

Electric-Driven Actuators

for SRV, PM Valves, and IGV

at *Fort St. Vrain Station, Platteville, Colorado*



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with
Permission of
David Such

7F Users Group Annual Conference, May 17, 2017
David B. Such, Principal Production Engineer, Xcel Energy

Ft. St. Vrain Station

Unit 1: GE D8 Steam Turbine

Unit 2: 7221 (COD 1996)

Unit 3: 7231 (COD 1999)

Unit 4: 7241 (COD 2001)

Combined
Cycle

403,500 Total Fired Hrs
4,375 Total Fired Starts

Units 5 & 6: 7241 (COD 2009)
Simple Cycle



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The Problem

- Oil varnish created by micro-dieseling in servos
- Sticking hydraulic valve actuators due to varnishing
- Turbine trips due to inconsistent valve tracking
- Annual replacement / cleaning of servos

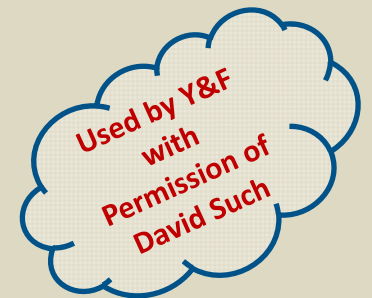


Band-Aids

- Side-stream electrostatic filtration
- Periodic in-kind oil replacement

Solutions

- Synthetic Oil (Polyalkylene Glycol) → FSV 3
- Replace hydraulic actuators with electric → FSV 4



Considerations

- Ambient temperature challenges
- Explosive environment
- Control system interface modifications
- Control system logic modifications
- Sufficient force to move IGV rack
- Failure modes
- Reliability
- Design life
- Periodic Maintenance



Ambient Temperature Ratings

- Gas valves rated to 100°C/212°F
- IGV rated to 130°C/266°F



SRV

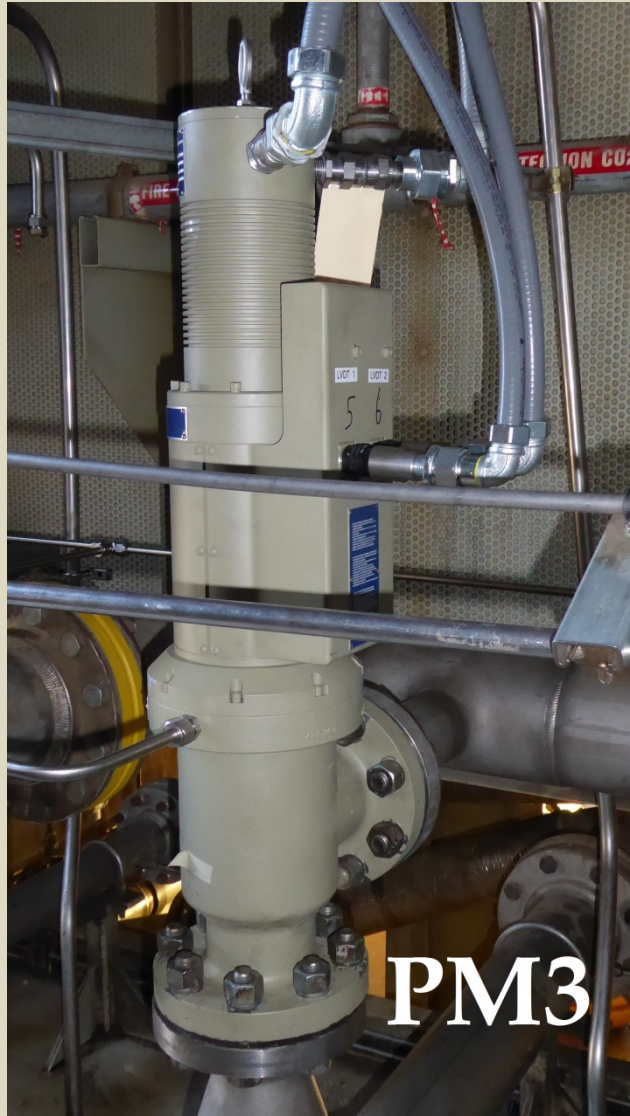


Electric-driven Stop/Ratio Valve (SRV)

- Installed on FSV #4 in Spring 2016
- Smooth installation and commissioning
- Minor control loop tuning issues
- Operational test for future applications



PM1



PM3



PM2

Installed May 2017 on Ft St Vrain Unit #4

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IGV

Installed May 2017
on Ft St Vrain Unit #4

New turnbuckle

Convenient step stool

Hard-Wired

2Meter LVDT wiring

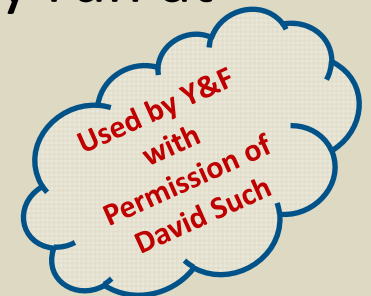
10Meter Motor wiring

Left hydraulic lines in place

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Control System Logic Changes

- Changed start permissive to look for valve controller faults
- Changed hardware assignments for trip oil relays (L20FG1X and L20TV1X)
- Removed trip logic from low hydraulic pressure
- Removed hydraulic protection trouble alarm
- In Post-Ignition and First-Out Trip logic, replaced low hydraulic pressure trip with electric controller fault trip.
- Changed hydraulic oil pump lead/lag logic to only run at turbine speed < 50% (for lift oil)
- Modified graphics accordingly



