10 CFR 50.73

BOSTON EDISON
Pilgrim Nuclear Power Station
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BECo Ltr. 92-052

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

Docket No. 50-293
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The enclosed Licensee Event Report (LER) 92-004-00, "Three Automatic Group 1 Isolations During Plant Shutdown", 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.

Roy Anderson

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TFM/bal

Enclosure: LER 92-004-00

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NRC FORM 366 (6-89) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92
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-630), 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)	DOCKET NUMBER (2)	PAGE (3)
Pilgrim Nuclear Power Station	0 5 0 0 0 2 9 3	1 OF 0 8

TITLE (4) Three Automatic Group 1 Isolations During Plant Shutdown

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 3	2 6	9 2	9 2	- 0 0 4	- 0 0	0 4	2 7	9 2	N/A	0 5 0 0 0

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)					
POWER LEVEL (10)	0 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 366-A)	
		20.405(a)(1)(iii)	X 50.73(a)(2)(i) (B)		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
	AREA CODE
Thomas McElhinney - Senior Compliance Engineer	5 0 8 7 4 7 - 8 4 6 5

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	

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)

On March 26 and 27, 1992, three automatic Primary Containment Isolation Control System (PCIS) Group 1 isolations occurred during plant shutdown. The first and third Group 1 isolations were due to a false high Reactor Vessel (RV) water level signal. The second isolation was due to RV water level expansion (swell) when Inboard Main Steam Isolation Valve (MSIV) 203-1D was reopened following the first isolation. The actuations resulted in the automatic closing of the related Primary Containment System isolation valves. The false high RV water level signals were primarily due to improper thermal performance of the reference leg condensate chamber and head equalizing line connecting the condensate chamber to the RV. The second Group 1 isolation was due to the reactor water level being maintained slightly higher than the desired level prior to opening the MSIV. The procedure used for opening the MSIVs did not specify the desired water level. Corrective action taken included removing the insulation from the "B" head equalizing line. Additional data will be collected during plant operation and shutdown activities to help confirm the identified causes. A procedure change will be made to specify the desired reactor water level prior to opening a MSIV.

These events occurred when in the hot shutdown mode of operation with the reactor mode selector switch in the SHUTDOWN position. The reactor power level was zero percent. The RV pressures for the three events were as follows: first event, 55 psig: second event 82 psig and; third event, 10 psig. This report is submitted in accordance with 10 CFR 50.73(a)(2)(i)(B) and (a)(2)(iv). These events posed no threat to the health and safety of the public.

BACKGROUND

As discussed in the Similar Events section, false high reactor water level spiking has been noted previously during plant shutdowns. LER 50-293/90-003-00 documents a Primary Containment Isolation Control System (PCIS) Group 1 main steam line isolation due to false high reactor water level spiking that occurred during a plant shutdown on March 11, 1990. The cause was believed to be trapped air in the "B" side reactor water level instrumentation reference leg. Corrective action taken was to backfill the sensing lines with demineralized water using an approved station procedure. LER 50-293/91-08-01 discusses three PCIS Group 1 main steam line isolations during a plant shutdown on April 30, 1991. A Multi-Disciplined Analysis Team (MDAT) conducted an in-depth review of the false high reactor water level spiking. Root cause determination identified the head equalizing line connecting the condensing chamber to the reactor vessel as being undersized. A plant modification (PDC 91-40) completed during Refueling Outage (RFO) 8 increased the size of this line from 1 inch to 2 inch. Post modification testing was satisfactorily completed by pressurizing the reactor to approximately 380 psig and then depressurizing to 32 psig. This testing did not identify similar false high reactor water level spiking. The plant restarted from RFO 8 on August 11, 1991 and operated until October 30, 1991. Reactor water level perturbations were noted on the "B" reactor water level instrumentation during the plant shutdown on October 30, 1991. However, these perturbations were of less magnitude and did not result in a Group 1 isolation. A walkdown of the "A" and "B" head equalizing lines identified a difference in the insulation installed. The "A" head equalizing line had the required 2 1/2 inch insulation but the "B" head equalizing line had only 1 inch insulation. The required insulation on the "B" head equalizing line was installed.

EVENT DESCRIPTION

On March 26 and 27, 1992, three automatic PCIS Group 1 isolations occurred during plant cooldown and depressurization. The reactor had been shutdown on March 26, 1992 at 1438 hours to repair a Reactor Core Isolation Cooling (RCIC) steam inlet isolation valve as discussed in LER 50-293/92-003-00. The three Group 1 isolations are discussed separately for clarity.

