



10 CFR 50.73

BOSTON EDISON

Pilgrim Nuclear Power Station
Rocky Hill Road
Plymouth, Massachusetts 02360

Roy A. Anderson

Senior Vice President - Nuclear

April 24, 1992
BECo Ltr. 92- 047

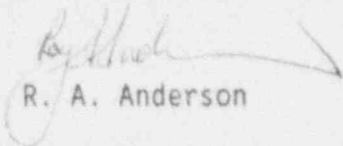
U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Docket No. 50-293
License No. DPR-35

Dear Sir:

The enclosed supplemental Licensee Event Report (LER) 90-010-01, "Completion of a Shutdown Due to One Inoperable Recirculation System Loop", is submitted in accordance with 10 CFR Part 50.73.

Please do not hesitate to contact me if there are any questions regarding this report.


R. A. Anderson

RAG/bal

Enclosure: LER 90-010-01

cc: Mr. Thomas T. Martin
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LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503

FACILITY NAME (1): Pilgrim Nuclear Power Station
DOCKET NUMBER (2): 050000293
PAGE (3): 1 OF 07

TITLE (4): Completion of a Shutdown Due to One Inoperable Recirculation System Loop

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
07	03	90	90	010	01	04	24	92	N/A
								DOCKET NUMBER(S):	
								050000	

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 50. (Check one or more of the following) (11)

OPERATING MODE (9): <input checked="" type="checkbox"/> H	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10): 100	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)(vi)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iii)	<input checked="" type="checkbox"/> 50.73(a)(2)(vii) A	50.73(a)(2)(vii)(A)	
	20.405(a)(1)(iv)	50.73(a)(2)(vi)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(vii)	50.73(a)(2)(ix)	

LICENSEE CONTACT FOR THIS LER (12)

NAME: Robert A. Gay - Compliance Engineer	TELEPHONE NUMBER: 508 747-8047
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COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRRDS
Y	AD	IRIG	GE	Y					

SUPPLEMENTAL REPORT EXPECTED (14): YES (If yes, complete EXPECTED SUBMISSION DATE) NO

EXPECTED SUBMISSION DATE (15): MONTH: DAY: YEAR:

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

On July 3, 1990 at 0500 hours, a shutdown was completed because one recirculation system loop became inoperable (drive motor trip and generator lockout) on July 2, 1990 at 0511 hours and could not be returned to service within 24 hours as required by the Facility Operating License. An Unusual Event was declared in accordance with administrative requirements at 0419 hours (when the insertion of the control rods began) and was terminated at 0503 hours. The Motor-Generator (MG) set 'A' drive motor trip and generator lockout were attributed to a generator loss-of-field, due to low generator field voltage. The low field voltage was caused by oscillations of the MG set voltage regulator (General Electric model 3S7930SA211A4). Investigation indicated the most probable cause of the voltage oscillations was a degraded voltage adjust potentiometer in the voltage regulator. The cause for the MG set 'A' incomplete startup sequence trip(s) was insufficient recirculation pump differential pressure developed during the start sequence. The control circuitry for the recirculation MG sets ('A' and 'B') was modified while shutdown. The recirculation MG sets/pumps 'A' and 'B' were satisfactorily tested prior to startup and after startup. A test procedure was performed to tune the voltage regulator. The tuning revealed that the voltage regulator is sensitive to voltage changes and speed changes. The event that led to the shutdown occurred during power operation while at 100 percent reactor power. The Reactor Vessel (RV) pressure was 1034 psig with the RV water temperature at 548 degrees Fahrenheit. This report is submitted in accordance with 10 CFR 50.73(a)(2)(i)(A) and the event and shutdown posed no threat to the public health and safety.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 500 HOURS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO: RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20545. AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1) Pilgrim Nuclear Power Station	DOCKET NUMBER (2) 0500029139	LER NUMBER (8)			PAGE 2 OF 17
		YEAR 90	SEQUENTIAL NUMBER 0110	REVISION NUMBER 01102	

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

REASON FOR SUPPLEMENT

This supplement meets the previous commitment to identify the results of the investigation regarding the impact of the modification (PDC 90-14) on the ability to restart the reactor recirculation motor generator (MG) set 'A' after the July 2, 1990 event. The investigation had not been completed when the initial report was submitted. This report also provides additional detail in the cause and corrective action sections.

