LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4)

Manual Reactor Trip on Loss of Normal Feedwater Due to Unknown Condensate/Feedwater Transient

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MON	DAY	YR	YR	SEQUENTIAL NUMBER	REVISION NUMBER	MON	DAY	YR	FACILITY NAME	DOCKET NUMBER
07	02	97	97	- 0 0 3 -	0 1	09	19	97		

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)	
1	X	10 CFR 50.73(a)(2)(iv)
POWER LEVEL (10)		OTHER
1 0 0	(SPECIFY IN ABSTRACT BELOW AND IN TEXT, NRC FORM 366A)	

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER	
	AREA CODE	
Vickie A. Backman - Senior Regulatory Services Engineer	805	545-4289

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRPDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRPDS
X	S D	C N V	L 1 3 0	No					

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MON	DAY	YR
[ ] YES (If yes, complete EXPECTED SUBMISSION DATE)	[X] NO				

ABSTRACT (16)

On July 2, 1997, at 0456 PDT, with Unit 2 in Mode 1 (Power Operation) at 100 percent power, a manual reactor trip was initiated due to a trip of both main feedwater pumps (MFWPs). A 4-hour, non-emergency report was made to the NRC, in accordance with 10 CFR 50.72(b)(2)(ii) at 0853 PDT.

On July 2, 1997, at 0452 PDT, a condensate/feedwater system transient initiated an automatic start of the standby condensate and booster pump set. Approximately 4 minutes later, low condensate flow and increasing MFWP demand resulted in condensate flashing and an overspeed trip of both MFWP steam driven turbines. The overspeed trip of both MFWP turbines resulted in a loss of normal feedwater. Plant operators manually tripped the reactor.

An event response plan (ERP) was initiated to investigate the cause of the event and implement immediate corrective actions to return Unit 2 to Mode 1. ERP actions included verification of proper operation of condensate system components and additional system monitoring during the Unit startup.

Due to the unknown root cause of this event, no corrective action to prevent recurrence could be identified. PG&E believes that a failure of a condensate system control valve coincident with an unknown rapid reduction in condenser vacuum resulted in the loss of main feedwater.

This revision is submitted to identify the contributory causes and add a conclusion regarding the cause of this event in Section III.

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I. Plant Conditions

Unit 2 was in Mode 1 (Power Operation) at approximately 100 percent power.

II. Description of Problem

A. Summary

On July 2, 1997, at 0456 PDT, plant operators initiated a manual reactor trip on loss of normal feedwater due to independent automatic overspeed tripping of both main feedwater pumps (MFWPs). A 4-hour, non-emergency report was made to the NRC, in accordance with 10 CFR 50.72(b)(2)(ii) at 0853 PDT.

B. Background

The condensate system [SD] provides suction to the MFWPs, as well as cooling to the main turbine generator (TG) coolers, the gland steam condenser (GSC), and steam jet air ejector (SJAE) condensers. A flow bypass line balances the system in response to the TG hydrogen cooling gas temperature, GSC and SJAE flow demand, and main feedwater (MFW) requirements (see attached "Condensate System" diagram).

Condensate pump discharge flow is distributed between the three parallel major flow paths and is controlled by three valves. The primary flow control is provided by a temperature control valve (TCV-23) in the bypass line, which reacts to TG hydrogen cooling gas temperature inputs. The secondary flow control is provided by a flow control valve (FCV-31) that responds to maintain a nearly constant GSC and SJAE condenser flow. The third valve (FCV-30) opens to maintain a minimum GSC and SJAE flow.

C. Event Description

On July 2, 1997, at 0452 PDT, an automatic start of the standby condensate and booster pump set alarm was received in the control room (CR). Plant operators observed decreasing MFWP suction pressure, degraded condenser vacuum, and a reduction in main TG electrical output.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

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TEXT

On July 2, 1997, at 0452 PDT, MFW flow control valve (FCV-520) to Steam Generator (SG) 2-2 transferred to manual mode in the full open position consistent with design due to a momentarily high MFW flow condition following the condensate pump and booster pump start. Plant operators responded to the CR alarm and confirmed FCV-520 manual control mode. A load reduction was initiated. MFWP suction pressure and condenser vacuum continued to degrade and an order was given to increase the electrical load reduction rate.

