NRC Form 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/200

LICENSEE EVENT REPORT (LER)

(See reverse for number of digits/characters for each block)

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TITLE (4)
Non-Conservative Degraded Voltage Trip Setpoint

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 NAME	DOCKET NUMBER
									N/A	05000
06	22	98	1998	015	01	11	25	98	N/A	05000

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (Check one or more) (11)							
POWER LEVEL (10)	100		20.2201 (b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
			22.2203(a)(1)		20.2203(a)(3)(i)	X	50.73(a)(2)(ii)(B)		50.73(a)(2)(x)
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
			20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
			20.2203(a)(2)(iii)		50.36(c)(1)	X	50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Kristin R. DiCroce - Senior Regulatory Affairs Engineer	(508) 830-7667

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

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 15 single-spaced typewritten lines) (16)

On June 22, 1998, during a review of the operating characteristics of the degraded voltage logic and overcurrent relays, engineers identified a potential low voltage condition, coincident with a loss-of-coolant accident, that may cause the core spray pump motors to fail to start, contrary to that assumed in the design basis accident analysis.

The cause was attributed to a deficiency in the original design of the degraded voltage protection system. Immediate corrective actions were taken to ensure that safety related components will operate within their design limits during degraded voltage conditions. Planned long-term corrective actions include a review of the design basis and operational requirements of the loss-of-voltage and degraded voltage logic and evaluation of their ability to satisfy degraded voltage design criteria.

This condition was identified while at 100 percent reactor power with the reactor mode selector switch in the RUN position. The reactor vessel pressure was approximately 1034 psig with the reactor water temperature at the saturation temperature. This report is submitted in accordance with 10 CFR 50.73(a)(2)(ii)(B) and 50.73(a)(2)(v). The condition posed no threat to public health and safety.

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REASON FOR SUPPLEMENT

This supplemental report is submitted to correct a statement in the SAFETY CONSEQUENCES and to provide a status of corrective actions. In SAFETY CONSEQUENCES, the words "an accident causing" were removed, because the source of the plant trip is not specified when calculating the number given.

BACKGROUND

The Pilgrim Station 4160V Auxiliary Power Distribution System (APDS) is designed to operate for a short time at degraded voltage levels to ensure (1) the condition is not a temporary reduction due to large load additions or 345Kv transmission system grid transients that depress APDS voltage and that (2) periods of undervoltage or degraded conditions are not so long that equipment could be damaged. These design factors, coupled with the need to ensure the availability and timely operation of safety-related equipment and systems, form the existing relay settings. The delay is a function of the bus voltage level (i.e., the lower the voltage, the shorter the time the system stays connected to a degraded power source). In the event of a loss-of-coolant accident (LOCA), the safety-related buses would be transferred from the Unit Auxiliary Transformer (UAT) to the Startup Transformer (SUT). If a sustained degraded voltage condition persists for a maximum of 10.6 seconds, load shedding would begin and the emergency buses would be transferred to the on-site power source (Emergency Diesel Generators).

Technical Specification Tables 3.2.B and 3.2.B.1 require that, during a degraded voltage condition, the SUT trip delay setting be set to 10.24 (+/-0.36) seconds. The degraded voltage time delay was initially set at 9.2 seconds based on the starting requirements of the largest motor.

The degraded voltage setpoint is approximately 3878V or 93 percent of normal voltage. The voltage at which the loss-of-voltage relays provide coordination with the core spray (CS) pump overcurrent relay is approximately 2940V or 71 percent of normal voltage. Therefore, a window exists between these two values where the CS pump motor current relay may trip prior to transfer from the offsite power source.

On June 22, 1998, during an engineering review of the operating characteristics of the loss-of-power relay and the CS pump overcurrent, engineers identified a potential low voltage condition that, coincident with a LOCA, could cause the CS pump motors to trip. Problem Report (PR) 98.9335 documents this discovery.

On June 25, 1998, an engineering evaluation (EE 98-0054) was performed to show that at a degraded voltage (between approximately 71 and 80 percent of the CS pump motor starting voltage), the CS pump overcurrent relay could trip prior to the transfer from the preferred source. If the degraded condition continued, the SUT feeder breakers to the emergency buses would trip and the Emergency Diesel Generators (EDGs) loading sequence would start; however, this feeder breaker trip will occur after the CS pump(s) tripped on overcurrent.

