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GGC-94-080

May 11, 1994

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Reference: Quad Cities Nuclear Power Station
Docket Number 50-265, DPR-30, Unit Two

Enclosed is Licensee Event Report (LER) 93-025, Revision 01, for Quad Cities Nuclear Power Plant Station.

This report is submitted in accordance with the requirements of the Code of Federal Regulations, Title 10, Part 50.73(a)(2)(ii)(B). Any event or condition that resulted in the condition of the nuclear power plant, including its principal safety barriers being seriously degraded or that resulted in the nuclear plant being in a condition that was outside the design basis of the plant.

The following commitments are restated:

1. All MSIV's that are disassembled will have new locking devices installed during reassembly.

2. Develop a maintenance procedure for disassembly and reassembly of MSIV's.

3. Review the existing Preventive Maintenance program for MSIV's and revise as necessary to include vendor and industry experience.

If there are any questions or comments concerning this letter, please refer them to Nick Chrissotimos, Regulatory Assurance Administrator at 309-654-2241, ext. 3100.

Respectfully,

COMMONWEALTH EDISON
QUAD CITIES NUCLEAR POWER STATION

G. G. Campbell
Station Manager

GGC/TB/plm

Enclosure

cc: J. Schrage
C. Miller
INPO Records Center
NRC Region III

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LICENSEE EVENT REPORT (LER) Form Rev. 2.0

Facility Name (1)	Docket Number (2)	Page (3)
Quad Cities, Unit Two	0 5 0 0 0 2 6 5	1 of 0 6

Title (4)

A Loop Main Steam Isolation Valves Exceed Tech Spec Leakage Limits

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)
										0 5 0 0 0
1 2	0 5	9 3	9 3	-- 0 2 5	-- 0 1	0 5	1 1	9 4		0 5 0 0 0

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)				
01		20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)	
POWER LEVEL (10)		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)	
0		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)		
		20.405(a)(1)(iv)	X 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
Dale Thayer, Regulatory Assurance, Ext. 3109	3 0 9 6 5 4 - 2 2 4 1

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
D									

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)

A. ABSTRACT:

Unit 2 was in the SHUTDOWN mode at 0% power for a maintenance outage on 12/05/93 at 2300 hours at which time, during the performance of a combined Local Leak Rate Test of the "A" loop Main Steam Isolation Valves (MSIV's) [SB] [ISV], the leakage exceeded the 11.5 standard cubic feet per hour (scfh) Technical Specification limit of T.S. 3.7.A.2.e. The measured leakage was 24.8 scfh. The MSIV's are 20 inch Y-pattern globe valves, Crane Drawing DR-34289, Revision "H".

The 1A MSIV was subsequently disassembled for inspection. The cause of the excessive leakage was steam erosion on the pilot and main disc. The fasteners which retain the main valve disc to the valve stem were also found to be loose.

The apparent cause of the valve internal deficiencies was the failure of the fastener locking devices. The primary causal factors of this deficiency are inadequate MAINTENANCE/TESTING and WRITTEN COMMUNICATION which both resulted in the improper use of the fastener locking devices.

PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2511 MWt rated core thermal power.

EVENT IDENTIFICATION: A loop main steam isolation valves exceed Tech Spec leakage limits.

A. CONDITIONS PRIOR TO EVENT:

Unit: Two Event Date: December 5, 1993 Event Time: 2300

Reactor Mode: 1 Mode Name: Shutdown Power Level: 0

This report was initiated by Licensee Report 265\93-025.

SHUTDOWN (1) - In this position, a reactor scram is initiated, power to the control rod drives is removed, and the reactor protection trip systems have been deenergized for 10 seconds prior to permissive for manual reset.

B. DESCRIPTION OF EVENT:

On 12/04/93, during cold shutdown fail-safe testing of the Unit 2 inboard Main Steam Line Isolation Valves (MSIV's) [SB] [ISV], the AO-2-203-1A MSIV failed to completely close. The valve remained open approximately 1-3/4 inches. The 1A MSIV did close when air was valved back into its actuator. The fail-safe test was performed again for the 1A MSIV later on 12/04/93, with the same results. All other Unit 2 MSIV's successfully passed the fail-safe test.

On 12/05/93, Local Leak Rate Testing of the 1A and 2A MSIV's (AO-2-203-1A and AO-2-203-2A) was performed. At 2300 hours on 12/05/93, it was determined that the Local Leak Rate Test failed due to a combined leakage rate of 24.8 standard cubic feet per hour (scfh). The MSIV Technical Specification limit is 11.5 scfh for one (1) valve (T.S. 3.7.A.2.a.3).