EVENT DESCRIPTION

On July 3, 1990 at 0500 hours, a controlled shutdown from power was completed when the reactor mode selector switch (RMSS) was moved from the RUN position to the SHUTDOWN position while at 30 percent reactor power. This action was taken in accordance with step 8 of procedure 2.1.5 (Rev. 36) Attachment 1 section 'G', "Controlled Shutdown With One Recirculation Pump Out Of Service", and resulted in the expected Reactor Protection System (RPS) scram signal and scram. This action was taken near the end of a 24 hour Limiting Condition for Operation (LCO) for an inoperable Recirculation System loop. The resulting systems responses occurred as expected and licensed operator responses were in accordance with procedures.

Failure and Malfunction Report 90-204 was written to document the initiation of the shutdown. The NRC Operations Center was notified in accordance with 10 CFR 50.72 on July 3, 1990 at approximately 0419 hours.

The shutdown occurred when the Reactor Vessel (RV) pressure was 952 psig with the RV water temperature at approximately 539 degrees Fahrenheit.

BACKGROUND

The Reactor Recirculation System consists of two recirculation pump loops ('A' and 'B') external to the RV. The pumps provide the driving flow of water to the jet pumps that are internal to the RV. Each external loop contains one high capacity motor driven recirculation pump and two motor operated valves for pump isolation. The recirculation loops are part of the nuclear system process barrier and are located within the primary containment structure (Drywell). The recirculated coolant consists of water which has been subcooled by incoming feedwater. This water passes down through the annulus between the RV wall and the core shroud. A portion of the coolant exits from the RV and passes through the external recirculation loops ('A' and 'B') to become the driving flow for the (Loop 'A' and 'B') jet pumps. Each recirculation pump/motor is controlled by its individual motor-generator (MG) set. Each pump ('A' and 'B') motor is a variable speed, alternating current (AC), induction type motor that can drive the pump over a range of 20 percent to 102 percent of rated pump speed. The MG set, located outside the Drywell, supplies variable frequency and variable voltage power to the recirculation pump motor. Each MG set consists of an induction motor that drives a synchronous generator via a variable speed coupling (fluid drive). The generator speed is adjustable by an individual controller that functions to control the generator's output frequency and, thereby, the pump/motor speed.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATIONESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS
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REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO
THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE
OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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

Prior to the shutdown, Control Room alarms for a Recirculation System (Loop 'A') MG Set 'A' drive motor breaker trip and generator lockout occurred on July 2, 1990 at 0511 hours. This occurred while at 100 percent reactor power, the RV pressure was approximately 1034 psig with the RV water temperature at 548 degrees Fahrenheit, the MG set 'A' (and 'B') speed was at approximately 92 percent, the RV water level was at +28 inches, and the reactor core flow was approximately 69 E+06 pounds per hour. The MG set 'B' speed was not affected but reactor power decreased to approximately 65 percent due to an increased void fraction in the RV water that resulted from decreased recirculation flow. The RV water level gradually increased to approximately +34 inches due to swell (i.e., increase in the void fraction) and gradually returned to +28 inches in response to the Feedwater Control System.

Initial Control Room licensed operator response was taken in accordance with procedure 2.4.17, "Recirculation Pump(s) Trip", and a 24 hour LCO (A 90-91) began in accordance with Facility Operating License condition 3.E (Recirculation Loop Inoperable). The license requires that the plant be placed in a hot shutdown condition (RMSS in the SHUTDOWN position, no core alterations being performed, and RV water temperature greater than 212 degrees Fahrenheit) within 24 hours unless the loop is sooner returned to service. Failure and Ma function Report 90-202 was written to document the event.

