Rx power. Since turbine load has not changed, actual RCS Tavg increases.

c. The increase in actual Tavg causes an insurge into the PZR, compresses the

PZR steam bubble and increases PZR pressure. The insurge increases PZR pressure faster than the PZR control system can reduce pressure. The Rx will trip on high RCS pressure.

d. The large positive neutron error may produce a Rx Cross Limits to Feedwater and resulting TRACK condition. Because the NI signal (Rx power) is less than the Rx Demand signal, the Rx Cross Limits would reduce the FW Demand signal, which in turn would reduce FW flow. The reduction in FW flow would further increase actual RCS Tavg.

2. IM Actions

   a. The increase in actual Tavg also increases turbine header pressure. Since turbine header pressure is now greater than the setpoint, the Pressure Error (Modifier), the kicker signal, reduces the FW demand signal.

3. Feedwater Demand Actions

   a. The Unit Thot is part of the BTU limits calculation. Since the Unit Thot was selected to Loop A Thot and it failed LOW, the BTU limits calculation "thinks" there is not sufficient superheat for the current FW Demand and both OTSG BTU alarms actuate. Since this is an alarm function only, the FW Demand subassembly does not change the FW flow to the OTSGs.

4. The transient created by the RCS Loop A Thot failing LOW result in a Rx trip on high RCS pressure.

19.2.5.2 RCS Loop A Tc (Narrow Range) Fails High

Initial conditions: Unit load is at 100% power. Group 7 control rods are ~ 76% withdrawn. One of the Loop A Tcold (Narrow Range) is selected as the Loop A Tcold input. Note that Loop A Tcold Avg is normally selected as the Loop A Tcold input for the ICS. Unit Tavg is selected as the input for the ICS. Note that Unit Tavg is normally selected as the input for the ICS.

1. Reactor Demand Actions

   a. The Loop A Tcold is part of the Loop A Tavg calculation. Since Loop A Tcold failed HIGH, Loop A Tavg is higher than actual. The Unit Tavg is developed from the average of the Loop A Tavg and Loop B Tavg. Since Loop A Tavg is higher than actual, the Unit Tavg is higher than actual.

   b. Since the Unit Tavg is above the setpoint, a large Tavg error signal is produced which reduces the Rx Demand signal. Since the Rx Demand signal is below NI power (Rx power), the negative neutron error signal inserts Group 7 rods. The inward rod motion adds negative reactivity, which briefly reduces Rx power. Since turbine load has not changed, actual RCS Tave decreases.

c. The drop in actual Tavg results in a PZR outsurge, expansion of the PZR steam bubble and reduction in PZR pressure. The Rx may trip on Variable Low RCS pressure or Low RCS pressure.

2. Feedwater Demand Actions

a. The Loop A Tcold is part of the Unit delta Tcold signal which is used to equalize loop Tcold temperatures to prevent unequal radial flux distribution in the core. Since the selected Loop A Tcold failed HIGH, the delta Tcold signal increases FW flow to the A OTSG in an attempt to equalize RCS loop Tcold temperatures.

b. The increase in Loop A FW Demand signal causes a reduction in Loop B FW Demand signal. The A OTSG is being overfed and RCS loop A temperature decreases. The B OTSG is being underfed and RCS loop B temperature increases. The overall result is actual total FW flow is less than the sum of the FW Demand signals.

c. The Total FW Demand signal being greater than Total FW Flow produces a Feedwater Cross Limits to the Reactor. The Feedwater Cross Limit further reduces the Rx Demand signal.

3. The transient created by the Loop A Tcold (Narrow Range) failing HIGH result in a Rx trip on Variable Low RCS pressure or Low RCS pressure.

19.2.6 RCS Loop A Flow Instrument Fails Low

Initial conditions: Unit load is at 100% power. Group 7 control rods are 78% withdrawn. The selected RCS Loop A flow instrument fails LOW.