After an overcurrent trip, which is annunciated and displayed in the main control room, an operator would be required to manually restart the CS pump by placing the pump control switch in the STOP position, and then in the START or AUTO position.

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A preliminary review showed that the coordination between the original loss-of-voltage relay and CS pump motor overcurrent protection did not consider a prolonged degraded voltage condition. The logic was designed for loss-of-voltage which would have resulted in the loss-of-voltage relay tripping before the CS pump overcurrent relay tripped on locked rotor current. Therefore, the transfer of the safety-related loads from the degraded off-site power system to the on-site emergency AC distribution system would have occurred prior to the tripping of the core spray pump overcurrent relay.

The degraded voltage logic was designed to prevent prolonged operation at an unacceptable voltage level; however, the logic associated with the CS pumps was inadequate because it did not consider the interrelationships between degraded voltage and motor overcurrent protection. The response time of the CS pump overcurrent relay, just below the minimum motor starting voltage of 80 percent rated voltage, is approximately 8.0 seconds. The response times of the loss-of-voltage relay and the CS pump overcurrent relay intersect at 8.8 seconds or 71 percent of rated voltage. Thus, the area of concern is between approximately 8.0 and 8.8 seconds where the overcurrent relay dominates.

The Eastern REMVEC Low Voltage Guide (the "Guide") requires REMVEC to notify PNPS anytime the PNPS switchyard voltage could potentially drop below 342 kV. REMVEC monitors the PNPS switchyard continuously to ensure the switchyard voltage remains within its normal range of 355 to 358 kV. In addition, REMVEC uses a stability program to review system generation, loading, and line availability to determine if a loss of a critical generator (including PNPS) could result in a system voltage below the minimum PNPS voltage requirements. The program used for these studies alarms anytime the PNPS switchyard voltage could drop below the 342 kV level due to any contingency.

Should the program alarm, REMVEC will contact Pilgrim Station's Control Room in accordance with the Guide. Upon notification, remedial action will be taken in accordance with Operations procedure 2.4.144, "Degraded Voltage." Simultaneously, REMVEC would take corrective action to improve the grid stability.

Operations procedure 2.4.144 instructs operators to start both EDGs and connect them to the emergency buses. The UAT or SUT breakers supplying the emergency buses are opened and the emergency buses are supplied independent of the off-site power source. In the event of a LOCA with the EDGs connected to their associated safety bus and offsite power disconnected, the expected plant response is bounded by the accident analysis.

EVENT DESCRIPTION

On June 22, 1998, during an engineering review of the operating characteristics of the loss-of-power relay and the CS pump overcurrent, engineers identified a potential low voltage condition that, coincident with a LOCA, could cause the CS pump motors to trip. Subsequently, the Operations Department declared the degraded voltage protection system operable based on a verbal recommendation from the Engineering Department. A problem report, PR 98.9335, was written to document this discovery.

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The NRC Operations Center was notified in accordance with 10 CFR 50.72(b)(1)(ii)(B), on June 22, 1998, at 2050 hours.

On June 26, 1998, an engineering evaluation (EE 98-0054) was finalized recommending that operations declare the system operable.

This condition was identified while at 100 percent reactor power with the reactor mode selector switch in the RUN position. The reactor vessel pressure was approximately 1034 psig with the reactor water temperature at the saturation temperature.

CAUSE

The cause of the problem was an inadequate original design of the degraded voltage protection system.

CORRECTIVE ACTION

On June 24, 1998, the Operations department issued a standing order (SO 98-09) requiring operators to contact REMVEC once per shift to verify the Eastern REMVEC Low Voltage Guide is being implemented to ensure the transmission system/switchyard voltage will remain above 342 Kv. This interim action may be discontinued after the completion of corrective actions to be taken.

Corrective actions to be taken (RC 98.2097, RC 98.2096):

- review the design basis and operational requirements of the loss-of-voltage and degraded voltage logic; and
- evaluate the ability of the existing design logic to meet the competing design criteria of (1) staying connected to the preferred power source and (2) ensuring that adequate power is available in the event of loss or degradation of the preferred source (345Kv). The evaluation will include but is not limited to a review of the loss-of-voltage and degraded voltage relay voltage and relay settings, grid stability and response characteristics, motor starting characteristics, and system and motor overcurrent protection.
- The results of the analysis and evaluation will be used as the basis to implement relay setting changes and/or logic circuit modifications. It is expected that the necessary modifications will be implemented by the end of the next refueling outage (i.e., Refueling Outage 12).