Because initial investigation revealed no apparent reason for the MG set drive motor breaker trip and generator lockout, no immediate attempt was made to restart the MG set/pump 'A'. Following plant information computer (EPIC) data review and analysis by technical personnel, attempts were made to restart the MG set/pump 'A' in accordance with procedure 2.2.84, "Reactor Recirculation System". The lockout was reset on July 2, 1990 at approximately 1100 hours and prestart checks began at approximately 1400 hours. The MG set/pump 'B' speed was reduced to (slightly) less than 35 percent in accordance with procedure (2.2.84) prior to the initial restart attempt, and remained at that speed for the subsequent attempts. The initial restart attempt was made at 1550 hours and resulted in an incomplete startup sequence trip. The incomplete startup sequence trip was due to the pump's differential pressure being not greater than 1' psid for 4.5 seconds during the 20 second startup sequence interval. Subsequently, the MG set 'A' fluid drive scoop tube positioner was checked in accordance with procedure 3.M.2-15 (Rev. 7), "Scoop Tube Positioner Calibration", and the pump 'A' differential pressure instrument (DPT-261-5A) was calibrated in accordance with procedure 8.E.42 (Rev. 21), "Recirculation System Instrumentation Calibration", with satisfactory as-found results. A second restart attempt was made at 2149 hours and resulted in an incomplete startup sequence trip (pump differential pressure). A Temporary Modification (TM 90-20) for the MG set 'A' was implemented at 0344 hours. Essentially, the modification attempted to increase the stroke time of the MG set 'A' fluid drive scoop tube positioner by decreasing the voltage supplied to the field of the positioner's drive motor. At 0406 hours, the third restart attempt was made and resulted in an incomplete startup sequence trip (pump differential pressure). At 0414 hours, procedure 2.1.5 Attachment 1 Section 'G' was initiated. At 0419 hours, an Unusual Event was declared in accordance with the administrative requirements of procedure EP-IP-100 (Rev. 1) section 6.1.1.1 (initiation of a required plant shutdown) when the sequential insertion of the control rods began. The control rods were manually inserted in accordance with procedure 2.1.5 Attachment 1 Section 'G' step 4. At 0500 hours, the RMSS was moved from the

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TEXT CONTINUATION

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FACILITY NAME (1) Pilgrim Nuclear Power Station	DOCKET NUMBER (2) 015010049300-010-0101014	LER NUMBER (6)			PAGE (3)	
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TEXT (If more space is required, use additional NRC Form 366A's) (17)

RUN position to the SHUTDOWN position in accordance with procedure 2.1.5 Attachment 1 Section 'G' step 8. The Unusual Event was terminated at 0503 hours. Temporary Modification 90-20 was removed from the MG set 'A' control circuitry on July 3, 1990 after the shutdown was completed.

CAUSE

The cause for the MG set 'A' drive motor breaker trip and generator lockout, and incomplete startup sequence trip(s) was investigated by a multi-discipline task force. The task force included personnel from the Plant and Nuclear Engineering Departments, and was augmented by General Electric personnel having design and technical experience with recirculation MG set controls.

The cause for the MG set 'A' drive motor trip and generator lockout was attributed to a generator loss-of field due to low generator field voltage. The low field voltage was caused by oscillations of the MG set voltage regulator. Investigation indicated the most probable cause of the voltage oscillations was a defective voltage adjust potentiometer in the voltage regulator. Other contributing causal factors included Zener Diode 2ZD and Transformer 4T that were found not to be in optimum condition when troubleshooting of the MG set 'A' voltage regulator was performed.

