

LICENSEE EVENT REPORT (LER)

Form Rev. 2.0

Facility Name (1)

Quad Cities Unit Two

Docket Number (2)

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Page (3)

Title (4)

Failure Of MOV 1301-61 Due To Broken End Bell Tie Bolts

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	8	2	8	9	3	9	3	--	0	1	8	--	0	3	2	9	9	4		0	5	0	0	0		

OPERATING MODE (9)

04

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

POWER LEVEL (10)	0	9	7	<input type="checkbox"/> 20.402(b)	<input type="checkbox"/> 20.405(c)	<input type="checkbox"/> 50.73(a)(2)(iv)	<input type="checkbox"/> 73.71(b)
				<input type="checkbox"/> 20.405(a)(1)(i)	<input type="checkbox"/> 50.36(c)(1)	<input checked="" type="checkbox"/> 50.73(a)(2)(v)	<input type="checkbox"/> 73.71(c)
				<input type="checkbox"/> 20.405(a)(1)(ii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> Other (Specify in Abstract below and in Text)
				<input type="checkbox"/> 20.405(a)(1)(iii)	<input type="checkbox"/> 50.73(a)(2)(i)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)	
				<input type="checkbox"/> 20.405(a)(1)(iv)	<input type="checkbox"/> 50.73(a)(2)(ii)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)	
				<input type="checkbox"/> 20.405(a)(1)(v)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME

Dan Brigl, Process Expert Group, Ext. 3115

TELEPHONE NUMBER

AREA CODE

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	
X	B	N	I	S	V	L	2	0	0	N

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)

ABSTRACT:

At approximately 1605 on 08/28/93, Unit-2 was in the Run mode at approximately 97 rated core thermal power. Operations was informed by System Engineering that Diagnostic Evaluation Team (DET) members had found bolts broken on Reactor Core Isolation Cooling (RCIC) [BN] valve 2-1301-61. Investigation revealed two of four Motor Operated Valve (MOV) [ISV] motor end bell tie bolts were completely broken due to shear. The RCIC system was declared inoperable at 1640, August 28, 1993.

The root cause for the RCIC 2-1301-61 MOV broken motor end bell tie bolts was not determined. Possible causes investigated were Written Communication, Change Management, Design and Configuration Analysis, Equipment Specification, Manufacture & Construction, Maintenance and Testing.

Corrective actions completed were to replace the remaining Porter/Peerless Class B, DC MOV motors of 25 pounds with an improved motor, testing the failed bolts, and performing an operability evaluation on remaining valves of similar manufacturer and model. A documented review of the Station trending program will be initiated to evaluate how the program failed to identify an adverse trend associated with these motors.

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TEXT Energy Industry Identification System (EIS) codes are identified in the text as [XX]

PLANT AND SYSTEM IDENTIFICATION:

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

EVENT IDENTIFICATION: Failure of MOV 1301-61 due to broken end tie bell bolts.

A. CONDITIONS PRIOR TO EVENT:

Unit: 2 Event Date: August 28, 1993 Event Time: 1605
 Reactor Mode: 4 Mode Name: RUN Power Level: 97

This report was initiated by Licensee Report 265\93-018.

RUN (4) - In this position the reactor system pressure is at or above 825 psig, and the reactor protection system is energized, with APRM protection and RBM interlocks in service (excluding the 15% high flux scram).

B. DESCRIPTION OF EVENTS:

At approximately 1605 on 08/28/993, Unit-2 was in the Run mode at approximately 97 percent rated core thermal power. Operations was informed by System Engineering that Diagnostic Evaluation Team (DET) members, performing a plant inspection, found bolts broken on Reactor Core Isolation Cooling (RCIC) [BN] valve 2-1301-61. The broken bolts were the valve motor end bell tie bolts. The valve is the RCIC turbine steam admission valve [ISV].

Immediately, Operations contacted the Maintenance Staff Motor Operated Valve (MOV) expert, and asked him to investigate. He reported to operations at 1640, that two of four MOV motor end bell tie bolts were completely broken due to shear. The two broken bolts were adjacent to each other, not opposite, and it was decided that torque associated with operating the valve could cause the remaining bolts to break.

At approximately 1640, 08/28/93, the Shift Engineer (SE) declared the RCIC system inoperable. Unit-2 entered a fourteen day LCO per Technical Specification 3.5.E.3. Nuclear Work Request (NWR) 009786 was generated as a priority request, and PIF # 93-0029 was started for investigation of failed bolts. Outage report QCOS 1300-2 was initiated.

Immediate corrective actions involved verifying the Unit-2 HPCI was operable per Technical Specification 3.5.E, completing work to the valve under the priority NWR, and testing/inspection on similar MOV's.

