PETROTECH

Applications and Capabilities

EXPERIENCE • CAPABILITY • EXECUTION

www.petrotechinc.com

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Contents

Petrotech Incorporated

Company Overview

With over a half century of experience and thousands of installations worldwide, Petrotech provides customized control solutions in a full turnkey package, from engineering concept to installation and commissioning.

Petrotech provides an extensive range of products and engineering services for rotating machinery and plant control system upgrades, mechanical retrofits, standalone control products and new equipment solutions for turbomachinery industry OEMs.

Petrotech's products include integrated control systems for gas, hydro and steam turbines, generators, reciprocating/diesel engines, compressors, centrifugal and axial compressors, pumps and all associated ancillary systems. Our turnkey services include engineering design (software and hardware), project management, control panel fabrication, system integration, site I&E services, commissioning, training, customer service and startup.

Petrotech has remained committed to providing its customers with advanced controls that improve the performance and mechanical reliability of turbo and rotating machinery. This commitment is demonstrated by continued focus and improvement of its core competencies and turnkey solutions.

Advances in the company's control software development have allowed Petrotech to develop its fully open architecture so that it continues to be transportable to all major commercially available control platforms. These Petrotech control algorithms are based on application knowledge of the company's founding members and extensive field experience. The advanced functionality continues to evolve with the development of additional capabilities that serve the customer's ever-changing needs.

In our peer group of turbomachinery control system companies, Petrotech provides the most innovative solutions for unusual and difficult control challenges.

Our corporate office is located in New Orleans, Louisiana, with full-service offices in Houston, Texas and Bury St. Edmunds, Surrey, in the UK, as well as support offices worldwide.

Petrotech's History

1970s

Petrotech's turbomachinery control knowledge is traceable to a 1960's era company called Compressor Automation Controls, later known as Baker CAC. In 1978 Petrotech Incorporated was formed by the turbomachinery group that separated from Baker CAC. Originally the group produced pneumatic compressor controllers and wellhead safety systems. The group focused primarily on the upstream and midstream Oil & Gas sectors.

1980s

Petrotech begins to market its system to the midstream pipeline compressor market. The company becomes the preferred anti-surge control supplier for Solar Turbines and Demag Delaval. Petrotech also develops its solid-state, stand-alone compressor controller – the ASC-M series, providing more functionality.

In the eighties, Petrotech expands into I&E and System Integration. This significantly expands its capabilities beyond Turbomachinery into the Reciprocating Equipment and Balance of Plant (BoP) automation.

1990s

The company sees significant growth in its market share of pipeline compressor control retrofits. Also, the PLC (Programmable Logic Controller) begins to emerge as a superior alternative to proprietary controllers. Petrotech leads the Turbomachinery industry by adopting an open architecture approach to control system solutions.

Petrotech expands into an EPC role. Designated as an engineering and construction unit producing whole offshore modules, the EPC business unit is built around compressors and general I&E engineering work.

In 1995 Petrotech buys Unitech, a New York-based gas turbine/generator control systems supplier. Unitech brings extensive experience in General Electric and other gas turbines and integrated generators.

In 1997 Roper Industries acquires Petrotech.

With the popularity of the PLC making sizable market share gains, the ASC-M series standalone anti-surge controller product lines are brought to a close in 1999 in favor of commercially available superior processors.

2000s

Petrotech consolidates its various offerings into the core Compressor & Turbine Controls Group, forming the total solution Petrotech of today.

In 2003 Roper Industries divests the unified Petrotech Company to a management led, private investors group.

Following the aftermath of Hurricane Katrina in 2005, Petrotech expands into full-scale operations in Houston, Texas to accommodate double-digit growth.

In addition to its fully integrated systems, Petrotech introduces a series of new products to address existing stand-alone compressor control requirements in the marketplace. The Em-400 series, a comprehensive system, includes a color touch-screen display, high speed processing and state-of-the-art connectivity. It is designed to provide a migration path for the ASC-M series, some of which are still in use 30 years after installation.

In 2009 Petrotech wins the prestigious Frost & Sullivan Excellence in Customer Value Award. This award recognizes the consistent value customers receive from Petrotech's Turbomachinery control capabilities and experience, combined with custom solutions, an unmatched return on investment and reduced life cycle costs.

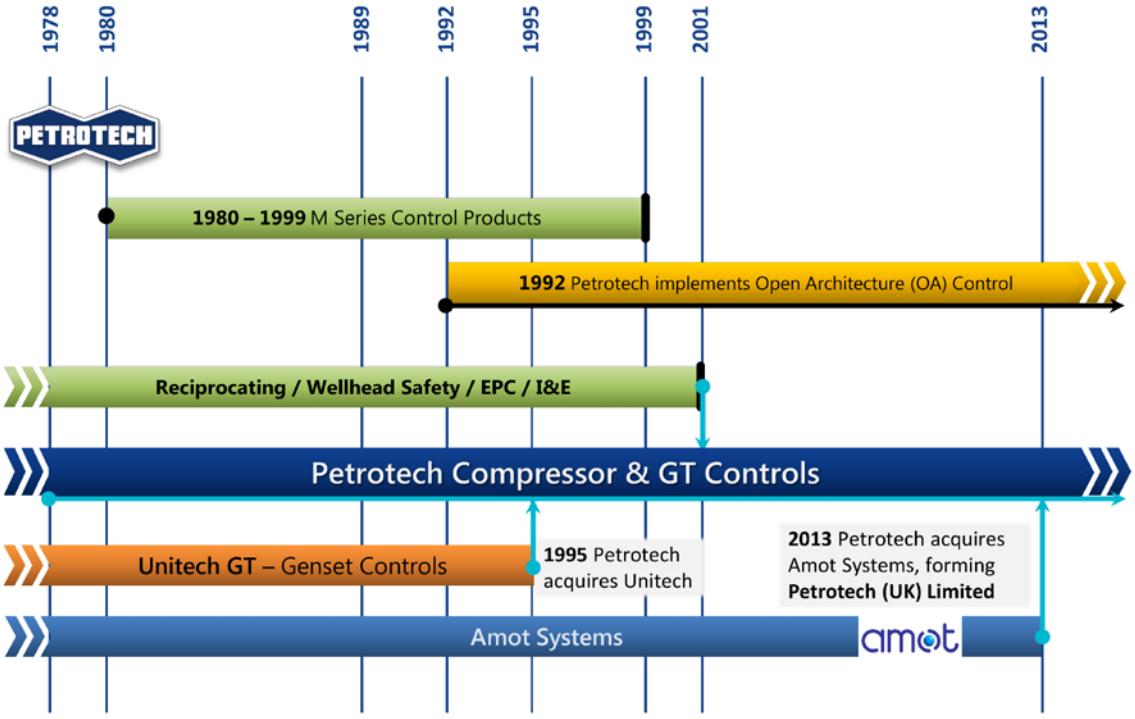
2010s

In 2013 Petrotech acquires Amot Systems, a division of Amot, a Roper Industries subsidiary. Amot Systems, now Petrotech (UK) Limited, brings over 50 years of design experience in control and monitoring systems, specializing in diesel engine controls, hazardous area electrical and mechanical engineering. The addition of a manufacturing, sales and service facility in the United Kingdom expands Petrotech's footprint closer to customers in Europe and the rest of the world. Additionally, the UK facility and engineering staff enhance the ability of Petrotech to meet unique certification requirements worldwide.

Petrotech's acquisitions and product expansions over the years are designed to expand its market leadership role in full turnkey services for all rotating equipment such as Gas, Hydro and Steam Turbines, Compressors, Reciprocating and Diesel Engines, Pumps with all their auxiliary systems and Balance of Plant control needs.

Petrotech continues to pride itself on being a leader in Turbomachinery controls, serving several major industries within the energy sector, including:

- Oil & Gas Production
- Pipeline & Gas Processing
- Petrochemical & Refining
- Power Generation
- Other Industrial Processes



Petrotech's Business Segments

Customers look to Petrotech for complete driver control, load control, sequencing, protection, and information systems integrated into a control system hardware platform of their choice. To understand the depth of products and services provided by Petrotech, let's look at its business segments.

Applications

Proven-in-use turbomachinery software and standardized software modules for use across multiple control platforms. These applications are built to the internationally accepted IEC 61131 programming standards. Petrotech Applications includes all software products such as configuration tools and HMI (Human machine Interface) display standard screen sets.

Solutions

Petrotech Solutions are engineer-to-order solutions which often incorporate Petrotech Applications software into integrated panel systems. These solutions include the full-range of project management, project engineering, project services, system integration, factory testing, and customized configurations.

Elements

Elements are Petrotech products. These systems bundle the same proven Petrotech Applications into a lower cost, pre-engineered, configure-to-order package. Elements may be combined with other systems to enhance functionality or provide an economical configurable solution.

Support

The most experienced part of the Petrotech business is its customer support. With a full range of services, the Petrotech Support group delivers the Petrotech expertise to the customer's location.

Petrotech Applications (AP)

Petrotech Applications (AP) are the software and standardized program modules that are based on Petrotech's long history of ongoing development. The seventy-five plus Petrotech Applications form the basis of an extensive library, specifically developed to be used in a wide range of industry standard control systems. Petrotech Applications are written in IEC 61131, an international consensus programming standard. These applications provide the customer with a comprehensive suite of configuration tools, HMI (operator display) screens, and application templates. The available templates include Fuel/Speed Modules, Compressor Anti-surge Control, Compressor Loadsharing, Compressor Performance, Gas and Steam Turbine Control, Generator Control, Dual Fuel Conversion, Condition Monitoring, Integrated Controls, Fallback Strategies, Fail-safe Control, Surge Protection, Safety Systems, Reliable Start-up, Black Start, Flexible Platform, Fuel Governor, DCS Interface, and Inlet Guide Vane Control.

Petrotech's advanced control software development has evolved to a fully open architecture that is transportable to all major commercially available hardware platforms.

Petrotech's advanced control software development has evolved to a fully open architecture that is transportable to all major commercially available hardware platforms. The control algorithms that have been developed are based on over 50 years of experience in providing control systems for rotating machinery. The advanced functionality continues to evolve with the development of additional capabilities.

Petrotech's Research and Development team are continuously working to improve our value added applications to customers worldwide. In our peer group of turbomachinery control companies, Petrotech provides the most innovative solutions for difficult control challenges for rotating equipment. Examples of such complex systems are:

- An advanced five-section centrifugal compressor for a Urea Plant, each section having independent inlet guide vanes to control flow. The compressor control system also included on-line optimization and calculations of thermodynamic parameters.
- A turnkey upgrade of sixteen (16) GE Frame 5 turbine generators with dual fuel capability and auxiliary systems.

