

Control Solution Capabilities

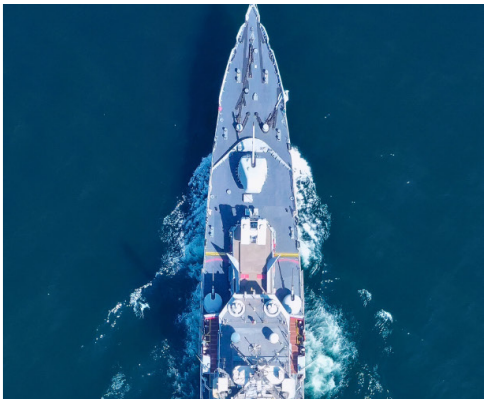
MSHS
Pacific Power Group
An Industrial Service Solutions® Company

mshs.pacificpowergroup.com

About Us

Keeping Business Moving





MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), specializes in designing, selling, and serving power and propulsion solutions in the marine, power generation, and defense sectors.

With the goal of building enduring partnerships that Power & Propel the world forward.

With full-service workshops in Alaska, California, Florida, Hawaii, Louisiana, and Washington plus a reach that not only serves the United States but also goes beyond to the furthest corners of the world, MSHS PPG ISS technicians and engineers specialize in power generation and distribution solutions for all types of prime movers (gas, diesel, and dual fuel engines, steam, gas, and hydro turbines, as well as solar and micro-grid solutions), high-speed engines, and power generation applications.

With over 60 years of experience, MSHS PPG ISS has developed Integrated Power Management and Control Systems and Solutions to ensure your equipment and systems operate safely at peak efficiency.

When it comes to Power Plants and their control systems we offer a wide variety of services:



- Planned maintenance
- Emergency/urgent repairs
- Major overhaul or rehabilitations
- Diagnostics & troubleshooting
- Modernization & upgrades
- Monitoring & planning support
- Spare parts inventory
- Bundled services & planning
- Installation & commissioning



As the largest authorized Woodward channel partner, the MSHS PPG ISS sales, service, and engineering teams are recognized as Woodward governor and controls system specialists. With experience and recognition comes special access to core software that you cannot get with just any partner. Our access to Woodward and an extensive parts and products inventory ensures MSHS PPG ISS delivers unmatched service and delivery. When power plants require optimal performance, safety, and efficiency, Woodward speed, protection, synchronization, and fuel management control systems developed and delivered by MSHS PPG ISS are the customer's number 1 choice.

Types Of Control Systems We Specialize In:

Power Management Systems: Delivers a seamless and reliable power supply by efficiently managing power generation and distribution.

Synchronization and Load Sharing Control Systems: Ensures synchronization, load control, and balance between gensets.

