SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT □ 6201 S Street, Box 15830, Sacramento, California 95813; (916) 452-3211

November 16, 1979

Mr. Robert W. Reid, Chief
Operating Reactors Branch #4
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Docket No. 50-312
Rancho Seco Nuclear Generating Station
Unit No. 1

Dear Mr. Reid:

Your letter of September 28, 1979, requested information concerning PORV and safety valve lift frequency and mechanical reliability. This letter forwards the requested information.

Sincerely,

John J. Mattimoe

John J. Mattimoe
Assistant General Manager
and Chief Engineer

ATTACHMENT I (12 PAGES)

Request 1

According to statements made by B&W, there are approximately 146 documented occasions where PORV actuation occurred at B&W facilities prior to the accident at Three Mile Island, Unit 2 (TMI-2). For each of these events which have occurred at your facility(ies), provide the following information:

a. The cause of the event;

b. the initial power level prior to the transient;

c. Indicate which of these transients caused the reactor to trip on high RCS pressure and/or caused the safety valves to lift; and,

d. If you assume that the present setpoints for high RCS pressure trip and PORV actuation were in effect at the time of each of these transients, estimate whether either of the following would have taken place:

   (1) PORV actuation, and

   (2) lifting of the safety valves.

   (For this item assume no credit for the anticipatory control-grade reactor trip on loss of feedwater or turbine trip.)

Response

The requested information has been compiled in the following plant specific tables (Reactor trips with a PORV actuation).

In addition, there have been seven (7) instances when the PORV stuck open - three (3) when the plant was at power and four (4) when it was not producing power.

a. At power:

   (1) Oconee-3, June 13, 1975 (Feedwater oscillations while shutting down)

   (2) Davis-Besse 1, Sept. 24, 1977 (Loss of Feedwater)

   (3) TMI-2, March 28, 1979 (Loss of Feedwater)

ATTACHMENT I (Cont'd)

b. Not producing power:

(1) Oconee-2, August 15, 1973 (Pre-op Testing)

(2) Oconee-2, November 6, 1973 (RCS Heatup)

(3) Davis-Besse 1, October 13, 1977 (Hot Standby)

(4) TMI-2, March 29, 1978 (Zero Power Physics Testing)

PORV ACTUATIONS - OCONEE-1 (PAGE 1)

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED PORV ACTUATION?	IF PRESENT SETPOINTS HAD BEEN USED LIFT SAFETY VALVES?
5-5-73	Loss of Feedwater	Manual	Operations Error Tripped MFW Pump	18	No	No	No
5-16-73	Loss of Feedwater	Hi RCP	Operator Error	15	No	No	No
5-23-73	Loss of Feedwater	Hi RCP	Operator and/or Procedure Error	25	No	No	No
5-26-73	Loss of Feedwater	Hi RCP	Operator and/or Procedure Error	35	No	No	No
5-27-73	Loss of Feedwater	Hi RCP	Began as CRDM Fault	40	No	No	No
5-28-73	Loss of Feedwater	Hi RCP	Attempt to Transfer from B to A FWP	40	No	No	No
5-30-73	Loss of Feedwater	Hi RCP	Cleaning Hotwell Pump Strainer	40	No	No	No
6-9-73	Loss of Feedwater	Hi RCP	Switching Powdex Units	40	No	No	No
6-13-73	Turbine Trip	Manual	CRDM Fault Following Turbine Trip Test and ICS Runback Signal	52	No	No	No
6-14-73	Loss of Feedwater	Hi RCP (?)	Maintenance Work on Hotwell Strainer	40	No	No	No
6-21-73	Loss of Feedwater	RCP/ Temp Ratio	Tripped Hotwell Pump Initiated FWP Trip	19	No	No	No
- - - -	- - - -	- - - -	- - - - Prior to Commercial Operation - - - -				
7-15-73	Loss of Feedwater	Hi RCP	Faulty Speed Controller on a Main FW Pump	75	No	No	No
8-11-73	Turbine Trip	Loss Pwr to Pumps Ind.	Inadvertent Closure of Turbine Intercept Valves	85	No	No	No
9-16-73	Turbine Trip	Hi Temp Pressure Ratio	Manually Initiated Turbine Trip Decreased Closing Setpoint of Bypass Valves	40	No	No	No
10-12-73	Turbine Trip	Hi RCP	Main Steam Bypass Valves did not open: Operator put rods in manual	20	No	No	No
10-26-73	Turbine Trip	Hi RCP	Loss of Condensor Vacuum	75	No	No	No
12-11-73	Turbine Trip	Hi RCP	Spurious MWe Signal Detected by EHC System lead to Turbine Trip	90	No	No	No
8-23-74	Load Rejection	Hi RCP	Unit Loss of Electrical Load Acceptance Test	95	No	No	No
3-12-75	Loss of Feedwater	Hi RCP	Shorted Transistor in ΔT_c Controller	25	No	No	No
4-22-75	Turbine Trip	Hi RCP	Loss of EHC Control Power	100	No	No	No
4-23-75	Loss of Feedwater	Hi RCP	Rapid Feedwater Oscillations	46	No	No	No
6-8-75	Turbine Trip	Hi RCP	Low EHC Hydraulic Pressure T.T	100	No	No	No
6-9-75	Loss of Feedwater	Hi RCP	FW Flow Oscillation	30	No	No	No
8-2-75	Instrument Failure	Hi RCP	Failure of Temperature Switch on Stator Coolant System	75	No	No	No
8-8-75	Turbine Trip	Flux/ Flow	Positive Voltage Spike in Turbine Speed Error Circuit	92	No	No	No
1-22-76	Turbine Trip	Hi RCP	Loss of Excitation on Generator	100	No	No	No
5-31-76	Loss of Feedwater	Hi RCP	FWP Turbine IH Speed Momentarily Decreased when Switching from Auxiliary to Main Steam	~15	No	No	No