Our Research and Development team take pride in developing reusable software modules for Petrotech Solutions. The user benefits through this approach because software development by a dedicated team results in advanced capabilities and features that would not be possible from software developed on the shop floor by a systems panel integrator. Some of the Petrotech advanced software capabilities are:

- Typical applications contain more than 300 owner-adjustable calibration values and configuration flags
- Near 100% gas turbine Soft Light-off reliability
- EGT (exhaust gas temperature) hot and cold spot detection with sophisticated failed thermocouple detection routine

- Bumpless transfer between isochronous and droop control
- Isochronous loadshare control
- Bumpless transfer between gas and liquid fuel operation

The Petrotech Applications Modules are grouped by their particular functionality. We use three-letter acronyms to distinguish them in user documentation.

TFR Gas Turbine Fuel Regulator covering all major brands of frame (industrial) and aero-derivate gas turbines. Controls single and dual fuel machines.

ASC Anti-Surge Control for centrifugal and axial gas compressors. The ASC logic employs comprehensive strategies to deal with severe process upsets such as: high gain backup controller (i.e., Backstop Control), configurable input signal filtering options, surge detection, automatic surge control margin adjustment, and recycle transfer controller.

RTC Recycle Transfer Control.

CAP Compressor Capacity Control.

LSC Multi-Compressor Loadsharing.

SCC Station-level/Multi-Compressor Control providing multiple compressor capacity/ loadshare master functionality and optimization

PRF Performance Control including Flow (AGA3-1, ASME ISO 5167 nozzle, Annubar/Itabar), Aero and Frame Gas Turbine, Compressor (NX19 & RKZ compressibility calculations)

STC Steam Turbine Governor Control

RCC Reciprocating Compressor Control

GEN Generator Control includes synchronizing routines and interfaces to VAR and station control.

Petrotech Solutions (SL)

Petrotech Solutions (SL) incorporate Petrotech Applications into a variety of controller scenarios. Petrotech has built its over 50 year reputation on supplying engineer-to-order solutions and panel systems for a wide range of rotating machinery applications. Petrotech's customers often return to purchase additional solutions for their fleet. Some customers have purchased as many as 100 systems from Petrotech. Repeat business of this magnitude is a clear testimony to Petrotech's quality and experience. Petrotech offers a complete line of rotating and turbomachinery control system related products and services for new installations as well as retrofits of existing controls.

Petrotech Solutions means integrated control systems. Petrotech provides complete asset driver control, load control, functional safety, sequencing, machinery protection, and information systems all integrated into a world-class control system hardware platform. Petrotech provides control solutions for the following types of rotating machinery:

Petrotech Solutions are focused on providing an optimum combination of capability and low cost.

- **Turbine Drives** – gas, hydro or steam turbine driven compressors, generators, and pumps
- **Reciprocating Engine Drives** - reciprocating engine driven compressors, generators, and pumps
- **Electric Motor Drives** - electric motor driven compressors and pumps
- **Compressor Trains** - complex centrifugal and axial compressor trains
- **Station / Balance of Plant controls**
- **Station Supervisory Control Systems** - Pipeline Compressor Stations, Gas and Power Plants

The typical Petrotech Solution includes project management, project engineering, project services, system integration, factory acceptance test, site acceptance test, and commissioning assistance and training. Many Solutions also include complete turnkey installation services, a service not available with smaller turbomachinery suppliers. Petrotech Solution history includes control systems for General Electric, Solar Turbines, Pratt & Whitney, Dresser-Rand, Westinghouse, Hispano Suiza, Waukesha, Worthington, Rolls-Royce, Lycoming, Ruston, Allison, Cooper, Elliott, Clark, Ariel and Fiat.

A large part of each Petrotech Solution is focused on providing an optimum combination of capability and low cost. Petrotech systems are integrated solutions. Integrated means the user has a single control system rather than a collection of dedicated function systems or small boxes. Integration brings together the process control in and around the compressor (i.e., capacity controls such as suction, discharge pressure control, etc.) into a common processor.

Use of a common processor simplifies the system layout, cost, and functionality. While many controls suppliers can integrate machine control into a single controller, they are not able to provide software with their solution. Petrotech Applications software is an advantage that others simply cannot offer.

Petrotech Engineered Solutions bring value through:

- Very flexible I/O and function capability
- Open Architecture, Non-proprietary interface
- IEC 1131 standard based open-code programming
- Systems designed for the toughest environments
- World-class systems include industry required approvals and certifications
- Reduced cost of ownership through common spares and training
- Provides the ability to enforce customer hardware preferences across all of customer's rotating asset fleet regardless of nameplate

Advantages of the Petrotech's Integrated Control System

Petrotech's Open Architecture (OA) systems offer numerous advantages to the customer. Some of these advantages include: lower cost than proprietary type systems, standardization with existing installed hardware base, reduced spare parts inventory, and simplifyed maintenance and service. Since spare parts are readily available worldwide from many sources, open architecture allows for new control functions to be easily added at a future date.

The following are some of the major advantages of a Petrotech Integrated Control System:

Integrated Control Capability: Turbine fuel control, driven equipment 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.

Firmware: Petrotech proven-in-use Application Control Packages are derived from well-proven, mature functions that have been implemented in thousands of similar control systems.

Auxiliary Controls: Complete auxiliary systems including gas turbine fuel system upgrades and conversions, water and steam injection systems for gas turbine NOx reduction and power augmentation, machinery hydraulic system upgrades, and fast response recycle valves for centrifugal compressor applications.

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. Standard communication protocols are all available.

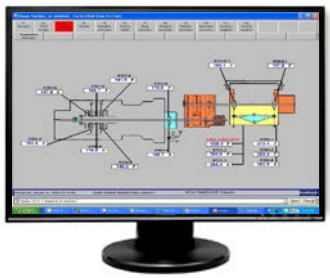
Improved Fuel Regulation: Fast loop sampling rate, Petrotech proven-in-use control application, improves steady-state set-point control, and reduce overshoot during transients. The same application also performs bumpless fuel transfer control.

Critical Function Redundancy Assembly: Even though many of the world-class control systems available in the market today, have availability in the 99% range, Petrotech includes the Critical Function Redundancy (CFR) Assembly to insure system reliability in the face of unexpected component failures. The CFR assembly provides redundant protection for critical shutdowns, and will trip the machine independent of the main PLC control, upon detection of an abnormal operating condition

Improved Start-Up Reliability: Special Petrotech "lean light-off" procedure ignites all burners with essentially 100% reliability. This reduces turbine thermal stress and minimizes fired-hours penalties for starting.

Improved Exhaust Temperature Monitoring and Control: Advanced statistical algorithms detect turbine hot/cold spots and automatically reject failed thermocouples. Asset protection is maintained thorough out the operating cycle.

Fail-Safe Features: Redundant over speeds; open/short monitoring of analog signals; read back monitoring of outputs; and special self-check features improve safety.



Improved Operator Information with Graphic Interface: Industrial workstation graphically displays start-up sequencing, speeds, temperatures, operating points, and alarm/shutdown status. Optional data logging and trending can be used as part of a preventative maintenance program.

Fault Tolerant: Most reliable of control solutions. System designed to withstand multiple faults or failures without loss of mission. Highest availability. Redundant speed and EGT protection using entirely separate hardware from the main control hardware.

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.

World-class 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 compared to proprietary systems.

Petrotech OA (Open Architecture)

Petrotech supplies its engineered solutions in industry standard open architecture, Petrotech OA Solutions. End-users enjoy a lower cost of ownership because it is built with the same types of controllers performing other functions throughout the customer's facility. This means the Petrotech turbomachinery training directly supports the existing user training, reducing customer errors and costly control mistakes. With the Petrotech OA Solutions being based on non-proprietary control hardware, spares and hardware repairs can be managed by regional suppliers avoiding the obligation to purchase from a single source.

The key element in Petrotech OA Solutions is the use of the IEC 1131 programming standard, which was first released in 1993. After finalization it was known as IEC 61131. The 1131 standard is a worldwide consensus standard in that it is born of industry based users and vendors. The stated purpose of the 1131 standard is: "to establish a universal programming system specifically designed to deliver optimal performance and ease of use, as well as minimal configuration, programming and maintenance costs." The standard contains five PLC programming languages.

1. **LLD** – Ladder Logic Diagram
2. **FBD** – Function Block Diagram
3. **ST** – Structured Text
4. **IL** – Instruction List
5. **SFC** – Sequential Function Chart

Key advantages in using the IEC standard are:

- Efficient: experienced automation suppliers can create a modular approach to programming.
- Deploy in world-class: components meet world-wide safety and electrical protection regulations
- Competitive pricing: marketplace pressures results in a robust, fully certified system that must compete with many other controllers

In general, having standard programming languages results in; Reduced waste of human resources (in training, debugging, maintenance) Improved problem solving due to software re-usability (reduced application investment and supplier dependency) Reduced misunderstandings and errors, Programming techniques usable in more environments (general industrial control), Combining harmoniously different controllers from different locations, companies or countries, or projects, Increased connectivity (investment protection).

Petrotech OA Solutions are delivered in accord with purchaser requirements. In addition to the variety of platforms available to implement the solution in Petrotech also offers the full range of performance configurations. Whether the user's needs are simple simplex configuration or high-available/high-reliable Triple Modular Redundancy, Petrotech has supplied all of these configurations.

System Architecture Selection

SIMPLEX

A Simplex architecture is one based literally on "one of everything". PLC's of today are very reliable and have an excellent availability. Simplex systems is more than suitable for most turbomachinery applications.

Key aspects of a Simplex system are:

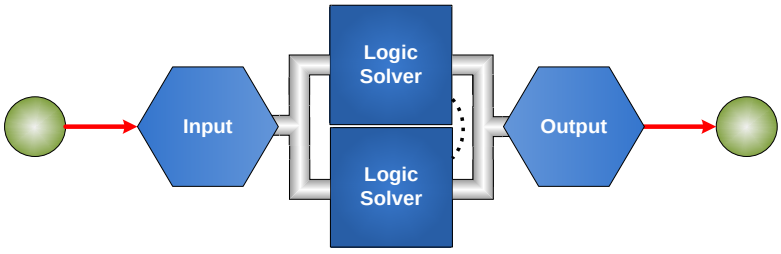
- Lowest Cost
- Good performance
- Simple to Maintain
- No Fault Tolerance
- Single Points of Failure
- No On-Line replacement
- Minimum Diagnostic Coverage

REDUNDANT

A Redundant architecture is almost the same as a Simplex one except it has two processors or logic solvers. The reason for this configuration is the fact that the processor portion of a PLC is the most complex part of the system. By providing a second processor as a "Hot Standby" (active but not in control) unit, the item which has the highest probability of failure has been automatically spared to avoid an unplanned system or process shutdown. This level of redundancy has a primary or basic level of fault tolerance. Redundant systems are commonly used in Turbomachinery applications where improved availability is justified by a modest increase in system cost.

