

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

February 4, 1994

NRC INFORMATION NOTICE 94-10: FAILURE OF MOTOR-OPERATED VALVE ELECTRIC POWER TRAIN DUE TO SHEARED OR DISLODGED MOTOR PINION GEAR KEY

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the potential for motor-operated valve (MOV) electric power train failures caused by structural failure or improper installation of the motor pinion gear key. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background

The motor pinion gear is located on the shaft of the electric motor and transmits motor torque to the worm shaft gear. The motor pinion gear is connected to the motor shaft by means of a key which transfers rotary force from the motor shaft to the gear. A set screw is used to prevent axial movement of the motor pinion gear on the motor shaft.

In 1989, Limitorque Corporation issued Maintenance Update 89-1 which made recommendations for securing the motor pinion gear key when replacing the motor or the gears. The update stated that some users had not adequately secured the key, permitting it to subsequently slide out of the keyway and decouple the motor from the actuator. The update gave a procedure for staking the motor shaft at the open end of the keyway to mechanically lock the key in place.

In 1992, Limitorque issued Maintenance Update 92-2 which stated that the material for motor pinion keys supplied with SMB-000 through -2 actuators had recently been changed from American Iron and Steel Institute (AISI) 1018 to AISI 4140 steel because of customer requests for the higher strength material. Limitorque stated that all SMB-3 through -5 actuators with motors rated in excess of 13.8 kg-m [100 ft-lbs] and serial numbers greater than 12160 were supplied with motor pinion keys of AISI 4140 steel. In the maintenance

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update, Limitorque recommended that, if not already done, the motor pinion key be replaced with AISI 4140 steel for SMB-3 through -5 actuators with motors rated in excess of 13.8 kg-m [100 ft-lbs].

Description of Circumstances

On August 30, 1993, the high-pressure coolant injection system pump discharge isolation valve at the Cooper Nuclear Station failed to open during the performance of a surveillance procedure, causing the valve to be declared inoperable. Subsequent investigation revealed that the SB-3 Limitorque actuator motor pinion gear key had migrated out of its keyway, allowing the motor shaft to spin without transferring torque to the motor pinion gear. The cause of this event was attributed to the failure to stake the motor shaft keyway following a motor replacement in 1990.

The licensee for Cooper Nuclear Station incorporated the recommendations of Limitorque Maintenance Update 89-1 in a 1991 revision to its MOV maintenance procedures. However, at that time, the licensee did not investigate the potential consequences of maintenance activities that had been performed before the procedure was revised. During that time, staking of the motor shaft had not been a requirement. Based on vendor contacts and independent sampling, the licensee determined that the particular actuators at Cooper initially procured from Limitorque were properly staked. Therefore, the potential extent of the condition at Cooper was limited to actuators that had received onsite maintenance (affecting the motor pinion gear set) before the procedures were revised. The licensee further narrowed the scope of its investigation based on a Limitorque assertion and industry information that only larger size actuators (SMB/SB-0 and above) are susceptible to this problem.

On October 8, 1993, the licensee of the Waterford Steam Electric Generating Station, Unit 3, notified the NRC that the motor pinion keys in both MOVs used for isolating the shutdown cooling system suction line were not staked to the motor shaft. The actuators were size SMB-0.

On October 8, 1993, the licensee of the Clinton Power Station, Unit 1, notified the NRC that the SB-3 Limitorque actuator motor pinion key to the high-pressure core spray injection MOV had sheared. The actuator was attached to a motor rated at 11 kg-m [80 ft-lbs]. The licensee determined that the key material was AISI 1018 steel. This motor was rated lower than the threshold for replacement recommended by Limitorque Maintenance Update 92-2 and is a different actuator type.