PORV ACTUATIONS - OCONEE-1 (PAGE 2)

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED	
						PORV ACTUATION?	LIFT SAFETY VALVES?
6-27-76	Instrument Failure	Hi RCP	Short in Signal Amp for RPS Flow Indication: Secondary Flow Runback	100	No	No	No
7-7-76		Hi RCP	Personnel Error	99	No	No	No
7-14-76	Loss of Feedwater and Power Supply Failure	Hi RCP	ICS Hand Power Circuit Breaker Tripped when Circuit was Overloaded with Calibration Equipment	100	No	No	No
8-14-76	Rod Drop	Hi RCP	Heat and Moisture Affected Electrical Components in CRD System Cabinets	60	No	No	No
4-3-77	Instrument Failure	Hi RCP	Failure of ICS Component	~15	No	No	No
4-24-77	Turbine Trip	Hi RCP	Misaligned Linkage Caused High Moisture Separator Reheater Drain Tank Level	68	No	No	No
5-24-77	Turbine Trip	Hi RCP	Loss of Condenser Vacuum	70	No	No	No
6-6-77	Turbine Trip	Hi RCP	Personnel Error	99	No	No	No
10-18-77	Loss of Feedwater	Hi RCP	Standby Condensate Pumps Off	15	No	No	No
12-30-77	Loss of Feedwater	Hi RCP	Personnel Error - Inadvertent Closure of MFW Block Valve	100	No	No	No
6-1-78	Turbine Trip	Hi RCP	High Level in Moisture Separator Tank Caused by Failure of MSDT Dump Valve and MSDT Level Control Valve	95	No	No	No
8-2-78	Turbine Trip and Power Supply Failure	Hi RCP	EHC-DC Power Lost	100	No	No	No
12-25-78	Power Supply Failure	Hi RCP	Blown Fuses Led to LOFW	10	No	No	No
3-23-79	Instrument Failure	Hi RCP	Startup FW Summer Module Failed	100	No	No	No

1398 257

PORV ACTUATIONS - OCONEE-2 (PAGE 1)

