NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Trojan Nuclear Plant	0 5 0 0 0 3 4 4	1 OF 0 4

TITLE (4)

Reactor Trip Resulting From Unit Auxiliary Transformer Cooling Failure

EVENT DATE (5)			LER NUMBER (6)				REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR		SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
										N/A	0 5 0 0 0
0 7	2 0	8 5	8 5	—	0 0 9	— 0 0	0 8	1 9	8 5		0 5 0 0 0

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	1 0 0	20.402(b)	20.405(c)	X 50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
S. A. Bauer, Onsite Regulation Engineer	AREA CODE 5 0 6 — 5 5 6 — 3 7 1 3

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
B	I M	R L Y	E 0 9 0	Yes							

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

ABSTRACT

On July 20, 1985, the reactor was in Mode 1 at 100% power. At 0707 PDT, the reactor tripped following a turbine trip which was caused by a generator lockout and trip from high temperature on the unit auxiliary transformer. The Reactor Protection System and plant safety systems functioned as designed with the exception of the diesel-driven auxiliary feedwater pump which tripped on low suction pressure after its automatic start. After repairing the transformer and retesting the auxiliary feedwater system, a reactor startup was conducted. When the severity of a condenser tube leak which had initiated during the trip was recognized, the reactor was shut down and main condenser vacuum broken.

Corrective action was taken to repair the defective unit auxiliary transformer cooling fan connector which led to the overheating and to resolve the auxiliary feedwater pump suction trip problem.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

DESCRIPTION OF EVENT

On July 20, 1985, the plant was operating in Mode 1 at 100% power, steady state. The average coolant temperature was 585°F and Reactor Coolant System (RCS) pressure was 2,235 psig. At 0707, a generator lockout from the unit auxiliary transformer occurred which caused a turbine trip and a subsequent reactor trip. The unit auxiliary transformer overheated as a result of a short in a cooling fan connector which caused a trip of the entire cooling system rather than a selective trip of the individual fan. Without the cooling unit, the temperature of the unit auxiliary transformer rose and actuated the high temperature sensor. Due to a failed relay, no alarm was received in the Control Room. A unit auxiliary transformer high winding temperature indication was received in the Control Room on the plant computer at 0701, but went unnoticed because no audible alarm was received.

After the plant trip, the auxiliary feedwater (AFW) pumps received a signal to automatically start. Both pumps started, but the diesel AFW pump tripped on low suction pressure during the starting sequence. The operator blocked the diesel AFW pump low suction pressure trip after ensuring conditions for doing so were met, and restarted the pump. After the restart, the turbine AFW pump tripped on low suction pressure (approximately three to five minutes later). The operator throttled down the AFW pump discharge valves and restarted the turbine AFW pump satisfactorily.

The low suction pressure trips for the AFW system were inspected and determined to be set properly. The operators then verified the position of the AFW discharge throttle valves since the valve controllers for these valves were replaced during the outage. This position ensures the required flow is available to the steam generators while minimizing the Net Positive Suction Head (NPSH) requirements for the pumps. The position of the throttle valves was verified and the AFW pumps were automatically started. Both pumps started and ran properly with the Condensate Storage Tank (CST) level at 78%.

At 1300, during recovery from the trip, the on-shift chemistry technician noted indications of a 'B' train circulating water leak into the 'C' condenser. The severity of the condenser tube leak was not apparent to the technician or the Control Room operators. With the unit auxiliary transformer repaired and the AFW system retested, a reactor startup was conducted. When the severity of the condenser tube leak was discovered the reactor was shutdown and main condenser vacuum broken. The condenser tube leak was repaired.

CAUSE OF OCCURRENCE

The unit auxiliary transformer overheated because a cooling fan connector shorted and caused a trip of the main cooling unit. The cooling fan connector shorted as a result of water leaking into an electrical coupling. Water had been sprayed on the transformers to provide additional cooling in the hot weather. The electrical coupling should have been watertight, but was not. The individual fan failure caused the main cooling unit to trip due to a design deficiency in the selective tripping scheme. A failed relay was found to be the cause of the high temperature alarm not being received in the Control Room.