1. Feedwater Demand Actions

a. The selected Loop A RCS flow transmitter fails LOW. Feedwater flow is rationed to the OTSGs by reducing the FW Demand signal to the A OTSG and increasing the FW Demand signal to the B OTSG.

b. The A OTSG is being underfed and RCS loop A temperature increases (predominate effect). The B OTSG is being overfed and RCS loop B temperature decreases. The overall result is an increase in RCS Tavg.

c. The increase in RCS Tavg causes an insurge into the PZR, compresses the PZR steam bubble and increases PZR pressure. The insurge increases PZR pressure faster than the PZR control system can reduce pressure. The Rx will trip on high RCS pressure.

d. The Loop A RCS flow is part of the BTU limits calculation. Since it failed LOW, the BTU limits calculation may “think” there is not sufficient superheat for the current FW Demand and the A OTSG BTU alarm may actuate. Since this is an alarm function only, the FW Demand subassembly will not change the FW flow to the A OTSG.

2. Reactor Demand Actions

a. The overall increase in RCS Tavg above the setpoint produces a Tavg error signal which in turn reduces the Rx Demand signal. Since the Rx Demand signal is below NI power (Rx power), the negative neutron error signal inserts Group 7 rods. The inward rod motion adds negative reactivity, which briefly reduces Rx power. Since turbine load has not changed, actual RCS Tave decreases. The increase in RCS Tavg due to reduced FW flow is greater than the reduction in Tavg due to rod insertion and RCS Tavg and pressure continue to increase.

3. The transient created by the selected RCS Loop A flow instrument failing LOW results in a Rx trip on high RCS pressure.

19.2.7 Feedwater Loop Flow Instrument Failures

19.2.7.1 Loop B Feedwater Flow Fails High

Initial conditions: Unit load is at 100% power. Group 7 control rods are 78% withdrawn. The selected Loop A FW flow instrument fails HIGH.

1. Feedwater Demand Actions

a. The selected Loop B FW flow fails HIGH. Since indicated Loop B FW flow is much greater than Loop B FW Demand, the error signal closes the B Main FRV. Since the B OTSG is underfed and turbine load has not changed, the B OTSG level decreases, RCS Loop B temperature increases and RCS Tavg increases.

b. The B OTSG level decreases to the low level limit and the B Main FRV opens to maintain level at the low level limit (2 feet).

c. Since RCS Loop B temperature increases, Loop B Tcold also increases. The delta Tcold signal increases FW flow to the B OTSG in an attempt to equalize RCS loop Tcold temperatures. The flow rationing is a minor effect.

d. Since Total FW Demand is still 100% and Total FW flow is greater than its pre-failure value, Total FW Flow signal is greater than Total FW Demand. This may produce a TRACK condition. Because of the TRACK condition, the ICS will close the turbine governor valves to control turbine header pressure at setpoint.

2. IM Actions

   a. Since the level in the B OTSG is so low, steam production is reduced and turbine header pressure decreases. Lower turbine header pressure results in a reduction in actual MWe generated. Since actual MWe generated is below the ULD Demand signal, the MW Error signal is created. The MW Error signal modifies the turbine header pressure setpoint to a lower value.

   b. The setpoint modification is so large that it more than compensates for the lower turbine header pressure. Turbine header pressure is compared to the lower modified turbine header pressure setpoint and "tells" the ICS system that turbine header pressure is too high. The ICS opens the turbine governor valves in an attempt to reduce turbine header pressure back to setpoint. Generated MWe output decreases.

   c. Opening the governor valves further reduces turbine header pressure and actual MWe generated. This cycle of reduced turbine header pressure, reduced MWe generated, lower modified turbine header pressure setpoint and opening the governor valves continues until the governor valves are fully open. Generated MWe continue to drift down.

3. The transient created by the selected Loop A FW flow instrument failing HIGH is a relatively slow moving event. The operators are expected to stabilize the plant.

19.2.7.2 Loop B Feedwater Fails Low

Initial conditions: Unit load is at 100% power. Group 7 control rods are 78% withdrawn. The selected Loop A FW flow instrument fails LOW.

