ENCLOSURE 1

MFN 15-042 R0

Description of Evaluation

Discussion

Background

GEH provides various parts and components that are designed to actuate Electromatic Relief Valves (ERVs). The only manner in which these valves can be opened is from an electrical signal received by the actuator. The ERV Actuator Assembly contains the Solenoid Assembly which contains the cutout switch assembly as shown in Figure 1.

The cutout switch bypasses the secondary holding coil in order to develop the magnetic field energy to engage the plunger. When the plunger is fully seated the cut out switch is open allowing current flow thru the secondary coil providing additional inductance to be introduced into the circuit. Upon the actuation of the solenoid the plunger lowers and impacts the back end of the plunger lever arm. The lever arm pivots, raising the front end of the arm which is connected to the tension spring. This causes the contact support to rotate (clockwise in Figure 2) creating a gap between the contact blocks and the contact bar. The gap between the contact bar and the contact blocks removes the bypass of the secondary coil. The purpose of the secondary coil is to prevent burnup of the primary coil. When the electrical signal is removed the plunger lifts allowing the plunger lever arm to lift which releases the tension on the tension spring and allowing the torsion spring to close the contacts, resetting the actuator. The resetting force is provided by a torsion spring by F2 which may be seen in Figure 1. If the secondary coil is not bypassed before the actuation signal is received the actuator will fail to provide the force necessary to actuate its valve.