The cause for the MG set 'A' incomplete startup sequence trip(s) was insufficient recirculation pump differential pressure. The differential pressure permissive was not achieved for 4.5 seconds (or greater) during the 20 second startup sequence interval. The differential pressure was insufficient because the pump, although starting during the startup sequence, was not supplied with enough torque to achieve the required speed during the startup sequence. The required torque is greater while pressurized because reactor pressure pushes the shaft upward against the upper thrust bearing. The speed control systems for MG sets 'A' and 'B' were previously modified (PDC 90-14) while shutdown during the March - April, 1990 mid-cycle outage. The impact of modification (PDC 90-14) on the ability to restart the MG set 'A' was analyzed and the modification greatly increased the speed at which the Scoop Tube positioner ramped back from its startup position. This led to less coupling and a shorter time period to break away the pump and establish the pump differential pressure. The purpose of this modification was to alleviate operating difficulties (chiefly, speed instabilities) in the speed control loops. It involved removing the error limit networks, the speed controllers, and severing the speed feedback signal. To prevent an excessive rate of change from being inserted at the Control Room manual control stations, a rate-of-change limiter ('rate limiter') was installed in each control loop immediately downstream of the manual controller. This effectively limited excessive rates of change which may have been inserted by operators. Post modification testing for PDC 90-14 was satisfactorily completed and the testing did not identify similar incomplete start-up sequence trip. Testing and evaluations were conducted by the multi-discipline task force and it was determined that the most probable cause was insufficient recirculation pump differential pressure during start-up.

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TEXT (If more space is required, use additional NRC Form 3661a) (17)

CORRECTIVE ACTION

The speed control systems of MG sets 'A' and 'B' were modified while shutdown. The modification (PDC 90-14/Field Revision Notice 90-14-11) electrically relocated the rate limiter 262-036A (and 262-038B) to the downstream side of the number 1 (one) speed limiter 262-26A (and 262-26B) within the speed control circuitry for MG set 'A' (and 'B'). This modification decreased the response time (i.e., rate of change) of the fluid drive scoop tube positioner and, thereby, increased the time the pump was near 50% speed to allow pump differential pressure to be established and maintained. The modification also included a change in the differential pressure permissive setting (from 11 psid to 2.7 psid) for each pump.

The control system(s) for MG sets 'A' and 'B' were post work tested while shutdown in accordance with procedure TP 90-62 (Rev. 0), "Pre-operational Test of Recirculation MG Set Control System". The testing began on July 9, 1990 and was completed with satisfactory results on July 10, 1990. The testing included several successful starts of the MG sets/pumps 'A' and 'B' with the RV depressurized.

The surface of the scored collector ring (outboard at the motor end) for the MG set 'A' was refurbished using a stoning process while shutdown. The finishing, performed by manufacturer's (General Electric) personnel, was conducted in accordance with procedure TP 90-61, "Recirculation A MG Set (X-204A) Uncoupled Run To Stone Collector Rings". The stoning was performed to eliminate surface scoring (observed during inspection) and, thereby, provide proper contact between the collector ring and related brushes. The brush rigging was reinstalled and the brushes properly seated. In addition, the brushes in the tachometer were inspected and found to be incorrectly installed for the direction of rotation. This condition was also corrected. A new tachometer had recently been installed during previous troubleshooting.

Oil samples were obtained from the recirculation pump 'A' motor (upper and lower bearings) while shutdown. Onsite analysis of the oil samples were performed with satisfactory results prior to startup. This action was taken to check for unusual bearing wear or possible bearing damage. Additional oil samples were obtained from recirculation pump 'A' motor during Refueling Outage No. 8. Offsite Ferrographic Analysis was performed on the oil samples and the analysis concluded the oil viscosity was lower than expected; therefore, the oil was subsequently changed.

Based on the satisfactory results of corrective actions taken while shutdown, and the planned testing (TP 90-62) after startup under controlled conditions, the unit was returned to commercial service on July 11, 1990 at 0455 hours.

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

Additional testing of the MG sets/pumps 'A' and 'B' was performed on July 11, 1990 after startup. The testing was performed with the reactor power level at approximately 35 percent, and with the RV pressure at approximately 950 psig. The tests were performed in accordance with procedure TP 90-62 (Rev. 1) section 10.4 (Pressurized Starts of Recirculation Pumps 'A' and 'B'). The MG set/pump 'B' was secured for testing at 1344 hours and a 24 hour LCO (A 90-96) began at that time. The MG set/pump 'B' was started with satisfactory results at 1407 hours and the LCO (A 90-96) was terminated at 1409 hours. The MG set/pump 'A' was secured for testing at 1421 hours and a 24 hour LCO (A 90-97) began at that time. The MG set/pump 'A' was started with satisfactory results at 1435 hours and the LCO (A 90-97) was terminated at that time. Based on the satisfactory results of the testing (TP 90-62) performed while shutdown and after startup, commercial service was continued.