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED PORV ACTUATION?	IF PRESENT SETPOINTS HAD BEEN USED LIFT SAFETY VALVES?
12-2-73	Loss of Feedwater	Hi RCP	Leak in 1" Line Around One FWP. Operator Manipulation of FW SU Valves Led to LOFW	15	No	No	No
12-3-73	Loss of Feedwater	Hi RCP	Control Rod Groups 6 and 7 Lost Proper Overlap	9	No	No	No
12-12-73	Loss of Feedwater	Hi RCP	Too Large a Pressure Loss in Powdex Units. Condensate Booster Pumps Tripped	30	No	No	No
1-4-74	Turbine Trip	Hi RCP	Erroneous Activation of Breaker Failure Relay System	75	No	No	No
5-30-74	Manual Rx Trip	Manual	Operator Mistakenly Injected HPI Water into RC System	75	No	No	No
6-13-74	Turbine Trip	Hi RCP	Turbine Intercept Valves Closed Due to Faulty Pot	?	No	No	No
- - - Prior to Commercial Operation - - -							
9-17-74	Turbine Trip	Hi RCP	TT During Testing of Thrust Bearing Wear Detector	100	No	No	No
9-23-74	Power Supply Failure and Loss of Feedwater	Hi RCP	ICS Power Lost During Switching of Feeds to Inverter. Main Feed Pumps Tripped	95	No	No	No
3-27-75	Load Rejectic	Hi RCP	Loss of Electrical Load Test During Startup	100	No	No	No
3-27-75	Instrument Failure	Manual	Loss of Condensor Vacuum Led to FWP Trip	15	No	No	No
4-1-75	Turbine Trip	Hi RCP	Manual Trip as Part of Turbine/Reactor Trip Test	100	No	No	No
8-5-75	Loss of Feedwater	Hi RCP	Blown Gasket on Emergency Governor Lockout Valve in Hydraulic Control System	62	No	No	No
8-23-75	Loss of Feedwater	Manual	Malfunction of Condensor Vacuum Switches Tripped FWPs. Reactor Manually Tripped	14	No	No	No
9-19-75	Loss of Feedwater	Manual	FWP Trip on Low Vacuum. Manual Reactor Trip	10	No	No	No
7-12-76	Turbine Trip	Hi RCP	FW Oscillation Ocurred While Taking Main Turbine Off Line	23	No	No	No
7-27-76	Loss of Feedwater	Hi RCP	Steam Leak on Main Turbine Caused Load to Hold at 20%. ICS Caused FW Oscillations	20	No	No	No
9-7-76	Turbine Trip	Hi RCP	Back-Up Speed Control System Failed and Intercept Valves Closed During TT Test	100	No	No	No
5-4-78	Turbine Trip	Hi RCP	Moisture Separator Level Controls Failed to Function	100	No	No	No
10-17-78	Loss of Feedwater	Hi RCP	Air Line Blew Off Startup FW Valve	100	No	No	No
10-30-78	Loss of Feedwater	Hi RCP	Welding Crew Ignited Oil Around FW Pump with Sparks, Causing FWP to Trip	55	No	No	No
10-30-78	Loss of Feedwater	Hi RCP	FW Pump Leak. Switching of Pumps not Accomplished	12	No	No	No

PORV ACTUATIONS - OCONEE-3

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED PORV ACTUATION?	IF PRESENT SETPOINTS HAD BEEN USED LIFT SAFETY VALVES?
10-13-74	Loss of Feedwater	Power to Pumps	Debris Obstructed Hotwell Pump Strainer	15	No	No	No
10-17-74	Loss of Feedwater	Hi RCP	Debris Obstructed Hotwell Pump Strainer	16	No	No	No
- - - - - -	- - - Prior to Commercial Operation - - -						
4-7-75	Loss of Feedwater	Hi RCP	Servicing Powdex Tripped Condensate Booster Pump	75	No	No	No
4-30-75	Load Rejection	Hi RCP	Loss of Electrical Load Test	100	Yes	No*	No
6-13-75	----	Low RCP	While Shutting Down, Turbine Switched to Manual at 19%, Bypass Valves Opened, ULD Increased FW Demand → FWP and OTSG Level Oscillations	19	No	No	No
7-1-76	Turbine Trip	Power to Pumps	TT on Low Turbine Shaft Oil Pressure	98	No	No	No
4-6-77	Turbine Trip	Power to Pumps	TT on Momentary Loss of DC Power to EHC	100	No	No	No
8-21-77	Loss of Feedwater	Hi RCP	Manual Adjustments to FW by Operators	15	No	No	No
11-3-78	Loss of Feedwater	Hi RCP	TT Due to Low FWP Discharge Pressure	44	No	No	No
2-21-79	Instrument Failure	Hi RCP	Noise Spike on ICS Cable After CRDM Testing	99	No	No	No

1398 259

*SETPOINT WOULD HAVE BEEN REACHED, BUT BLOCK VALVE WAS CLOSED.