1. Feedwater Demand Actions

   a. The selected Loop B FW flow fails LOW. Since indicated Loop B FW flow is much lower than Loop B FW Demand, the error signal opens the B Main FRV. Since the B OTSG is overfed and turbine load has not changed, the B OTSG level increases RCS Loop B temperature decreases and RCS Tavg decreases.

b. The drop in actual RCS Tavg from increased FW flow (and rod insertion - see below) results in a PZR outsurge, expansion of the PZR steam bubble and reduction in PZR pressure. The Rx will trip on Variable Low RCS pressure or Low RCS pressure.

c. Since Total FW Demand is still 100% and indicated Total FW flow is about one-half of its pre-failure value, a large Feedwater Cross Limits to the Reactor signal and resulting TRACK condition is generated. The Feedwater Cross Limit reduces the Rx Demand signal.

2. Reactor Demand Actions

   a. The large reduction in the Rx Demand signal from the Feedwater Cross Limits creates a large negative neutron error signal. The negative neutron error signal inserts Group 7 rods. The inward rod motion adds negative reactivity, which briefly reduces Rx power. Since turbine load has not changed, actual RCS Tave continues to decrease.

   b. The large negative neutron error produces a Rx Cross Limits to Feedwater and another TRACK condition. Because the Rx Demand signal is less than the NI signal (Rx power), the Rx Cross Limits increases the FW Demand signal, which in turn increases FW flow. The increase in FW flow would further decrease actual RCS Tavg.

3. IM Actions

   a. Because of the TRACK conditions created from the Feedwater Cross Limits and Rx Cross Limits, the ICS will adjust the turbine governor valves to control turbine header pressure at setpoint. Since RCS Tavg is lowering due to rod insertion and increased FW flow, turbine header pressure decreases. The ICS will close the turbine governor valves in an attempt to increase turbine header pressure to setpoint. Generated MWe output decreases.

4. The transient created by the selected Loop B FW flow failing LOW result in a Rx trip on Variable Low RCS pressure or Low RCS pressure.

19.2.8 Loss of One Main Feedwater Pump (MFP)

Initial Conditions: Unit Load is at 96% power. Group 7 control rods are 72% withdrawn. Feedwater flow is 1.9 Mlbm/hr per OTSG.

1. ULD Actions

   a. When the MFP is lost, a runback signal is initiated.

   b. A maximum load value of 60% is established.

   c. A load reduction at the rate of 50% per minute is set into motion.

   d. Plant will continue to runback until the generated load is less than the maximum load value.

2. IM Actions

   a. The rapidly decreasing megawatt demand signal closes the turbine governor valves by modifying the turbine header pressure setpoint to a value higher than the actual header pressure.

   b. The closing of the turbine governor valves increases actual steam pressure. If steam pressure exceeds its setpoint by 50 psi, the turbine bypass valves (TBVs) will open to relieve excess energy. TBVs should not have opened for this event.

   c. The demand to feedwater and the reactor will be further reduced by the pressure-error-(modifier) difference unit (Δ) signal.

   d. If the negative error between the Turbine Header Pressure and Turbine Header Pressure Setpoint becomes too high, the EHC might revert to operator auto.

3. Reactor Demand Actions

   a. The reduced demand signal from the IM causes inward regulating rod motion due to the combined neutron error (NI Power & Reactor Demand) and T_{avg} error.

   b. The T_{avg} error (T_{avg} > setpoint) also decreases the reactor demand signal.

   c. Feedwater Cross-Limits would momentarily be activated due to large negative difference between Feedwater Demand and Feedwater Flow. If Feedwater Flow is less than Feedwater Demand by more than 5%, Reactor Demand will be reduced to allow the Reactor and Feedwater Demand to be balanced. Track condition occurs. Since the runback limits are inserted downstream of transfer relay T_1 IM subassembly, the runback signal from the ULD is not affected. However, the TRACK condition causes transfer relay T_2 to bleed the pressure setpoint modification signal to zero over a 100-sec time constant. If cross-limits persist, then the reduction of turbine load will be accomplished by the pressure error that results from the decrease in reactor power and feedwater flow.