FIRST GROUP 1 ISOLATION

The first automatic Group 1 isolation occurred on March 26, 1992 at 2059 hours. The RV water level was at +29 inches as indicated on control room instruments LI-640-29A and -29B. A momentary spike to +48 inches was observed on the "B" side level instrumentation while the "A" side level instrumentation remained unchanged. The high water level Group 1 isolation setpoint is calibrated at approximately +45 inches.

The Group 1 isolation signal resulted in the following designed responses. The inboard and outboard Main Steam Isolation Valves (MSIVs) closed automatically. The inboard and outboard Reactor Water Sample Valves closed automatically. The inboard Main Steamline drain valve closed automatically. The outboard Main Steamline drain valve remained open because it is controlled by the "A" side reference leg instruments only which did not actuate.

Failure and Malfunction Report 92-78 was written to document the event. This event occurred during the hot shutdown mode of operation with the Reactor Mode Selector Switch (RMSS) in the SHUTDOWN position. The reactor power level was zero percent with the control rods fully inserted. The RV pressure was approximately 55 psig.

SECOND GROUP 1 ISOLATION

The second automatic Group 1 isolation occurred on March 26, 1992 at 2129 hours. The indicated RV water level was initially at +29 inches and spiked momentarily to approximately +46 inches. The operators had reset the previous Group I isolation and were reopening the MSIVs to facilitate decay heat removal when this spike occurred. The Group 1 isolation signal resulted in the expected designed responses as described for the first event with the exception that the outboard Main Steamline drain valve closed and the inboard Main Steamline drain valve remained open since the "A" side circuitry initiated the isolation. The "B" side instrumentation also spiked but not high enough to actuate the trip units. The isolation signal was reset and the MSIVs and the Main Steamline drain valves were reopened on March 27, 1992 at 0025 hours.

Failure and Malfunction Report 92-79 was written to document this event. The NRC Operations Center was notified of the first and second Group 1 isolations in accordance with 10 CFR 50.72 on March 26, 1992 at 2240 hours. This event occurred with the RV pressure at approximately 82 psig. The RMSS was in the SHUTDOWN position.

THIRD GROUP 1 ISOLATION

The third automatic Group 1 isolation occurred on March 27, 1992 at 0545 hours. The "B" RHR pump was in the Shutdown Cooling (SDC) mode of operation with the indicated RV water level at + 29 inches. The indicated RV water level momentarily spiked to approximately +47 inches on the "B" side instrumentation. The "A" side instrumentation also spiked but not high enough to actuate the trip units. The Group 1 isolation signal resulted in the expected designed responses as described for the first event. The isolation signal was reset, the Main Steamline drains to the condenser were opened and a decision was made to leave the MSIVs closed using the RHR System for plant cooldown.

Failure and Malfunction Report 92-80 was written to document this event. The NRC Operations Center was notified of the third event in accordance with 10 CFR 50.72 on March 27, 1992 at 0620 hours. This event occurred with the RV pressure at approximately 10 psig. The RMSS was in the SHUTDOWN position.

CAUSE

A root cause analysis team was formed to investigate the cause of the false high RV water level signals and to recommend corrective actions. As discussed previously in the Background section, significant efforts have been dedicated to eliminate the false high reactor water level spiking including a major modification completed during RFO 8. The root cause team reviewed these previous efforts,as well as considering other possible causes. The teams conclusions are discussed below.

The RV water level instrumentation is connected via instrument piping to condensing chambers. The condensing chambers maintain the water level in the RV water level reference legs. The condensing chambers are connected to the RV water level nozzles via a head equalizing line. The head equalizing line is 2 inches in diameter and approximately 32 inches long. The head equalizing line provides an open path between the RV and the RV water level reference leg. The water from the condensing chambers drains back to the vessel via this line. There are two condensing chambers connected to each head equalizing line. The "A" and "B" side reference legs each have redundant instruments that provide input into both the "A" and "B" PCIC logic trains.

The first and third Group 1 isolations were initiated from Reactor Water Level trip units LIS-263-58A and LIS-263-58B. These trip units received false high RV water level signals from level transmitters LT-263-58A and LT-263-58B that are both connected via instrument piping to common condensing chamber 12B. As noted in previous shutdowns, the "B" side spiking occurred at a higher pressure and of greater magnitude than the "A" side instrumentation. The team concluded the most probable cause was improper thermal performance of the reference leg condensate chamber and its associated head equalizing line. The improper thermal performance of the condensate chamber and head equalizing line was believed to be due to insulation installed on the head equalizing line. With the insulation installed, the head equalizing line metal temperature is maintained close to the reactor vessel temperature. It is believed the following occurs during plant shutdown. When the reactor pressure is decreased, the head equalizing line temperature decrease lags and can remain above the reactor coolant system saturation temperature. The condensation in the head equalizing line rapidly vaporizes and flows towards the lower pressure reactor vessel. This extracts vapor from the condensing chamber thus reducing the pressure in the condensate chamber. This pressure reduction results in the level spiking.