On July 2, 1997, at 0456 PDT, MFWPs 2-1 and 2-2 tripped on mechanical overspeed trip device actuation due to flashing of condensate in the MFW suction line caused by low suction pressure and high MFW flow demand.

On July 2, 1997, at 0456 PDT, a Unit 2 manual reactor trip was initiated at the shift foreman's order. Plant operators entered Emergency Operating Procedure (EOP) E-0, "Reactor Trip or Safety Injection," transitioned to EOP E-0.1, "Reactor Trip Response," and confirmed proper equipment actuation.

On July 2, 1997, at approximately 0515 PDT, plant operators stabilized the Unit in Mode 3 (Hot Standby) at normal operating pressure and temperature.

On July 2, 1997, at 0853 PDT, a 4-hour, non-emergency report was made to the NRC, in accordance with 10 CFR 50.72(b)(2)(ii). Event Response Plan (ERP 97-03) was initiated to investigate the cause of the event and implement immediate corrective actions to return Unit 2 to Mode 1. ERP actions included verification of proper operation of condensate system components and additional system monitoring during the Unit startup.

On July 5, 1997, Operations Department personnel reviewed the additional system monitoring data, identified intermittent erratic flow of the condensate system and requested technical maintenance perform additional investigation of TCV-23 control loop response.

On July 10, 1997, a suspect module in the TCV-23 positioner control was replaced. Technical maintenance personnel confirmed the failure of a voltage to pneumatic (E/P) converter (TM-3) utilized for TCV-23 position control under test conditions. The TM-3 failure would cause an intermittent large position change demand to TCV-23 in response to small input changes.

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D. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

E. Dates and Approximate Times for Major Occurrences

1. July 2, 1997, at 0452 PDT: An automatic start of the standby condensate and booster pump set alarm was received in the control room.

2. July 2, 1997, at 0452 PDT: FCV-520 was confirmed in manual and a TG load reduction initiated.

3. July 2, 1997, at 0456 PDT: MFWP 2-1 and 2-2 tripped due to mechanical overspeed trip actuation.

4. July 2, 1997, at 0456 PDT: Event/discovery date: A manual reactor trip was initiated due to a loss of normal feedwater.

5. July 2, 1997, at 0515 PDT: Plant operators stabilized the Unit in Mode 3.

6. July 2, 1997, at 0853 PDT: A 4-hour, non-emergency report was made to the NRC, in accordance with 10 CFR 50.72(b)(2)(ii). An ERP was initiated for the event.

F. Other Systems or Secondary Functions Affected

None.

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G. Method of Discovery

The event was immediately apparent to plant operators due to alarms and indications received in the CR.

H. Operator Actions

Licensed plant operators responded to alarms and indications in the CR in accordance with established plant procedures and conservatively initiated a manual reactor trip (RT). Plant operators confirmed the RT, verified proper engineered safety feature actuation, and initiated manual actions to stabilize the Unit in Mode 3.

I. Safety System Responses

1. The RT breakers [AA][BKR] opened.

2. The main turbine [TA][TRB] and generator [TB][GEN] tripped.

3. The control rod drive mechanisms [AA][DRIV] allowed the control rods to drop into the core.

4. Both motor driven auxiliary feedwater (AFW) pumps [BA][P] and the turbine driven AFW pump started automatically on low-low SG water level.

5. Diesel Generator 2-2 [EK][DG] started on momentary bus undervoltage due to light bus loading conditions, but by design did not close onto its 4 kV bus since startup power was available.

III. Cause of the Problem

A. Immediate Cause

A condensate/feedwater system transient reduced the condensate system flow and pressure provided to the MFWP suction. Increasing MFWP flow demand due to decreasing SG levels further reduced condensate system pressure. The continued low condensate flow and increasing MFW demand condition, resulted in condensate system pressures below the saturation point, causing flashing and MFWP turbine overspeed trip actuation.

B. Root Cause

The root cause of this condensate/feedwater transient event is unknown.

Because no definitive initiating event was identified based upon an extensive review of available data, ERP 97-03 required added instrumentation of the condensate/feedwater system to verify proper operation during the restart of the Unit.

During the Unit startup, Operations Department personnel reviewed the additional system monitoring data, identified intermittent erratic flow of the condensate system and requested that technical maintenance perform additional investigation of TCV-23 control loop response.

