



Hydraulic Controls on Combustion Turbines

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Learning Objective:

The student will become familiar with the most common configurations for powering hydraulically actuated controls (fuel valves, guide vane actuators) and how they compare to electrically powered controls. The focus will be on the GE Heavy Frame configurations and the Siemens/Westinghouse Heavy Frame (60 hz) configurations. The class will span the following system elements: oil selection, sump, hydraulic power unit, filters, trip oil, hydraulic actuators, servo control valves, trip relays, permissives, pressure regulation, pressure switches, and accumulators. Hydraulic system maintenance and overhaul requirements will be discussed. Typical hydraulic system trouble shooting, system weak-points, wear/replacement items and principles will be explained.

This class does not cover lube oil systems except as they relate to the Hydraulic Controls.

Course Outline

- I. Industrial Turbine vs. Aero traditions
 - a. Oil pressure based controls in Industrial (VCO)
 - i. Piston Lever based controls
 - ii. Shared oil sump
 - iii. Shift to servo control valves
 - b. Fuel-draulic based controls in Aero
 - i. Shift to electric, faster systems and controls, natural gas
- II. Basic Hydraulic Actuation Elements
 - a. Single acting vs. double acting
 - b. Piston, Rod, Cylinder, Dynamic Seals
 - c. Hydraulic manifold, Static Seals
 - d. Emergency Trip Relay
 - e. Servo Control Valve construction and action
 - i. Pencil filter
 - ii. Coils/torque motor
 - iii. Spool Valve
 - f. LVDT, RVDT Position transducers
- III. Operating Requirements
 - a. Force vs. piston area

- b. Speed vs. flow
- c. Stored Energy
- d. Pressure
- e. Flow
- f. Leakage Flow
- IV. Basic Hydraulic Power System Elements
 - a. Oil Sump
 - b. Oil Filters
 - i. Particles
 - ii. Electrostatic
 - iii. Absorption
 - iv. Ion Exchange Resin Bonding
 - c. Oil Selection, wear, care
 - i. Base Oil
 - ii. Additives
 - iii. Degradation Mechanisms, testing
 - d. Accumulators
 - e. Positive Displacement Pumps, pressure regulation
 - f. Pressure Switches, control system interlocks
 - g. Hydraulic fittings, Static Seals
 - h. Drains
 - i. Trip Oil System, Solenoid dump valves
- V. Electrically Powered Controls, Comparison Model
 - a. Brushless DC Motors/Ball Screw designs
 - b. Limited Angle Torque Motor designs
 - c. Position transducers
 - d. AC vs. DC power source
 - e. Stored Energy
 - f. Wear mechanisms
 - g. Interlocks and permissives
- VI. Actuator Wear and Maintenance
 - a. Static and Dynamic Seals
 - b. Force trains and side loads
 - c. Duty cycles, dither
 - d. Filter inspections and replacements
 - e. LVDT calibration
 - f. Servo Control Valve bias
 - g. Trip relay
 - h. Inspection points and intervals
 - i. Signs of accelerated wear
 - ii. Inspection and reassembly
 - iii. Testing
 - i. Leaks
 - i. Fire Hazards
 - ii. Personnel hazards
 - j. Time-zero overhaul

- k. Parts and repairs
- VII. Troubleshooting and trouble prediction
 - a. Seals
 - b. Slow response
 - i. Varnish
 - ii. Galling, scoring
 - c. Inconsistent response