Key aspects of a Redundant system are:

- Moderate Cost
- Good performance
- Some redundancy
- Primary (twin processors) Fault Tolerance
- Still no On-Line replacement
- Improved Diagnostic Coverage



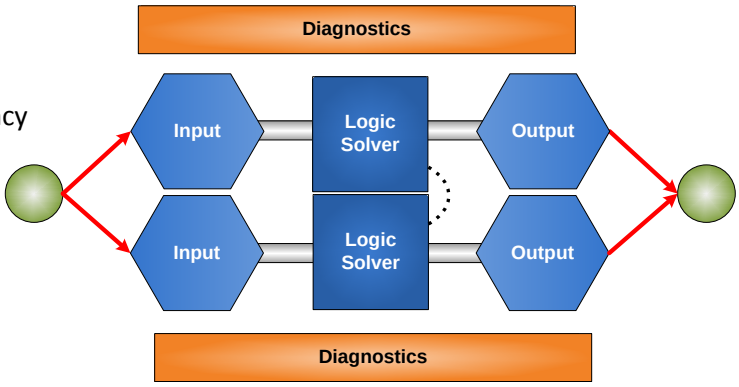
System Architecture Selection, continued

DUAL REDUNDANT

Dual-Redundant architecture means that there is now “two of everything”. Along with the doubling of the system hardware, additional diagnostic/housekeeping functions are now present to facilitate the testing and switch-over to the healthier component. A Dual-Redundant system introduces data voting as a way to perform validity tests on inputs and reliability on outputs. This configuration has multiple level fault tolerance for mission sensitive control applications. Dual-Redundant systems are used in many Turbomachinery applications where the improved availability coupled with voting and effective fault tolerance is necessary for long-term continued operation.

Key aspects of a Dual-Redundant system are:

- Increased Cost
- Good Performance
- Comprehensive System Redundancy
- Effective Fault Tolerance
- Greater Reliability Than Redundant Systems
- Limited On-Line Replacement
- Very Good Diagnostic Coverage

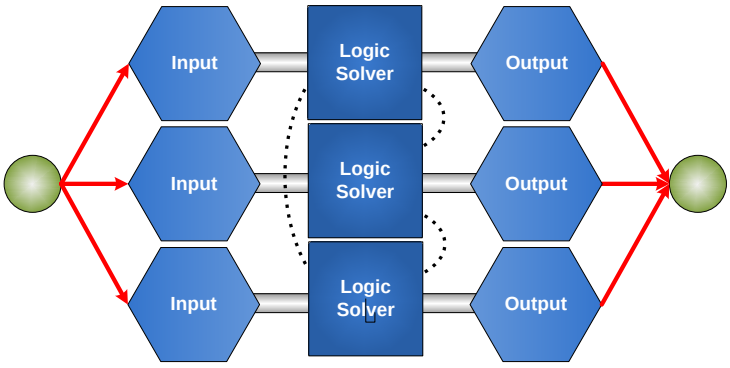


TRIPLE MODULAR REDUNDANT (TMR)

Triple Modular Redundant (TMR) is unlike the other types of system architecture. Born from the US Space Shuttle program development, this system has a minimum of three independent path ways of signal and logic processing. Of the TMR systems in the market today, all will have the same overall functionality. The purpose for this level of redundancy is to provide the user with a both a high-reliable and high-available control platform. A TMR platform can withstand multiple faults and still control without loss of functionality. Often these systems offer a repair-on-line capability to insure continuous operation. The TMR system also uses a robust voting scheme called 2oo3 (two out of three) to validate, signals, logic execution and final element outputs. These systems have a useful place in turbomachinery applications where unplanned shutdowns can exceed the cost of the system in an hour or less. TMR systems are also deployed as Emergency Shutdown Systems (ESD) in the same facilities.

Key aspects of a TMR system are:

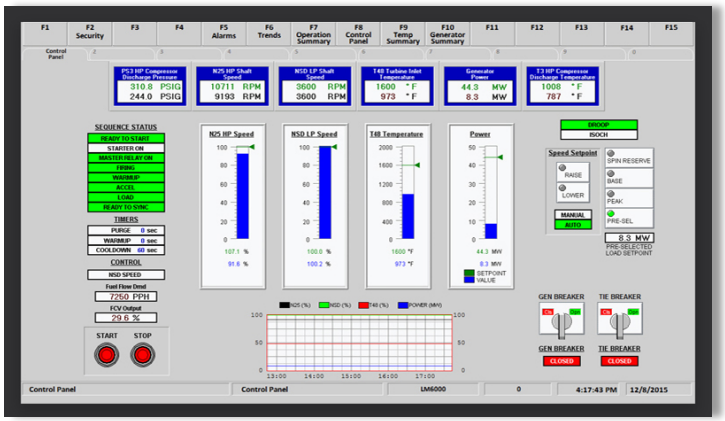
- Highest Cost
- Good Performance
- Elaborate System Redundancy (often transparent to the user)
- Durable Fault Tolerance
- Highest Reliability
- Full On-Line Replacement
- Certified Diagnostic Coverage



Petrotech HMI (Human Machine Interface) Display

While there are many types of display dynamics, facility operators and rotating machinery owners need to have the right information available in the day-to-day control and monitoring of their rotating assets. Petrotech provides HMI displays that reflect its three decades of experience. These displays are designed not just to draw multi-colored lines but also provide answers to the critical information the user needs. Although custom screens are always available with the Petrotech solution, Petrotech provides a base-line of screen-types to insure proper rotating machine control. The typical Petrotech HMI Solution rotating machinery screen-set includes as a minimum:

- Unit Overview
- Vibration and RTD
- Control setpoints
- Alarms / Trip history
- Permissives
- Real-time trending
- Dynamic alarms



The Petrotech HMI Solution, much like the Petrotech OA System Solution, is based on industry standard HMI display applications. Customer requests determine which HMI software and screen-set are provided. Petrotech HMI history includes applications using Wonderware InTouch, RS View ME, Factory Talk, WinCC, Citect, Intellution iFix, US Data Factory, Proficy, Cimplicity, and Indusoft IWS.

The Petrotech HMI Solution reduces project costs in the same way that the Petrotech OA does by using software already in use in other parts of the customer facility. Using popular controllers and HMI displays reduces startup and maintenance cost that would be associated with non-common elements. Each Petrotech HMI solution includes the following standard features:

- Flexible multi-lingual operator interface
- Real-time control and monitoring
- Interface to large number of controllers and monitoring equipment
- Process mimic graphics
- Alarm pages with first out notification
- Trending (real-time as well as historical)
- Event logging
- User reports
- SCADA (Supervisory Control and Data Acquisition) applications
- Redundant configurations
- Process control
- Sequence control
- Remote Web access
- Notification enhancement (pager, email, cell phone)
- Time sync to facility standard
- Historian/SQL database tools

Auxiliary Systems

Petrotech Solutions also encompass more than just control systems. Petrotech also provides for upgrades for turbine support systems such as fuel and hydraulic assemblies. As part of a gas turbine compressor controls upgrade, it is generally necessary to replace older auxiliary systems to interface to the new controls. Petrotech can modify or retrofit fuel valve systems, hydraulic systems, speed sensing elements, thermocouples, flame detectors, compressor recycle valves, pressure switches, and transmitters.

Modernizing these older field devices is an essential part of an overall controls upgrade scheme in terms of functional control improvements and increased reliability and maintainability.

The following auxiliary systems and components are examples of assemblies Petrotech has supplied along with complete or partial system upgrades:

Fuel Control Valve Systems	The 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.
Inlet Guide Vane Control	Hydraulic controls for inlet guide vanes.
Interstage Nozzle Controls	Complete second stage nozzle actuator and hydraulic system retrofit for GE Frame 3, with an increased capacity industrial RAM and servo with accumulator, pumps, and support components integrated into a complete system.
Dual Fuel Conversion	Dual fuel conversion skids including addition of a gas or liquid fuel valve system.
Water or Steam Injection Systems	Skidded systems for Nitrous Oxide (NOx) reduction and power augmentation. Speed probe and exciter gear assemblies. Flame detectors for combustion chambers.
Recycle Control Valves	Engineered compressor recycle control valves to prevent surge.
Recycle and Sequencing Skids	Skid mounted recycle and isolation valves for centrifugal compressors.

Control Flexibility

Gas Turbine Driver

The Petrotech integrated gas turbine control system provides cost-effective complete or partial control system retrofits for gas turbine driven compressor packages. The system provides replacement controls for outdated electro-hydraulic and analog-electronic controls.

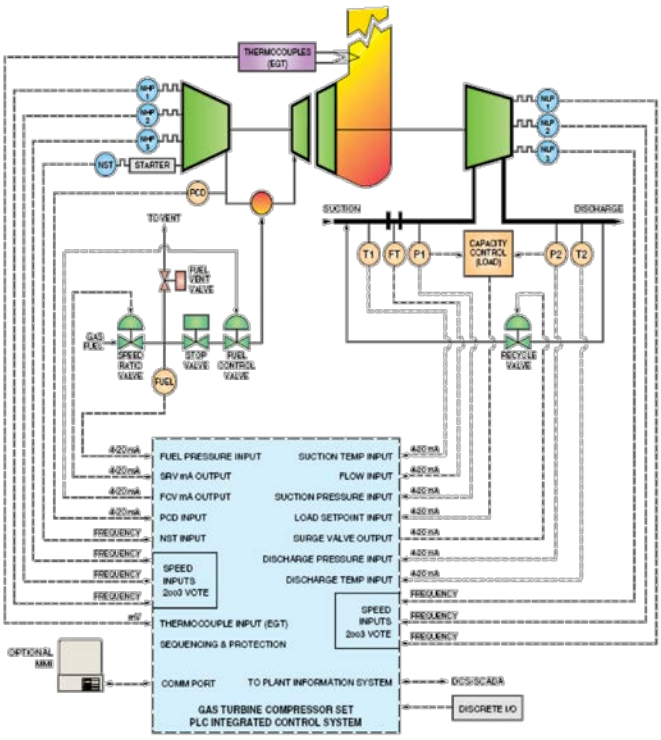
The PLC-based system typically includes complete turbine and compressor control, turbine and compressor sequencing, capacity control, DCS interface, and a graphic operator interface for system status, trending, and data logging.