STATUS OF CORRECTIVE ACTIONS:

Duke Engineering & Services was selected to perform the engineering analysis. Based on the preliminary results, design modifications and supporting calculations are being prepared.

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SAFETY CONSEQUENCES

The condition posed no threat to public health and safety.

No component or system failure occurred as a result of the condition.

As previously discussed, existing precautions will anticipate in advance the possibility of a degraded voltage condition so that the safety buses can be powered by the associated emergency diesel generator and then be disconnected from the offsite power supply. These steps ensure that in the event of a LOCA, the expected plant response will be bounded by the accident analysis.

The probability of occurrence of a plant trip and a coincident degraded voltage condition is extremely low (calculated to be approximately 1.694E-9/year - even less with compensatory measures) and substantially below the 1E-6/year threshold for plant design scenarios prescribed by ANSI/ANS-52.1-1983, "Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants." Although the probability of occurrence is extremely low for a LOCA and a degraded voltage condition that causes a failure of the Core Spray pumps to start, as described below, the consequences of such a failure scenario is outside the plant design basis accident analysis.

The PNPS LOCA analysis may be affected by the degraded voltage condition described in this report. The two most limiting single failures are the battery failure and the low pressure coolant injection (LPCI) valve failure. The effect of one or more CS pumps failures on the limiting LOCA scenarios is described below.

This report is submitted in accordance with 10 CFR 50.73(a)(2)(ii)(B) and 50.73(a)(2)(v).

Battery Failure

In the current LOCA analysis, if a battery failure occurs, one CS pump starts and delivers the required flow within approximately 30 seconds and two LPCI pumps start and deliver the required flow within approximately 50 seconds to restore and maintain core cooling. If the CS pump fails to start during a LOCA because of the feeder breakers trip due to a sustained low voltage and overcurrent, the contribution to the core cooling flow, that is provided by the CS pump, will be delayed for a few minutes until operators diagnose the cause of the trip and take manual action to start the pump. A delay of a few minutes in restoring the core cooling flowrate may cause the peak clad temperature (PCT) to exceed the temperature limits specified in 10 CFR 50.46. However, this scenario is less limiting than a scenario involving a failure of the LPCI injection valve as discussed below.

LPCI Injection Valve Failure

The limiting design basis event in the LOCA analysis (DBA-LOCA) assumes a failure of the LPCI valve, and assumes that both CS pumps start and deliver the required flow within approximately 30 seconds to restore and maintain core cooling. In this limiting scenario, CS pumps are the only source of water for core cooling. If both CS pumps fail to start during a DBA-LOCA because of feeder breakers trip(s) caused by sustained low voltage and overcurrent, core cooling will be delayed for a few minutes until operators diagnose the cause of the trip and take manual action to start the pump(s). A delay of a few minutes in restoring core cooling after a DBA-LOCA may cause PCT to exceed the temperature limits specified in 10 CFR 50.46.

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This report is submitted under 10 CFR 50.73(a)(2)(ii)(B) because the core standby cooling system does not meet the design basis as stated in the FSAR. This condition is also reportable under 10 CFR 50.73(a)(2)(v) because the degraded voltage condition alone would have prevented the core spray system from fulfilling its safety function following a LOCA.

SIMILARITY TO PREVIOUS EVENTS

A review of Pilgrim Station LERs submitted since 1991 was conducted based on impact of degraded voltage on electrical systems. The following related LERs were identified: LER 91-018-00, "Setpoints of Degraded Voltage Relays Too Low During Low Probability Degraded Voltage Conditions" and LER 97-015-01, "SSW Pumps Overload Settings Too Low For Single SSW Pump Operation With Degraded Voltage."

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS codes for this report are as follows:

COMPONENTS	CODES
Relay (Degraded Voltage)	RLY
Relay, Instantaneous Overcurrent	50
Relay, Tripping	94
Relay, Undervoltage	27
SYSTEMS	
Medium-Voltage Power System -- Class 1E	EB
Low Pressure Core Spray	BM