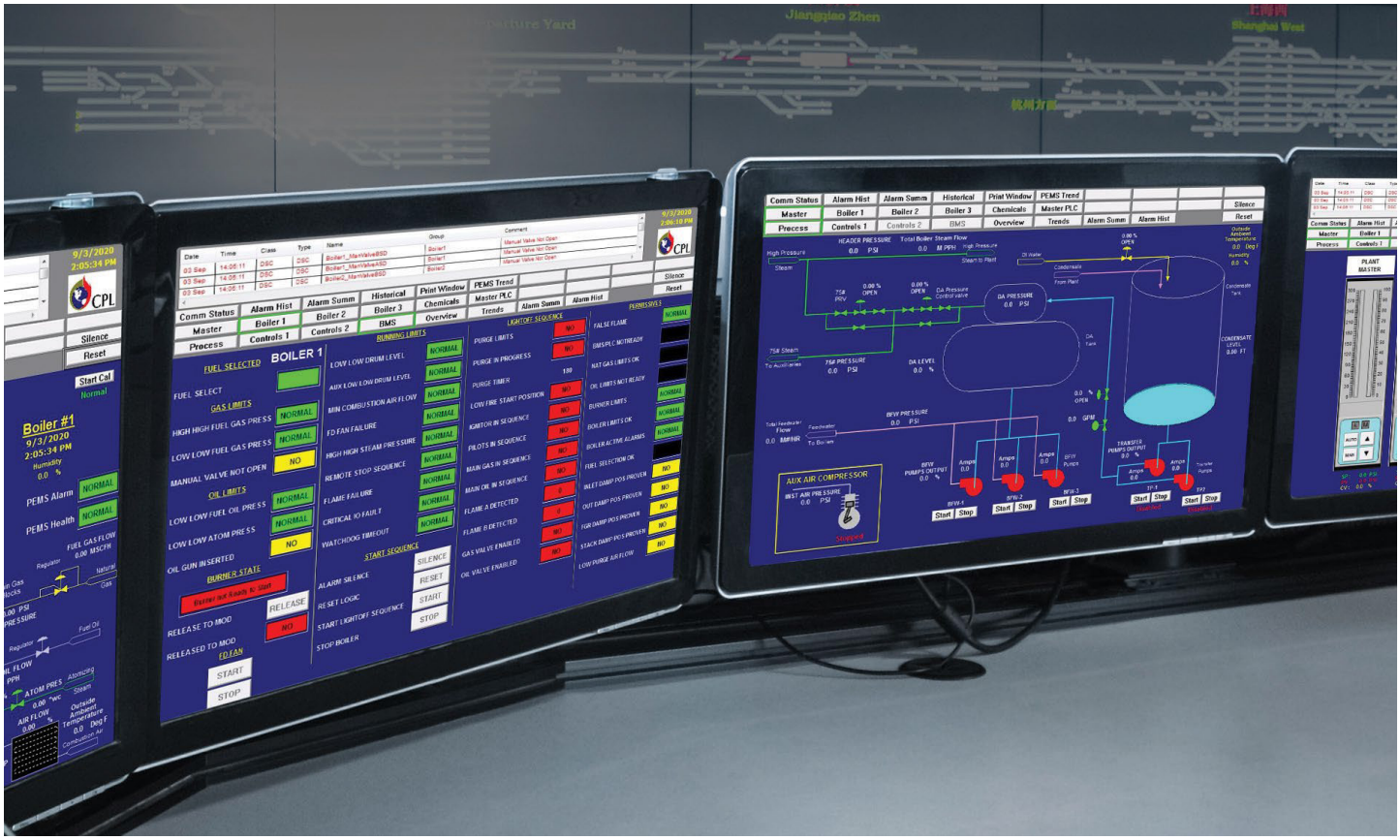
Engine/Genset Control Systems: Manages engine performance and generator power output ensuring operation at optimal performance and fuel efficiency.

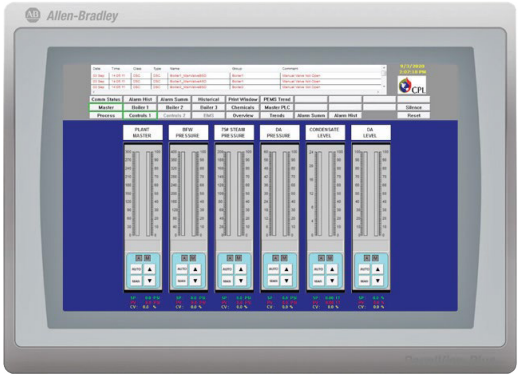
Governors & Actuators: Regulates engine and turbine speed while maintaining stability across various operating conditions.

Our customer case studies are our strongest endorsement, and we've compiled several here for your review. We hope you find these successes as compelling as we do.

Control & Automation Systems

VFDs / Soft Starters / Controls / PLCs





MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), is capable of handling and supplying all of your control requirements and offer equipment from a large variety of industrial control manufacturers.

Variable Frequency Drives (VFDs)

We provide single-phase and three-phase VFDs for a variety of AC and DC applications, from small electric motors to high power induction motors.



Soft Starters

We utilize soft starters to ensure the best performance for each application. They allow motors to start and stop in a smooth and efficient way, which protects the motor and the load from torque shocks or jolts.