4. Feedwater Demand Actions

   a. Remaining MFP speed is increased by the Feedwater Valves (FRVs) ΔP (Δ) error signal. Initially the remaining MFP Hand/Auto station will be at 100% demand attempting to maintain approximately 50 psid across the main feedwater regulating valves (FRVs).

   b. Reactor Cross-Limits would momentarily be activated due to large negative difference between reactor demand and reactor power (greater than -5%), this would limit the decrease in feedwater demand. Track condition occurs. Since the runback limits are inserted downstream of transfer relay T_1, the runback signal from the ULD is not affected. However, the TRACK condition causes transfer relay T_2 to bleed the pressure setpoint modification signal to zero over a 100-sec time constant. If cross limits persist, then the reduction of turbine load will be accomplished by the pressure error that results from the decrease in reactor power and feedwater flow.

5. Final Conditions

   a. The actions listed above continue until the load has stabilized just less than 60% and Feedwater Valve D/P is returned to setpoint.

   b. Final Feedwater flow is approximately 5 Mlbm/hr per OTSG

19.2.9 Dropped Control Rod Assembly – Group 3 Rod 1

Initial Conditions: Unit Load is at 96% power. Group 7 control rods are 72% withdrawn.

1. ULD Actions

   a. When group 3 rod 1 drops fully into the core, an asymmetric fault is generated activating an asymmetric rod runback.

   b. A maximum load value of 60% is established.

   c. A load reduction at the rate of 30% per minute occurs.

   d. Plant will continue to runback until the generated load is less than the maximum load value.

2. IM Actions

a. The rapidly decreasing megawatt demand signal closes the turbine governor valves by modifying the turbine header pressure setpoint to a value higher than the actual header pressure.

b. The closing of the turbine governor valves increases actual steam pressure. If steam pressure exceeds its setpoint by 50 psi, the turbine bypass valves (TBVs) will open to relieve excess energy. TBVs should not have opened for this event.

c. The demand to feedwater and the reactor will be further reduced by the pressure-error-(modifier) difference unit (Δ) signal.

d. If the negative error between the Turbine Header Pressure and Turbine Header Pressure Setpoint becomes too high, the EHC might revert to operator auto.

3. Reactor Demand Actions

a. The reduced demand signal from the IM causes inward regulating rod motion due to the combined neutron error (NI Power & Reactor Demand) and T_{avg} error. The neutron error may is affected by the power range response to the dropped rod. The core location where the dropped rod occurs; will have a greater impact on the neutron error. The selected power range NI had a 4-5% lower indication than normal.

b. The T_{avg} error (T_{avg} > setpoint) also decreases the reactor demand signal. The T_{avg} error signal will be larger for this event due to the dropped control rod.

c. Feedwater Cross-Limits would momentarily be activated due to large negative difference between Feedwater Demand and Feedwater Flow. If Feedwater Flow is less than Feedwater Demand by more than 5%, Reactor Demand will be reduced to allow the Reactor and Feedwater Demand to be balanced. Track condition occurs. Since the runback limits are inserted downstream of transfer relay T_1 IM subassembly, the runback signal from the ULD is not affected. However, the TRACK condition causes transfer relay T_2 to bleed the pressure setpoint modification signal to zero over a 100-sec time constant. If cross-limits persist, then the reduction of turbine load will be accomplished by the pressure error that results from the decrease in reactor power and feedwater flow.

4. Feedwater Demand Actions

a. The reduced demand signal from the IM causes Feedwater Demand to reduce feedwater flow by reducing MFP speeds based on the (Δ) error signal. The required 50 psid will be maintained across the main FRVs.

b. Reactor Cross-Limits would momentarily be activated due to large negative difference between reactor demand and reactor power (greater than -5%), this would limit the decrease in feedwater demand. Track condition occurs. Since the runback limits are inserted downstream of transfer relay T_1, the runback signal from the ULD is not affected. However, the TRACK condition causes transfer relay T_2 to bleed the pressure setpoint modification signal to zero over a 100-sec time constant. If cross limits persist, then the reduction of turbine load will be accomplished by the pressure error that results from the decrease in reactor power and feedwater flow.

5. Final Conditions

   a. The actions listed above continue until the load has stabilized just less than 60% and Feedwater Valve D/P is returned to setpoint.

   b. Reactor power may be slightly lower due to the affect on the dropped rod.

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