Petrotech controls include:

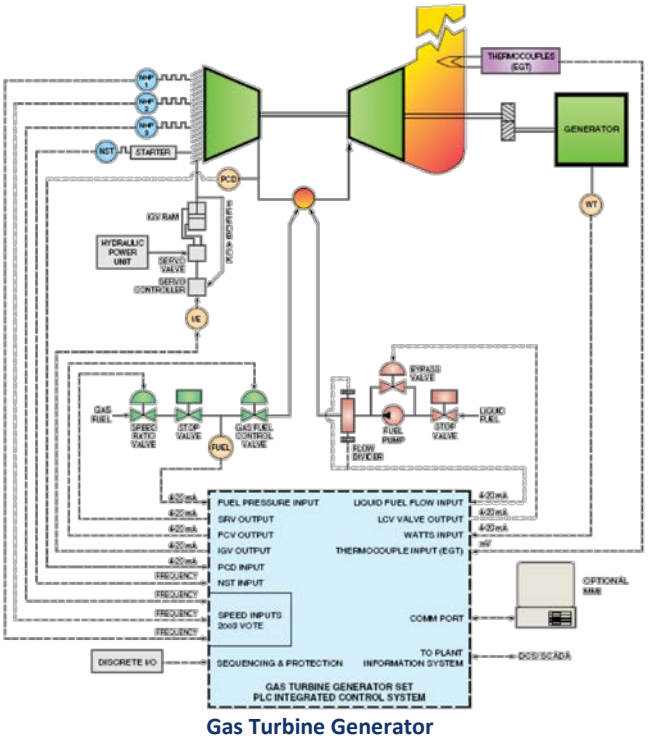
- Improved fuel regulation: The Petrotech TFR algorithm combined with high-speed sampling rate improves steady-state setpoint control, and reduces overshoot during transients.
- Improved start-up reliability: Special “lean lightoff” procedure ignites all burners with near 100% reliability.
- Improved exhaust temperature monitoring and control: Advanced statistical algorithms detect turbine hot/cold spots and automatically reject failed thermocouples.
- Fail-safe features: Redundant overspeed detection; open/short monitoring of analog signals; readback monitoring of outputs and special self-check features improve safety.

The gas turbine application control package also includes:

- Firing (soft lightoff) ramp
- Startup controller
- NHP acceleration controller
- NLP acceleration controller
- EGT rate of rise controller
- Combustion monitoring system



Gas Turbine Compressor



Gas Turbine Generator

Steam Turbine Driver

The Petrotech integrated steam turbine control system provides cost-effective complete or partial control system retrofits for steam turbine driven assets. The control 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.

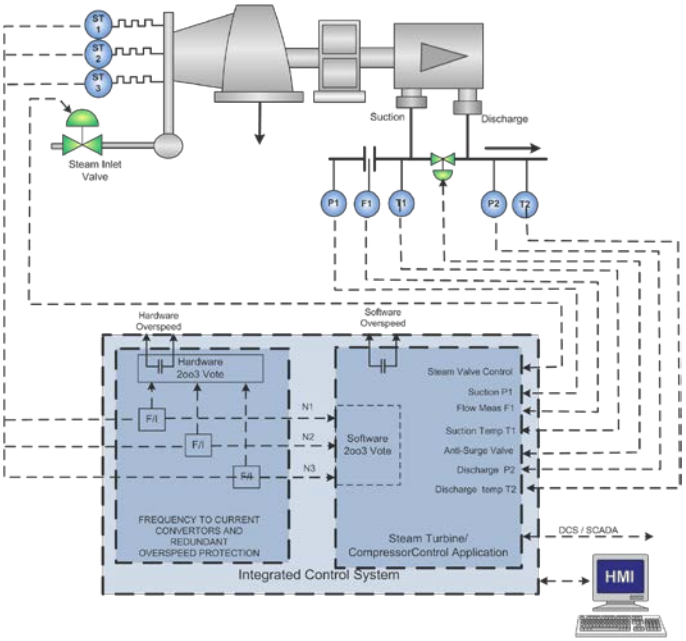
The control package for the steam turbine provides overspeed protection and critical speed avoidance:

Two schedules prevent steady-state operation at critical speeds and increase the speed rate of change through criticals on start-up to prevent damage due to excessive modal vibration.

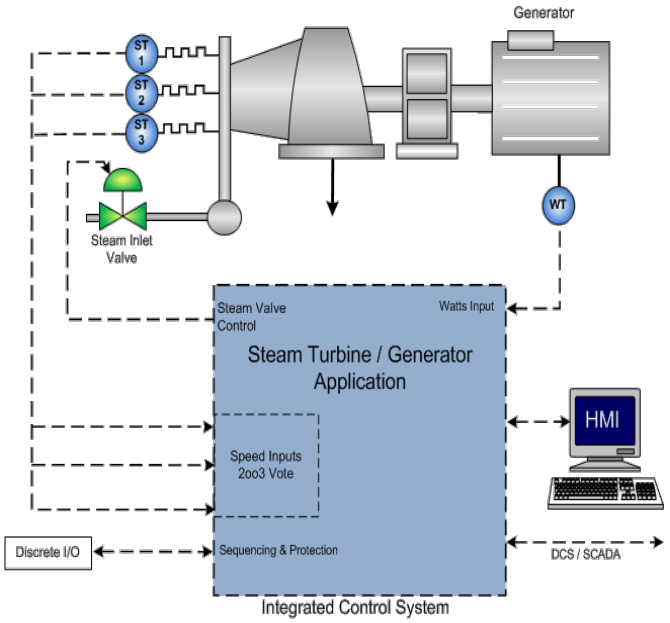
Operating states:

- Start/stop
- Slow roll
- Accelerate
- Load/cool down
- Active/standby
- Remote/local
- Auto/manual
- Isochronous Loadsharing
- Status, alarms, and shutdowns

Compressor Capacity control also includes integrated capacity (pressure/flow) control which eliminates the need for additional hardware and communication links thereby providing a cleaner, cost-effective system.



Steam Turbine Compressor



Steam Turbine Generator

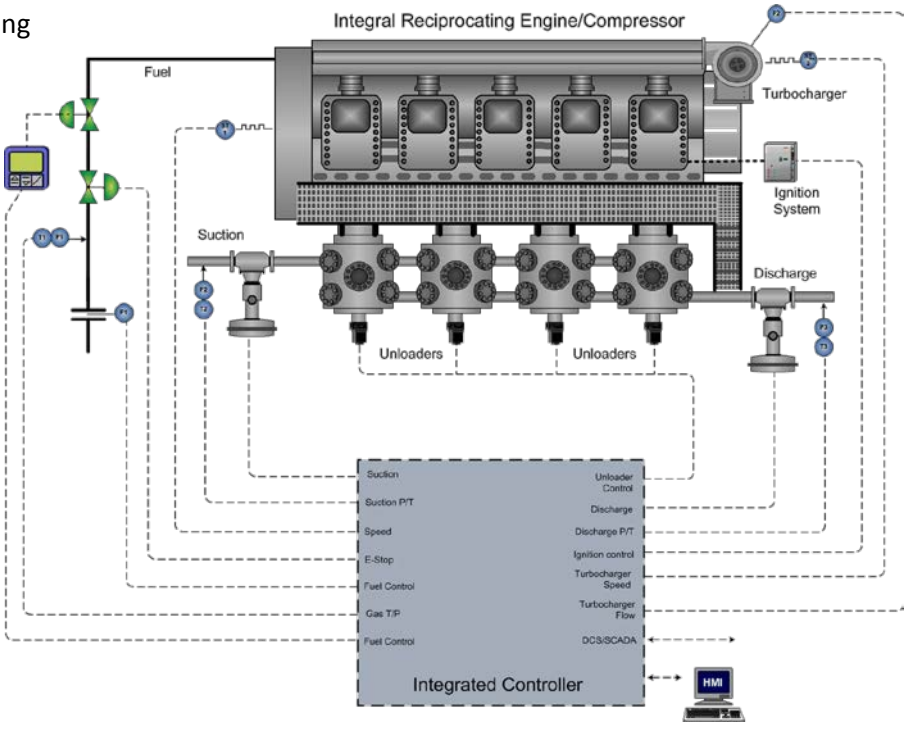
Reciprocating Compressors

Petrotech's custom integrated control systems provide cost-effective complete or partial control retrofits for integral reciprocating engine or separable motor driven compressor packages. The PLC-based system can include speed control (governor), torque control, air/fuel ratio control, ignition timing setpoint generation, temperature controllers, capacity control, DCS/ SCADA interface, and a graphic operator interface for system status, trending, and data logging.

Petrotech solutions for reciprocating compressors are designed to control load step control, ignition timing control, air fuel ratio control, speed setpoint control, and sequencing and protection. The software also includes extended engine diagnostics, unit performance, process calculations, and predictive horsepower calculations for optimum load step selection, station throughput control, and unit load management. All engine/compressor control functions, discreet logic functions, and calculations are accomplished in the PLC, using mature and proven Petrotech software applications. They include the means for adjusting ignition and speed setpoints, modifying output to waste-gate valve (air-fuel ratio control), and loading/unloading compressor pockets (load step control).

RECIPROCATING COMPRESSOR CONTROL FEATURES

- Governor/speed control
- Torque control
- Air/fuel ratio control
- Ignition timing set-point generation
- Process temperature controls
- Engine/compressor diagnostics
- Engine/compressor performance calculations
- Start/stop sequencing
- Process valve sequencing
- Auxiliary pump control