The 1A MSIV was subsequently disassembled for inspection. An inspection of the valve internals was performed on 12/12/93, with the following results concerning the locking devices and fasteners:

All eight (8) disc plate nuts were found not to be tight. All disc plate studs were still threaded securely to the main disc, but a number of the studs appeared to be bent. One disc plate stud was broke about 1/2 inch from the top. Significant thread damage was noticed at the fractured end of the broken stud, with less thread damage on the other studs. Remains of two (2) nut locking devices were found.

A determination was made to disassemble and inspect four (4) additional MSIV's on Unit 2. After inspection of these additional valves, the decision was made to shut down Unit 1 and inspect those MSIV's even though the operability determination for Unit 1 indicated "operable, but degraded".

C. APPARENT CAUSE OF EVENT:

The apparent cause of the valve damage was the failure of the fastener locking devices due to improper use of the devices, which is believed to have contributed to excessive wear of the main and pilot seats and discs due to vibration of the loose parts. Improper use may include reuse of old locking devices, or locking devices installed, but the tabs not being properly bent, or locking devices not being installed. The primary Casual Factors related to the event were lack of proper MAINTENANCE/TESTING and WRITTEN COMMUNICATION. Information describing why these Casual Factors contributed to this event is listed below:

1. MAINTENANCE/TESTING

Improper reassembly of the component (improper use of the locking devices) was the primary cause. The work instructions contained no provisions for positive control of the installation of the locking devices.

System Materials Analysis Department (SMAD) test results were as follows:

The SMAD test report (#M-00680-94, dated 02/08/94) concludes that the 1A MSIV disc plate stud failed due to fatigue cracking.

Visual inspection of the 1A MSIV disc plate stud revealed that the stud had fractured transversely at the fourth thread root. Over 80% of the fracture surface of the stud was oxidized and flattened, probably caused by exposure to the service environment after the fracture. Due to the condition of the fracture surface, the time of failure was indeterminate. Remnants of beach marks (crack arrest marks) were visible on the fracture surface emanating from a thread root for approximately 1/8" across the fracture face. Beach marks are characteristic of fatigue crack propagation. The pattern of the remnant beach marks implies failure under unidirectional bending conditions in the presence of a high nominal stress.

Although the fracture surface had been flattened, a cross section revealed that the cracking initiated at a thread root and propagated transgranularly. No crack initiation at adjacent thread roots was observed.

Fatigue cracking of fasteners is most often caused by improper tightening of the fastener. If the disc plate nut is not properly tightened and secured, the disc plate stud experiences cyclic stresses due to the greater than normal operational vibration of the disc plate. These stresses are concentrated and amplified at the thread roots, which leads to fatigue crack initiation and propagation. The disc plate nuts on the 1A MSIV may have come loose due to improper torquing of the nuts or improper installation of the nut locking devices.

To prevent fatigue cracking of the disc plate studs, the fasteners should be properly tightened. The disc plate nuts should be torqued to the manufacturer's specified torque value. To properly secure the disc plate nuts, the tabs on the nut locking devices should be bent in opposite directions; upward against a nut flat, and downward against the valve disc plate.

SMAD also issued a letter dated 03/28/94 addressing the use of Inconel 600 locking tabs for securing MSIV disc plate studs. This letter stated the following:

The failure analysis of pieces of Inconel 600 locking tabs from the Quad Cities 1A MSIV revealed the failures were caused by ductile tearing and fatigue crack propagation.

Inconel 600 is not generally susceptible to stress corrosion cracking (SCC) in a BWR steam environment. However, highly stressed Inconel 600 material is susceptible to SCC under creviced conditions of a BWR water environment.

Inconel 600 is not susceptible to thermal or radiation embrittlement in the MSIV application. Radiation embrittlement would only be expected to occur in high influence areas near the reactor core.

SMAD considers Inconel 600 to be an acceptable material for the MSIV locking tab application. However, if water can accumulate in the locking tab area, Type 304L or Type 316L stainless steels should be considered for future replacements due to SCC concerns. It should be noted that the examined tabs from the 1A MSIV did not fail due to SCC.

Installation of the locking tabs results in severe cold working of the bend areas. Cold working causes an increase in strength and residual stresses, along with a reduction in ductility. If the locking tabs are used more than once, the straightening and rebending process will produce additional cold working which may initiate tears. Therefore, SMAD does not recommend re-using the locking tabs.

2. WRITTEN COMMUNICATION

The maintenance work instructions (Work Package Traveler) did not contain any statements about proper use of the locking devices. The vendor manual instruction did not address the reuse of the locking devices, and did not address preventive maintenance requirements. In both cases, omission of relevant information contributed to the locking devices being reused.