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The Electrical maintenance (EM) Department, working with operations, investigated the MOV's of the same manufacturer and model to verify the motor end bell tie bolts were not broken, and the field windings were not open. Additionally, the EM Department began work under NWR Q09786 to repair the 2-1301-61 valve. The 2-1301-61 MOV motor was replaced with an improved model (enclosed end bell tie bolts, better construction). Repair to the MOV was completed at approximately 1315, 08/29/93. No additional problems were noted.

The SE was notified that the 2-1301-61 valve repair was complete, and the RCIC system was available, at 1315 08/29/93.

Due to concerns associated with the MOV motor end bell tie bolt breakage, the Shift Foreman (SF) was instructed to walk down MOV's in the following areas; top of torus, around torus, HPCI rooms, RCIC rooms, Core Spray rooms. The walkdown was complete at 1835, 08/29/93, and no problems were noted.

At 1935, 08/29/93, the Unit-2 RCIC was released, and the system was declared operable. NWR Q09786 was completed, outage report QCOS 1300-2 was terminated, and the Unit exited the fourteen day LCO.

C. CAUSE OF THE EVENT:

The root cause for the RCIC 2-1301-61 MOV broken motor end bell tie bolts was not determined. There are four possible causes that were investigated.

The following is a summary of conclusions and Causal Factors (C/F) relating to problems which may have influenced human performance and/or contributed to equipment malfunctions.

The possible C/F for this event are as follows:

1. C/F: Written Communication
Change Management
Design and Configuration Analysis
Equipment Specification, Manufacturer & Construction

The Class B Porter/Peerless MOV motor of 25 pounds, has motor end bell tie bolts typically made of low strength material. Breaking of this type of MOV motor end bell tie bolts first occurred in 1989. Since 1989 the EM Department has tracked eleven failures to date of this type of MOV motor.

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A system Material Analysis Department (SMAD) report (M-00240-94) performed a metallurgical evaluation on the failed bolts. The evaluation did not reveal the presence of any material related defect associated with the bolts. Additionally, the fibrous appearance of the broken surface of the bolts suggest they failed in a ductile manner.

2. C/F: Written Communication
Change Management
Design and Configuration Analysis
Equipment Specification, Manufacture & Construction Maintenance/Testing

The Class B Porter/Peerless MOV motor of 25 pounds, has the motor end bell tie bolts failing due to high torque values applied. The torque applied to the MOV motor end bell tie bolts, could have been too great. The high torque values could cause cracks in the bolt thread root. The cracks could propagate and eventually fail the bolt. The SMAD report (M-00240-94) suggests the possibility that two of the four bolts were either overtorqued or experienced an overload condition. The probable cause for overtorquing is attributed to maintenance activities.

All class B Porter/Peerless MOV motors 25 pounds have been replaced with an improved model that has end bell tie bolts enclosed in the motor. Because the end bell tie bolts are enclosed, no maintenance can be performed on these motors, and overtorquing is no longer a concern.

3. C/F: Equipment Specification, Manufacture & Construction

The Porter/Peerless MOV motor of 25 pounds, could have broken motor end bell tie bolts due to motor shunt field winding failure. Eleven of the sixteen Porter/Peerless Class B Direct Current motors, of 25 pounds, have had the shunt field windings found open since original installation. The shunt field windings were found open while performing normal maintenance during valve overhauls. The shunt field of the motor winding controls the speed of the motor. When the winding fails, the MOV motor could speed up faster than originally designed. The increased speed could cause greater torque and excess stress on the motor end bell tie bolts, causing bolt failure.

A 10CFR Part 21 notification is not required at this point because no conclusive manufacturer deficiency has been identified. SMAD report M-00240-94, and previous failures of similar motor bolts, suggest that overtorquing of the bolts during maintenance activities caused breakage. (Reference SMAD reports M-163-91, M-619-89, M-6102-89).

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4. C/F: Change Management

The Stations equipment failure trending programs did not identify the failure trend associated with breakage of the Class B Porter/Peerless MOV motors end bell tie bolts. An identified failure trend for this type of MOV motor did not occur. The failure to identify a trend prevented the Station from comprehensively replacing the Porter/Peerless motors with an improved motor.

D. SAFETY ANALYSIS:

At no time during this event were station personnel or the public at risk. The safety significance of this event was minimal due to the availability of backup systems, and the short time period that RCIC was inoperable.

The amount of time that RCIC was inoperable for repairs was approximately 26 hours and 55 minutes.

If all the 2-1301-61 MOV motor end bell tie bolts would have completely failed, the motor could have come off the pinion assembly. The valve would become inoperable in respect to electrical operation. Manual actuation would have been available to operate the valve in an emergency situation.

If the MOV became completely inoperable, steam to the RCIC turbine would be isolated, and the system would be inoperable. Since all other Emergency Core Cooling Systems were available, the reactor would have been brought to a safe shutdown condition.