Test procedure TP 90-46, "Recirculation MG Set Voltage Regulator Tuning", was partially performed to tune the voltage regulator for MG set 'A'. The purpose of the testing was to adjust the stability and gain potentiometers of the voltage regulator at selected speeds in accordance with the vendor manual. The tuning of the MG set 'A' voltage regulator began during a planned power reduction during the weekend of July 27, 1990. The results of tuning the MG set 'A' voltage regulator revealed that the regulator is sensitive to voltage changes and speed changes. During the MG set 'A' outage, the degraded voltage adjust potentiometer in the voltage regulator (General Electric model 3S7930SA211A4) was replaced. Other parts found not to be in optimum condition in the voltage regulator including the 2CB circuit board, Zener Diode 2ZD and Transformer 4T were also replaced. The silicon-controlled rectifiers (SCRs) were changed out to provide more closely-matched characteristic SCRs.

The additional equipment used for recording data on the MG set 'A' voltage regulator control circuitry was connected to the voltage regulator portion of the MG set 'A' via Temporary Modification 90-22. This temporary modification was removed during a system outage (MRI9080445) in January 1991.

SAFETY CONSEQUENCES

This event posed no threat to the public health and safety.

The Recirculation System has two safety functions: (1) to assure an adequate fuel barrier thermal margin following a recirculation pump malfunction; and (2), assure that a failure of the recirculation piping integrity does not compromise the ability of the RV internals to provide a refloodable volume. This event did not involve the integrity of the recirculation piping.

A recirculation pump malfunction is within the analysis described in the Updated Final Safety Analysis Report Chapter 14 (Station Safety Analysis). The UFSAR Chapter 14 analysis bounds the analyses in the UFSAR Appendix R that includes a trip of the recirculation pump(s), recirculation flow control failure (resulting in decreasing flow or increasing flow), and recirculation pump seizure (locked rotor).

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

This report is submitted in accordance with 10 CFR 50.73(a)(2)(i)(A) because of the completion of a required shutdown.

SIMILARITY TO PREVIOUS EVENTS

A review was conducted of Pilgrim Station Licensee Event Reports (LERs) submitted since January 1984. The review focused on LERs that involved a shutdown due to a problem with the Recirculation System (Loop 'A' or 'B'). The review identified a related event reported in LER 50-293/85-003-00.

For LER 85-003-00, a shutdown was completed on February 10, 1985 at 0040 hours in accordance with the Facility Operating License condition 3.E. The reason for the shutdown was a trip of the Recirculation System Loop 'A' pump while at 30 percent reactor power on February 9, 1985 at 0143 hours. Prior to the shutdown, recirculation pump hi/low oil level alarms occurred. [This alarm had occurred on previous occasions and, when checked during a subsequent outage, the actual oil level was satisfactory. Further investigation had shown that the alarm was the result of a false high level signal.] Based on the historical information, and because an oil check requires entry into the Drywell, the oil level was not immediately checked. Instead, and in accordance with procedure, the pump motor bearing temperature was closely monitored with no perceptible temperature increase noted until just before the pump trip. After initial investigation, an (unsuccessful) attempt was made to restart the MG set/pump 'A'. After the shutdown, entry into the Drywell revealed that the cause for the recirculation pump trip was an oil leak at the oil packing gland surrounding the cooling water inlet piping that penetrates the pump's motor housing. The oil leak resulted in a low oil level and insufficient lubrication of the pump motor's upper bearings. The damaged bearings were replaced and the oil leak was corrected.

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS Codes for this report are as follows:

<u>COMPONENTS</u>	<u>CODES</u>
Generator Set, Motor	MG
Pump	P
Regulator (Voltage Regulator)	RG
 <u>SYSTEMS</u>	
Reactor Recirculation System	AD