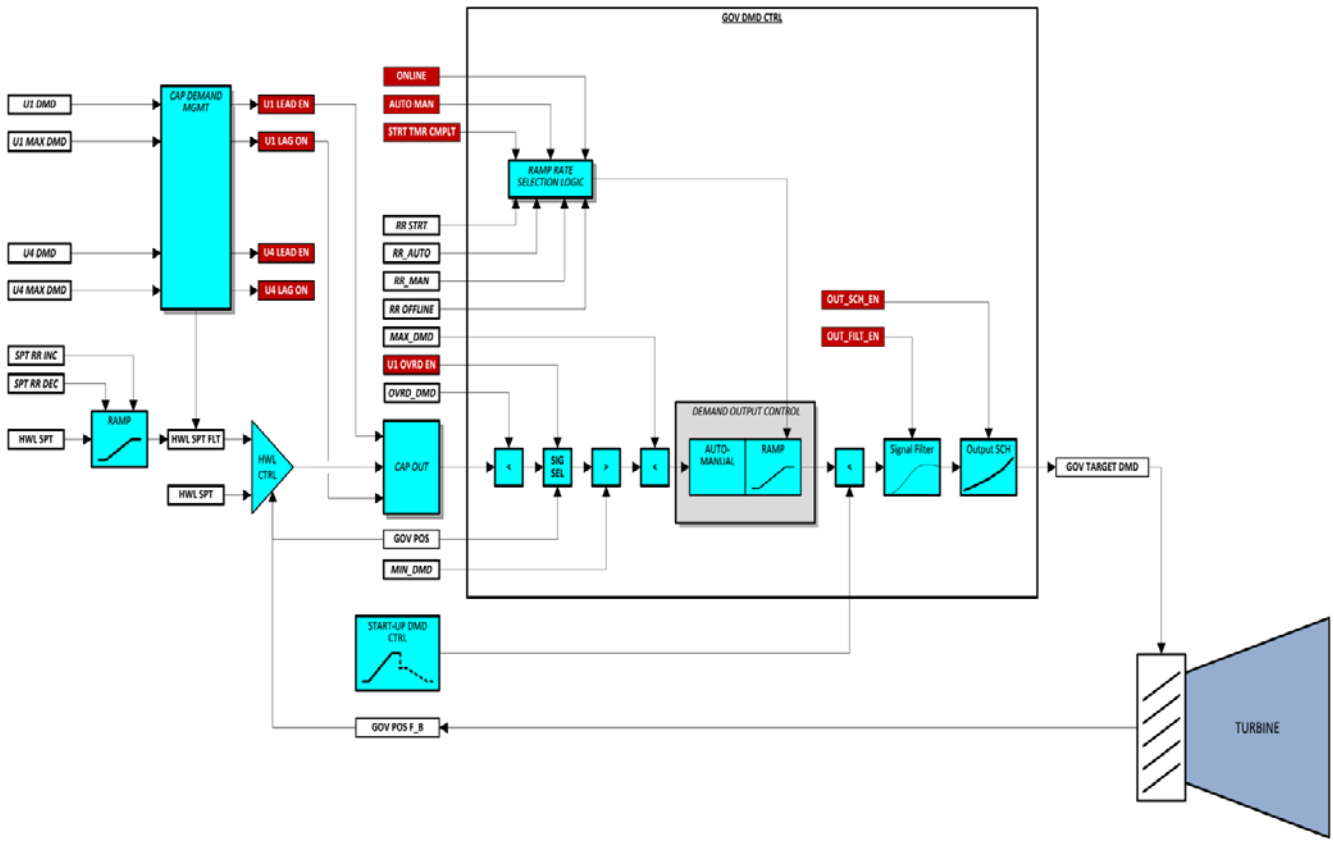
Hydro-Electric Turbine Generator Drive

The Petrotech integrated Hydro-Electric turbine control system provides cost-effective complete or partial control system retrofits for Hydro-Electric turbine driven generator packages. The control 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.

The control package for the Hydro-Electric turbine provides overspeed protection and critical speed avoidance. A coordinated control strategy for run-of-river hydro-turbine operations requires the following core components:

- Start-Up Demand Control
- Head-Water Process Controller
- Head-Water Anticipation Control
- Capacity Demand Management
- Unit Governor Demand Control



Petrotech Elements (EM)

Petrotech Elements (EM) are stand-alone products that incorporate Petrotech's proven Applications into a pre-engineered package. Petrotech Elements may also be combined with other systems to enhance functionality or provide low-cost configurable solutions. Each of these control products includes field-proven Petrotech software, a result of decades of extensive knowledge and experience in providing turbomachinery control solutions.

Em-400

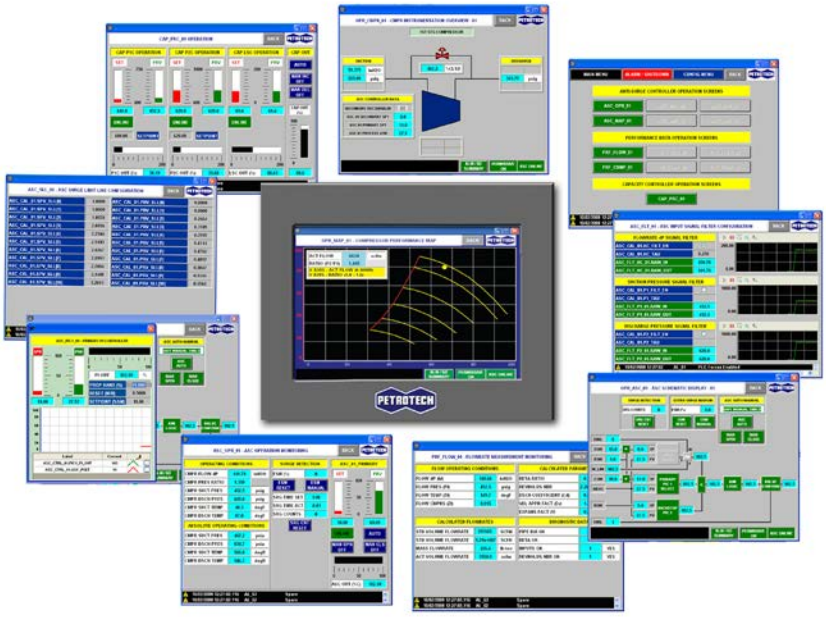
The Em-400 stand-alone compressor controller combines field-proven multi-loop surge protection with a built-in live surge map display resulting in an easy to use feature-rich control system. Part of the Petrotech Elements family of products, this system may be used for single and multiple-body compressors.

Petrotech Surge Control

Utilizing the field-proven Petrotech anti-surge control algorithm, the Em-400 provides a stable, robust, and practical approach to compressor and surge control applications. The Petrotech algorithm provides accurate anti-surge control by defining the surge point over a wide range of process gas conditions which results in optimum surge protection and eliminates unnecessary recycling. The advanced Petrotech anti-surge protection method automatically compensates for changes in molecular weight, temperature, compressibility, pressure, and compressor rotor speed.

Em-400 Pluses

- Petrotech field-proven Anti-Surge Control
- Touch-screen HMI with over 65 User Screens
- Multi-body Control
- User configurable operation
- Performance control
- Ethernet & Serial ports
- Alarm logging



Em-451/Em452

Em-451 Single-Body Add-on Anti-Surge Compressor Controller

Designed to attach to an existing controller, the Em-451 delivers Petrotech's field-proven configurable anti-surge control algorithms for **single body compressors** in a small, add-on controller. The controller is easily attached to any SIMATIC® Series 300 or 400 Master Controller via the Profibus communications protocol. The Em-451 module is equipped with anti-surge protection for a single-body (recycle loop) compressor and includes an integral recycle transfer control. An optional touch-screen display with pre-loaded screens is also available to supplement the existing display system.

Em-452 Multi-Body Add-on Anti-Surge Compressor Controller

Designed to attach to an existing controller, the Em-452 Petrotech's field-proven configurable anti-surge contro algorithms for **multiple body compressors** in a small add-o controller. The controller is easily attached to any SIMATIC Series 300 or 400 Master Controller via the Profibu communications protocol. The Em-451 module is equippe with anti-surge protection for a multi-body (recycle loop compressor and includes an integral recycle transfer contro An optional touch-screen display with pre-loaded screens i also available to supplement the existing display system.

Petrotech Support (Su)

Within Petrotech, the most experienced part of the company is its customer Support (Su) group. With a full range of services, the Petrotech Support team brings the long-standing Petrotech expertise to the customer's site. Support services include Telephone Support, after-market parts for a wide variety of installed systems and components, Turnkey Installation to supply all needed tools, materials, and labor to get the job done, Field Service work to repair-recalibrate-reprogram the controller, Installation Supervision to assist the customer with a successful start-up, and Customer Training.

Value

No cost telephone support and parts sourcing.

Experience

Over 50 years of field services execution.

With Petrotech Support customers benefit in these key areas:

Telephone Support:

No charge 24x7x365 availability. Customers speak to a real person, not an automated system. Once a Petrotech engineer or technician is assigned to the problem they have ownership until the issue is resolved. Telephone Support includes assistance in fault finding and control systems operational issues.

Parts Supply:

No charge parts sourcing. Petrotech services what we sell. Provides first line of support for Petrotech installed systems. Global email address for inquiries.

Turnkey Installation:

(*a Petrotech differentiator service*) Petrotech is one of the few rotating machinery control vendors with specifically trained installation crews. Some supervisors have managed more than 200 rotating machinery control installation projects. Our highly trained crews are familiar with special heat, vibration, and wiring integrity requirements for high value rotating machinery control installations. Experienced Single vendor responsibility. Reduces risk for customer. Includes all installation labor and materials. Utilizes local content. ISO 9001-2000 QC program inclusion. Petrotech maintains construction licenses in many areas.

I&E Services:

The Petrotech I&E team provides a wide range of skills to assist customers with field contract services needs. I&E support begins with assisting customers with their design and detail engineering requirements and progresses to specifying new equipment, development of preventative maintenance, calibration programs, and facilitating the servicing of existing instrumentation systems.

Installation Supervision:

A Petrotech engineer or technician will oversee control system retrofit installation activities (labor and material provided by others).

Commissioning:

Petrotech commissioning engineers and technicians operate worldwide and have special training and equipment for commissioning, calibration, and tuning. An experienced Petrotech engineer or technician actively participates in the initial system start-up. Commissioning includes loop check responsibilities, SAT (Site Acceptance Testing) execution, system tuning, and on-site warranty support.

Field Service:

An experienced Petrotech technician is provided on-site to address control system operational issues. This includes fault finding, calibration, repair/replace actions, system modification, system updates, and programming services.

Technical Training:

Petrotech offers training at the beginner, operator, engineer, and senior technical management levels, for basic machinery control technology, compressor control, gas turbine control, and energy management. Standard courses are offered at Petrotech in a classroom setting with all required equipment and simulators. Custom courses can also be given on-site, designed for your specific control system.

Technical Surveys and Studies:

Petrotech offers site surveys and studies of control problems with already-installed machinery to identify specific problems in process piping or layout that require correction or mitigation to achieve satisfactory results.

Technical Support and Services:

Petrotech offers an optional Site Support Agreement for remote troubleshooting services via the Internet or a dial-up connection. Using this connection, Petrotech engineers can direct on-site technicians with trouble-shooting efforts, and see an exact representation of real-time site conditions. Changes can be made remotely if needed.

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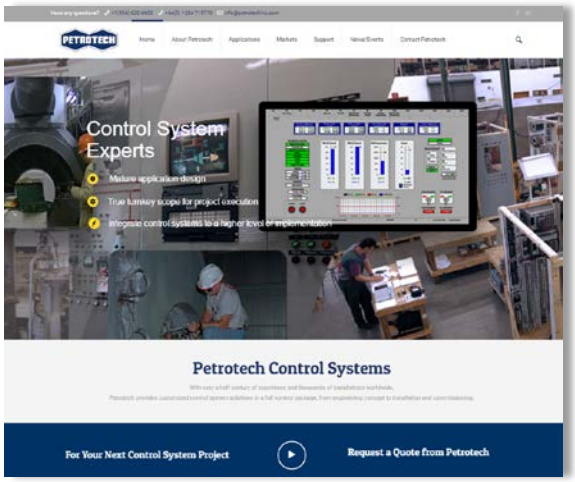
Visit the Petrotech website to learn more about us and download information. Our website has a link to request a quote or to have one of our representatives contact you.



www.petrotechinc.com

Petrotech facilities include corporate offices in New Orleans, Louisiana, full-service offices in Houston, Texas and Suffolk, United Kingdom as well as support offices in all major regions of the world.

Petrotech Experience

The following contains a partial reference list of Turbomachinery and Rotating Machinery Control Systems that have been supplied by Petrotech for over four decades.

The majority of the Turbine and Reciprocating Engine Control System projects are retrofits that were designed to replace the (OEM) original equipment manufacturers' controls that had become a liability to the end-user.