PORV ACTUATIONS - DAVIS-BESSE-1

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED PORV ACTUATION?	IF PRESENT SETPOINTS HAD BEEN USED LIFT SAFETY VALVES?
9-2-77	Turbine Trip	Lo RCP	OTSG Overfed by Operator	~75	No	No	No
9-24-77	Loss of Feedwater	Manual	"Half-Trip" of SFRCS Isolated OTSGs	9	No	No	No
10-23-77	Loss of Feedwater	Lo RCP	SFRCS Caused Isolation of 1 OTSG, Later Both	16	No	No	No
- - - - - - - - - - Prior to Commercial Operation - - - - - - - - - -							
12-16-77	ICS in Manual	Lo RCP	Overfed "B" OTSG. Operator had MFW Pump in Hand	11	No	No	No
12-30-77	Loss of Feedwater	Lo RCP	FWP Tripped on High Exhaust Casing Water Level	72	No	No	No
1-31-78	Loss of Feedwater	Hi RCP	Spurious SFRCS Trip After Performing SFRCS Monthly Test	67	No	No	No
3-1-78	Loss of Feedwater	Hi RCP	SFRCS Actuated on FW/STM Pressure ΔP; Deaerator Level Cont. Valve Failed Shut	49	No	No	No
4-2-78	Turbine Trip	Lo RCP	TT Test - During Runback, Rx Tripped, Overfed OTSG's	75	No	No	No
9-10-78	Turbine Trip	Lo RCP	Tripped Turbine for Test TP-800-14	~75	No	No	No
9-28-78	Instrument Failure	Lo RCP	Loop 2 RCS Flow XMTR Failed Low, Runback @ 20%/Min Initiated. Operator Lost Control	90	No	No	No
10-3-78	Turbine Trip	Lo RCP	TT Caused by Starting 2nd EHC Pump. ICS Oversupplied FW	68	No	No	No
10-29-78	Loss of Feedwater	Lo RCP	EM Relief Cycled and Stuck Open Too Long	4	No	No	No
11-13-78	Power Supply Failure	Power to Pumps	Fuse for RC Pump Control Circuitry Blew	99	No	No	No
1-12-79	Loss of Feedwater	Hi RCP	Technician Shorted Inverter Causing Loss of Vital Bus Y2; SFRCS Trip	100	No	No	No
2-22-79	Loss of Feedwater	Hi RCP	Malfunction in Turbine Speed Control System Led to SFRCS Actuation	87	No	No	No

1398 260

PORV ACTUATIONS - RANCHO SECO

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINT HAD BEEN USED PORV ACTUATION?	IF PRESENT SETPOINT HAD BEEN USED LIFT SAFETY VALVES?
11-19-74	Loss of Feedwater	Manual	FDW Ocsillations During ICS Tuning	25	No	No	No
11-22-74	Loss of Feedwater and Power Supply Failure	Hi RCP	Technician Misoperation. Power Lost to "Y" and "Z" NNI Busses	32	No	No	No
12-4-74	Loss of Feedwater	Hi RCP	Inadvertent Actuation of Reheater Intercept Valve	40	No	No	No
12-15-74	Rod Drop (GRP. 6 & 7)	Lo RCP	CRDM Motor Fault: Programmer Assembly	39.5	No	No	No
12-17-74	Rod Drop (GRP. 7)	Lo CRP	Same as Preceding Transient	41.3	No	No	No
12-26-74	Loss of Feedwater and Power Supply Failure	Hi RCP	Failure of 2 SCR's in "C" Inverter	39.5	No	No	No
12-31-74	Power Supply Failure	Pressure/ Temp.	Operator Error in Paralleling Inverters	40	No	No	No
2-12-75	Turbine Trip	Hi RCP	Spurious Overspeed Trip Signal	92	No	No	No
2-18-75	Manual Load Rejection for Trip	Lo RCP	Poor ICS Tuning	75	No	No	No
4-14-75	Loss of Feedwater	Hi RCP	Startup Valve in Auto (Closed), but "A" OTSG Blew Down	15	No	No	No
- - - - - -	- - - Prior to	Commercial	Operation - - -				
6-15-75	Loss of Feedwater	Hi RCP	Transferring Steam Supply for FWP from Aux. to Main Steam	13	No	No	No
10-10-76	Loss of Feedwater	Hi RCP	FWP Speed Control Lost. FWP Governor was Dirty	13.6	No	No	No
10-10-76	Loss of Feedwater	Hi RCP	Same as Preceding Transient	?	No	No	No
1-13-77	Loss of Feedwater	Hi RCP	Technician Shorted Out FWP Thrust Bearing Indicator	98	No	No	No
1-5-78	Unknown	Hi RCP (?)	Unknown	100	No	No	No
3-20-78	Loss of Feedwater	Hi RCP	Dropped Light Bulb Shorted NNI Cabinet	72	Yes	No	No
12-31-78	Loss of Feedwater	Hi RCP	Condensate Valve Failure	100	No	No	No
1-2-79	Loss of Feedwater	Hi RCP	Loss of Vital Bus 1A	100	No	No	No
1-5-79	Loss of Feedwater	Hi RCP	Technician Shorted Wires in ICS Cabinets	100	No	No	No

