Rotork Sealed Valve Actuators

Rotork Controls, Inc.
19 Jet View Drive
Rochester
New York 14624

telephone (716) 328-1550
telex 978-290
cables Rotork Rochester

rotork

50-413/414

your reference | our reference | date

April 6, 1984

Director
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Rotork 14NAT1 Torque Limiter Failure - 10CFR21 Report

Dear Sir:

It has come to my attention that a specific type of Rotork actuator located at Duke Power's Catawba Nuclear Station Unit #1 has experienced a defect which could result in a loss of safety function. On March 29, 1984, we tested valve and actuator combinations at Catawba Unit #1. On March 30, 1984, Duke Power and Rotork had a second meeting where our findings were summarized and solutions were discussed.

The problem is limited to high speced (173 RPM) Rotork 14, 16 and 30 model actuators with torque limiters. After investigating our records, we find the only site with these actuators is Catawba. Since there are no operating plants with this defect and we will rectify the units at Catawba in the very near future, the significance of this defect is limited.

The problem occurred because of high speed operation on particular valve assemblies. Rotork's torque limiter design (see Section 9.2 attached and Figure 1) is an optional feature of our standard nuclear actuators. The torque limiter provides a means of guaranteeing and limiting final torque from the actuator under stall conditions.

Testing at Catawba has shown that although the close torque switch tripped, the inertia and contactor dropout delay time was sufficient that the brake disc (Item 1) did contact the close side brake pad (Item 3). During subsequent operation in the open direction, the brake disc would contact the open side brake pad (Item 2). Unfortunately, the torque on the locking set screw (Item 6) was incorrect. The open side thrust pad (item 4) is held in position by the locking ring (Item 7) exerting force through the set screws (Item 6). The outside of the locking ring and the thrust pad are threaded to the brake housing (Item 5).

IE 19

1/1

Note that the threading on the housing is left handed. With low torque values on the set screws, the open side brake position tended to move towards the disc. Eventually, the brake disc hit the brake pad during normal operation and caused several motors to burn out.

Testing in our facility has shown that we have been putting approximately 15 inch pounds of torque on the 10-24 set screws (Item 6). The correct torque for these set screws is 33 inch pounds. After placing 33 inch pounds of torque on the set screws, the actuator torque limiter worked properly. To avoid a design which is sensitive to the torque placed on these set screws, we have changed to 5/16 UNF set screws with a torque of 12 - 13 foot pounds. Tests on the design with 5/16 UNF set screws have shown that the actuator will function properly throughout its life.

All 14, 16 and 30NAT1 actuators with 173 RPM (all located at Catawba) will have the open locking ring (Item 7) replaced. The new locking ring will have 5/16 UNF set screws. A procedure has been developed to enable field replacement of these locking rings.

As you can see, the impact of this design problem is limited. Since the problem occurred at a non-operating nuclear plant, is limited to that plant and will be resolved in the next few weeks, we discussed whether we were obligated to report this event as a 10CFR21 occurrence. I presume you will evaluate this problem and take the appropriate steps, if any.

Please let me know if you have any questions regarding the above.

