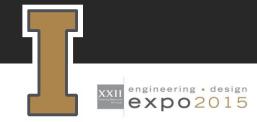
ELECTRONIC FUEL CONTROL FOR GE-T58 GAS TURBINE

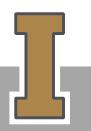
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PROBLEM STATEMENT

Replace a mechanical fuel control for a racing gas turbine engine with an electronically controlled fuel controller that will measure exhaust gas temperature, turbine speeds, throttle position, and thermocouple readings. Develop a programmed controller that will respond to these readings and output fuel to the nozzles and stator vane actuator. The fuel supply to the nozzles and stator vane actuator vane actuator, respectively. The valves will be packaged within an aluminum manifold that will bolt into the proper location on the engine.



GE-T58 Gas Turbine PROJECT LEARNING

- 7 stages of compressors, first 3 are stationary
- Stator vane actuator controls first 3 compressors
- 2 stages of turbines, N1 and N2
- 16 fuel nozzles to combustion chamber
 - Only 8 in use during start up
- Fuel pump is powered by N1
- Tach generator outputs N2 speed: 4200 rpm (tach) = 100% (N2)
- 8 thermocouple type-K EGT sensors



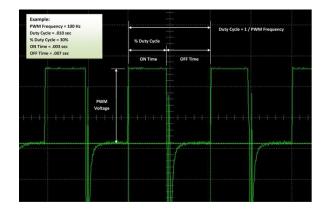


Electronic Hydraulic Controller & Hardware **PROJECT LEARNING**

Electronic Hydraulic Controller

- Understanding block diagrams
- Gaining knowledge of electrical systems
- 2 Way Hydraulic valve
 - Gaining knowledge of pulse width modulation (PWM)

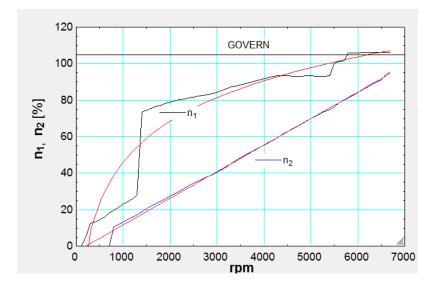






Electronically controlled hydraulic controller **DESIGN GOALS**

- Read exhaust gas temperature (EGT), turbine speeds (N1 and N2), throttle position (TPS), thermocouple readings
- Govern N1 and N2 while having a safety switch to stop fuel flow at 105% speed
- Respond to readings by outputting fuel to nozzles and compressor guide vane actuator





Manifold DESIGN GOALS

- Bolt into place of existing FADEC fuel control
- Flanges to connect fuel pump and tach generator
- Encompass hardware
- Compact and one solid piece





SPECIFICATIONS

No.	Component	Need	Imp.
1	Fuel Control	Programmed hydraulic controller	5
2	Fuel Control	2 way valve wired to controller	5
3	Fuel Control	4 way valve wired to controller	5
4	Inputs	Read type K T.C	5
5	Inputs	Read turbine speeds, N1 & N2 - AC Frequency	5
6	Inputs	TPS (0-5v)	3
7	Inputs	Read compressor discharge pressure (0-5v)	1
8	Record	Read RTD inlet temperature	4
9	Outputs	PWM for fuel outlet control	5
10	Outputs	Fuel to compressor guide vane actuator	5
11	Manifold	Bolts in place of existing fuel control	5
12	Manifold	Throttle position sensor mounted	5
13	Manifold	Package sensors	5
14	Manifold	Aluminum	3
15	Manifold	Cap off unnecessary ports	3
16	Manifold	Drawing package	5
17	Manifold	Bypass fuel control (manual)	1

CONSTRAINTS

- GE-T58 Turbine
 - Prior knowledge
 - Complexity of mechanical fuel control
 - Accessibility
- Hydraulic Controller
 - Technical support
 - Software knowledge
 - Lack of structured text knowledge
 - Lack of Programmable logic controller (PLC) knowledge
 - Lack of program organization units (POU) knowledge

Manifold

Single piece of aluminum





DELIVERABLES

Sealed aluminum manifold

- Contain industrial off the shelf valves, hoses, fittings, and hydraulic controller
- Flanges to mount existing fuel pump and tach generator
- Bolt on replacement with minor adjustments

