

# Limitorque Corporation

Automated Valve Actuators and Jacks for Industry

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December 7, 1992

U. S. Nuclear Regulatory Commission  
Washington, D.C. 20555

SUBJECT: Title 10 CFR Part 21 Notification  
Dated December 7, 1992  
SMB/SB-000, SMB/SB/SBD-00 Declutch System Anomaly

Attention: Director, Nuclear Reactor Regulation

Gentlemen:

Pursuant to the requirements of Title 10 of the Code of Federal Regulations Part 21 herein provided is notification of a potential defect in the SMB/SB-000, SMB/SB/SBD-00 Declutch System depending on Licensee operating conditions, as detailed in the attached letter. In order to expedite the notification of the facilities affected, Limitorque has made simultaneous written notice to both the commission and the attached list of nuclear utility customers.

Signed:

I. E. Wilkinson  
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Attachment

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Subject: Potentially Reportable 10 CFR Part 21 Condition  
SMB/SB-000, SMB/SB/SBD-00 Declutch System Anomaly

Please be advised that Limitorque Corporation has discovered through actuator testing that the possibility exists for malfunction of the subject actuators under certain conditions of seismic excitation. This situation could potentially be reportable depending on the operating practices of the licensee. Therefore, pursuant to the requirements of Title 10 CFR Part 21, notification is herein provided of a potential malfunction of the subject actuators.

#### Identification of Basic Component

The affected components are the declutching mechanisms in the SMB/SB-000 and SMB/SB/SBD-00 actuators.

#### Nature of the Defect

##### A. The Basic Defect

When the actuator is vibrated in the vertical axis with sufficient amplitude near the natural frequency of the declutch system, oscillations of the declutch system can cause the motor to become disengaged. MOVs which are required to operate during such a seismic event may exhibit longer stroke times. The malfunction only occurs during the seismic event. After the vibrations stop, the actuator will return to proper operation.

The SMB/SB/SBD-00 and the SMB/SB-000 share the same basic design of declutch system which consists of the declutch lever, shaft, declutch fork, clutch ring, clutch keys, return spring, and tripper lever assembly. The system is imbalanced in the vertical axis because the declutch lever exerts more counter-clockwise torque on the shaft than the other parts exert in the clockwise direction. Thus, the lever can provide a driving force causing the declutch system to oscillate with enough amplitude to disengage the motor.

#### B. Defect Observed in SMB/SP/SBD-00

Limiterque has on two occasions experienced malfunctions of the SMB/SE/SBD-00 declutch mechanism during seismic testing. The type of test performed was a seismic dwell test. In this test the actuator was vibrated at frequencies from 2 hz to 32 hz in one quarter octave intervals with a sinusoidal waveform in a single axis. The acceleration level was 7.6 gs except at some of the lower frequencies where limitations of the shaker tables prevented reaching that level. At each frequency, the actuator was vibrated for fifteen seconds. During each of these fifteen second dwells, the actuator was electrically operated simulating a close and open valve stroke. This procedure was performed with vibrations in the vertical axis of the actuator and in two horizontal axes.

On the occasions in which the malfunction was observed, the actuators would not complete a stroke electrically in the expected amount of time during the seismic dwell. The problem was only found in the vertical axis, the units operated correctly in the horizontal axes. Further, the problem was only found at two specific vertical dwell frequencies: 11.3 and 13.5 hz. The problem was not seen at the 9.5 hz test and lower frequencies nor was it seen at the 16.0 hz test and higher frequencies.

Limiterque has tested SMB-00 actuators in the manner described above on seven occasions. Refer to the table below for a summary. Of these seven tests, the declutch problem was seen in two of the tests (numbered 4 and 6 below). Note that in test 6 the amplitude of the fundamental frequency did not reach 7.6 gs at either 11.3 or 13.5 hz but there were spikes of 15 gs present on the waveforms due to difficulties in controlling the seismic table. Due to these spikes, test 6 may have been more severe with respect to exciting the declutch system than the other tests which had cleaner waveforms.

SMB-00 Seismic Tests  
Pertinent to Declutch Problem

#	Declutch Problem Frequencies	Test Date	Acceleration at Frequencies of Interest
1	none	12/19/80	7.6 gs at 11.4 hz and 13.6 hz
2	none	4/14/81	7.6 gs at 11.4 hz and 13.6 hz
3	none	2/3/83	7.6 gs at 11.4 hz and 13.6 hz
4	11.3 hz	9/28/90	7.6 gs at 11.3 hz and 13.5 hz
5	none	1/8/91	7.6 gs at 11.3 hz and 13.5 hz
6	11.3, 13.5 hz	8/22/91	See Note 1
7	none	1/23/92	7.6 gs at 11.3 hz and 13.5 hz

Note 1  
During test #6 the fundamental frequency reached an amplitude of 6.5 gs at 11.3 hz and 7.5 gs at 13.5 hz. However, at both of these frequencies there were spikes of 15 gs present on the waveforms due to difficulties in controlling the seismic table.