A review of the reference list will indicate that there are many repeat customers who have purchased Petrotech Solutions to control and protect their valuable machinery, some spanning over a decade.

Turbine Experience

ABB Stal GT35B Turbine Generator Drive			
Defense Ministry of Oman	2	Power Generation	Oman
Stork Turbine Services	1	Power Generation	Germany
Allison 501 Series Turbine Compressor Drive			
Amerada Hess	2	Gas Processing Plant	U.S.A.
Columbia Gas Transmission	2	Pipeline	U.S.A.
Columbia Gulf Transmission	3	Pipeline	U.S.A.
El Paso/Tennessee Gas Pipeline	4	Pipeline	U.S.A.
Enron	2	Pipeline	U.S.A.
Enron/NNG	2	Gas Processing Plant	U.S.A.
Enterprise Products	8	Gas Processing Plant	U.S.A.
Epic Energy	1	Pipeline	Australia
Kinder Morgan	1	Pipeline	U.S.A.
Kinder Morgan/Natural Gas Pipeline	3	Pipeline	U.S.A.
North West Pipeline	1	Pipeline	U.S.A.
Williams Natural Gas	3	Pipeline	U.S.A.
Allison 501 Series Turbine Generator Drive			
Aiken County Public Service	1	Wastewater Treatment Plant	U.S.A.
BP Alaska	3	Stand-by Generator	U.S.A.
Genser Power Colombia	1	Cogeneration	Colombia
Phelps Dodge	2	Metals Processing	U.S.A.
Powertech Services	1	Power Generation	U.S.A.
Salomon Smith Barney	3	Emergency Backup Power	U.S.A.
Allis Chalmers Turbine Generator Drive			
Consumers Energy	35	Power Generation	U.S.A.
Dresser DC 990 Turbine Compressor Drive			
Duke Energy	2	Pipeline	U.S.A.
Duke Energy/Texas Eastern Transmission	4	Pipeline	U.S.A.
El Paso/Tennessee Gas Pipeline	2	Pipeline	U.S.A.
Elliott Steam Turbine Compressor Drive			
Pemex	3	Refinery-Refrigeration	Mexico
Pemex	3	Refinery-Residual Gas	Mexico

Fiat TG-16 Turbine Compressor Drive			
Exxon Mobil	1	Pipeline	U.S.A.
GE DEV Steam Turbine Generator Drive			
Williams	1	Gas Processing Plant	U.S.A.
GE Frame 3 Turbine Compressor Drive			
Arco Alaska	5	Gas Processing Plant	U.S.A.
CMS Energy/Trunkline Gas Company	4	Pipeline	U.S.A.
ConocoPhillips	6	Pipeline	U.S.A.
Duke Energy/Texas Eastern Transmission	20	Pipeline	U.S.A.
El Paso Energy	4	Pipeline	U.S.A.
El Paso/American Natural Resources	10	Pipeline	U.S.A.
El Paso/Tennessee Gas Pipeline	13	Pipeline	U.S.A.
Enron	2	Pipeline	U.S.A.
Enron/NNG	3	Pipeline	U.S.A.
Gulf South Pipeline	1	Pipeline	U.S.A.
Kinder Morgan/Natural Gas Pipeline	4	Pipeline	U.S.A.
Koch Gateway Pipeline	3	Pipeline	U.S.A.
Maraven	6	Refrigeration	Venezuela
Nerco	1	Refrigeration	U.S.A.
Northern Natural Gas	1	Pipeline	U.S.A.
Panhandle Energy	2	Pipeline	U.S.A.
PCS-Nitrogen	1	Pipeline	Trinidad
Southern Star Central Gas Pipeline	1	Pipeline	U.S.A.
Shell	1	Gas Gathering	U.S.A.
Tesoro Petroleum	1	Refinery	U.S.A.
Williams Natural Gas/Texas Gas Transmission	12	Pipeline	U.S.A.
Williams Natural Gas/Transco	8	Pipeline	U.S.A.
Williams Pipeline	3	Gas Processing Plant	U.S.A.
GE Frame 3 GT Compressor w/ Tandem Steam Turbine for Power Boost			
Tosco	1	Refinery	U.S.A
GE Frame 3 Turbine Generator Drive			
Elf Aquitaine	4	Power Generation	France
ELF Petroland	4	Power Generation	West Africa
GE Frame 5 Turbine Compressor Drive			
BP-Alaska	1	Gas processing Plant	U.S.A.
BP-Alaska	2	Pipeline	U.S.A.
Duke Energy	4	Gas Processing Plant	U.S.A.
Duke Energy/Texas Eastern Transmission	9	Pipeline	U.S.A.
El Paso Energy	1	Pipeline	U.S.A.
El Paso/American Natural Resources	1	Gas Gathering	U.S.A.
El Paso/Tennessee Gas Pipeline	1	Pipeline	U.S.A.
Enterprise Products	2	Propane Refrigeration	U.S.A.
Maraven	1	Gas Injection	Venezuela

GE Frame 5 Turbine Generator Drive			
Alberta Pacific Forest Industries	1	Pulp/Paper Processing	Canada
Aluminium Bahrain	5	Aluminum Plant	Bahrain
American Atlas	1	Cogeneration	U.S.A.
Arizona Electric Power Company	4	Utility	U.S.A.
Central Vermont Public Service	1	Utility	U.S.A.
Chevron Angola	1	Utility	Angola
Citizens Utilities	3	Utility	U.S.A.
City of Lakeland	1	Utility	U.S.A.
City of Marquette	1	Utility	U.S.A.
City of Medicine Hat	2	Utility	Canada
City of Springfield Utility	2	Utility	U.S.A.
ConocoPhillips	1	Power Generation	Alaska
Consolidated Edison	4	Utility	U.S.A.
Delmarva Power	2	Utility	U.S.A.
Electricity Generating Authority	1	Utility	Thailand
Electroquil	2	Utility	Ecuador
Enelbar	2	Power Generation	Venezuela
Federal Electricity And Water	5	Utility	Dubai, U.A.E.
Houston Light and Power	1	Utility	U.S.A.
Imperial Irrigation	2	Gas Processing Plant	U.S.A.
Kentucky Utilities	3	Utility	U.S.A
Koch Power Company	4	Utility	U.S.A.
Madison Gas & Electric	4	Utility	U.S.A.
Manitowoc Power Company	1	Utility	U.S.A.
MidAmerican Energy	4	Utility	U.S.A.
New Smyrna Beach Utility	1	Utility	U.S.A.
Northern Indiana Public Service	1	Utility	U.S.A.
Northern States Power	4	Utility	U.S.A.
Pennsylvania Power & Light	4	Utility	U.S.A.
Reliant Energy/Orion Power	16	Utility	U.S.A.
Rochester Gas and Electric	1	Utility	U.S.A.
Sunbury Generation	2	Utility	U.S.A.
Texas Petrochemical	1	Petrochemical Plant	U.S.A.
Union Carbide	1	Petrochemical Plant	U.S.A.
U.S. Power Gen	17	Utility	U.S.A.
Virgin Islands Water & Power	2	Utility	Virgin Islands
GE Frame 7 Turbine Generator Drive			
Lincoln Electric	1	Utility	U.S.A.
GE LM 1500 Turbine Compressor Drive			
Enron/NNG	3	Pipeline	U.S.A.
Sempra Energy/Southern California Gas	3	Pipeline	U.S.A.

GE LM 2500 Turbine Generator Drive			
Arkansas Electric Cooperative Corporation	3	Power Generation	U.S.A.
CMS Energy	1	LNG Storage	U.S.A.
GE LM 5000 Turbine Generator Drive			
American Municipal Power	2	Utility	U.S.A.
Ecopetrol	1	Refinery	Colombia
Tractebel	1	Utility	U.S.A.
Hispano Suiza Model 1203 Turbine Compressor Drive			
Connecticut Natural Gas	2	Pipeline	U.S.A.
Total Peaking	1	Gas Processing Plant	U.S.A.
Kongsberg KG2 Turbine Generator Drive			
Northwest Suburban Municipal Joint Action Water Agency	1	Power Generation	U.S.A.
Repsol E&P T&T Limited	1	Power Generation	Trinidad
Shanghai Advanced Research Institute	1	Power Generation	China
Lycoming TF-35 Turbine Generator Drive			
Cooperativa Electrica	1	Power Generation	Argentina
Pratt & Whitney GG3 Turbine Compressor Drive			
Columbia Gulf	1	Pipeline	U.S.A.
Duke Energy/Texas Eastern Transmission	1	Pipeline	U.S.A.
Williams Natural Gas/Texas Gas Transmission	1	Pipeline	U.S.A.
Pratt & Whitney GG4 Turbine Compressor Drive			
Columbia Gulf	3	Pipeline	U.S.A.
Pratt & Whitney GG4 Turbine Generator Drive			
Consolidated Edison	1	Utility	U.S.A.
ZADCO	2	Power Generation	Abu Dhabi
Rolls-Royce Avon Series Turbine Compressor Drive			
Columbia Gulf Transmission	3	Pipeline	U.S.A.
Kinder Morgan/Natural Gas Pipeline	2	Pipeline	U.S.A.
Maraven	2	Gas Gathering	Venezuela
Vico	2	Pipeline	Indonesia
Rolls-Royce Avon Series Turbine Generator Drive			
Qatar Fertilizer Company	2	Fertilizer Plant	Qatar
Rolls-Royce RA 211 Turbine Generator Drive			
Pro Energy	1	Power Generation	U.S.A.
Ruston TA Series Turbine Compressor Drive			
Chevron	1	Pipeline	U.S.A.
Ruston TB Series Turbine Compressor Drive			
Petroleum Development of Oman	4	Pipeline	Oman
YPF	6	Pipeline	Bolivia
Ruston TB Series Turbine Generator Drive			
ConocoPhillips Alaska	14	Power Generation	U.S.A.
Oman Refinery Corporation	2	Refinery	Oman
Petroleum Development of Oman	4	Refinery	Oman