Fueling Equation

Analysis of turbine based off of prior dynamometer data

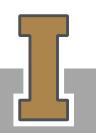
Electronic hydraulic controller

 Blink LED as a simulation of pulse width modulation (PWM) to the 2 way valve

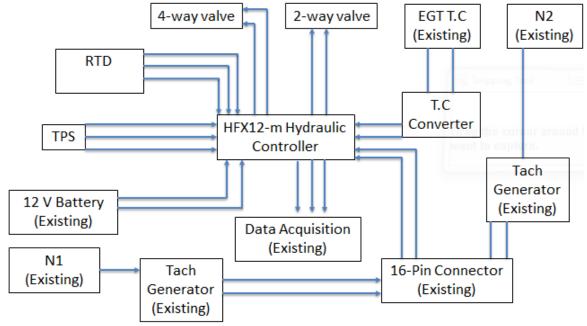


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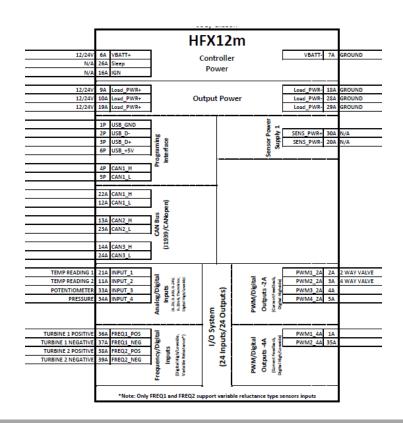


Wire Schematic **DESIGN**

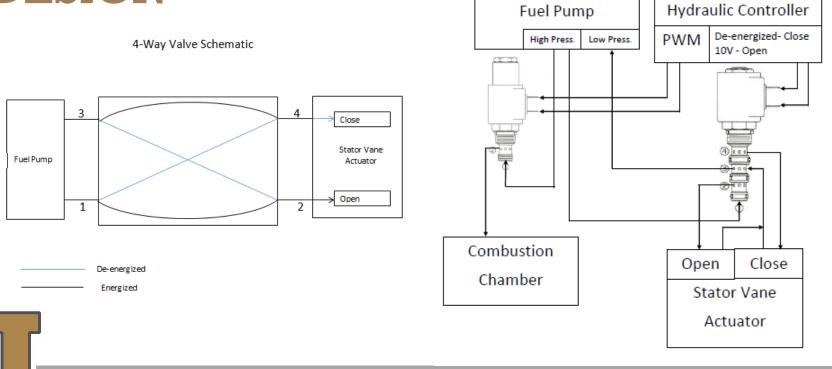


Block Diagram

 This block diagram will be the final wiring for the electronic controller



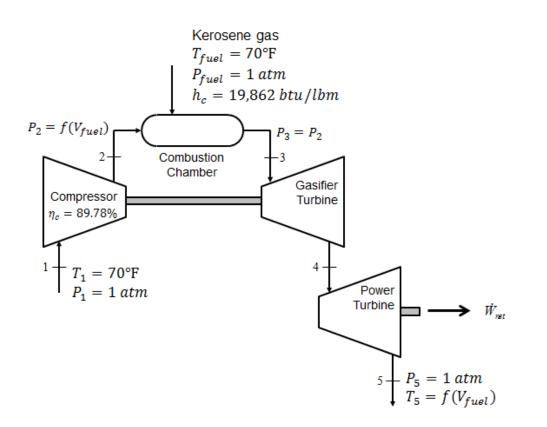
Valve schematic **DESIGN**



Turbine Analysis **DESIGN**

Process

- Energy balance to solve unknowns
- Inputs from previous dyno run
- Varying atmospheric conditions
- Calculations
 - Fuel volumetric flow rate
 - Air fuel ratio
 - Compressor efficiency
 - Power delivered





Manifold DESIGN

- Single piece of aluminum
- Directs fuel flow
- Mounting brackets for fuel pump and tach generator
- Mounts controller











Future **RECOMMENDATIONS**

Further Combustion analysis

- Consider localized moist air in intake air Electronic Controller
- More in depth code
- Dyno tuning
- Bench scale testing





QUESTIONS/COMMENTS