#### C. Defect Observed in SMB/SB-000

Limiterque is aware of a similar malfunction in the SMB/SB-000 declutch mechanism during a utility sponsored seismic test. The type of test performed was a sine beat test. In this test the actuator was vibrated at frequencies from 2 hz to 35 hz in one third octave intervals with sine beat excitation of 15 cycles per beat in a single axis. Each sine beat test at each frequency consisted of a continuous train of sine beats with no pause between beats. The acceleration level was 4.5 gs except at some of the lower frequencies where limitations of the shaker table prevented reaching that level. At each frequency, the actuator was vibrated for a minimum of fifteen seconds. During each fifteen second test, the actuator was electrically operated simulating a close and open valve stroke. This procedure was performed with vibrations in the vertical axis of the actuator and in two horizontal axes.

The SMB-000 tested was reported as operating intermittently during the 12.5 hz and 16.0 hz tests in the vertical axis. The acceleration level reached 4.6 and 4.8 gs respectively during these tests. After the first 16.0 hz test, the declutch lever was prevented from vibrating in further tests by being taped to the handwheel. Thus, it is unknown whether the problem would have occurred at the next highest frequency (20.0 hz). It is known that the problem was not seen at the 10.0 hz test and lower frequencies. And, in the horizontal axes the unit operated correctly (the lever was not taped during these axes).

#### D. Critical Frequencies

Based on the above tests, the potential exists for this malfunction to occur in the SMB/SB/SBD-00 at frequencies between 9.5 and 16.0 hz. This represents a maximum range of critical frequencies of three quarters of an octave. The SMB/SB-000 declutch system should have a similar frequency range due to its similarity with the SMB/SB/SBD-00 system. For a conservative estimate of the highest potential problem frequency in the SMB/SB-000 it is calculated that three quarters of an octave above 12.5 hz is 21.0 hz. Thus, the potential exists for this malfunction to occur in the SMB/SB-000 at frequencies between 10.0 and 21.0 hz.

Limiterque does not have adequate data to determine the minimum acceleration level which could potentially cause the malfunction. Note that the malfunction only occurs during the seismic event. After the vibrations stop, the actuator will return to proper operation.

#### E. Actuator Output Torque Can Prevent Malfunction

In the observed cases of this malfunction, the actuators had minimal torque load present. When torque load is present, side loads are applied to the clutch keys and the side loads in turn generate frictional forces. These frictional forces oppose clutch key movement and thus movement of the declutch system. This is observed, for example, when an actuator is declutched while under valve seating load. Much more force must be applied to the declutch lever than when the valve is in an unloaded condition. The driving force causing oscillations of the declutch system is due to the imbalance of the system as the actuator is

accelerated vertically. If sufficient torque load is present, the frictional forces on the clutch keys will be high enough to oppose the driving force due to the imbalanced lever and oscillations of the system will be prevented. At higher acceleration levels more driving force is generated and more torque load is required to prevent oscillation.

Limitorque has performed calculations comparing the frictional key forces to the driving force to determine how much torque load is required to prevent shaft oscillations at a given acceleration level. In order to provide a conservative margin of safety and allow for uncertainties in the calculations, a factor of safety of approximately 4 is included in the resulting formulas. Torque is measured in ft lbs and Acceleration is measured in gs.

SMB/SB-000

$$\text{Torque} = 4 \times \text{Acceleration}$$

SMB/SB/SBD-00

$$\text{Torque} = 7 \times \text{Acceleration}$$

Example: For an SMB-000 undergoing a seismic event of 7.6 gs maximum acceleration the torque calculated is 30 ft lbs. For an SMB-00 at the same acceleration level the torque calculated is 53 ft lbs.

These calculations may be used to provide assurance that an actuator will be able to open a valve from the torque seated condition to a point at which the opening torque drops to the level calculated.

#### Affected Equipment

The equipment affected are SMB/SB/SBD-00 and SMB/SB-000 actuators.

#### Limitorque Corporation Corrective Action

To correct this problem, Limitorque has designed a declutch lever which balances the torque of the other components in the declutch system. With this lever installed, there is no imbalance in the system and thus no driving force to cause oscillations. Levers have been designed for the SMB/SB/SBD-00 and for the SMB/SB-000. Such a lever was installed during the course of the SMB-00 test 6 mentioned above. This cured the declutch problem in that test. Also, one of these levers was present in a test of an SB-00 and no declutch problem was observed.

Limitorque will make the new levers standard for future orders of SMB/SB/SBD-00 and SMB/SB-000 units for nuclear service. Lever availability is scheduled during the first quarter of 1993.

Licensee Corrective Action

Limitorque recommends that each licensee evaluate this situation based on the potential of actuator malfunction at the frequencies mentioned above. If a specified valve stroke time is required, it must be assumed that valve motion ceases during seismic event which includes these frequencies in a vertical orientation relative to the actuator. Therefore, the actual valve stroke time will be increased by the duration of the seismic event. An exception to this is a situation in which the torque load on the actuator is sufficient to create enough frictional forces to prevent declutch shaft oscillations as described in section E, above. In this case the actuator will function as long as the torque load remains above the critical value.

Balanced levers may be purchased from Limitorque. For the SMB/SB/SBD-00 the new lever is part 0301-059 and for the SMB/SB-000 the new lever is part 0101-081. In the interim it is recommended that levers be secured to prevent potential movement.

Any questions regarding the above notification may be directed to P. McQuillan, Nuclear/Special Projects Manager at (804) 528-4400 Ext. 714.

Signed:



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