Ruston TB Series Turbine Pump Drive			
Arco Alaska	4	Production	U.S.A.
BP Alaska	2	Pipeline	U.S.A.
ConocoPhillips Alaska	5	Production	U.S.A.
Petroperu	3	Pipeline	Peru
Ruston Tornado Turbine Generator Drive			
BP Alaska	4	Power Generation	U.S.A.
Ruston Tornado Turbine Pump Drive			
BP Alaska	2	Production	U.S.A.
SARI ZK1200 Turbine Generator Drive			
Shanghai Advanced Research Institute	1	Power Generation	China
SARI ZK1200 Turbine Pump Drive			
Shanghai Advanced Research Institute	1	Fire Suppression	China
Solar Centaur Turbine Compressor Drive			
Apache/Shamrock	1	Pipeline	U.S.A.
Columbia Gas Transmission	1	Pipeline	U.S.A.
ConocoPhillips	1	Pipeline	U.S.A.
Enron/TGS	3	Pipeline	Argentina
Koch Gateway Pipeline	2	Pipeline	U.S.A.
National Gas Company of Trinidad	3	Production	Trinidad
Petroleum Development of Oman	8	Pipeline	Oman
Southern Star Central Gas Pipeline	1	Pipeline	U.S.A.
Texaco	1	Gas Gathering	U.S.A.
TotalFinaElf	2	Gas Gathering	The Netherlands
UMIC	1	Gas Gathering	West Africa
Williams Natural Gas	1	Pipeline	U.S.A.
Williams Natural Gas/Northwest Pipeline	2	Pipeline	U.S.A.
Solar Centaur Turbine Generator Drive			
AGIP	2	Power Generation	Nigeria
Plains Exploration	2	Power Generation	U.S.A.
Source Energy	1	Power Generation	U.S.A.
Verizon	3	Power Generation	U.S.A.
XTO Energy	2	Power Generation	U.S.A.
Solar Mars Turbine Compressor Drive			
Wood Group	1	Gas Processing Plant	Dubai
Wood Group	1	Gas Processing Plant	Indonesia
Solar Mars Turbine Generator Drive			
ONGC	4	Offshore Power Generation	India
Solar Saturn Turbine Compressor Drive			
Columbia Gas Transmission	1	Pipeline	U.S.A.
Conoco	1	Gas Gathering	U.S.A.
El Paso Natural Gas	4	Pipeline	U.S.A.
El Paso/American Natural Resources	1	Pipeline	U.S.A.
Enron/NNG	3	Pipeline	U.S.A.

Enven	1	Production	U.S.A.
Gaz de France	2	Gas Gathering	The Netherlands
Kerr-McGee/Oryx Energy	1	Pipeline	U.S.A.
Kinder Morgan	2	Pipeline	U.S.A.
KN Energy	2	Pipeline	U.S.A.
Petronas Carigali	2	Pipeline	Malaysia
South Carolina Pipeline	42	Pipeline	U.S.A.
Williams Natural Gas/Northwest Pipeline	2	Pipeline	U.S.A.
Solar Saturn Turbine Generator Drive			
Bras Nigeria	2	Power Generation	Nigeria
Eco Green	1	Power Generation	Indonesia
Petronas Carigali	6	Offshore Power Generation	Malaysia
XTO Energy	3	Power Generation	U.S.A.
Solar Taurus Turbine Generator Drive			
PT Cheil Jedang Indonesia	4	Power Generation	Indonesia
Westinghouse 251 Turbine Compressor Drive			
Duke Energy/Pan Energy	1	Gas Processing Plant	U.S.A.
Westinghouse 251 Turbine Generator Drive			
DSM	1	Power Generation	The Netherlands
Lubbock Light and Power	1	Power Generation	U.S.A.
Proplant	1	Power Generation	Nigeria
Texas Petrochemical	1	Petrochemical Plant	U.S.A.
Westinghouse 251 GT Hot Gas Generator w/ Steam Turbine for Power Boost			
Global Octanes	1	Refinery	U.S.A.
Westinghouse 501 Turbine Generator Drive			
Arizona Electric Power Cooperative	1	Power Generation	U.S.A.

Compressor Experience

Single-section Air Separation Compressor			
Air Liquide	1	Gas Processing Plant	Canada
Argonal/Air Liquide	1	Chemical Plant	Canada
City of Los Angeles	5	Chemical Plant	U.S.A.
City of Los Angeles	5	Hyperion Plant	U.S.A.
Dragoso	1	PTA Plant	Canada
Single-section Alkaline Process Compressor			
Tesoro Petroleum	1	Refinery	U.S.A.
Single-section Carbon Monoxide Compressor			
Liquid Carbonic Industrial	1	Chemical Plant	U.S.A.
Single-section Chlorine Process Compressor			
Formosa Plastics	6	Chemical Plant	U.S.A.
Single-section Crack Gas Process Compressor			
Dow Chemical	2	Chemical Plant	U.S.A.
Single-section Ethylene Compressor			
Han Yang Chemical	3	Refinery	South Korea
Single-section FCCU Process, Axial Compressor			
Fina Oil & Chemical	2	Refinery	U.S.A.
Mobil Refinery	2	Refinery	U.S.A.
Mobil Refinery	1	Refinery	U.S.A.
Single-section FCCU Wet Gas Compressor			
Sinclair Oil	2	Refinery	U.S.A.
Single-section H2S Compressor			
Brigita	2	Gas Processing Plant	Germany
Single-section HCL Blower Compressor			
Han Yang Chemical	2	Refinery	South Korea
Single-section Hydrogen Compressor			
Mobil Refinery	3	Refinery	U.S.A.
Shell Refining Inc.	2	Refinery	U.S.A.
Texaco	6	Refinery	U.S.A.
Single-section Hydrogen/Methane Compressor			
Zhongyuan Petrochem	6	Chemical Plant	China
Single-section Liquid Extraction Compressor			
Mid Con	2	Pipeline	U.S.A.
Single-section LPG Compressor			
Amoco	1	LPG Plant	Sharjah, U.A.E.
Single-section Maleic Anhydride Compressor			
Miles Inc.	2	Refinery	U.S.A.
Single-section Natural Gas Compressor			
AGIP	1	Gas Gathering	Italy
Al Furat Petroleum	5	Gas Processing Plant	Syria
American Pipeline	1	Pipeline	U.S.A.

Amoco	3	Refinery	U.S.A.
Amoco	1	LPG Plant	Sharjah, U.A.E.
Amoco	4	Pipeline	Sharjah, U.A.E.
Arco Indonesia	6	Gas Gathering	Indonesia
Arco	2	Gas Gathering	China
Arco	2	Pipeline	U.S.A.
Arkla Energy	2	Pipeline	U.S.A.
Chevron Overseas	2	Gas Gathering	West Africa
Chevron Overseas	8	Gas Lift	West Africa
Chevron	8	Gas Gathering	U.S.A.
China Pipeline	2	Pipeline	China
CMS Energy/Trunkline Gas Company	3	Pipeline	U.S.A.
Columbia Gas Transmission	2	Pipeline	U.S.A.
Consolidated Edison	1	Pipeline	U.S.A.
Consolidated Natural Gas	3	Pipeline	U.S.A.
Crescent Petroleum	1	Gas Gathering	Dubai, U.A.E.
Delhi Gas	2	Pipeline	U.S.A.
Pipeline	2	Pipeline	U.S.A.
Duke Energy/Algonquin Gas Pipeline	6	Pipeline	U.S.A.
Duke Energy/Pan Energy	1	Gas Processing Plant	U.S.A.
Duke Energy/Texas Eastern Transmission	29	Pipeline	U.S.A.
Duke Energy	1	Gas Processing Plant	U.S.A.
El Paso Energy	4	Pipeline	U.S.A.
El Paso Natural Gas	4	Pipeline	U.S.A.
El Paso/American Natural Resources	9	Pipeline	U.S.A.
El Paso/Tennessee Gas Pipeline	24	Pipeline	U.S.A.
Elf Petroland	3	Gas Processing Plant	The Netherlands
Enagas	4	Pipeline	Spain
Enron/NNG	12	Pipeline	U.S.A.
Enron/TGS	3	Pipeline	Argentina
Enron	6	Pipeline	U.S.A.
Enserch	2	Gas Gathering	U.S.A.
EPMI	1	Gas Injection	Malaysia
Exxon	2	Gas Processing Plant	U.S.A.
Exxon	2	Gas Gathering	U.S.A.
Exxon	3	Gas Injection	U.S.A.
Exxon	4	Gas Processing Plant	U.S.A.
Foothills Pipeline	3	Pipeline	Canada
GPM	2	Gas Processing Plant	U.S.A.
GUPCO	1	Gas Gathering	Egypt
Hadson Energy	2	Gas Processing Plant	Australia
Huffco	1	Gas Gathering	Indonesia
Kerr-McGee/Oryx Energy	3	Gas Gathering	U.S.A.
Kinder Morgan/Natural Gas Pipeline	6	Pipeline	U.S.A.

KN Energy	2	Pipeline	U.S.A.
Koch Gateway Pipeline	5	Pipeline	U.S.A.
Maersk	6	Gas Gathering	The Netherlands
Maraven	7	Pipeline	Venezuela
Maraven	1	Gas Gathering	Venezuela
Maraven	1	Gas Injection	Venezuela
Maraven	5	Gas Lift	Venezuela
Megal	4	Pipeline	Germany
Mesa Petroleum	4	Gas Gathering	U.S.A.
Mesa Petroleum	2	Pipeline	U.S.A.
Mobil Netherlands	1	Gas Gathering	The Netherlands
Pennzoil	9	Gas Gathering	Russia
Petrobel	4	Gas Gathering	Egypt
Petrocanada	2	Gas Gathering	Canada
Petrocanada	2	Gas Processing Plant	Canada
Petroleum Development of Oman	2	Gas Processing Plant	Oman
Petroleum Development of Oman	6	LPG Plant	Oman
Petronas Carigali	2	Gas Lift	Malaysia
Petronas Carigali	3	Pipeline	Malaysia
Phillips Petroleum	2	Gas Lift	The Netherlands
Placid Oil	6	Gas Processing Plant	U.S.A.
SECWA	6	Pipeline	Australia
Shell Brunei	2	Gas Gathering	Brunei
Shell Offshore Inc.	6	Gas Gathering	U.S.A.
Shell	1	Gas Gathering	U.S.A.
Sonatrach	1	Pipeline	Algeria
South Carolina Pipeline	9	Pipeline	U.S.A.
Southwest Gas	1	Pipeline	U.S.A.
Spectra Energy	6	Pipeline	U.S.A.
Texaco	1	Gas Gathering	U.S.A.
Texas Utilities	4	Pipeline	U.S.A.
Union Gas	1	Pipeline	Canada
Union Pacific Resources	2	Gas Processing Plant	U.S.A.
Union Pacific Resources	3	Pipeline	U.S.A.
United Texas Transmission	10	Pipeline	U.S.A.
Universal Compression	1	Fuel Gas Compression	Iraq
Unocal	3	Gas Gathering	Thailand
Valero Energy	2	Gas Processing Plant	U.S.A.
Valero Energy	30	Pipeline	U.S.A.
Virginia Indonesia Company	2	Gas Gathering	Indonesia
Warren Petroleum	3	Pipeline	U.S.A.
Williams Natural Gas/Northwest Pipeline	10	Pipeline	U.S.A.
Williams Natural Gas/Texas Gas Transmission	13	Pipeline	U.S.A.
Williams Natural Gas/Trans OK	1	Pipeline	U.S.A.

