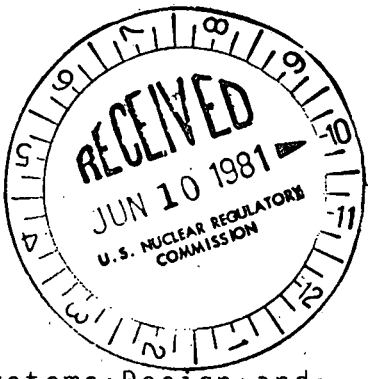
Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

June 8, 1981



Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden 2
SEP Topic IV-4, Reactivity Control Systems Design and Protection Against Single Failure
NRC Docket 50-237

Reference a) Dennis M. Crutchfield letter of December 15, 1980 to J.S. Abel

Dear Mr. Crutchfield:

In reference a the staff made four requests for information concerning SEP Topic IV-2. This letter is in response to the request.

Request 1 Describe the single failures within systems used for reactivity control which can:

a) Cause an inadvertent reactivity insertion.
b) Cause a single or combination of rods to be positioned in other than the design sequence. For PWR's this should include consideration of single rod withdrawal/insertions which can result from a single equipment component failure.

Response: Boiling Water Reactors have two means of reactivity control during reactor operation that are subject to equipment failure. These are control of neutron absorption via control of rod movement, and control of neutron moderation via control of core coolant temperature and pressure. Therefore, any failure which results in a control rod withdrawal, a core coolant temperature decrease, or a reactor pressure increase will cause an inadvertent reactivity insertion.

Control Rod Withdrawal

The control rod drive system is designed such that a single failure can only result in the abnormal withdrawal of a single control rod. There are two types of abnormal rod withdrawal that are possible:

A035
S
1/1

8106110136

P

1. The control rod drive (CRD) moves more than one notch when given a single notch withdrawal signal. This can be caused by:

   a. The hydraulic control unit (HCU) directional control
   b. The automatic sequence timer switch in the reactor manual control system being out of adjustment or defective valves being out of adjustment or defective.
   c. Excessive pressure in the drive water header.
   d. Internal leakage in the HCU scram valves.

2. The CRD could drift-out following a withdrawal signal. This can be caused by:

   a. Failure of the HCU directional control valve in the line to the CRD over-piston port.
   b. Failure of the CRD collet to latch following a notch insert or withdrawal.

Core Coolant Temperature Decrease

Reactivity increases as a result of a temperature decrease can be caused by any single failure that results in a:

1. Loss of feedwater heating as a result of:

   a. Closure of steam extraction valves
   b. Feedwater bypass valves failing open

2. An uncontrolled increase in recirculation flow as a result of:

   a. An individual motor-generator set speed controller failure
   b. Failure of the master flow controller

3. A sudden increase in feedwater flow caused by feedwater controller failure.

Reactor Pressure Increase

Reactivity increases as a result of pressure increases can be caused by any single failure that results in a:

1. Turbine trip
2. Generator trip
3. Main steam isolation valve (MSIV) closure

Request 2 Delineate those design features which limit reactivity insertion rates and rod malpositions resulting from a single failure. Provide the appropriate circuit schematics showing these design features.

Response: The design feature for limiting reactivity insertion of all these events is the reactor protection system (RPS). The appropriate circuit schematics for the RPS are attached. Attachment A lists the attached drawings.

Request 3 Provide or reference appropriate analyses to demonstrate that specified acceptable fuel damage limits are not exceeded in the event of any of the single failures identified in Item 1 above.

Response: With the exception of a failure that results in the drift-out of a control rod following a withdrawal signal all the events identified in Item 1 above are bounded by the analysis described in NEDO 24011 Generic Reload Fuel Application, Section 5.2 MCPR Operating Limit Calculational Procedure and the Dresden Unit 2 reload license submittal for reload 4. The reload 4 submittal is Enclosure II of Cordell Reed's letter to the Director of Nuclear Reactor Regulation dated January 15, 1979.

