

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

June 9, 1993

NRC INFORMATION NOTICE 93-42: FAILURE OF ANTI-ROTATION KEYS IN MOTOR-OPERATED VALVES MANUFACTURED BY VELAN

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 potential problems resulting from the failure of anti-rotation keys in motor-operated globe valves manufactured by Velan Valve Corporation. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On March 28, 1993, Wisconsin Public Service Corporation, the licensee for Kewaunee Nuclear Power Plant, reported that during motor-operated valve (MOV) dynamic testing on March 27, 1993, one of two redundant safety injection recirculation valves to the refueling water storage tank failed to close completely. Investigation revealed that the anti-rotation device, an L-shaped key between the valve stem and the yoke bushing (Attachment 1), had broken. The shorter part of the broken L-shaped key had apparently worked its way toward the valve stem and had jammed the valve stem, preventing closing. The valve that failed was a 2-inch bonnetless globe valve manufactured by Velan Valve Corp. The licensee inspected all nine similar motor-operated valves and found that six had broken anti-rotation keys. The inspections were visual and did not require disassembly of the motor-operated valve. Failures usually can be observed on normally closed valves, since the broken long leg of the L-shaped key slides down partially and becomes visible below the yoke bushing.

According to the licensee, the keys failed in a brittle manner. The fractures began on either side of the key at the sharp radius of the inside corner of the L-shaped key and propagated into the body of the key. Machining of the sharp inside corner of the L-shaped key may have contributed to the failure of the anti-rotation keys by producing high stresses in the corner of the keys. It is likely that the rotational action of the valve stem impacted on both sides of the key, exceeding the impact strength of the material at the sharp radius of the key.

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updated 6/30/93

POR I&E Notice 93-042

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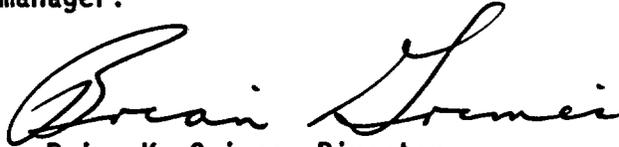
In 1990, at the Maine Yankee Atomic Power Station, anti-rotation keys in 4-inch MOVs manufactured by Velan failed. Maine Yankee Atomic Power Company, the licensee, discovered that spare keys supplied by Velan for several of the valves were not of the proper hardness; they were Rockwell C-20 instead of the harder Rockwell C-59 as originally specified. Valves that may have had the wrong anti-rotation keys installed were disassembled, and the licensee replaced the Rockwell C-20 keys with keys made of the correct material. The non-conforming keys that were removed showed signs of significant wear. During post-maintenance testing, several of the new (hardened) keys broke at the corner of the "L" shape. This happened because the keyway in the valve adaptor plate was too tight considering the service-related wear that had occurred to the rest of the keyway. Maine Yankee engineers specified that new larger keyways should be cut in the adaptor plate to prevent the key from breaking when the valve is actuated. The licensee repaired all the affected valves and then tested the valves to ensure that they operated satisfactorily.

Before testing MOVs at Prairie Island this past winter, an inspection of Velan globe valves also discovered anti-rotation key failures (2 broken keys found in 16 valves) in similar systems. Because of the location of the break on the anti-rotation key, and the length of the key and key slot, Northern States Power Company, the licensee, believed that the broken anti-rotation keys would still perform their intended function and that the broken piece (i.e., the short leg of the L-shaped key) would not interact with the valve stem so as to impede valve operation. This is at variance with the Kewaunee event discussed above. The licensee added a step to their generic actuator replacement procedure to inspect, clean, debur, and lubricate anti-rotation devices.

### Discussion

On April 5, 1993, Velan issued the attached (Attachment 2) Service Bulletin #SB-106. This bulletin recommends that the anti-rotation keys be inspected for possible wear which could result in failure and that consideration be given to replacing the keys at the earliest convenient time. The replacement keys, which have been supplied by Velan for the past 2½ years, are made of material meeting American Iron and Steel Institute (AISI) 4140 alloy steel, as opposed to 440C stainless steel (440C SS). AISI 4140 is significantly tougher than 440C SS. According to Velan, the material was changed to 4140 because 4140 is easier to procure and to heat treat properly. Velan plans to send this bulletin to all U.S. nuclear utilities. On the basis of conversations between the NRC staff and Velan subsequent to the issuance of the bulletin, and because of the hardness of anti-rotation keys made out of 440C SS, Velan suggests that both the keys and the keyways be inspected for damage and deterioration. The experience cited above indicates that the use of brittle material in anti-rotation keys can lead to failures, although valve operation may not always be impaired.

