



Repeat Actuator Failures During Commissioning of New Valves – Prior to Using Diagnostics

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Overview

The Modification was an identical installation of a new emission control system on two high pressure coal fired units.

The valve function was to open and close to regulate Boiler Feedwater through the economizer section of the Boiler in conjunction with an AOV control valve to control flue gas outlet temperature.

During initial startup of the system, the valve (EGOT-001) the valve was set up manually and then stroked electrically at the recommended torque switch setting and suffered a mechanical failure.

The valve was disassembled and no damage was identified. The actuator and gear reducer were removed and returned to the factory for disassembly and inspection. Failure of the bevel gear reducer was identified.

Overview (Cont.)

The actuator and gear reducer for the other unit was installed. the valve was set up manually and then stroked electrically at the recommended torque switch setting and suffered a similar mechanical failure.

The valve was manually placed in the open position to allow the Unit to operate while repairs were made and a new spur gear reducer was procured.

The client decided that diagnostic testing would be performed during subsequent setup of the valve(s).

Valve and Actuator Configuration

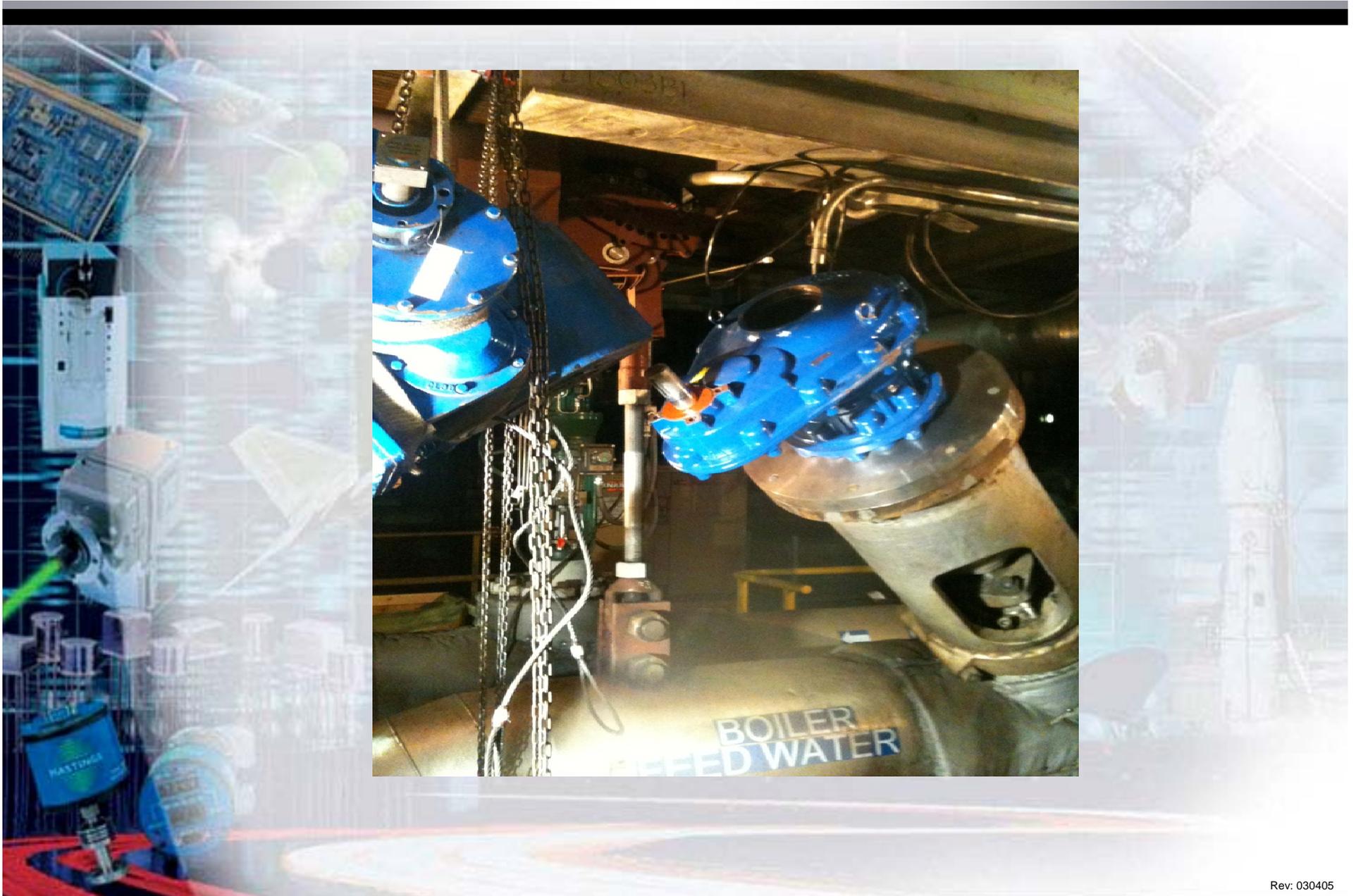
The valve is a 20 inch Wye pattern globe valve with flow under the seat with a 5 inch stem and design conditions are 4300 psig underseat and 4100 psig overseat.