The failures that results in the drift-out of a control rod identified in Item 1 has been reviewed by Commonwealth Edison and General Electric as a result of its identification in BWR Service Information Letter No. 292. It has been concluded from this review that the occurrence of this type of failure is not a significant safety problem in that operator action could preclude any violation of thermal limits, and since no failure of this type has occurred at Dresden or Quad Cities Station. A failure of this type is bounded by the analysis of a control rod drop. This analysis is described in Section 5.5.1 of NEDO-24011.

Request 4 Identify the operating procedures, alarms interlocks, or protection system actions which must be used in limiting the consequences following a single failure within systems used for reactivity control. Where equipment actions are required, indicate whether the equipment meets the criteria of IEEE-279.

Response: The RPS System meets the single failure criterion of IEEE 279. For a complete discussion of the design of the system see R.L. Bolger's letter of April 6, 1976 to D.L. Ziemann and G.A. Abrell's letter of April 19, 1976 to D.L. Ziemann. Attachment B identifies all the operating procedures associated with reactivity control.

Please address any questions you may have concerning this matter to this office.

One (1) signed original and thirty-nine (39) copies of this transmittal letter have been provided for your use. One aperture card of each of the referenced drawings are also attached for your use.

Very truly yours,

T. J. Rausch
Nuclear Licensing
Administrator
Boiling Water Reactors

NPS/ji
0188a*
cc: RIII Resident Inspector, Dresden

Attachment A

Index of Attached RPS Circuit Schematics

Drawing Number	Drawing Title	Revision	Date
12E-2464	Schem. Diag. Rx Protection System Chan A&B Trip Aux. Relays	P	9-3-76
12E-2465	Schem. Diag. - Reactor Protection System Part 1 Channel "A" Scram & Aux. Trip Relays	T	10-4-76
12E-2466	Schem. Diag. - Reactor Protection System Part 2 Channel "B" Scram & Aux. Trip Relays	U	9-3-76
12E-2467	Schem. Diag. - Reactor Protection System - Part 3 Scram Valve Sols & Misc. Aux. Relays	R	4-26-81
12E-2468	Schem. Diag. - Reactor Protection System - Part 4 Scram Accumulators Cont & Valves Pos. Ind.	N	3-15-77
12E-2468A	Schem. Diag. - Reactor Protection System - Plug Connectors for Scram Valves Pos & Hyd Accum. Press. & Lev. In.	C	11-8-68
12E-2469	Schem. Diag - Reactor Protection System - Part 5 Alarms & Computer Inputs	J	2-1-77
12E-2470	Schem. Diag - Power Range Neutron Monitoring System - Part 1	N	2-22-78
12E-2471	Schem. Diag. - Power Range Neutron Montoring System - Part 2	J	3-1-71
12E-2472	Schem. Diag. Power Range Neutron Monitoring System - Part 3	K	4-9-70
12E-2474	Reactor Protection System - Interconnection Diag. Sh. 1	K	9-3-76
12E-2475	Reactor Protection System - Interconnection Diag. Sh. 2	G	9-3-76

Attachment B

Operating Procedures and Alarms with Reactivity Control

Procedure Number	Procedure Title
DGA 6	Reactor High Pressure
DGA 7	Unpredicted Reactivity Addition
DOA 300-5	Inoperable or Failure of Control Rod Drive
DOA 600-1	Feedwater Regulating Valve Failure
DOA 3500-2	Loss of Feedwater Heaters
DOA 5600-1	Turbine Trip
DOA 5650-1	Turbine Governor Failed Open/Closed
DOA 5650-2	Pressure Regulator Failure
DOA 5650-3	Turbine Control Valve Failed Open
DOA 6000-1	Loss of Generator Load or Generator Trip
DGP 2-3	Unit 2/3 Reactor Scram
DGP 1-1	Unit 2/3 Normal Startup
DGP 3-1	Routing Power Changes
DGP 3-4	Control Rod Movements - Control Rod Sequences
DOP 202-3	Reactor Recirculation Flow Controller Operation
DOP 202-8	Placing Recirculation System in Master Auto Mode and Out of Master Auto Mode
DOP 202-12	Recirculation Pump MG Set Scoop Tube Operation