On Monday, July 22, 1985, the AFW pumps were retested. The diesel AFW pump tripped on low suction pressure during this test. Periodic Operating Test (POT) 5-3, "AFW System Performance and Valve Inservice Test," was again performed to verify the positions of the discharge valves. A deviation to POT 5-3 was written to test the AFW automatic start with the throttle valves in the maximum and minimum positions corresponding to the high and low limit switches for the SI Panel status lamp indication. Both low suction pressure trips were blocked while the pumps were started.

A temporary plant test (TPT-143) was written to perform six starts of the AFW pumps. The CST level was to be maintained at 75% for all tests. On the first test, the diesel AFW pump tripped on low suction pressure. The test was rerun with the CST level at 80% and the diesel AFW pump again tripped. CST level was increased to 83% and the test start was performed satisfactorily three times. The fourth test failed when the diesel AFW pump tripped on low suction pressure. The low suction pressure trip for the diesel AFW pump was then blocked in order to determine the duration of the low suction pressure condition. When the test was performed, the turbine AFW pump tripped on low suction pressure.

The cause of the AFW pump low suction pressure trips was discovered to be a design deficiency in the application of the pump speed controllers. The AFW pump speed controllers are set to establish an AFW pump discharge pressure 100 psi greater than the steam generator pressure. The differential pressure transmitter which senses the differential pressure between the pump discharge and the steam generator will output a 4-20 mA signal corresponding to a 0-100 psid differential pressure (0 psid = 4 mA, 100 psid = 20 mA). This transmitter is limited to a maximum 20 mA output signal. The differential pressure setpoint controller outputs a 20 mA signal equivalent to the desired differential pressure of 100 psid. When the AFW pumps start, the discharge pressure normally overshoots the desired 100 psid. When the overshoot occurs, the differential pressure transmitter continues to output the maximum signal of 20 mA. Since this output corresponds with the desired setpoint, the pump receives little or no signal to reduce speed and therefore, to reduce discharge pressure. Depending on the starting conditions, the pump could stabilize at or above the desired 100 psid differential pressure. The higher the differential pressure reached during the overshoot, the greater the pump flow and thus the lower the pump suction pressure. It was during the overshoot period that the suction pressure dropped below atmospheric and the low suction pressure trips were actuating.

CORRECTIVE ACTION

The shorted fan connector on the unit auxiliary transformer was repaired and the failed relay was replaced. The selective tripping scheme for the cooling fans has been evaluated and the breakers involved will be modified.

The controllers for both the turbine and the diesel AFW pumps were respanned such that the 4-20 mA transmitter range corresponds to a differential pressure of 0-200 psid rather than 0-100 psid. This change resulted in the desired 100 psid

differential pressure equating to 12 mA from the differential pressure transmitter and the setpoint controller. When the discharge pressure overshoots the 100 psid value, there is now a differential between the differential pressure transmitter output and the setpoint controller which results in a smaller overshoot and a faster return to the desired setpoint.

After the change was made to the AFW pump speed controllers, additional testing was performed with the CST level as low as 60%. Data from these tests showed the AFW pump suction pressure was still subatmospheric for a short period during the diesel AFW pump overshoot. The length of time the low pressure condition exists was determined (varied between 13 and 18 seconds) and the time delay relays for bypass of the low suction pressure trips were adjusted. The turbine AFW pump time delay was unchanged at 7.5 seconds and the diesel AFW pump time delay was reset to 25 seconds (originally 10 seconds). The manufacturer of the pumps has indicated the pumps can run with no suction source for 30 seconds without damage.

An administrative control has been implemented to maintain CST level at 60% or greater.

SIGNIFICANCE OF OCCURRENCE

This occurrence had no effect on plant or public safety. The reactor shutdown systems actuated as required with the exception of the diesel AFW pump. The turbine AFW pump was available and operating and the diesel AFW pump could be restarted. The low suction pressure trips were installed to protect against a loss of the suction source, but were tripping under conditions acceptable from a pump design standpoint. The manual overriding of the low suction pressure trip and pump restart were performed within minutes of the event and there was no significant loss of AFW capability.

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US Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

Licensee Event Report No. 85-09 is attached.

Sincerely,

W. S. Orser
General Manager

SB cse
WSO/SAB:bb
Attachment

c: Distribution
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