Actuator is a Limitorque L120-420 (SMB-3), 46:1OAR, Heavy Spring Pack, 150# 1700 RPM motor with a 5:1 (85% efficiency) bevel gear reducer

OEM required seating thrust is 230,237 lbs.

Original OEM structural limit was 359,700 lbs. (Bevel Gear Reducer). Replacement Spur Gear Reducer structural limit is 1,056,600 lbs.

Actuator and Gear Reducer



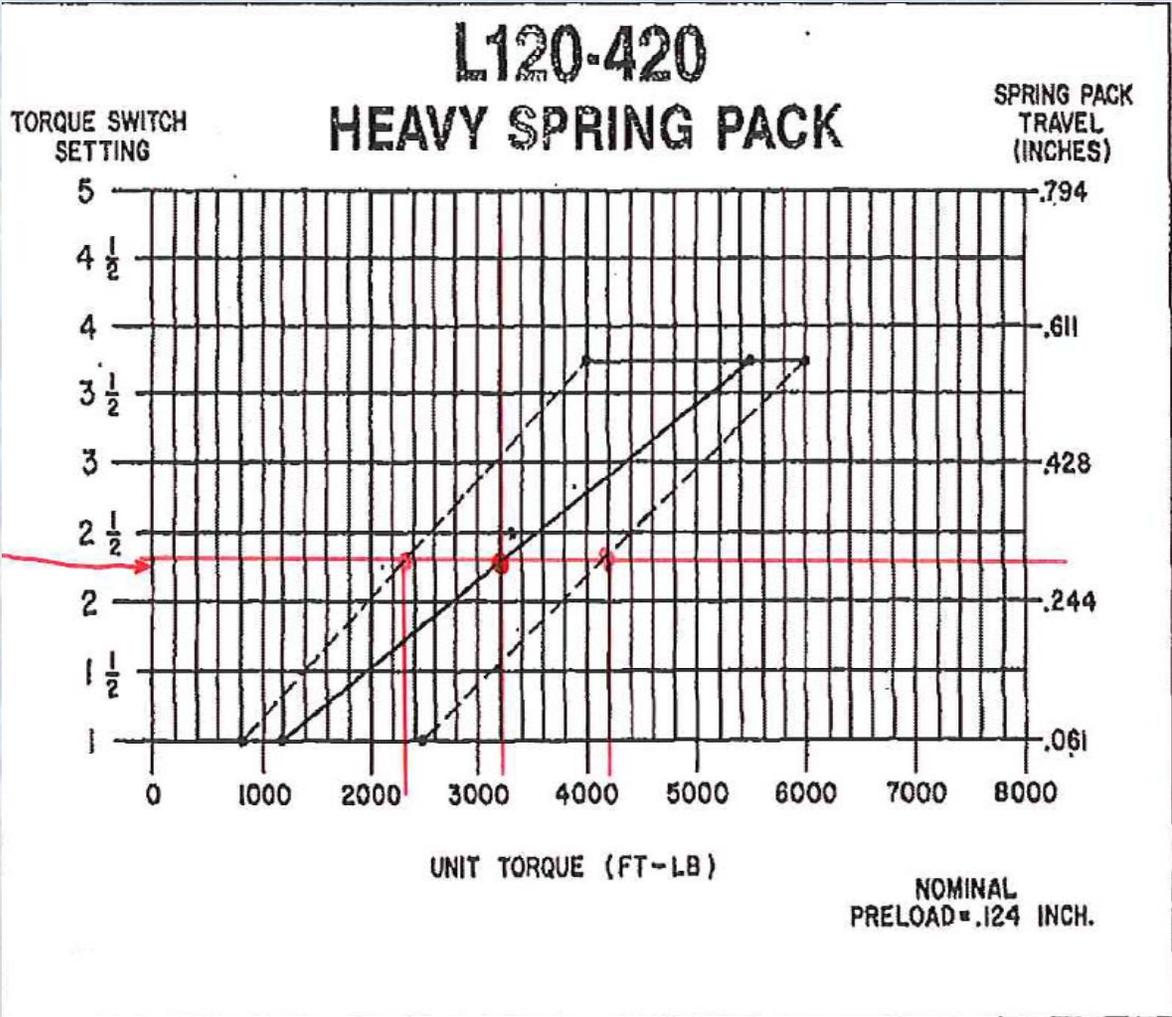
Stem and Yoke



Estimated Torque Switch Setting

- Minimum Required thrust was calculated to be 230,372 lbs.
- Stem COF was assumed to be 0.15 corresponding to a F_s of 0.04065
- Bevel Gear assembly was 5:1 with an efficiency of 0.85.
- The calculated required actuator torque output is 2203 ft-lb
- To assure the functional capability of the assembly was achieved, the lower tolerance on the spring curve was assumed (note: curve is from 1988)
- Based on the Curve for a L120-420 Heavy Spring Pack a setting of 2.25 was selected. (Nominal 2225 ft-lb output)

Spring Pack Chart



Estimated Torque Switch Setting (Cont.)

- The nominal structural limit is 359,700 lbs
- Based on the published range of range of the Spring Pack (minimum value to maximum value) the estimated output thrust at a torque switch setting of 2.25 for a Stem Factor of 0.15 could vary from 232,626 lbs.to 439,114 lbs.
- The estimated output thrust at a torque switch setting of 2.25 for a Stem Factor of 0.10 could vary from 445,902 lbs.to 585,246 lbs.

Diagnostic Testing



Diagnostic Testing Results

- The valves were tested when the spur gear assemblies were available and plant conditions allowed.
- Initial testing progressed from a torque switch setting of 1.0 until desired margin was achieved. For Unit 1 an as left thrust of 292,226 lbs. was achieved at a torque switch setting of 1.75. For Unit 2 an as left thrust of 332,064 lbs. was achieved at a torque switch setting of 1.5.