Williams Natural Gas/Transco	31	Pipeline	U.S.A.
Williams Natural Gas	1	Pipeline	U.S.A.
Wintershall Noordzee	2	Gas Gathering	The Netherlands
Wintershall Noordzee	2	Gas Lift	The Netherlands
Single-section Nitric Acid Expansion Compressor			
C.F. Industries	2	Chemical Plant	U.S.A.
Mississippi Chemical	2	Chemical Plant	U.S.A.
Single-section Nitrogen Process Compressor			
Liquid Carbonic Industrial	2	Chemical Plant	U.S.A.
Single-section Process Air Compressor			
Sterling Chemicals	3	Chemical Plant	U.S.A.
Single-section Propane Refrigeration Compressor			
Enterprise Products	1	Chemical Plant	U.S.A.
Mobil Refinery	2	Refinery	U.S.A.
Shell Refining Inc.	2	Refinery	U.S.A.
Enron	2	Gas Processing Plant	U.S.A.
Single-section Refrigeration Compressor			
Enron	2	Gas Processing Plant	U.S.A.
Valero Energy	2	Gas Processing Plant	U.S.A.
Wesfarmers	4	Gas Processing Plant	Australia
Will Gas Company	1	Gas Processing Plant	U.S.A.
Single-section Residual Gas Compressor			
PEMEX	3	Refinery	Mexico
Single-section Turbo Expander Compressor			
Eagle Rock Energy	1	Refinery	U.S.A.
PEMEX	2	Refinery	Mexico
Petroleum Development of Oman	8	LNG Plant	Oman
Single-section Waste Gas Compressor			
Quantum Chemical	2	Chemical Plant	U.S.A.
Single-section Maleic Anhydride Compressor			
Miles Inc.	2	Refinery	U.S.A.
Two-inlet Refrigeration Compressor			
Al Furat Petroleum	3	Gas Processing Plant	Syria
Nerco	1	Gas Processing Plant	U.S.A.
Petroleum Development of Oman	1	Gas Processing Plant	Oman
Two-section Carbon Monoxide Compressor			
Liquid Carbonic Industrial	1	Chemical Plant	U.S.A.
Two-section Coker Gas Compressor			
PEMEX	1	Refinery	Mexico
Petrobras	1	Gas Processing Plant	Brazil
Shell Refining Inc.	2	Refinery	U.S.A.
Two-section FCCU Wet Gas Compressor			
Petrobras	1	Gas Processing Plant	Brazil
Petrobras	1	Refinery	Brazil

Two-section Flash Gas Process Compressor			
Petroleum Development of Oman	4	LPG Plant	Oman
Two-section H2S Gas Compressor			
PEMEX	4	Gas Processing Plant	Mexico
Two-section Hydrogen Gas Compressor			
B.P. Alliance Refinery	1	Refinery	U.S.A.
Two-section LNG Refrigeration Compressor			
Williams Natural Gas/Northwest Pipeline	1	LNG Plant	U.S.A.
Williams Natural Gas/Northwest Pipeline	1	Pipeline	U.S.A.
Two-section Natural Gas Compressor			
Amerada Hess	6	Gas Processing Plant	U.S.A.
Apache Corporation	1	Pipeline	U.S.A.
Arco Alaska	5	Gas Lift	U.S.A.
Arco	1	Gas Gathering	U.S.A.
Chevron Cabinda	1	Gas Gathering	Cabinda
Chevron Zaire	5	Gas Gathering	Zaire
Chevron	2	Gas Gathering	U.S.A.
El Paso/Tennessee Gas Pipeline	2	Pipeline	U.S.A.
Elf Petroland	2	Gas Gathering	The Netherlands
EPMI	3	Gas Gathering	Malaysia
GUPCO	1	Gas Gathering	Egypt
GUPCO	2	Gas Lift	Egypt
Maraven	1	Pipeline	Venezuela
Maraven	3	Gas Gathering	Venezuela
Maraven	2	Gas Lift	Venezuela
Gas Processing Plant	1	Gas Processing Plant	U.S.A.
Mesa Petroleum	2	Pipeline	U.S.A.
NORAM	2	Pipeline	U.S.A.
PEMEX	3	Gas Gathering	U.S.A.
Sempra Energy/Southern California Gas	3	Gas Injection	U.S.A.
Shell Offshore Inc.	7	Gas Gathering	U.S.A.
Shell Offshore Inc.	1	Gas Lift	U.S.A.
Sovereign Oil	2	Gas Lift	United Kingdom
Union Pacific Resources	1	Pipeline	U.S.A.
Union Texas Petroleum	1	Gas Gathering	U.S.A.
Unocal	2	Gas Gathering	Malaysia
Chevron Chemical	2	Chemical Plant	U.S.A.
Two-section Process Air Compressor			
Aggreko	1	Offshore	U.S.A.
Two-section Propane Refrigeration Compressor			
Duke Energy/Pan Energy	1	Gas Processing Plant	U.S.A.
Two-section Propylene Compressor			
Fina Oil & Chemical	2	Refinery	U.S.A.

Two-section Coker Gas Compressor			
PEMEX	1	Refinery	Mexico
Two-stage Refrigeration Compressor			
PEMEX	3	Refinery	Mexico
Three-inlet Refrigeration Compressor			
El Paso/Coastal Javelina	4	Gas Processing Plant	U.S.A.
Maraven	2	Gas Processing Plant	Venezuela
Three-section Natural Gas Compressor			
Amoco	2	Gas Gathering	Trinidad
Amoco	2	Gas Lift	Trinidad
Pipeline	4	Pipeline	U.S.A.
Chevron Cabinda	1	Gas Gathering	Cabinda
Chevron Zaire	1	Pipeline	Zaire
Chevron	1	Gas Gathering	U.S.A.
Chevron	1	Gas Lift	U.S.A.
EPMI	2	Gas Lift	Malaysia
GUPCO	2	Gas Gathering	Egypt
GUPCO	3	Gas Lift	Egypt
Maraven	1	Gas Gathering	Venezuela
Maraven	3	Gas Injection	Venezuela
Maraven	4	Gas Lift	Venezuela
Maraven	2	Gas Processing Plant	Venezuela
Maraven	1	Pipeline	Venezuela
PEMEX	3	Gas Gathering	U.S.A.
Pennzoil	1	Gas Gathering	U.S.A.
Petrobras	2	Gas Lift	Brazil
Petrobras	4	Pipeline	Brazil
Petroleum Development of Oman	4	Gas Lift	Oman
Union Pacific Resources	3	Gas Gathering	U.S.A.
Union Texas Petroleum	2	Gas Gathering	U.S.A.
Unocal	2	Gas Lift	Indonesia
Three-section Refrigeration Compressor			
Liquid Energy Corporation	1	Refinery	U.S.A.
Four-section Natural Gas Compressor			
Petroleum Development of Oman	6	Gas Lift	Oman
Shell Gabon	3	Gas Injection	Gabon
Four-section Process Air Compressor			
Petrocel	1	Refinery	Mexico
Ten-stage C02 Process Compressor			
Borsig/Azot	1	Gas Processing Plant	Russia
Nowomoskowsk	1	Chemical Plant	Russia

Reciprocating Compressor Experience

Ariel Compressor Drive			
Brotherhood, Ltd.	4	Pipeline	Argentina
Ariel JGB12 Compressor Drive			
El Paso/Tennessee Gas Pipeline	1	Pipeline	U.S.A.
Chicago Compressor Compressor Drive			
PEMEX	1	Oil/Gas Separation	Mexico
Clark BA-8M Compressor Drive			
El Paso/Tennessee Gas Pipeline	9	Pipeline	U.S.A.
Clark HBA-6 Compressor Drive			
El Paso/Tennessee Gas Pipeline	16	Pipeline	U.S.A.
Clark HBA-8 Compressor Drive			
El Paso/Tennessee Gas Pipeline	3	Pipeline	U.S.A.
Clark HBA-8T Compressor Drive			
Duke Energy	3	Pipeline	U.S.A.
Clark TCV-16 Compressor Drive			
Duke Energy/Texas Eastern Transmission	2	Gas Storage	U.S.A.
Clark TCVA-16 Compressor Drive			
Enron/NNG	1	Pipeline	U.S.A.
Clark TCVC-20 Compressor Drive			
Enron/NNG	1	Pipeline	U.S.A.
Clark TLA-6 Compressor Drive			
Enron/NNG	4	Pipeline	U.S.A.
Clark TRA-8M Compressor Drive			
El Paso/Tennessee Gas Pipeline	1	Pipeline	U.S.A.
Cooper-Bessemer 14-4 Compressor Drive			
Williams Natural Gas/Texas Gas Transmission	1	Pipeline	U.S.A.
Cooper-Bessemer GMV-10 Compressor Drive			
El Paso/Tennessee Gas Pipeline	21	Pipeline	U.S.A.
Cooper-Bessemer GMVA-8 Compressor Drive			
PEMEX	3	Pipeline	Mexico
Cooper-Bessemer GMWA-10 Compressor Drive			
Duke Energy/Texas Eastern Transmission	3	Pipeline	U.S.A.
El Paso/Tennessee Gas Pipeline	12	Pipeline	U.S.A.
Cooper-Bessemer GMWA-6 Compressor Drive			
Enron/NNG	2	Pipeline	U.S.A.
Cooper-Bessemer GMWA-8 Compressor Drive			
Enron/NNG	1	Pipeline	U.S.A.
Cooper-Bessemer GMWC-6 Compressor Drive			
Enron/NNG	4	Pipeline	U.S.A.
Dresser-Rand Compressor Drive			
Chevron	2	Pipeline	U.S.A.

Ingersol-Rand KVR-16 Compressor Drive			
Enron/NNG	1	Pipeline	U.S.A.
Ingersol-Rand KVS-12 Compressor Drive			
Southern California Pipeline	5	Gas Storage	U.S.A.
Trinidad Natural Gas	4	Gas Storage	Trinidad
Ingersol-Rand KVT-16 Compressor Drive			
Enron/NNG	1	Pipeline	U.S.A.
Ingersoll-Rand 2HHE-VE Generator Drive			
Shell Sarawak	3	Power Generation	Indonesia
Rolls-Royce Allen 5016 V16 Compressor Drive			
Power Engineering	1	Pipeline	Taiwan
Ruston 16 RKW Generator Drive			
Alstom/Kim Chuan	3	Power Generation	Singapore
Various Engines Compressor Drive			
Williams Natural Gas/Texas Gas Transmission	30	Pipeline	U.S.A.
Waukesha 7042 GU Generator Drive			
Southern California Pipeline	3	Power Generation	U.S.A.
Waukesha7042 V-12 Generator Drive			
Southern California Pipeline	4	Power Generation	U.S.A.
Worthington 168-LTC Compressor Drive			
El Paso/Tennessee Gas Pipeline	8	Pipeline	U.S.A.
Worthington LT-8 Compressor Drive			
El Paso/Tennessee Gas Pipeline	3	Pipeline	U.S.A.