Subsequently, technical maintenance personnel replaced the voltage to pneumatic (E/P) converter TM-3 in the TCV-23 position control circuit. Bench testing confirmed that the TM-3 failure could intermittently cause a large position change demand to TCV-23 in response to small input changes. No other significant component failures were identified.

Following restart of the Unit, the control loop parameters of TCV-23 and FCV-31 were revised to provide a more stable condensate and feedwater system response at normal full power operating conditions.

Conclusion:

There were two significant initial plant conditions; a rapid reduction in condenser vacuum and condensate/feedwater system pressure.

PG&E believes that an unknown condenser vacuum transient initiated a small demand change to TCV-23. Due to an intermittent failure mechanism, TCV-23 moved inappropriately. A plant simulator scenario with the condensate/feedwater system modeled for pretrip conditions, resulted in an unrecoverable transient similar to this event when a flow upset was introduced.

The cause of the condenser vacuum transient is unknown. Simulator modeling supports a conclusion that the transient was within the plant process system capabilities, without this additional equipment malfunction.

C. Contributory Cause

Various condensate/feedwater system control parameters were found to be unstable when challenged by a flow disturbance due to the cumulative effect of the following:

1. Manual throttling of condensate system valve (CND-2-165), downstream of SJAE condenser, was performed in the past to cause TCV-23 to operate further open. The higher system resistance may have resulted in significantly lowering suction pressure provided to the condensate booster pumps during transient conditions. Based upon operations simulator runs, inappropriate closing of TCV-23 or FCV-31, or opening of FCV-30 in response to a transient condition, would further lower MFWP suction pressure.

2. Condensate system control loops for TCV-23 and FCV-31 were not optimally adjusted for full load stability following a major condensate system maintenance outage performed during 1994. The Unit 1 condensate system valve controls had required full power adjustment following similar maintenance, however; Unit 2 did not exhibit the same instability upon initial return to full power, so no adjustments were considered to be required.

IV. Analysis of the Event

An RT due to a loss of normal feedwater is a previously analyzed Condition II event described in the Final Safety Analysis Report (FSAR) Update, Section 15.2.8, "Loss of Normal Feedwater." The FSAR Update analysis concludes that a loss of normal feedwater does not adversely affect the core, the reactor coolant system (RCS), or the steam system since the AFW capacity is such that RCS cooling is maintained. This event is bounded by the loss of normal feedwater analysis with automatic RT event presented in the FSAR. The plant operator manual RT is a conservative action initiated in accordance with plant procedures.

Therefore, the health and safety of the public were not adversely affected by this event.

V. Corrective Actions

A. Immediate Corrective Actions

PG&E initiated ERP 97-03 to investigate the cause of the event and document the immediate corrective actions required to return the Unit to Mode 1.

B. Corrective Actions to Prevent Recurrence.

Due to the unknown root cause of this event, no corrective actions to prevent recurrence could be identified.

VI. Additional Information

A. Failed Components

Leeds and Northrup Co. - Converter (PAT to Pneumatic) - Part # 10973-3

B. Previous LERs on Similar Problems

LER 2-97-002-00, "Reactor Trip on Low-Low Steam Generator Water Level Following the Failure of Main Feedwater Pump 2-1 Due to Mechanical Problems," reported an automatic RT due to MFWP failure. Corrective actions included flushing the MFWP 2-1 lube oil system, replacing oil filters, minimizing water contamination sources, and predictive maintenance systems improvements to ensure proper operation of the MFWP control oil system. The corrective actions of this LER would not have prevented this event due to the unrelated MFWP trip initiation mechanism.

LER 1-96-008-00, "Manual Reactor Trip on Loss of Normal Feedwater Due to Personnel Error," reported a RT resulting from a load transient bypass (LTB) control system actuation. Corrective actions included revision of plant operator and technical maintenance training regarding removing equipment from service for maintenance. The corrective actions of this LER would not have prevented this event due to the unrelated LTB initiation mechanism.

LER 1-95-015, "Manual Reactor Trip Due to Loss of Feedwater Due to Design Deficiency," reported a manual RT due to a MFWP trip on high

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discharge pressure. Corrective actions included replacing a failed speed probe, inspection of speed probes for both Units 1 and 2 MFWPs, and review of the event with maintenance personnel. The corrective actions of this LER would not have prevented this event due to the unrelated speed probe failure initiation mechanism.

CONDENSATE SYSTEM