It is believed the buildup of non-condensible gases in the condensing chamber may contribute to the reactor water level spiking with the following occurring. The non-condensible gases build up during normal plant operation. Eventually, equilibrium would be reached when the volume of non-condensibles transported to the condensate chamber by the steam equals that removed by the condensate flowing back to the reactor vessel. The buildup of gases in the condensing chamber can be determined by measuring the temperature difference between the top and bottom of the condensing chamber. As gases collect, the temperature difference is reduced. The temperature difference in the chamber is a function of the condensation rate. As non-condensibles collect the condensation rate is reduced thus decreasing heat transfer and steam flow to the chamber. This results in decreasing temperature differences between the top and bottom of the condensing chamber.

A review of the plant information computer traces shows trip units LIS-263-57A and LIS-263-57B tripped during the second event. Trip units LIS-263-57A and -57B receive a signal from LT-263-57A and -57B, respectively, that are connected via instrument piping to condensing chamber 12A. The computer traces also showed the "B" side instrumentation trending with the "A" side instrumentation during the second isolation but not high enough to actuate the trip units. This indicates the second Group 1 isolation was due to an actual reactor water level expansion (swell) as the operators opened the MSIVs following the first isolation. The operators were reopening the MSIVs in accordance with Procedure 2.2.92 (Rev. 24), "Main Steam Line Isolation and Turbine Bypass Valves". Section 7.1 "Opening MSIVs with Reactor Pressurized" instructs the operators to open the outboard MSIVs, equalize the main steam header and reactor pressures within 50 psig, and then open the inboard MSIVs one at a time. The operators followed the procedure and equalized pressures within 50 psig. However, the initial reactor water level was at +29 inches. Although well within the normal range, this level was higher than the desired level for opening an MSIV with the reactor pressurized. The procedure did not specify the desired level. Therefore, when the first inboard MSIV (203-1D) was opened the reactor water level expansion exceeded the trip setpoint by approximately one inch.

CORRECTIVE ACTIONS

The "B" head equalizing line insulation was removed via Temporary Modification 92-13 to improve the head equalizing line condensation. This modification is intended to allow the head equalizing line temperature to more evenly follow the moderator temperature during reactor depressurization thus reducing the vaporization occurring in the head equalizing line. Removing the head equalizing line insulation should also increase the removal of non-condensibles from the condensing chamber due to increased condensate return flow to the reactor vessel. The removal of non-condensibles will improve the condensation rate in the chamber. In order to startup and operate to demonstrate the effectiveness of this modification, a request for a Temporary Waiver of Compliance from the applicable sections of Technical Specification 3.1 and 3.2 was submitted to the NRC on April 6, 1992 (BECo letter 92-37) and supplemented on April 7, 1992 (BECo letter 92-38). This request was needed since the "B" side instrumentation was considered technically inoperable based on the magnitude of the observed spiking and technical specification instrument response and reliability criteria. The "A" side instrumentation was considered operable since the spiking occurred at lower pressures and was of less magnitude and duration. The waiver request was granted by the NRC on April 8, 1992. The plant was restarted on April 9, 1992 at 0859 hours. In order to approximate the conditions that existed when the spiking occurred, the reactor was operated at less than 15 percent until thermal equilibrium at normal pressures and temperatures was established.

Equilibrium temperatures were reached approximately ten hours after the mode switch was placed in the "Run" position. Reactor shutdown was commenced on April 10, 1992 at 1818 hours with cold shutdown achieved on April 11, 1992 at 0335 hours. The reactor water level was monitored on the plant computer during this evolution in accordance with Temporary Procedure 92-21 "Reactor Level Instrument Line Test From Rated Temperature/Pressure" (Rev. 1). TP 92-21 was completed at 0430 hours that same day. Temporary Modification (TM) 91-44 was revised to install additional resistance temperature devices (RTDs) to monitor both the "A" and "B" head equalizing lines and condensing chambers. Results of the test revealed no reactor water level spikes greater than one inch in amplitude. The "B" side reactor water level instrumentation was declared operable based on these indications and the plant was restarted on April 12, 1992. Since the collection of non-condensible gases is dependent upon the length of time the plant is operated, other actions are planned to gather more data to help confirm the root cause determination as well as potential contributing factors. Procedure 2.1.5 "Controlled Shutdown from Power" will be revised to include a step during shutdown to turn on the recorders installed via TM 91-44. Also, a method will be established to monitor and record TM 91-44 temperature data approximately each week to analyze condensate chamber performance during plant operation. Further actions, as appropriate, may be taken based on the review of this additional data.