1398 261

PORV ACTUATIONS - ANO-1

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED: PORV ACTUATION?	IF PRESENT SETPOINTS HAD BEEN USED: LIFT SAFETY VALVES?
10-15-74	Loss of Feedwater	Hi RCP	"A" FWP Tripped on High Vibration	[illegible]	No	No	No
12-6-74	Loss of Feedwater	Pressure/ Temp	Loss of Vacuum Due to "B" Main Chiller Getting Wet and Shorting	80	No	No	No
- - - - Prior to Commercial Operation - - - -							
1-6-75	Load Rejection	Hi RCP	Generator Tripped on Differential Current Due to Loss of Buss Cooling	98.5	No	No	No
5-15-75	?	Pwr/ Imbalance Flow	Flow Oscillations Occurred During Maneuvering	100	No	No	No
6-6-75	Instrument Failure	Pwr/ Imbalance Flow	Loose Connection on Loop "B" T_C Signal	99	No	No	No
7-3-75	Instrument Failure	Pwr/ Imbalance Flow	Technician Grounded TH Signal to ICS	95	No	No	No
7-23-75	Loss of Feedwater	Pressure/ Temp	Operator Lost Htr. Drain Pump Which Tripped FWP	50	No	No	No
7-8-76	Loss of Feedwater/Power Supply Failure	Hi RCP	Inst. Techs Shorted NNI Power Supply	94	No	No	No
9-23-76	Turbine Trip	Hi RCP	Turbine Tripped When Vibration Trip Module was Reinserted by Technician	99	No	No	No
12-20-76	Rod Drop/Power Supply Failure	Hi RCP	Rod 8 in Group 4 Dropped. Coupled with Loss of Y-11 Inverter	64	No	No	No
6-19-78	Turbine Trip	Hi RCP	Technician or Operator Error in Opening Wrong Feeder Breaker	?	No	No	No
9-16-78	----	Hi Flux	Burned Out Control Air Solenoid On MSIV	?	No	No	No
10-13-78	Instrument Failure	Pressure/ Temp	RPS Channel "B" RC Flow Signal Failed	?	No	No	No
12-20-78	Instrument Failure	Pressure/ Temp	Low Steam Pressure Caused by LVDT Linkage Breaking	99	No	No	No

1398 262

PORV ACTUATIONS - TMI-1

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED PORV ACTUATION?	IF PRESENT SETPOINTS HAD BEEN USED LIFT SAFETY VALVES?
6-18-74	Loss of Feedwater	Hi RCP	"A" Instrument NIR Compressor Tripped on Thermal Overload	7	No	No	No
7-13-74	Loss of Feedwater	Pressure/ Temp	LOFW Noticed Prior to 3-Sec. Rod Withdrawal	15	No	No	No
7-14-74	Loss of Feedwater	Pressure/ Temp	Technician Grounded T_{AVE} Signal	76	No	No	No
8-13-74	Load Rejection (Test)	Hi RCP	Generator Trip Test	98	No	No	No
8-30-74	Turbine Trip	Hi RCP	Turbine Bearing Failure	75	No	No	No
- - - - -	- - - - -	- - - - -	- - - Prior to Commercial Operation - - -	- - -	- - -	- - -	- - -
3-30-75	Turbine Trip	Hi RCP	Erroneous Signal from Faulty 701 Relay Indicated Loss of 125-V Supply to Turbine EHC Systems	100	No	No	No
5-9-75	Turbine Trip	Hi RCP	"B" Moisture Separator Drain Tank High Level Trip Device Shorted	100	No	No	No
6-18-75	Turbine Trip	Hi RCP	Voltage Spikes Transmitted Into Turbine EHC System	100	No	No	No
11-14-77	ICS Component Failure	Flux/Flow Imbalance	ICS Signal-Converter "L" Module Failed to Midrange	100	No	No	No

1398 263

PORV ACTUATIONS - TMI-2

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED PORV ACTUATION?	IF PRESENT SETPOINTS HAD BEEN USED LIFT SAFETY VALVES?
			No Pumps in Loop "A" Signal. Fuse Blew in 2-IV. RCP-2A Already Out				
4-19-78	Loss of Feedwater	Hi RCP	Operator Blew Down Condensate Strainers	15	No	No	No
9-20-78	Loss of Feedwater	Hi RCP	Valving Error Tripped Condensate Booster Pump	24	No	No	No
9-21-78	Low Feedwater	Hi RCP	Feed Pump and Feed Reg. Valve Problems	19	No	No	No
9-25-78	Load Rejection Normal	Hi RCP	High Pressure Due to Reducing Load on Turbine. Incorrect Suction Pressure Switch or Logic Error on C.B. Pumps Caused FWP Trip	17	No	No	No
10-14-78	Loss of Feedwater	Lo RCP	FWP-1A Lost	26	No	No	No
11-7-78	Loss of Feedwater	Pressure/ Temp	TP-800-05 (Reactivity Coefficients) was being performed at T_{AVE} = 588F. Heater Drain Tank Low Level Alarm Tripped FWP-1B.	92	No	No	No
- - - - - - - -	- - - - Prior to Commercial Operation - - - -						
1-15-79	Instrument Failure	Lo RCP	Atmospheric Relief Bellows Failed	5	No	No	No