Controls

Our controls take your machines to the next level of performance. They can be tailored to any machine make or model and are free of restrictions on configurations, customizations, and data access.



Programmable Logic Controllers (PLCs)

Optimize panel space and simplify maintenance jobs by replacing auxiliary contactors, timers, and counters with PLCs designed for interlocking, timing, counting, and math operation tasks at high-speed.



Custom Panels Designed & Fabricated

Certified UL 508A Panel Shop





AC Drive / VFDs Systems

We provide AC variable frequency drives (VFDs) for heavy-duty industrial applications in the most harshest of environments. We are a systems integrator providing tailored solutions to your exact specifications.



DC Drive / SCR Systems

We have over 40 years experience in SCR drive design. This allows us to provide SCR systems of any size and complexity. All components of our designed SCR systems are generic and not proprietary.



Generator Control Panels

Our controls utilize Woodwardor Basler Generator Control Modules, which facilitate engine control, synchronization, kW load control, re-active (KVAR) control, automatic generator sequencing, generator and engine protection, and communication interface and display.



Motor Control Centers (MCCs)

We can integrate any system on the market. Our motor control centers are customized to match your equipment. We can package MCCs inside e-houses that come pre-wired and ready to use.



Switchgear Cabinets

We build low, medium, and high voltage switchgears for heavy-duty applications. Our switchgears are built to your specifications and meet all regulatory requirements.



Custom E-Houses & Power Distribution Centers

Mobile / Semi-Mobile / Fixed / Skid / Onboard





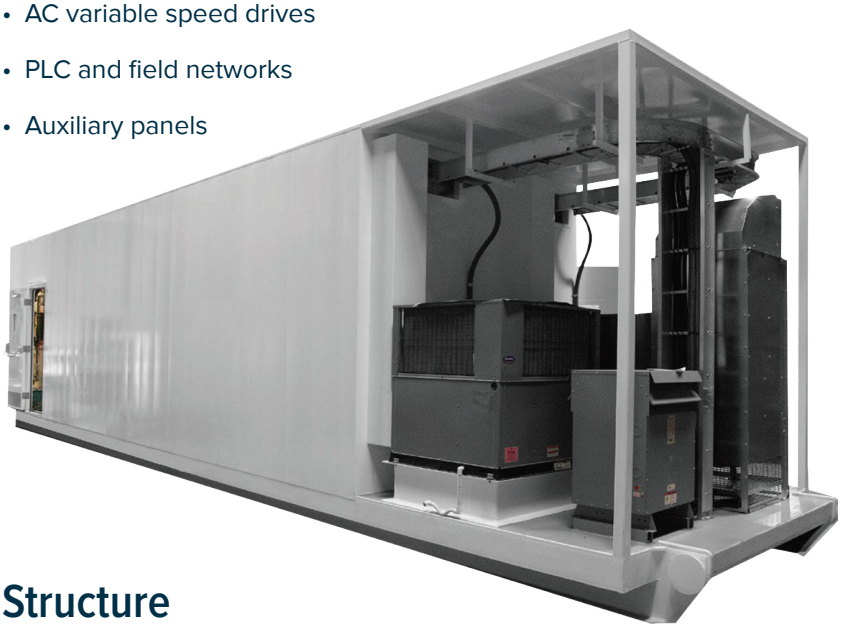
MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), integrates complete electrical and automation systems to specification and packages them in custom e-houses, control consoles, and containers. Each unit is delivered assembled, interconnected, and fully tested at the factory. There are no size limitations and can be used in many different environments, from the arctic to the tropics.