Sincerely,

Robert H. Arnold
Engineering Manager

RHA/ksz

Attachment

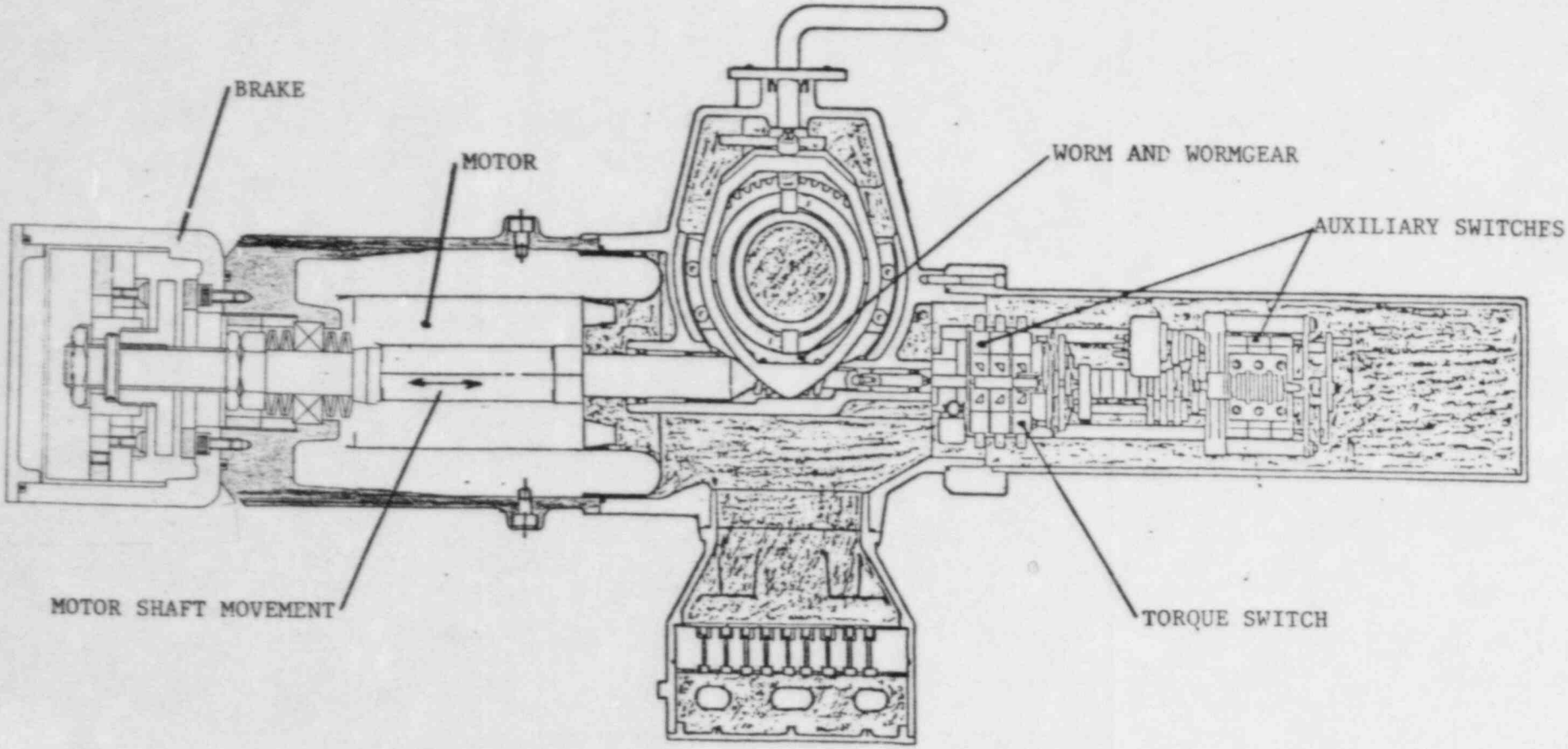
BRAKE
MOTOR
WORM AND WORMGEAR
AUXILIARY SWITCHES
MOTOR SHAFT MOVEMENT
TORQUE SWITCH

FIGURE 1

9 Torque limiting brake

Fast acting safety related motor operated valves have to be over-motored to guarantee valve design torque or thrust, particularly where voltage drops in excess of 10% must be taken into account. Under such conditions the maximum force to which the valve may be subjected under maloperation conditions may put the valve structure at risk. Rotork has developed a unique solution to this problem in the torque limiting brake, which is the subject of patent applications. Reference has been made to the fact that electro-magnetic brakes cannot protect against this condition, because they remain energised with the motor. The Rotork solution is entirely mechanical, and provides a certain means of ensuring that excess motor torque cannot be applied to the valve.