1398 264

PORV ACTUATIONS - CRYSTAL RIVER-3

REACTOR TRIPS WITH A PORV ACTUATION

DATE	TRANSIENT CLASSIFICATION	TRIP SIGNAL	CAUSE OF TRANSIENT	INITIAL POWER LEVEL	PZR. SAFETY VALVES LIFTED?	IF PRESENT SETPOINTS HAD BEEN USED: PORV ACTUATION?	IF PRESENT SETPOINTS HAD BEEN USED: LIFT SAFETY VALVES?
1-30-77	Instrument Failure/Turbine Trip	Lo RCP	Manual TT Due to Low Turbine Header Pressure Coupled with Inoperable MW Meter	15	No	No	No
3-2-77	Power Supply Failure	Loss of CRD Pwr	120 VAC-B Vital Bus was Lost Due to Failure of Diode in "B" Inverter	40	No	No	No
3-9-77	----	Manual	Reactor - Turbine Trip Test TP-800-14	40	No	No	No
- - - -	- - - -	- - - -	Prior to Commercial Operation	- - - -	- - - -	- - - -	- - - -
4-21-77	Power Supply Failure	Power/ # pumps	"X" Power Supply to ICS Lost Due to Blown Fuse	46	No	No	No
4-23-77	----	Manual	Part of Test (Outside Control Room)	20	No	No	No
10-26-77	Power Supply Failure/ Turbine Trip/Loss of Feedwater	Hi RCP	Inverter "A" Tripped Causing a Loss of Power to Vital Bus "A"	100	No	No	No
1-6-79	Turbine Trip	Manual	TT Followed by FW Block Valve FWV-30 Sticking Open or Partially Open	71	No	No	No
1-17-79	Loss of Feedwater	Manual	Solenoid Failure on Inlet Seawater Block Valve to Secondary Services Heat Exchanger "A".	100	No	No	No
1-30-79	Loss of Feedwater	Lo RCP	Reason for Decrease in FW Not Stated	100	No	No	No
7-17-77	Rod Drop	Manual	Grp. 1 Dropped During Surveillance Test	90	No	No	No
11-13-77	Loss of Feedwater	Pressure/ Temp	FW Upset While Passing Block Valve Point. Cause is Operator Control and Poor Control System Operation/Performance	57	No	No	No

1398 265

ATTACHMENT II (7 PAGES)

Request 2

Provide a complete listing of reactor trips for your facility(ies) which have occurred subsequent to the revised setpoints for PORV actuation and high RCS pressure trip. This listing should include the following items:

a. The cause of each event;

b. The initial power level prior to the transient;

c. Indicate which of these transients caused the PORV and/or safety valves to open; and,

d. If the old (pre-TMI-2) setpoints for high RCS pressure and PORV actuation were in effect at the time of these transients, estimate whether any or all of the following would have taken place:

(1) PORV actuation;

(2) Reactor trip on high RCS pressure, and

(3) Lifting of the safety valves.

Response

This information has been compiled and is presented in the attached tables. The hypothetical actuation of the PORV and/or safety valves and high pressure trip assuming the old setpoints had been in effect is not based on any analytical technique. Rather, Engineering judgement, coupled with past operating history led to these results.

REACTOR TRIPS SINCE TMI-2 - OCONEE 1

Date	Transient Classification	Cause of Transient	Initial Power Level	PORV Lifted?	PZR Safety Valves Lifted	If Old Setpoints Had Been Used: PORV Actuation?	If Old Setpoints Had Been Used: Trip on High Pressure?	If Old Setpoints Had Been Used: Lift Safety Valves?
6-11-79	Loss of feedwater	EHC Card Failure	99	No	No	No	No	No
6-11-79	Manual Reactor Trip	Low OTSG Level	1	No	No	No	No	No
6-17-79		Two RC Pumps Tripped	97	No	No	No	No	No
8-6-79	Turbine Trip	Valving-out of Pressure Switch	40	No	No	No	No	No