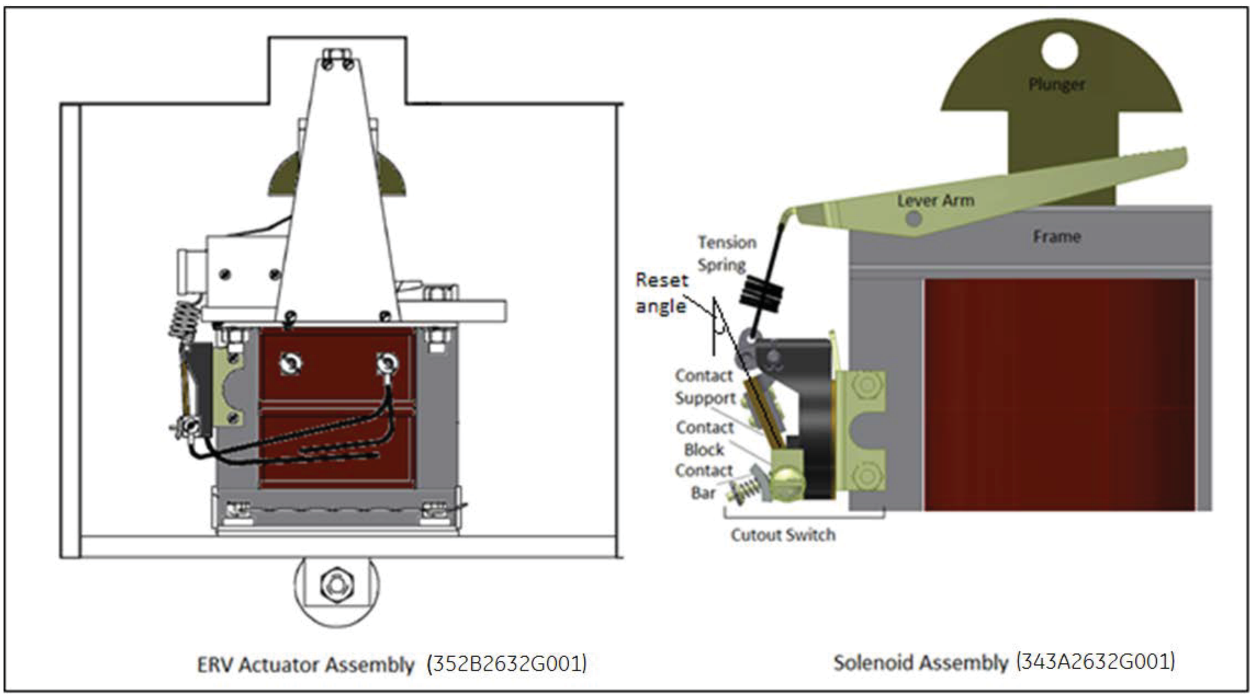

Figure 1 Actuator and Solenoid Assembly in the reset position

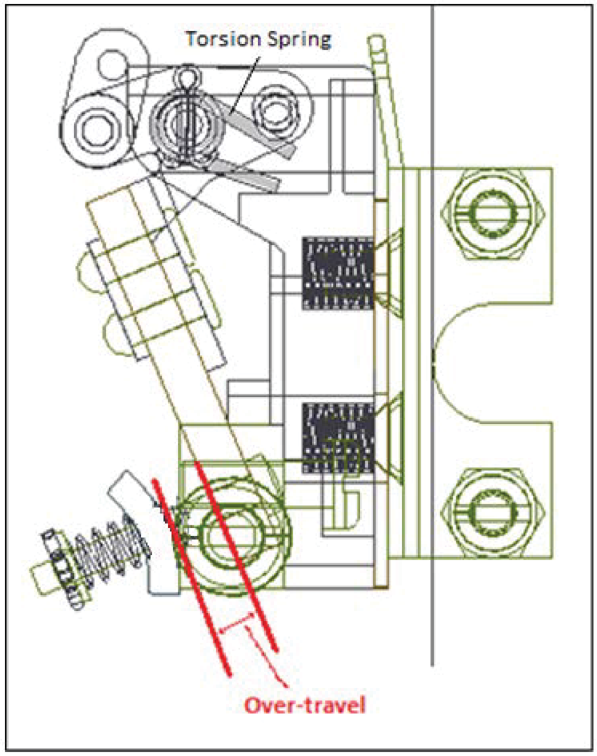

Figure 2 Over travel of cutout switch

Condition

Two ERV Actuators, GEH P/N 352B2632G001, designated as Unit #5 and Unit #8 were returned to GEH because of functionality issues identified during pre-installation bench testing. They were returned because Unit #5 failed to cycle and Unit #8 was found with a screw hole stripped. Engineering investigated the "as-found" condition of these two actuator assemblies. This investigation included cyclic testing, visual inspection, and dimensional checks. The investigation discovered that Unit #5 failed on the third cycle and Unit #8 failed on the 10^{th} cycle.

Following the observed failures, an investigation was initiated to determine the cause of the failures, and to determine whether the condition applied to components previously supplied to and accepted by licensees. The investigation concluded that the ERV actuator assemblies failed to change state because of the failure of the cutout switch to fully close and provide the appropriate current path. When Unit #5 failed, a 0.003 inch gap was present between the contact bar and one of the contact blocks. When Unit # 8 failed, a 0.001 inch gap was present between the contact bar and one of the contact blocks. For both Unit #5 and Unit #8 contact existed between the contact bar and one of the blocks but and a gap existed between the contact bar and the other contact block.

Multiple contributing factors were discovered which could have led to the presence of the gaps. The most significant of these factors is tolerance stack-up causing high forces in the tension spring which prevent proper closure of the cutout switch. Manufacturing tolerances and shop practices allowed for such a condition to exist at the extreme range of the combined tolerances. Additionally, insufficient clearances may have contributed to increased frictional forces in the part, becoming a second contributing factor.

Proper contact in the cutout switch is dependent on the reset angle. For discussion purposes the term reset angle refers to the angle of the contact support after the plunger lifts and the part resets. The solenoid assembly in Figure 2 is in the reset position therefore the contact support is in the reset angle. Unreliable performance occurs when the reset angle for a given part does not consistently ensure adequate contact. Conversely, reliability is achieved when the reset angle always ensures sufficient contact between the contact bar and the contact blocks.