Procedure DOA-902(3)-4
Listed Alarms

A-1	Recirc. MG A Speed Signal Failure	Rev. 1	5/81
A-2	Recirc. MG A Generator Lockout	Rev. 0	6/75
A-3	Recirc. Pump A Low DP	Rev. 0	6/75
A-5	Recirc. MG B Speed Signal Failure	Rev. 1	5/81
A-6	Recirc. MG B Generator Lockout	Rev. 0	6/75
A-7	Recirc. Pump B Low DOP	Rev. 0	6/75
A-9	Recirc. Sets Drive Motor Trip	Rev. 0	6/75
B-1	Recirc. MG A Incomplete Sequence	Rev. 0	6/75
B-2	Recirc. MG A Aux Lockout	Rev. 0	6/75
B-3	Recirc. Pump A Locked Rotor Trip	Rev. 0	6/75
B-4	Recirc. MG A Lube Oil Low Press	Rev. 1	10/76
B-5	Recirc. MG B Incomplete Sequence	Rev. 0	6/75
B-6	Recirc. MG B Aux Lockout	Rev. 0	6/75
B-7	Recirc. Pump B Locked Rotor Trip	Rev. 0	6/75
B-8	Recirc. MG B Lube Oil Low Press	Rev. 1	10/76
B-9	Recirc. Sets Pump Motor High Temp	Rev. 0	6/75
C-1	Scoop Tube Power Failure Recirc MG A	Rev. 1	5/81
C-2	Recirc. MG A Generator Ground	Rev. 0	6/75
C-3	Recirc. Pump A Hi Vibration	Rev. 3	1/80
C-4	Recirc. MG A Upper Lube Hi/Lo Level	Rev. 1	6/78
C-5	Scoop Tube B Power Failure	Rev. 1	5/81
C-6	Recirc. MG B Generator Ground	Rev. 0	6/75
C-7	Recirc. Pump B Hi Vibration	Rev. 2	10/79
C-8	Recirc. Pump B Upper Lube Oil Hi/Lo Level	Rev. 2	6/78
C-9	Recirc. MG Set A DC (Aux) Oil Pump Running	Rev. 1	10/76
D-2	Recirc. MG Gen Diff Current High	Rev. 0	6/75
D-3	Recirc. Pump A Control Seal High Flow	Rev. 1	10/79
D-4	Recirc. Pump A Lower Lube Oil Low Level	Rev. 0	6/75
D-5	Recirc. Pump 2A Low Level	Rev. 2	6/78
D-6	Recirc. MG Gen Diff Current High	Rev. 0	6/75
D-7	Recirc. Pump B Control Seal High Flow	Rev. 1	10/79
D-8	Recirc. Pump B Lower Lube Oil Low Level	Rev. 0	6/75
D-9	Recirc. MG Set B DC Oil Pump Running	Rev. 1	10/76
D-10	C-U Filter A Low DP	Rev. 0	6/75
D-11	C-U Demin A Post Strainer High DP	Rev. 0	6/75
D-12	C-U Recirc. Surge Tank Low Level	Rev. 0	6/75
E-1	Recirc. MG A/B Fire Prot Wtr Valve Closed	Rev. 2	9/77
E-3	Recirc. Pump A Control Seal Low Flow	Rev. 1	10/79
E-4	Recirc. MG A/B Gen Stator High Temp	Rev. 1	8/76
E-5	Recirc. MG A/B Drive Motor High Temp	Rev. 0	6/75
E-6	Recirc. Pumps 202-51A & 51B Speed Mismatch	Rev. 2	5/81
E-7	Recirc. Pump B Control Seal Low Flow	Rev. 1	10/79
E-8	Recirc. Pump 2(3) "B" Low Level	Rev. 1	6/78
E-9	Recirc. Pumps Lube Oil High Temp	Rev. 0	6/75
F-1	Recirc. MG A/B Fluid Drive Fire	Rev. 2	9/77
F-3	Recirc. Pump A No 2 Seal Leak	Rev. 1	10/79