- Back calculating from the measured stem torque, actual spring pack force was reasonably close to the nominal torque switch curve.
- Extrapolated thrust at the OEM recommended torque switch setting of 2.25 is 412,000 lbs. for Unit 1 and 492,000 lbs. for Unit 2. Both valves are estimated to exceed the structural limit of 359,700 lbs.

Adjusting Packing to 905 ft-lbs



Conclusion

Inclusion of diagnostic testing as part of the initial setup and testing of the valves would have prevented expensive rework of the actuator assemblies.

Testing of the spring pack, at a minimum, to determine the actual output of the spring pack would have allowed a more accurate recommended torque switch setting.

Diagnostic testing could have set up the valve within the initial thrust window (MRT of 230,372 lbs. to a maximum allowable of 359,700 lbs.) without having to replace the Bevel Gear Assembly with a higher rated Spur Gear Assembly.

The problems associated with these two valves delayed the commercial operation of this system, and the possible costs associated with these delays could have been avoided.

Related Consideration

From Reliance Motor Curve #586530 for a 150 ft-lb 1730 RPM motor the locked rotor current is 130 Amps. However, this motor produces 175 ft-lbs. at that value. The motor produces the rated 150 ft-lbs. at 60 amps

During initial commissioning of the valve, hand held amprobe readings were taken with the conclusion that a stall event had not occurred. Recorded values were as high as 56 Amps.

At a motor output of approximately 150 ft-lbs., the unit output would be approximately 17,977 ft-lbs. which exceeds the bevel gear assembly rating of 11,800 ft-lbs.

The resultant thrust would be:

696,802 lbs. of thrust at a measured COF of 0.08

442,795 lbs. of thrust at an assumed COF of 0.15

Both exceed the bevel gear assembly thrust rating of 359,700 lbs.