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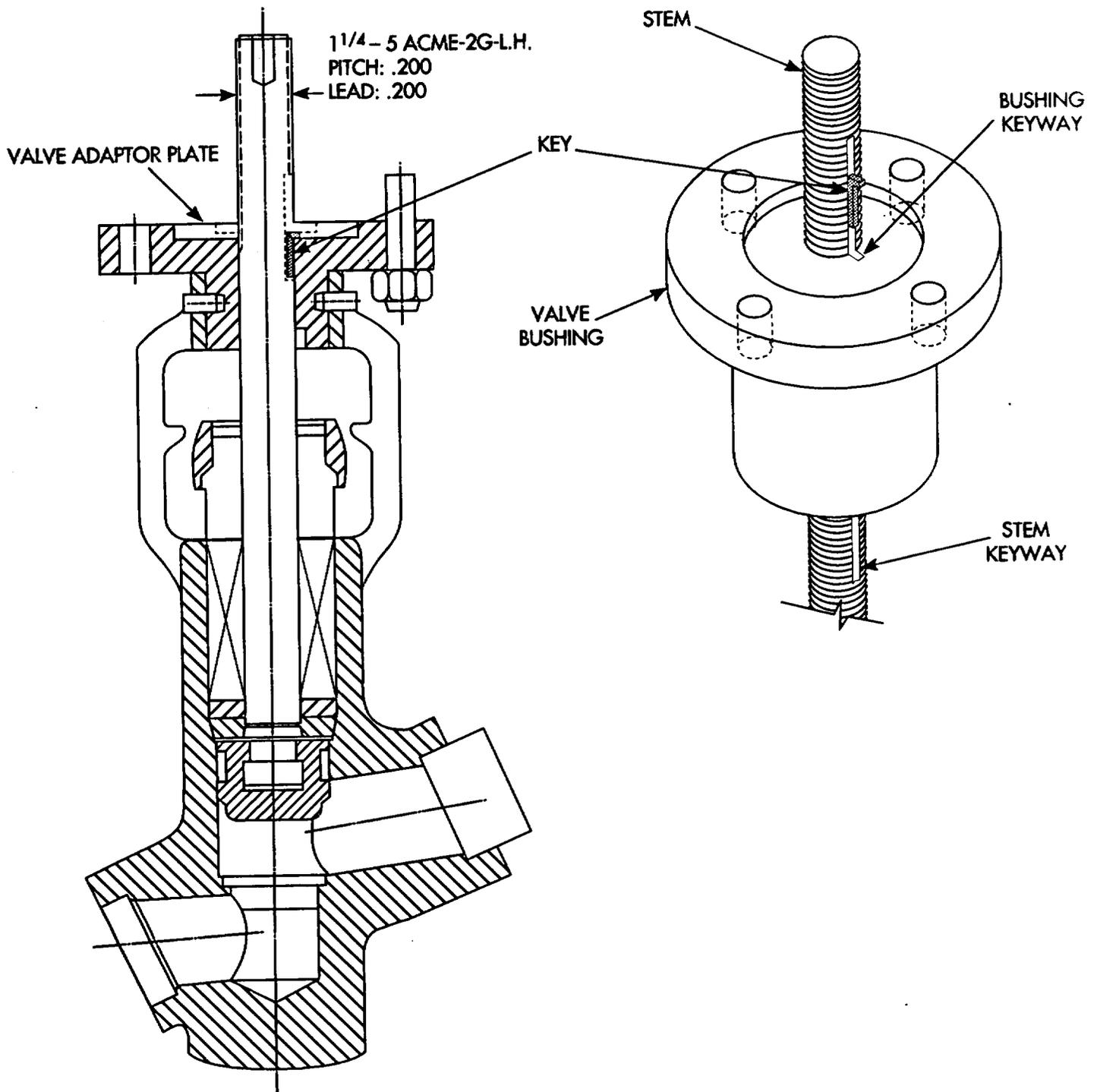
Brian K. Grimes, Director  
Division of Operating Reactor Support  
Office of Nuclear Reactor Regulation

Technical contact: David C. Fischer, NRR  
(301) 504-2728

Attachments: *(In Accordance To)*

1. Figure 1, Velan Valve and Anti-Rotation Key
2. Velan Service Bulletin #SB-106
3. List of Recently Issued NRC Information Notices

# VELAN VALVE AND ANTI-ROTATION KEY



	
- SERVICE BULLETIN -	#SB-106

SUBJECT: GLOBE VALVE STEM ANTIROTATION KEY

This is to advise you that an "L" shaped, globe valve stem anti-rotation key failed at Kewaunee Nuclear Plant. The valve in question is a 2" Motor operated globe valve originally supplied to drawing 137.116/1.