F-4	Recirc. MG A/B Vent Fan Auto Trip	Rev. 0	6/75
F-5	Recirc. MG A/B Exh Air High Temp	Rev. 0	6/75
F-6	Recirc. MG A/B Air Filter Runout	Rev. 0	6/75
F-7	Recirc. Pump B No. 2 Seal Leak	Rev. 1	10/79
F-8	Recirc. MG A/B Vent Fan Auto Start	Rev. 0	6/75
F-9	Recirc. Pump Clg Wtr High Temp	Rev. 0	6/75
G-1	Recirc. MG A Fluid Drive Low Oil Temp	Rev. 0	6/75
G-2	Recirc. MG A Cplg Fluid Pump 1 Trip	Rev. 0	6/75
G-3	Recirc. Pump A Seal Clg Wtr Low Flow	Rev. 0	6/75
G-4	Recirc. Loop A Flow Limit	Rev. 0	6/75
G-5	Recirc. MG B Fluid Drive Low Oil Temp	Rev. 0	6/75
G-6	Recirc. MG B Cplg Fluid Pump 1 Trip	Rev. 0	6/75
G-7	Recirc. Loop B Flow Limit	Rev. 0	6/75
G-8	Recirc. Loop High Conduct	Rev. 0	6/75
H-1	Recirc. MG A Fluid Drive High Oil Temp	Rev. 0	6/75
H-2	Recirc. MG A Cplg Fluid Pump 2 Trip	Rev. 0	6/75
H-3	Recirc. MG A Cplg Fluid Low Level	Rev. 1	6/76
H-4	Recirc. Loop A Water High Temp	Rev. 1	5/81
H-5	Recirc. MG B Fluid Drain High Oil Temp	Rev. 0	6/75
H-6	Recirc. MG B Cplg Fluid Pump 2 Trip	Rev. 0	6/75
H-7	Recirc. MG. B Cplg Fluid Low Level	Rev. 1	6/76
H-8	Recirc. Loop B Water High Temp	Rev. 1	5/81

Procedure DOA-902(3)-5
Listed Alarms

A-1	Scram Valve Air Supply Low Press	Rev. 2	9/80
A-2	Scram Valve Air Supply High Press	Rev. 1	8/76
A-3	Rod Drift	Rev. 3	8/80
A-4	SRM High or Inop	Rev. 1	5/81
A-5	IRM High	Rev. 1	5/81
A-6	APRM High	Rev. 0	6/75
A-7	RBM High or Inop	Rev. 2	5/81
A-9	Channel A Main Stm Line Low Press	Rev. 0	6/75
A-11	Channel A/B Condenser Low Vacuum	Rev. 0	6/75
A-12	Channel A/B Stop Vls Closed 405 Load	Rev. 1	8/76
A-13	Channel A/B Gen-Turbine Load Mismatch	Rev. 0	6/75
A-16	Channel B Main Stm Line Low Press	Rev. 0	6/75
B-2	Rod Drive Pump Trip	Rev. 0	6/75
B-3	Rod Worth Min Block	Rev. 0	6/75
B-10	Channel A Reactor Lo Lo Level	Rev. 0	6/75
B-16	Channel B Mn Stm Isol Hi Radiation	Rev. 1	12/79
C-2	Rod Drive Pump A Low Suct	Rev. 0	6/75
C-3	Rod Out Block	Rev. 1	8/76
C-4	SRM Downscale	Rev. 1	5/81
C-5	IRM Downscale	Rev. 1	5/81
C-6	APRM Downscale	Rev. 1	5/81
C-9	Channel A Main Stm Line High Flow	Rev. 0	6/75
C-10	Channel A IRM High High or Inop	Rev. 0	6/75
C-11	Channel A Reactor Vessel Hi Water Level	Rev. 0	6/75
C-12	Channel 1-3 APRM Hi Hi or Inop	Rev. 1	5/81
C-13	Channel A/B Reactor High Press	Rev. 1	5/81