Applications

- Mining & Metals
- Oil & Gas
- Power Generation
- Processing Industries

Components

- Medium voltage switchgear and controls
- Medium and low voltage Motor Control Centers (MCCs)
- Dry and oil transformers
- Control panels and protection relays
- Air conditioning and pressurization systems
- Fire detection and extinguishing system
- UPS system back-up integration, battery banks and rectifiers
- Medium and low voltage soft starters and frequency inverters
- Automation system, including supervisory and control stations
- DC SCR system for drilling applications
- AC variable speed drives
- PLC and field networks
- Auxiliary panels



Structure

- Wall, ceiling, and roof frames made from square steel tubes
- Thermal insulated walls and ceiling constructed from steel galvanized sheets and rock wool
- Thermal insulated doors with stainless steel hinges
- Weld and painting processes inspected by accredited personnel
- Options: gutters, platforms, catwalks, ladders, railings, hand rails, anti-slip floor paint, and acid/corrosion resistant coating





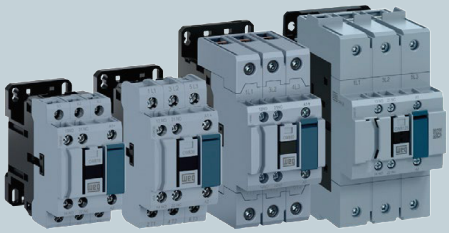


Replacement Parts for Control Panels





Circuit Breakers



Contactors



Relays



Push Buttons



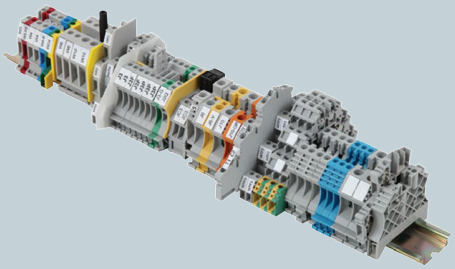
Pilot Lights



Switches



Quick Disconnects



Terminal Blocks

Other Spare Parts

Power Management Upgrade

Improving Legacy Controls



Problem
Unreliable and obsolete PLC system that had no more technical or parts support.

Solution
A new integrated control system with components that are modern, highly reliable, and common in the industry allowing for worldwide access to support and parts.

Application
Rig Power Plant

Prime Mover
CAT3516 1925kVA 600Vac
- (5x) MainGens
- (1x) EmergencyGen

System Components
Woodward

Engine control system for:
- Speed governing
- Voltage regulation
- Loadsharing, Baseload
- Reverse Power Triptesting
- Monitoring, Alarms & trips
- Electricalprotection

MSHS PPG ISS HMI
Operators tool to monitoring engine parameters, status and issue operator commands.



The drilling rig has 6 CAT3516 diesel generator sets. Generators 1-5 are considered main duty generator sets, and generator #6 is the emergency standby generator set.

The five Main Generators are started and stopped by operations, and Auto synchronized to the Main Bus. Generators on the bus maintain 60Hz and share load equally.

In the event of a loss of power the emergency generator will start and connect to the emergency bus. The operator can auto or manually synchronize to connect the emergency bus to the main bus. Auto load sharing is carried out anytime the multiple generators are on line.

Project Overview
The existing engine control system on this Rig was an obsolete PLC system, with very custom control modules where support and parts availability was nonexistent. The Engine Generator control was becoming unreliable, load sharing was poor and alarm monitoring was limited.

MSHS PPG ISS offered a new control system using Woodward generator controls which are supportable from anywhere in the world.



MSHS PPG ISS Supplied
- System design
- Electrical drawings, software
- Parts
- Demolition, Installation and Commissioning
- System Testing
- Improved performance and system availability
- Spare parts

Improving Legacy Controls

Standardized Design Approach

A modular design approach was taken to use standard off the shelf components with no custom hard to procure hardware parts.