The valves affected are those Motor Operated Globe valves requiring a key installed in mounting flange which prevents the stem from rotating. Globe valves which have been supplied with torque arms are not affected by this failure.

Based on the incident at Kewaunee Nuclear Plant we recommend that keys be inspected for possible wear which could result in failure. Consideration should also be given to replacing keys at your earliest possible convenience with new keys. These new keys are supplied in material meeting AISI 4140. This material replaces the 440C grade which several project drawings call up.

Replacement keys which have been supplied by us during the last 2 1/2 years have been from this new material. If these have been installed, only regular periodic verification will be required. If no inspection and or replacements has been made, we recommend that keys be replaced.

For additional information or replacement keys, please contact:

Velan Valve Corp.  
550 McArthur  
Montreal, Quebec  
H4T 1X8

Attn : Nuclear Division

Phone: 514-748-7743  
Fax : 514-342-2311



E.I. Francois  
Vice-President, Quality Assurance



B. Nilsson  
Manager, Nuclear Division

LIST OF RECENTLY ISSUED  
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-41	One Hour Fire Endurance Test Results for Thermal Ceramics Kaowool, 3M Company FS-195 and 3M Company Interam E-50 Barrier Systems	05/28/93	All holders of OLs or CPs for nuclear power reactors.
93-40	Fire Endurance Test Results for Thermal Ceramics FP-60 Fire Barrier Material	05/26/93	All holders of OLs or CPs for nuclear power reactors.
93-39	Radiation Beams from Power Reactor Biological Shields	05/25/93	All holders of OLs or CPs for nuclear power reactors.
93-38	Inadequate Testing of Engineered Safety Features Actuation System	05/24/93	All holders of OLs or CPs for nuclear power reactors.
93-37	Eyebolts with Indeterminate Properties Installed in Limitorque Valve Operator Housing Covers	05/19/93	All holders of OLs or CPs for nuclear power reactors.
93-36	Notifications, Reports, and Records of Misadministrations	05/07/93	All U.S. Nuclear Regulatory Commission medical licensees.
93-35	Insights from Common-Cause Failure Events	05/12/93	All holders of OLs or CPs for nuclear power plants (NPPs).
93-34, Supp. 1	Potential for Loss of Emergency Cooling Function Due to A Combination of Operational and Post-Loca Debris in Containment	05/06/93	All holders of OLs or CPs for nuclear power reactors.

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Original signed by  
Brian K. Grimes

Brian K. Grimes, Director  
Division of Operating Reactor Support  
Office of Nuclear Reactor Regulation

Technical contact: David C. Fischer, NRR  
(301) 504-2728

Attachments:

1. Figure 1, Velan Valve and Anti-Rotation Key
2. Velan Service Bulletin #SB-106
3. List of Recently Issued NRC Information Notices

\*See previous concurrence sheet

\*EMEB:DE:NRR  
DCFischer  
4/15/93

\*SC/EMEB:DE:NRR  
EJSullivan  
4/16/93

\*RPB:ADM  
TechEd  
4/15/93

\*C/EMEB:DE:NRR  
JANorberg  
4/19/93

\*C/EMCB:DE:NRR  
JRStrosnider  
4/20/93

\*C/RVIB:DRIL  
LJNorrholm  
4/20/93

\*DRS:RIII  
GCWright  
4/21/93

\*D/DE:NRR  
JERichardson  
4/23/93

\*OGCB:DORS:NRR  
RJKiesel  
05/03/93

\*C/OGCB:DORS:NRR  
GHMarcus  
05/12/93

D/DORS:NRR  
BKGrimes  
06/4/93

DOCUMENT NAME: 93-42.IN

Even though a broken anti-rotation key does not always impair valve operation, it is a concern to the NRC that anti-rotation keys made of such brittle material (440C SS) are used in safety-related valves.

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