C-14	Channel B Reactor Vessel High Water Level	Rev. 0	6/75
C-15	Channel B IRM or Inop High High	Rev. 0	6/75
C-16	Channel B Main Stm Line High Flow	Rev. 0	6/75
D-2	Rod Drive Pump B Low Suction	Rev. 0	6/75
D-3	Timer Half Rod Select Block	Rev. 0	6/75
D-7	LPRM High	Rev. 1	11/79
D-13	Channel 4-6 APRM Hi Hi or Inop	Rev. 1	5/81
D-15	Channel B Reactor Scram	Rev. 1	11/80
E-2	Rod Drive Water Filter High DP	Rev. 0	6/75
E-3	Rod Overtravel	Rev. 1	3/77
E-4	SRM Short Period	Rev. 0	6/75
F-2	Charging Water Low Press	Rev. 0	6/75
F-3	Rod Drive High Temp	Rev. 1	11/79
F-5	Condenser Low Vacuum	Rev. 0	6/75
G-3	RPIS System Inoperative	Rev. 0	6/75
G-8	Feed Wtr Pump Max Capacity	Rev. 1	5/81
H-4	Turb Press Gen Load Rej St Vlv Bypass	Rev. 0	6/75
H-5	Rx Vessel High Press	Rev. 1	5/81
H07	Rfp Suction Low Low Press	Rev. 1	4/81

Procedure DOA-902(3)-6
Listed Alarms

B-7	Heater 2(3) D1 Normal Drain Valve Closed	Rev. 0	6/75
B-8	Heater 2(3) D2 Normal Drain Valve Closed	Rev. 0	6/75
B-9	Heater 2(3) D3 Normal Drain Valve Closed	Rev. 0	6/75
B-10	Heater 2(3) D1 Ext Check Valve Trip	Rev. 0	6/75
B-11	Heater 2(3) D2 Ext Check Valve Trip	Rev. 0	6/75
B-12	Heater 2(3) D3 Ext Check Valve Trip	Rev. 0	6/75
C-1	Heater 2(3) D1 High Level	Rev. 0	6/75
C-2	Heater 2(3) D1 High Level	Rev. 0	6/75
C-3	Heater 2(3) D1 High Level	Rev. 0	6/75
C-4	Heater 2(3) D1 Emerg Drain Valve Open	Rev. 0	6/75
C-5	Heater 2(3) D2 Emerg Drain Valve Open	Rev. 0	6/75
C-6	Heater 2(3) D3 Emerg Drain Valve Open	Rev. 0	6/75
C-7	Heater 2(3) C1 Normal Drain Valve Closed	Rev. 0	6/75
C-8	Heater 2(3) C2 Normal Drain Valve Closed	Rev. 0	6/75
C-9	Heater 2(3) C3 Normal Drain Valve Closed	Rev. 0	6/75
C-10	Heater 2(3) C1 Ext Check Valve Trip	Rev. 0	6/75
C-11	Heater 2(3) C2 Ext Check Valve Trip	Rev. 0	6/75
C-12	Heater 2(3) C3 Ext Check Valve Trip	Rev. 0	6/75
D-1	Heater 2(3) C1 High Level	Rev. 0	6/75
D-2	Heater 2(3) C2 High Level	Rev. 0	6/75
D-3	Heater 2(3) C3 High Level	Rev. 0	6/75
D-4	Heater 2(3) C1 Emerg Drain Valve Open	Rev. 0	6/75
D-5	Heater 2(3) C2 Emerg Drain Valve Open	Rev. 0	6/75
D-6	Heater 2(3) C3 Emerg Drain Valve Open	Rev. 0	6/75
D-7	Heater 2(3) B1 Normal Drain Valve Closed	Rev. 0	6/75
D-8	Heater 2(3) B2 Normal Drain Valve Closed	Rev. 0	6/75
D-9	Heater 2(3) B3 Normal Drain Valve Closed	Rev. 0	6/75