When a part resets there are four moments that determine the reset angle. Three of these are caused by the forces shown in Figure 3. The fourth is caused by friction. For a given part the moments caused by forces F1, F2, and, F3 are only dependent on the angle of the contact support. Therefore any variance in the reset angle is due to variation of the moment due to friction in the part. The amount of over travel, as shown in Figure 1, is a good indication of the susceptibility of an assembly to unreliable operation. Positive over travel ensures proper contact is made despite frictional variation.

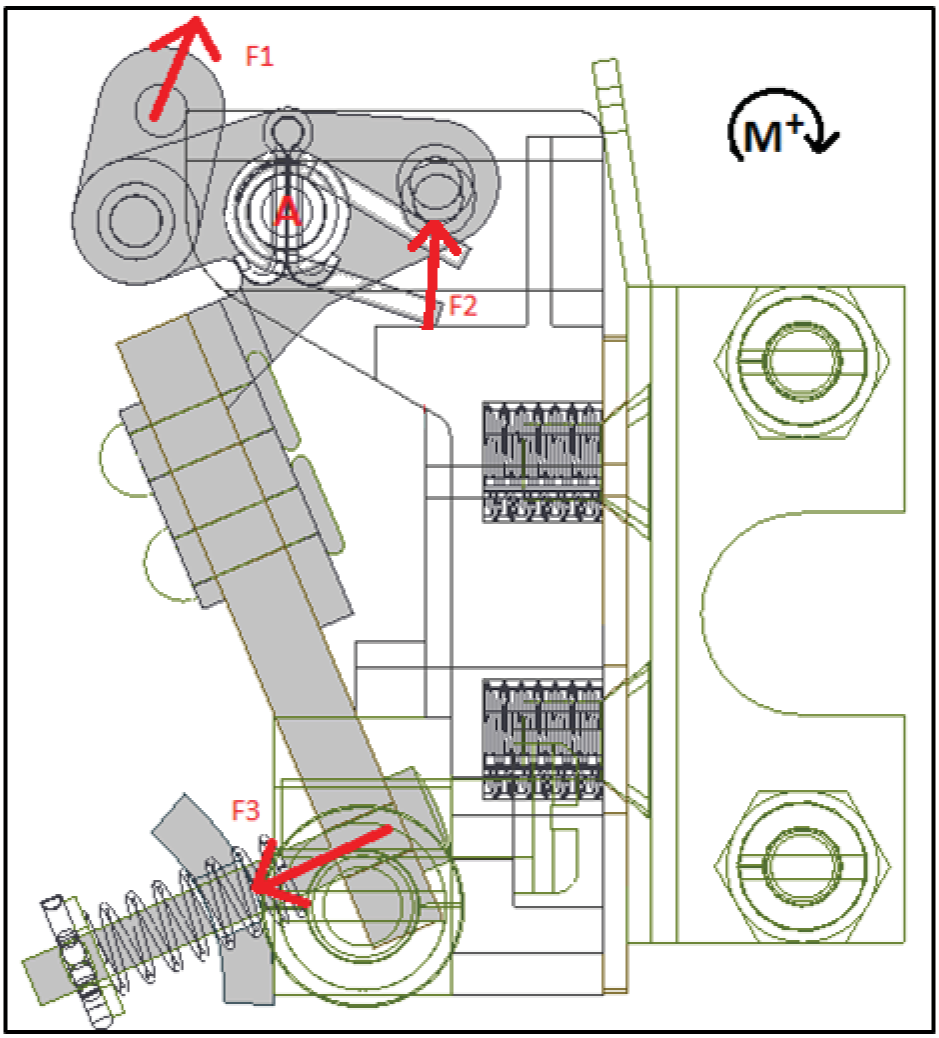

Figure 3

Friction is present when the assembly is reset, not allowing the contact support to proceed entirely to its neutral, zero friction reset angle. As energy is added to the system sufficient to overcome the frictional moment, the contact bar will tend to drift towards its zero friction angle. This means an assembly that doesn't consistently make contact when initially reset would be expected to do so as energy is added, as by normal system vibration. Units #5 and #8, which were previously observed to exhibit inconsistent operation, have been manually agitated during bench testing at GEH. These assemblies were found to function consistently in the presence of this agitation. This agitation was applied during bench testing which consisted of repeated instances of assembly actuation followed by mechanical agitation. Based on engineering judgment, the results of this bench testing are deemed representative of what would be observed during actual system operation. However, additional testing is planned to confirm this engineering judgment.