Procedure 2.2.92 will be revised to instruct the operators to maintain a lower initial reactor water level prior to opening an MSIV with the reactor pressurized. Training on this procedure change will be conducted accordingly. This will prevent a Group 1 isolation due to the expected level expansion.

SAFETY CONSEQUENCES

These events posed no threat to the public health and safety.

The isolations were the designed response to a high RV water level signal. The PCIS provides timely protection against the gross release of radioactive materials from the fuel, nuclear system process barrier and from the primary containment. The purpose of the RV high water level isolation is to protect against rapid depressurization due to malfunction of the pressure regulator system during startup when RV pressure is below approximately 880 psig. This isolation is only in effect during a startup or a shutdown. For two of these events, a false high RV water level signal occurred and the third event was a momentary actual level expansion. The PCIS fulfilled its safety functions for each event.

Operation with the "B" side instrumentation technically inoperable would not have prevented the system from performing its safety function since the "A" side instrumentation was operable. Additionally, a conservative analysis was done assuming the "A" side instrumentation exhibited similar spiking to the "B" side instrumentation. This analysis concluded sufficient margins existed in transient and Loss of Coolant Accident (LOCA) analyses for conditions when spiking was predicted to occur. Potential delays in initiation of some Core Standby Cooling Systems or containment isolation equipment by water level instruments would not affect the ability of the combined systems to perform their safety functions assuming a single active failure. These level fluctuations had no effect on limiting Final Safety Analysis Report (FSAR) transient and accident analyses because the fluctuations did not occur above 600 psig.

This report is submitted in accordance with 10 CFR 50.73 (a)(2)(i)(B) and (a)(2)(iv) because the plant operated in this condition since startup from RFO 8 and the Group 1 portion of the PCIS logic circuitry actuated.

SIMILARITY TO PREVIOUS EVENTS

A review was conducted of Pilgrim Station Licensee Event Reports (LERs) submitted since January 1984. The review focused on LERs submitted in accordance with 10 CFR 50.73(a)(2)(i)(B) and (a)(2)(iv) that involved PCIS Group 1 actuations due to false high RV water level signals and due to opening the MSIVs with the reactor pressurized. Four similar events were identified in LERs 50-293/84-019-00, 50-293/89-007-00, 50-293/90-003-00 and 50-293/91-08-01.

LER 84-019-00 documents a Group 1 isolation signal that occurred when reactor water level indication from the "A" level instrumentation trended up to +45 inches. The cause was excess cooling in the area of the "A" reference leg. Corrective action, related to the response of Generic Letter 84-23, included installing new reference legs outside the Drywell, minimizing the vertical piping drop inside the drywell and replacing the former reactor water level instrumentation with transmitters and electronic switching devices. The installations were completed during Refueling Outage 7.

LER 89-007-00 documents a Group 1 signal due to high reactor water level during MSIV testing. The high level occurred after opening an MSIV causing an expansion (swell) of the reactor vessel water. The root cause was an inadequacy in the development and review of the approved test procedure and a relatively fast opening time for the MSIV. The procedure did not identify the affect on reactor water level when opening a MSIV with a 150 psig differential pressure. The procedure concern was dispositioned and the MSIV maintenance procedure was revised relative to the MSIV opening time range.

LER 90-003-00 documents a Group 1 isolation signal that occurred when reactor water level indication from the "B" level instrumentation rapidly increased from +25 inches to +50 incnes for approximately thirty seconds. The cause was believed to be trapped air in sensing lines. A station procedure was developed that provided the necessary instructions for backfilling. Additionally, certain surveillance procedures were revised to minimize the possibility of introducing air into the system.

LER 91-08-01 documents three Group 1 isolations that occurred on April 30, 1991 during a plant shutdown due to false high reactor water level indications. The cause was believed to be an undersized head equalizing line connecting the condensate chamber to the reactor vessel. Corrective actions taken included increasing the size of the head equalizing line from 1 inch to 2 inches. This modification was completed during Refueling Outage 8.

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

COMPONENTS	CODES
Valve, Isolation (MSIVs)	ISV
Recorder, Level	LR
Transmitter, Level	LT
Switch, Level	LIS

SYSTEMS

Containment Isolation Control System (PCIS)	JM
Engineered Safety Feature-Actuation System (PCIS)	JE
Incore/Excore Monitoring System (RV water Level)	IG