D-10	Heater 2(3) B1 Extr Check Valve Trip	Rev. 0	6/75
D-11	Heater 2(3) B2 Extr Check Valve Trip	Rev. 0	6/75
D-12	Heater 2(3) B3 Extr Check Valve Trip	Rev. 0	6/75
E-1	Heater 2(3) B1 High Level	Rev. 0	6/75
E-2	Heater 2(3) B2 High Level	Rev. 0	6/75
E-3	Heater 2(3) B3 High Level	Rev. 0	6/75
E-4	Heater 2(3) B1 Emerg Drain Valve Open	Rev. 0	6/75
E-5	Heater 2(3) B2 Emerg Drain Valve Open	Rev. 0	6/75
E-6	Heater 2(3) B3 Emerg Drain Valve Open	Rev. 0	6/75
F-1	Heater 2(3) A1 Flash Tank High Level	Rev. 0	6/75
F-2	Heater 2(3) A2 Flash Tank High Level	Rev. 0	6/75
F-3	Heater 2(3) A3 Flash Tank High Level	Rev. 0	6/75
G-1	Heater 2(3) A1 High Level	Rev. 0	6/75
G-2	Heater 2(3) A2 High Level	Rev. 0	6/75
G-3	Heater 2(3) A3 High Level	Rev. 0	6/75

Procedure DOA-902(3)-7
Listed Alarms

A-4	Turb Tripped Shaft Pump Oil Low Press	Rev. 0	6/76
A-5	Turb Tripped Thrust Brg Failure	Rev. 0	6/76
A-7	Turb Brg Oil Low Press	Rev. 0	6/76
B-4	Turb Tripped Low Vacuum	Rev. 0	6/76
B-5	Turb EHC Fluid Level Hi/Lo	Rev. 0	6/76
B-6	EHC Fluid Level Hi/Lo	Rev. 0	6/76
B-7	Shaft Brg Oil Pump Disch Low Press	Rev. 0	6/76
C-4	Turb Tripped Exhaust Hood High Temp	Rev. 1	8/76
C-5	Turb Tripped EHC Fluid Low Press	Rev. 0	6/75
C-6	EHC Fluid Temp Hi/Lo	Rev. 0	6/75
C-7	Shaft Brg Oil Pump Overload	Rev. 0	6/75
C-8	Turb Oil Tank Level Hi/Lo	Rev. 0	6/75
D-4	Turb Tripped Stator Coolant Failure	Rev. 0	6/75
D-5	Turb Tripped EHC System Master PB	Rev. 0	6/75
D-6	EHC Fluid A/B Pump Overload	Rev. 0	6/75
E-4	Turb Tripped EHC Sys Speed	Rev. 0	6/75
E-5	Turb Tripped Overspeed	Rev. 0	6/75
E-7	Emergency Brg Oil Pump Overload	Rev. 0	6/75
F-4	Turb Tripped Trip Sys Oil Low Press	Rev. 0	6/75
F-5	Turb Tripped Overspeed BU	Rev. 0	6/75
F-6	EHC Fluid A/B Auto Trip	Rev. 0	6/75
F-7	Emergency Brg Oil Pump Auto Start	Rev. 0	6/75
G-4	Turb Tripped Moist Sep Drain Tank High Level	Rev. 0	6/75
G-5	EHC Electrical Malfunction	Rev. 0	6/75
G-6	EHC Fluid Filter Pump Auto Trip	Rev. 0	6/75
H-3	Turbine Low Vacuum	Rev. 0	6/75
H-4	EHC Filter Plugged	Rev. 0	6/75
H-5	EHC P/L Unbalance	Rev. 0	6/75
H-6	EHC Max Combined Flow Limit	Rev. 0	6/75

Procedure DOA-902(3)-8
Listed Alarms

A-11	Generator 2(3) Max Excitation Limit	Rev. 0	6/75
A-12	Gen 2(3) Tripped	Rev. 0	6/75
C-12	Gen 2(3) Trip FR T2(3) Sudden Press Relay	Rev. 0	6/75
D-12	Gen 2(3) Trip FR T21(31) Sudden Press Relay	Rev. 0	6/75
E-12	Gen/Exc 2(3) Field Ground	Rev. 0	6/75
F-6	Generator 2(3) Volt Regulator DC Pwr Failure	Rev. 0	6/75
F-12	Gen 2(3) Field Brkr Open	Rev. 0	6/75
G-12	Gen 2(3) Voltage Reg Amplifier Output High	Rev. 0	6/75

0188a*