The above causal factors are based on a review of the completed work package that was used when the valve was last disassembled in 1980, and test results received from SMAD.

D. SAFETY ANALYSIS OF EVENT:

The sudden closure of an MSIV due to the separation of the disc from the stem is bounded by current licensing based analysis. The transients which bound the event are MSIV closure on a Flux Scram, Turbine Trip Without Bypass, and Load Rejection Without Bypass at Increased Core Flow. The radiological consequences of the event are minimal since the pressure decay method of Local Leak Rate Testing is conservative and resulted in a combined leakage of 24.8 scfh. The normal practice is to perform individual leak rate tests, with the lowest individual valve leakage representing the leakage through the line assuming both valves are operable. In this case, individual leak rate tests were not conducted because the 1A MSIV had failed the fail-safe test and was scheduled for disassembly for inspection. The worst case assumption would be to assign a leak rate of 12.4 scfh to each valve. Considering the conservatism of the Technical Specification limit of 11.5 scfh, the leakage identified through the "A" main steam line would not result in exceeding the 10CFR100 limits.

E. CORRECTIVE ACTIONS:

1. CORRECTIVE ACTIONS COMPLETED:

a. Five (5) of the eight (8) MSIV's on Unit 2 have been disassembled and inspected. (Those inspected are: 2-203-1A, -2A, -1C, -2C, and -1D.) This action was determined prudent due to the inspection results of the 1A MSIV and the fact that these results were similar to the previous event in 1991 in which the disc separated from the stem on the 1B MSIV. All fasteners in all valves inspected were found to be tight. All locking devices in all valves inspected were found to be installed; however, some tabs on the locking devices in the 2A valve were found to be missing. A review of the work history for the three (3) remaining MSIV's indicated the locking devices were properly installed.

b. The main seat has been replaced in the 1A MSIV on Unit 2. The pilot seat and disc has also been replaced in the same valve.

c. Unit 1 was scheduled for a shutdown in order to obtain positive evidence as to the condition of the MSIV disc fastener locking devices so as to provide reasonable assurance that the disc and stem of each MSIV are properly secured. Subsequent to this decision, Unit 1 inadvertently scrammed prior to the scheduled shutdown (LER 1-93-023), and it was decided to keep the unit shut down until the status of the MSIV's could be ascertained.

d. The maintenance history records were reviewed for all eight (8) MSIV's on Unit 1 in order to obtain positive assurance that locking devices were properly installed during the last time each valve was worked on internally. Using this method, only one (1) MSIV (1-203-1C) could be verified as having the locking devices properly installed. The remaining seven (7) MSIV's on Unit 1 (1-203-1A, -1B, -1D, -2A, -2B, -2C, and -2D) were radiographically examined with the linear accelerator. The results indicated all fasteners are installed and locking devices are installed.

2. CORRECTIVE ACTIONS TO BE COMPLETED:

a. Machine the seating surface of the main disc in the 1A MSIV on Unit 2, and successfully pass a Local Leak Rate Test. The valve passed the Local Leak Rate Test on 01/16/94. This item was closed on 03/11/94 (NTS# 2651809302501).

b. All MSIV's that are disassembled will have new locking devices installed during re-assembly (NTS# 2651809302502).

c. Revise Work Package Travelers to include the requirement for installation of new locking devices when MSIV's are re-assembled and details pertaining to bending the tabs. This item was completed during the Q2M11 outage. This item was closed on 02/23/94 (NTS# 2651809302503).

d. Develop a maintenance procedure for disassembly and re-assembly of MSIV's (NTS# 2651809302504).

e. Review the existing Preventive Maintenance program for MSIV's, and revise as necessary to include vendor and industry experience (NTS# 2651809302505).

F. PREVIOUS EVENTS:

09/18/91 — A Unit 2 MSIV (AO-2-203-1B) main disc separated from the valve stem while at power. The unit was shut down. The cause of the failure was attributed to improper installation of the locking devices. Possibly, not all of the locking devices were installed, or the fasteners were not properly torqued. The event was not reported as an LER since the MSIV was disassembled without performing an "as found" Local Leak Rate Test.

LER 1-89-014 — Exceeding (T.S.) (LLRT) leakage limits for containment isolation valves and MSIV's.

LER 2-93-007 — "B" loop MSIV's failed LLRT.

G. COMPONENT FAILURE DATA:

Component

Description	Manufacturer/Model	As Found (scfh)
Main Steam Isolation Valve 2-203-1A/2A	Crane 20 inch 1250 lb model	24.8 * B102681-D

* Combined leakage of both Inboard and Outboard MSIV's.