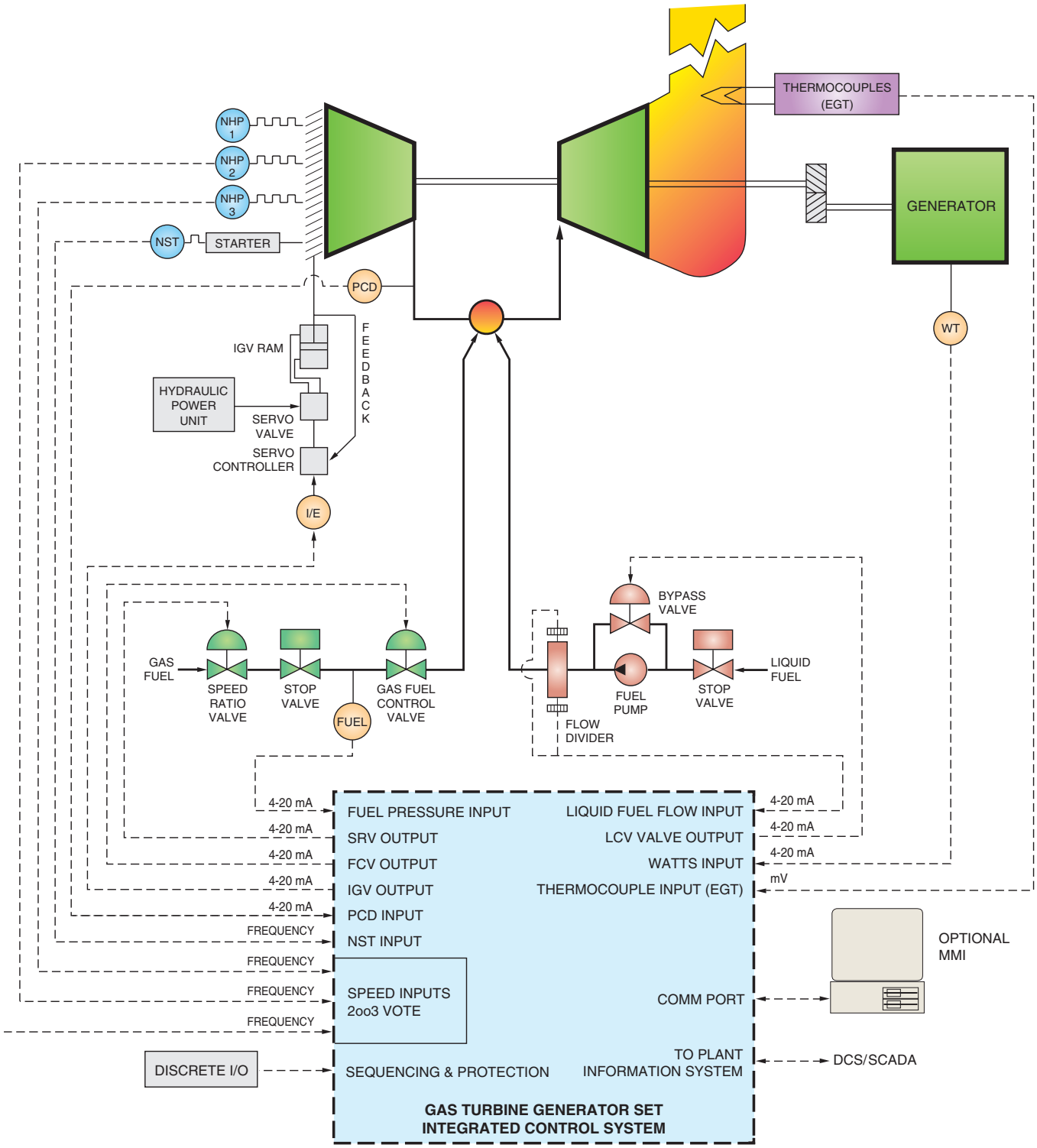
GAS TURBINE CONTROLS FOR GENERATOR DRIVE APPLICATIONS

MAY 2012



Simplified schematic showing a Petrotech advanced PLC-based integrated gas turbine control system for a generator set. The system provides turbine fuel control, temperature control, sequencing/protection, communication interfaces, and more.

APPLICATION

The Petrotech integrated control system provides cost-effective complete or partial control system retrofits for gas turbine driven generator packages. The system provides replacement controls for outdated electro-hydraulic and analog-electronic controls. The PLC-based system can include turbine and generator sequencing, complete turbine control, load control, DCS interface, and a graphic operator interface for system status, trending, and data logging.

ADVANTAGES

- **Integrated control capability:**
  Turbine fuel control and sequencing/protection are integrated into a single platform. This eliminates the need for additional hardware and communication links, thereby providing a less complicated, more cost-effective solution.
- **Open architecture system:**
  Application control package's portability allows customer choice of platform, reducing need for additional spare parts and training expenses. Available PLCs include General Electric 90-70 and 90-30, Siemens/TI, Modicon Quantum, and Allen-Bradley.

Replacement controls for one GE Frame 5 gen set in utility peaking service with water injection skid for NOx reduction.

Replacement controls for two Allison 501K gen sets in emergency backup power service.