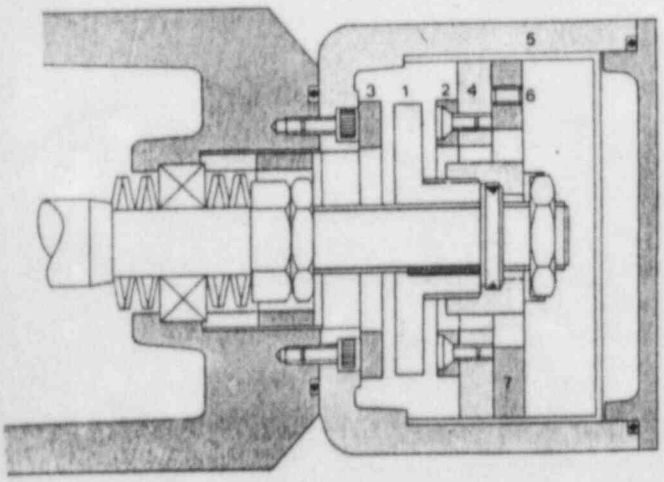

Figure 16 Typical Torque Limiting Brake assembly.

Factory setting
Open and Close brake pads (2) and (3) are adjusted to engage Disc (1) after wormshaft movement exceeds design torque setting, by rotating threaded thrust plate (4) in brake body (5) and locking in position by screws (6) and locking ring (7).

1 Construction (Figure 16)

This is extremely simple, comprising an extended motor housing and shaft, a brake disc and two adjustable brake pads. Because the motor shaft moves axially with wormshaft deflection against torque measuring springs, the brake disc will also do likewise. If the deflection required to achieve torque switch trip at maximum setting is exceeded, the brake disc will engage the appropriate brake pad, causing instant braking of the motor. The greater the torque the motor is applying to the wormshaft, the greater the braking force. Because the brake is dealing with the lowest force at the input rather than the output end of the actuator, wear and tear on the brake is negligible through thousands of operations. If the valve is under satisfactory torque switch control, the brake is never engaged in normal service.

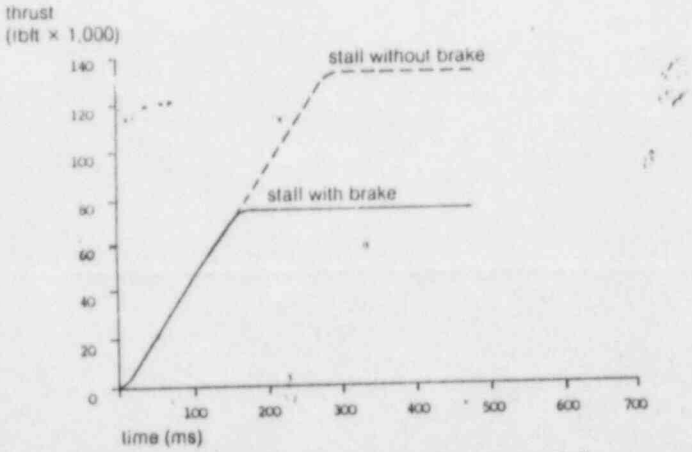

Figure 17 Effect of Torque Limiting Brake on actuator stall.

2 Torque limiting brake application

The primary objective of the torque limiting brake is to prevent damage to a valve in the event of the actuator being stalled, e.g. by incorrect wiring, incorrect phase rotation or electrical fault. The stall capability of safety related actuators has to be higher than normal to be able to guarantee performance under the worst conditions, particularly reduced voltage. Use of the torque limiting brake is recommended where voltage drops in excess of 10% may raise the stall capability of the actuator beyond a safe limit for the valve; this will again be most likely when the differential pressure is a substantial proportion of the nominal pressure classification.

It is impossible for Rotork to predict exactly the maximum forces to which a valve will be subject under stall conditions, or the difference in torque seating forces between differential pressure and dry run conditions, owing to the interaction of so many system variables like valve stiffness, friction, kinetic energy, efficiency variations, and so on. The torque limiting brake reduces the effect of those variables to insignificance and thus make safety qualification of motorized valves much simpler.