Technical Specification 3.5.E requires that if the RCIC system is found to be inoperable, continued reactor operation is permissible for fourteen days providing that the High Pressure Coolant Injection (HPCI) system is operable. In this event, once Unit-2 RCIC was found inoperable, the Unit-2 HPCI was verified to be operable per QCOS 1300-2.

E. CORRECTIVE ACTIONS:

The immediate corrective action consisted of declaring the RCIC system inoperable and initiating an outage report, NWR and PIF. The MOV expert in the Maintenance Staff was notified and input from him was used to declare the system inoperable.

The EM Department, working with Operations, inspected MOV's of same manufacture and model to verify the motor end bell tie bolts were not broken, and the shunt field windings were not open. The EM Department removed the 2-1301-61 MOV motor, and replaced it with an improved design that has end bell tie bolts that are internal.

To verify that MOV broken end bell tie bolts has not occurred at other locations, the SF performed walkdowns of several areas. The areas of concern were the top of Torus, around the Torus, HPCI rooms, and the RCIC rooms.

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The EM Department visually inspected the motor end bell tie bolts, and tested the shunt field windings after each operation of the valve until the motors were replaced with the improved motor (NTS# 2651809301807).

The failed bolts from MOV 2-1301-61 were sent to SMAD for metallurgical evaluation, and analysis of the failure. The analysis suggested failure of the concerned bolts due to overtorquing. (Reference SMAD report: M-00240-94) (NTS# 2651809301801).

An operability evaluation was performed on the five class B Porter/Peerless MOV's of 25 pounds, before the valve motors eventually got replaced with an improved model. The following MOV motors were replaced with an improved motor having enclosed end bell tie bolts. Because the bolts are enclosed, no maintenance can be performed on these motors, and overtorquing is no longer a concern. The NWR associated with replacing each MOV with an improved motor is listed after each valve number. A brief description of each listed valve has been provided. (NTS# 2651809301802) (NTS#2651809301805).

MOV Number: 1-1301-48 NWR Q10558 (U-1 RCIC outboard injection valve)
 1-1301-49 NWR Q10553 (U-1 RCIC inboard injection valve)
 2-1301-60 NWR Q10562 (U-2 RCIC minimum flow valve)
 2-2301-35 NWR Q10560 (U-2 HPCI torus suction valve (inboard))
 1-2301-36 NWR Q10561 (U-1 HPCI torus suction valve (outboard))

The corrective actions to be completed are:

1. If radiological conditions allow, remove and test a Class B Porter/Peerless MOV motor of 25 pounds, to specifically address degradation of the motor field windings. This was intended to address the potential 10CFR part 21 issue; however, there were no motors available for radiological unconditional release and testing. It was suggested that the MOV 1-1301-49 motor be tested because it was of same design (Porter/Peerless) as the concerned valve motor. History indicates the MOV has the original motor intact, and to date has not had problems concerning the shunt field winding. The 1-1301-49 motor has been replaced with the improved motor.
2. A documented review of the Station's trending program will be initiated to evaluate how the program failed to identify the adverse trend associated with Porter/Peerless Class B, DC MOV motors. (NTS# 2651809301806)

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F. PREVIOUS OCCURRENCE:

There has been three LER's associated with the RCIC system and failures of MOV's. The LER's, and a brief description are as follows:

LER 87-016: Failure of RCIC MOV 2-1301-16. The valve failed to close when given a demand signal due to auxiliary contacts binding.

LER 89-001: Failure of RCIC MOV 1-1301-48. The valve failure was attributed to binding of the MOV torque switch.

LER 90-005: Failure of RCIC MOV 1-1301-61. The valve would not operate due to contact at the feed breaker not closing properly.

A search of the Nuclear Tracking System indicated there has not been any LER's associated with failure of MOV motor end bell tie bolts at Quad Cities Station.

There has been one DVR associated with bolt failure and it involved motor mount breakage associated with mechanical overload. The DVR is 04-01-89-009.

A search of the Nuclear Plant Reliability Data System (NPRDS) could find no failures associated with broken MOV motor end bell tie bolts at Quad Cities station.

A nationwide search of the NPRDS indicated fourteen failures involving broken MOV motor end bell tie bolts. Only three involved the concerned Limitorque type SMB-000 model. Of the three, none involved over torquing, incorrect bolt material or field winding failures.

G. COMPONENT FAILURE DATA:

The limitorque motor was manufactured by Porter/Peerless, SN W78Q0877M. Nameplate information states the motor operates with a starting torque of 25 ftlbs, and has 1.8 Horse Power rating. The frame was #DK56H.

The Limitorque MOV model is SMB-00-25

The valve is Crane Company Model 7183

The replacement MOV motor is a Reliance, SN W78Q0877M-SN. Nameplate information states the motor operates with a starting torque of 25 ftlb, and has 1.8 Horse Power rating. The frame is #P56.