And remember, changing the logic and graphics is a piece of cake with **Ovation!**

Failure Mode / Trip Response

Gas Valves

- On a loss of power, spring action will slam valve closed (similar to spring-close)
- On unit trip, controller will rapidly close valve, but decelerate just before closed to preserve valve seat

IGV

- On loss of power, actuator will fail as-is (similar to hydraulic actuator)
- On unit trip, actuator will fail to the closed position **in approximately 4 seconds**

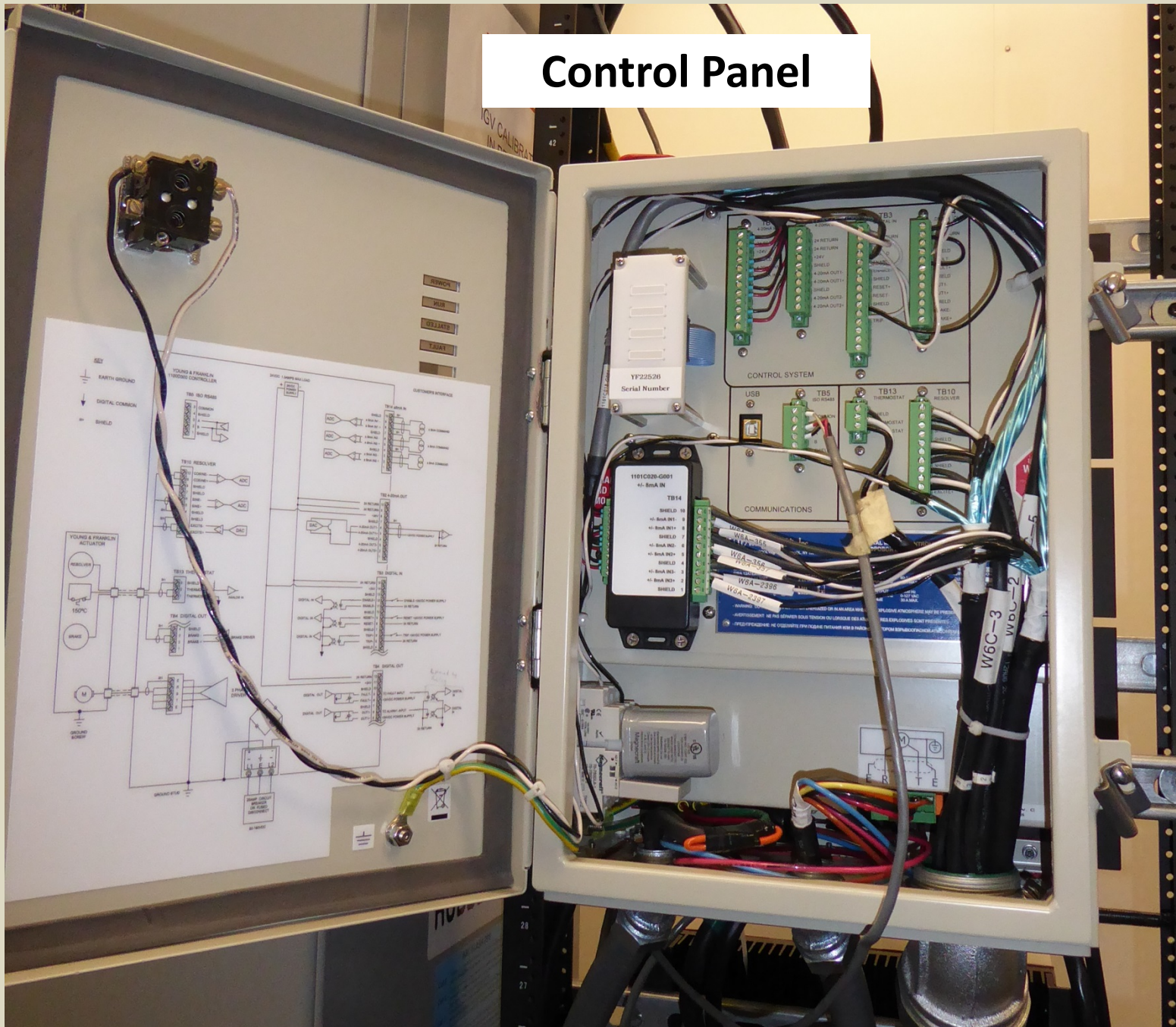


Disadvantages

- The controller box is cramped and laid out with inconvenient field wire access
- Individual control boxes per valve
- Added local reset button (**site preference**)
- Actuator motors are hard-wired; to pull a motor requires pulling cables back through seal-off



Control Panel



Future Remedies

- Redesigning control box / interface to have rack-mounted cards
- New version will have 2 racks total for PM valves and IGVs
- Quick disconnect cables for EMA products



Advantages

- No more varnished and sticky PM valves or IGV
- No more trip oil
- Hydraulic pumps only operate for lift oil when speed is less than 50% (Can be eliminated with Independent Lift Oil system)
- Young & Franklin were amazing to work with – very good experience
- 12 year recommended inspection interval



Questions?

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(The view from Fort St Vrain Station)