Extent of Condition

In 2006 the ERV actuator and solenoid assemblies shown in Figure 1 were modified to make them more robust to the effects of vibration. These parts were first delivered in 2008. The modified solenoid assemblies became 343A2632G001 and the modified ERV actuator assemblies became 352B2632G001. These modifications had the unintended consequence of greatly increasing the likelihood of producing parts that exhibit the condition. Therefore all the modified delivered 343A2632G001 and 352B2632G001 are classified as potentially affected. Table 1 shows the sites that have received these parts from GEH.

The likelihood of a part not performing its proper function is deemed to be low for the following reasons.

- In service parts have passed numerous functional and post-installation tests and there is no reason to believe that reliability would decrease over time.
- No operational experience exists in which an installed actuator failed in a manner consistent with this potential vulnerability.
- Settling of the components of the actuator assembly due to agitation has been observed in bench testing and is expected to occur during operation. This settling significantly reduces variation in frictional forces that could cause an assembly to function unreliably.

Further, if site maintenance procedures confirm visual over travel of the cutout switch in the final assembly, this then provides reasonable assurance that functionality is maintained. As the number of successful cycles of the component increases so does the confidence in the successful operation of the cutout switch.

Safety Impact

ERV function has the potential to affect the following BWR limits and systems.

- Minimum critical power ratio (MCPR)
- Reactor Coolant System (RCS)
- Automatic Depressurization System (ADS)
- Low set relief function

The actual safety impact on the plants is currently unknown. The safety impact depends on the number of valves, if any, which have been installed with this condition. Additional testing is also planned to confirm that plant vibrational forces are sufficient to ensure reliable operation in susceptible assemblies.

Conclusions

Based on the evaluations to date for the subject condition, GEH needs additional information to determine whether the subject condition would, or has, created a Substantial Safety Hazard or would have created a Technical Specification Safety Limit violation as it relates to the subject plant applications.

Additional testing is planned to further investigate this condition to determine whether a reportable condition exists, and presents this document as a 10CFR Part 21.21(b) 60-Day Interim Notification so that the GEH staff, along with input from Exelon, can determine Reportability of this condition.

Recommendations

If positive over travel has not been previously confirmed during maintenance activities, perform inspection at the next available opportunity to verify that the condition does not exist.

Table 1

Plant Description	Customer Name	Shipped Date	Shipped Quantity	Part Number	Part Description	Safety Class	Customer PO #
DRESDEN 1-3	Exelon	2014	4	352B2632G001	ERV Actuator Assembly	Q	00000707 13856
DRESDEN 1-3	Exelon	2014	6	352B2632G001	ERV Actuator Assembly	Q	00526352
QUAD CITIES 1&2	Exelon	2008	1	352B2632G001	ERV Actuator Assembly	Q	00000707 13133
QUAD CITIES 1&2	Exelon	2010	2	343A2632G001	Solenoid Assembly (modified)	Q	00000707 13252
QUAD CITIES 1&2	Exelon	2013	1	352B2632G001	Solenoid Assembly (modified)	Q	00000707 13727
QUAD CITIES 1&2	Exelon	2008	1	343A2632G001	Solenoid Assembly (modified)	Q	00000707 13234
QUAD CITIES 1&2	Exelon	2013	3	352B2632G001	Solenoid Assembly (modified)	Q	00000707 13795