REACTOR TRIPS SINCE TMI-2-OCONEE-2

Date	Transient Classification	Cause of Transient	Initial Power Level	PORV Lifted?	PZR Safety Valves Lifted	If Old Setpoints Had Been Used		
						PORV Actuation?	Trip on High Pressure?	Lift Safety Valves?
5-7-79	Loss of Feedwater	Underfed OTSG 2A	15	No	No	Yes	Yes	No
6-4-79	Loss of Feedwater	Malfunction of Main FDW Block Valve	30	No	No	Yes	Yes	No
7-18-79	Turbine Trip?	Lightning struck Substation Breaker	---	No	No	No	No	No

REACTOR TRIPS SINCE TMI-2-DAVIS-BESSE-1

Date	Transient Classification	Cause of Transient	Initial Power Level	PORV Lifted?	PZR Safety Valves Lifted	If Old Setpoints Had Been Used: PORV Actuation?	Trip on High Pressure?	Lift Safety Valves?
9-18-79	Turbine Trip	Perturbation In EHC Fluid Pressure	99.8	No	No	Yes	No	No
9-26-79	Turbine Trip	Failure Of Power Supply For Turbine Throttle Pressure Limiter XMTR	100	No	No	Yes	No	No

REACTOR TRIPS SINCE TMI-2-CRYSTAL RIVER-3

Date	Transient Classification	Cause of Transient	Initial Power Level	PORV Lifted?	PZR Safety Valves Lifted	If Old Setpoints Had Been Used: PORV Actuation?	Trip on High Pressure?	Lift Safety Valves?
8-16-79	Loss Of Feedwater	FW Upset After RCP Trip	73	No	No	Yes	No	No
8-17-79	Loss Of Feedwater	FW Valve Actuator Failure	47	No	No	Yes	No	No
8-17-79	Loss Of Feedwater	FW Going From One To Two-Pump Operations; "A" Pump Speed Lower And "B" Higher Than Required	48	No	No	Yes	No	No
8-17-79	Loss Of Feedwater	Operator Went From Manual To Auto With ICS With Off Normal Plant Conditions	24	No	No	Yes	No	No
9-18-79	Loss Of Feedwater	FWP Regulator Failed	72	No	No	Yes	No	No

REACTOR TRIPS SINCE TMI-2-RANCHO SECO

Date	Transient Classification	Cause of Transient	Initial Power Level	PORV Lifted?	PZR Safety Valves Lifted	If Old Setpoints Had Been Used: PORV Actuation?	Trip on High Pressure?	Lift Safety Valves?
4-22-79	Loss of Feedwater	Loss of "A" inverter	100	No	No	Yes	Yes	No
7-1-79	Loss of Feedwater	Test of STP-070	13	No	No	Yes	No	No
8-12-79	Turbine Trip	Spurious Activity In Overspeed Protection Circuit	100	No	No	No	No	No
9-12-79	Turbine Trip	Spurious Activity In Overspeed Protection Circuit	100	No	No	No	No	No
9-13-79	Unspecified	Imbalance on Restart	30	No	No	No	No	No

REACTOR TRIPS SINCE TMI-2-ARKANSAS

Date	Transient Classification	Cause of Transient	Initial Power Level	PORV Lifted?	PZR Safety Valves Lifted	If Old Setpoints Had Been Used: PORV Actuation?	Trip on High Pressure?	Lift Safety Valves?
8-13-79	Turbine Trip	Switchyard Relay Failure	75	No	No	Yes	No?	No
	Turbine Trip	Governor Valve Control Failure	75	No	No	Yes	No?	No

ATTACHMENT III (3 PAGES)

Request 3:

Provide an estimate of the increase in reactor trip frequency since lowering the high pressure trip setpoint and adding the anticipatory reactor trip. Include a review of the design criteria for the number of reactor trips over the plant life and evaluate the effect of the increase in trip frequency on these criteria. Also provide the basis for the acceptable number of reactor trips in terms of the limiting component(s).

Response

A. An increase in reactor trip frequency will result from a lowering of the high pressure trip setpoint and the addition of the anticipatory reactor trip. To estimate the effect of these changes, total reactor trips were divided into two (2) categories:

1. Category 1 - Trips that should not be affected by the above changes (e.g., total loss of feedwater, since this led almost invariably to a reactor trip with the old setpoints; power to flow trips; test trips; etc.)

2. Category 2 - Trips that are affected by the above changes (e.g., high pressure trips, feedwater upsets, and turbine trips).

Category 2 trips are listed in the following table (Table 1) in the "A" columns while total trips (Category 1 plus Category 2) are listed in the "B" columns. The number of trips and frequencies in Table 1 are based on commercial calendar time. The post-TMI-2 frequencies should be viewed with caution as they are based on only a short operating history following the setpoint changes.