- **Fault tolerant:**
  Control package is available on fault tolerant controllers for critical control applications.
- **Standard industrial components:**
  Non-proprietary, commonly available parts are less costly and more easily serviced by customer's on-site personnel. Much longer time to obsolescence than proprietary systems.
- **Reliability:**
  ALL control functions are performed by tested and proven industrial PLC equipment, not by MS-DOS based computer equipment which is not designed to function as a "controller".
- **Simplified interface to DCS or SCADA:**
  Communication tasks are handled with a separate, dedicated module in the PLC, increasing data rate and simplifying network installation.
- **Non-proprietary interfaces:**
  Interfaces in the form of 4-20 mA, RTD, frequency, thermocouple, and dry contact I/O allow simple integration into existing sequence/protection logic controller, making very low-cost partial control upgrades simple and practical.
- **Improved fuel regulation:**
  Fast loop sampling rate, combined with modern digital control techniques improve steady-state setpoint control, and reduce overshoot during transients.
- **Improved start-up reliability:**
  Special "lean lightoff" procedure ignites all burners with essentially 100% reliability, and with greatly reduced thermal stress.
- **Improved exhaust temperature monitoring and control:**
  Advanced statistical algorithms detect turbine hot/cold spots and automatically reject failed thermocouples.
- **Fail-safe features:**
  Redundant overspeeds; open/short monitoring of mA and thermocouples; readback monitoring of outputs, and special self-check features improve safety.

• Improved operator information with optional MMI:

Industrial workstation graphically displays start-up sequencing, speeds, temperatures, operating points, and alarm/shutdown status. Data logging and trending can be used as part of a preventative maintenance program.

• Simple installation:

A dimensionally identical replacement of the control panel is possible, saving substantial architectural and installation cost. Control panels can be installed one at a time allowing other units to continue operating.

• Rugged:

Control panels can be built Division 2, Nema 4X for installation in harsh local environments.

• Flexibility:

The control system package can accommodate many different control strategies based on the customer's need and budget.

CONTROLLERS/SPECIAL FEATURES

The gas turbine generator application control package typically includes:

- Firing (soft lightoff) ramp.
- Start-up controller.
- NHP controller.
- NHP acceleration and deceleration scheduling.
- EGT controller.
- EGT rate of rise controller.
- EGT controller for inlet guide vanes (if applicable).
- Isochronous load sharing.
- Combustion monitoring system with automatic rejection of failed thermocouples.
- Cooldown stop.
- Dual fuel capability with bumpless on-line transfer.

CUSTOMER SELECTABLE COMPONENTS FOR THE CONTROL SYSTEM

Advanced Programmable Controller:

- Siemens/TI 505.
- Allen-Bradley Series 5, Flex I/O, ControlLogix.
- GE Fanuc 90-70 and 90-30
- Modicon Quantum.

Application control package:

- Petrotech gas turbine control.
- Petrotech sequencing and protection.
- Vibration Monitor:
- Bently Nevada 3300, 3500, and 2201 (for Allen-Bradley systems only).
- Vibrometer.
- Metrix.
- Vibrotec.
- Customer specified.

Autosynchronizer:

- Basler.
- General Electric.
- Customer specified.

Man-machine interface (MMI), alphanumeric display (low end) plus panel meters for NHP, NLP, and EGT:

- NEMATRON.
- CTI Access 4000.
- Allen-Bradley Redi-Panel.
- Customer specified.

Man-machine interface (MMI), graphic display (high end):

- MMI Hardware:
  - Intecolor industrial computer and monitor.
  - IBM industrial computer and monitor.
  - Texas Microsystems industrial computer and monitor.
  - XYCOM industrial computer and monitor.
  - Nortech industrial computer and monitor.
  - NEMATRON industrial computer and monitor.
  - Customer specified.
- MMI Software:
  - Wonderware InTouch.
  - Citech.
  - Intellution.
  - Realflex.
  - Customer specified.

Critical function redundancy for fail-safe action:

- Customer specified shutdowns in addition to NHP, NLP, EGT, and low lube oil pressure.

Communication interface for DCS or SCADA:

- MODBUS.
- Ethernet
- Customer specified.

Type of control panel enclosure:

- Front and back plate for existing control enclosure (common for some GE gas turbine retrofits).
- Custom fabricated new control enclosure.
- Class I, Division II stainless steel purged panel enclosure for hazardous locations.
- Standard Rittal type panel enclosures.

Replacement controls for one GE LM2500 gen set in LNG plant power service.

AUXILIARY SYSTEMS FOR GAS TURBINE GENERATOR PACKAGES

The following auxiliary systems and components are also available for complete or partial system upgrades:

- Fuel control valve system upgrade can include replacement of fuel control valve, fuel speed ratio valve upgrade, addition of a fuel vent valve, compressor discharge pressure transmitter, and interstage fuel pressure transmitter.
- Dual fuel conversions including addition of a gas or liquid fuel valve system.
- Skidded water or steam injection systems for NOx reduction and power augmentation.
- Hydraulic servo controls if applicable, such as second stage nozzle controls on a GE Frame 3 gas turbine, or inlet guide vane controls on a GE Frame 5 gas turbine.
- Speed probe and exciter gear assemblies.
- Flame detectors for combustion chambers.
- Thermocouple retrofits.

Petrotech, Inc.
151 Brookhollow Esplanade
New Orleans, Louisiana 70123
USA

Phone: (504) 620-6600
Fax: (504) 620-6601
Email: info@petrotechinc.com
Website: www.petrotechinc.com