Discussion

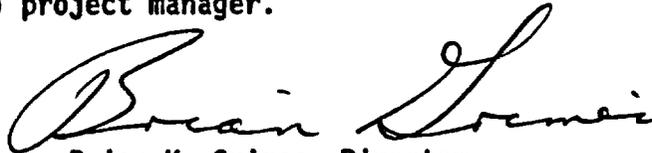
The NRC staff has reviewed information suggesting that a small, but not inconsequential, number of MOV motor shaft keyways may be unstaked at various nuclear power plants. Although a low incidence of motor pinion gear key dislodgements has been observed, it is possible that an extended time period may be necessary for axial migration of the key in a horizontally mounted motor, suggesting the potential for additional failures of this type.

The incidence of motor pinion key failures may be increased as a result of the higher thrust and torque found to be necessary to operate some valves under dynamic conditions.

Related Generic Communications

NRC has issued other generic communications on MOV motor pinion keys, including NRC Office of Inspection and Enforcement Information Notices (INs) 81-08, "Repetitive Failures of Limitorque Operator SMB-4 Motor-to-Shaft Key"; 85-22, "Failure of Limitorque Motor-Operated Valves Resulting From Incorrect Installation of Pinion Gear"; and 85-67, "Valve-Shaft-to-Actuator Key May Fall Out of Place When Mounted Below Horizontal Axis"; and NRC INs 88-84, "Defective Motor Shaft Keys in Limitorque Motor Actuators"; and 90-37, "Sheared Pinion Gear-to-Shaft Keys in Limitorque Motor Actuators."

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.



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Office of Nuclear Reactor Regulation

Technical contacts: Thomas F. Westerman, RIV Thomas G. Scarbrough, NRR
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Attachment:
List of Recently Issued NRC Information Notices

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Original signed by

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OFFICE	*EMEB/DE/NRR	*EMEB/DE/NRR	*C:EMEB/DE/NRR	D:DE/NRR
NAME	TGScarbrough	GJohnson	JANorberg	JTWiggins
DATE	11/30/93	11/30/93	11/30/93	12/ /93
OFFICE	*OGCB/DORS/NRR	*Tech Ed	*EB/DRS/R3	*C:EB/DRS/R3
NAME	RJKiessel	RSanders	JMJacobson	GCWright
DATE	12/ 9/93	12/10/93	12/16/93	12/22/93
OFFICE	*D:DRS/R3	*DRS/R4	*D:DRS/R4	C:OGCB/DORS/NRR
NAME	GEGrant	TFWesterman	SJCollins	*GHMarcus
DATE	12/22/93	12/15/93	12/16/93	01/10/94
OFFICE	D:DRS/NRR			
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Document Name: nrcin.3c1

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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-09	Release of Patients with Residual Radioactivity from Medical Treatment and Control of Areas due to Presence of Patients Containing Radioactivity Following Implementation of Revised 10 CFR Part 20	02/03/94	All U.S. Nuclear Regulatory Commission medical licensees.
94-08	Potential for Surveillance Testing to Fail to Detect an Inoperable Main Steam Isolation Valve	01/01/94	All holders of OLs or CPs for nuclear power reactors.
93-26, Supp. 1	Grease Solidification Causes Molded-Case Circuit Breaker Failure to Close	01/31/94	All holders of OLs or CPs for nuclear power reactors.
94-07	Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 CFR Part 20	01/28/94	All byproduct material and fuel cycle licensees with the exception of licensees authorized solely for sealed sources.
94-06	Potential Failure of Long-Term Emergency Nitrogen Supply for the Automatic Depressurization System Valves	01/28/94	All holders of OLs or CPs for boiling water reactors.
93-85, Rev. 1	Problems with X-Relays in DB- and DHP-Type Circuit Breakers Manufactured by Westinghouse	01/20/94	All holders of OLs or CPs for nuclear power reactors.
94-05	Potential Failure of Steam Generator Tubes with Kinetically Welded Sleeves	01/19/94	All holders of OLs or CPs for pressurized water reactors (PWRs).

OL = Operating License
CP = Construction Permit