Ideally (i.e., with a large enough data base), the Category 1 trip frequency ("B" column minus the "A" column) should be similar for the pre- and post-TMI-2 periods. The fact that this is not the case can be attributed to the difference in calendar time and also statistical variations of the pre- and post-TMI-2 samples.

However, on the average, it can be observed that the trip frequency in Category 2 (i.e., "A" column) has increased by approximately a factor of 3 (0.23 to 0.71); which would almost double the total trip frequency.

Thus, although the data indicate approximately a doubling of the average trip frequency, the following must be considered:

1. There has been a relatively short period of operation since the changes.

2. There have been many startups and shutdowns during the post-TMI-2 period.

ATTACHMENT III (Cont'd)

3. As operators become familiar with the revised setpoints and operating conditions, it is reasonable to assume the trip frequencies may decrease.

B. The structural design criterion for the number of reactor trips over the life of the plant is to keep the fatigue usage factors of all RCS components below 1.0 as supported by the component stress analysis. In general, this usage factor is made up of contributions due to all specified transients. Since the largest contribution to the fatigue usage factor is attributable to heatup and cooldown transients, with reactor trips producing only a small effect, the increase in trip frequency (indicated by the average data to date) should only have a small effect relative to plant life.

As a part of the total allowable transient picture, 400 reactor trips are specified. Assuming a 40-year life, this translates into 10 trips per year or .83 per month. With the pre-TMI-2 setpoints, only the most recent plants to come on line (Davis Besse-1, Crystal River-3, and TMI-2) exceed this figure. As these plants accumulate operating experience, their trip frequencies would be expected to decline under the pre-TMI-2 setpoints. With the new setpoints, three plants exceed 0.83; however, for the reasons discussed in A above, it is premature to draw any conclusions over the life of the plant based on the little data available with these setpoints.

C. To determine the acceptable number of reactor trips in terms of the limiting component(s), it is necessary to review the stress report for each component and plant and evaluate the fatigue usage factor.

If the number of trips were to exceed 400 on any plant, that plant would have to be reanalyzed based on actual transients and the limiting component would be a function of these actual transients plus those that would be expected throughout the remainder of the plant's life.

It is important to recognize that usage factors below 1.0 represent design margin in the plant design. Any change that increases the frequency of transients causes a decrease in this margin whether the actual limit is reached or not. Therefore, steps (such as raising the high pressure trip setpoint, etc.) should be considered to reduce the trip frequency thereby improving design and safety margins.

TABLE 1 - EFFECT OF REVISED SET-POINTS

AND ANTICIPATORY REACTOR TRIP ON TRIP FREQUENCY

PLANT	DATE COMMERCIAL	CALENDAR TIME (DAYS)	NO. OF TRIPS		TRIP FREQUENCY (TRIPS/MO.)		DATE CRITICAL WITH NEW SET-POINTS	CALENDAR TIME (DAYS)	NO. OF TRIPS		TRIP FREQUENCY (TRIPS/MO.)	
	PRE-TMI-2							POST-TMI-2				
			A	B	A	B			A	B	A	B
OCONEE-1	7-15-73	2082	31	52	.45	.76	5-18-79	125	2	4	.49	.97
OCONEE-2	9-9-74	1661	9	28	.16	.51	6-3-79	109	2	3	.56	.84
OCONEE-3	12-16-74	1563	17	27	.33	.53	--	--	-	-	-	-
DAVIS-BESSE 1	11-21-77	492	5	23	.31	1.42	7-11-79	93	2	2	.65	.65
CRYSTAL RIVER 3	3-13-77	745	8	28	.33	1.14	7-29-79	57	5	5	2.67	2.67
RANCHO SECO	4-17-75	1441	4	16	.08	.34	4-22-79	185	3	5	.49	.82
ARKANSAS	12-19-74	1560	6	24	.12	.47	6-20-79	120	2	2	.51	.51
TMI-1	9-2-74	1668	3	6	.05	.11	--	--	-	-	-	-
TMI-2	12-30-78	88	1	3	.35	1.04	--	--	-	-	-	-
TOTAL	--	11,300	84	207	.23	.56	--	689	16	21	.71	.93

A - considers only high pressure, FW upset, and turbine trip events (pre-TMI-2 trips exclude LOFW)

B - considers all trips

$$\text{Trip frequency (trips/mo.)} = \frac{\text{No. of Trips}}{\text{Calendar Time (days)}} \times \frac{365.25 \text{ days}}{12 \text{ months}}$$