



U.S. Nuclear Regulatory Commission
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LIMDOC-2021-001
Revision A
April 20, 2021

Subject: Final Report of the Evaluation of a Deviation Pursuant to 10 CFR 21.21(a)(2)

Description of the Deviation

Flowserve – Limitorque was informed by OPG Darlington Nuclear Plant that during testing of a SMB-0 actuator prior to installation, the actuator failed to return from manual handwheel mode to motor operation mode. Site personnel removed the electric motor from the actuator and discovered that the worm shaft gear cam pin had become detached from the worm shaft clutch gear. The actuator was one of six identical actuators supplied to OPG by Limitorque in January 2020. Subsequent site inspection of five other actuators received on the order revealed that the cam pins were loose in the worm shaft clutch gear. The issue was discovered prior to placing any of the actuators into service.

Update:

Flowserve’s investigation has concluded that the assembly error that resulted in the defect being reported was an isolated incident affecting the six parts identified below that were manufactured on a single work order in January 2020. No other gears were manufactured on that work order. Production records indicate that approximately 400 SMB-0 worm shaft clutch gears have been manufactured for nuclear and commercial applications in the past four years. No other instances of loose cam pins have been reported.

10 CFR21.21 Interim Report Details

- (i) *Name and address of the individual or individuals informing the Commission.*

Tyler Thompson
Director, Plant Manager
Flowserve, Limitorque Actuation Systems
Lynchburg VA, 24502

- (ii) *Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect.*

The basic component containing the defect is worm shaft clutch gear
Limitorque part # 60-420-0130-1

- (iii) *Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect.*

Flowserve Corporation, Limitorque Actuation Systems
Lynchburg VA, 24502

- (iv) *Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.*

The defect was the result of improper assembly of the worm shaft clutch gear. The cause of the defect was attributed to human error. The investigation revealed that during installation of the cam pin into the gear the machinist manufacturing the component failed to complete the process step required to permanently retain the cam pin in position.

A safety related function of the SMB/SB/SBD actuator is to automatically return from manual handwheel mode to motor operation mode. The function of the cam pin in this transition is to contact the clutch trippers, pushing them outward, until the declutch fork is released which allows the clutch to reengage with the worm shaft gear restoring motor operation. If the cam pin becomes detached from the worm shaft clutch gear, the actuator cannot return to motor operation. Therefore, the deviation described above constitutes a reportable defect.

- (v) *The date on which the information of such defect or failure to comply was obtained.*

Flowserve was initially notified by OPG December 9, 2020.

- (v) *In the case of a basic component which contains a defect or fails to comply, the number and location of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part.*

A quantity of six worm shaft clutch gears with the defect were supplied to OPG in SMB-0 actuators on Limitorque Order # 176325.001 (Actuator Serial # L1231918, L1231919, L1231920, L1231921, L1231922, & L1231923).

- (vii) *The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.*

Containment actions related to this issue consist of the following. The six gears affected were returned from OPG to Limitorque for evaluation and replacement. All SMB worm shaft gears of similar design in stock in Lynchburg were placed on temporary QC hold for enhanced inspection. No defective parts were found. For worm shaft gears currently being manufactured, an additional QC inspection point has been added for verification of proper cam pin installation.

Permanent corrective actions include the following. The cam pin installation procedure will be revised to include the use of a new assembly fixture that eliminates the issue that contributed to the improper assembly resulting in the defect. Limitorque engineering instruction procedure (EIP) 145 will be revised to document the new procedure. Quality control procedure QCP-10.5 will be revised to include inspection criteria for cam pin installation. Quality Control Supervisor Chris Shaffer has responsibility for ensuring assembly and quality control personnel are trained in the revised procedures on or before May 20, 2021.

- (viii) *Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.*

There is no action required by the nuclear plants in response to this Part 21 notification.

- (ix) *In the case of an early site permit, the entities to whom an early site permit was transferred.*

N/A

Technical questions concerning this notification can be directed to:

Kyle Ramsey, Senior Product Engineer, Flowserve – Limitorque
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A handwritten signature in black ink, appearing to read "Chris Shaffer", written over a horizontal line.

Chris Shaffer
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Limitorque Actuation Systems

Cc: Zachary Cox, Flowserve Limitorque Engineering Manager
Christopher Shaffer, Flowserve Limitorque Quality Assurance Supervisor