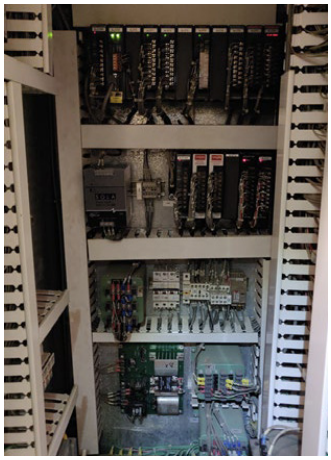
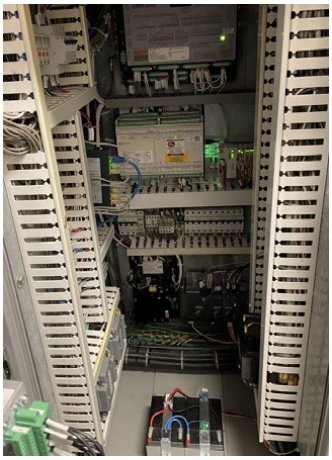


FIGURE 1: *Before Upgrade*



After Upgrade

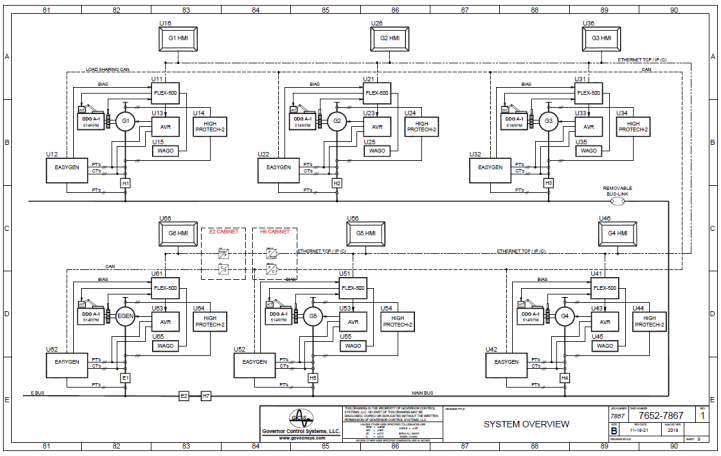


FIGURE 2: *Generator System Integration Overview*

Components



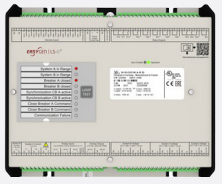
FLEX500 Programmable Controller

- Isochronous Loadsharing
- Load Control
- Alarm, Shutdown, monitoring
- Engine Safety Systems
- Interface to the HMI



easYgen 3400XT Generator Module

- Generator Synchronizing
- kW Loadsharing
- kVAr Loadsharing
- bus Synchronizing via LS6
- Data to HMI



easYgen LS6XT Bus Tie Module

- E2 Bus Tie Synchronizing
- H7 Bus Tie Synchronizing
- Data to HMI



WAGO IO Module

- Expansion IO
- Thermocouple Inputs



HMI Operator Control & Monitoring

- Start / Stop
- Idle / Rated
- Raise / Lower Speed / Volts Synchronize
- Loadshare / Baseload
- Reverse Power test
- Power Plant System
- Alarm and Trip monitoring



Basler DECS150 AVR Module

- Voltage Regulation
- Excitation Limiters
- Data to HMI



SEG HighProtec-2 Module

- Over/Under Voltage Trip
- Over Current Trip
- Reverse Power Trip
- Differential Trip

Control System Upgrades

Gas And DF 4-Stoke Engine



Problem

Obsolete control system. Scarce service / support / Parts for aging equipment. Engine controls and Balance of Plant controls EOL.

Solution

MSHS PPG ISS solution systems integration using current state of art controls with proven enhancements.

Application

Natural Gas Power Plant

Prime Mover

2x Wärtsilä 34SG 18V 6350kW

System Components

- Woodward Atlas-II
- Woodward LECM (Large Engine Control Module)
- Woodward LECM Coil
- Woodward SOGAV MCC & PCC
- Woodward Spark Plug Extender
- Basler DECS 250
- Automatic Voltage Regulator
- Engine Sequencing Logic - Allen Bradley Control Logix PLC
- SEL 700G Protection Relay
- Allen Bradley Control Logix PLX Balance of Plant

Due to the obsolescence of the existing WECS3000 engine control and the plant's need for a reliable and reputable solutions provider to provide long-term support for their equipment, this customer hired MSHS PPG ISS to upgrade the original system controlling two Wärtsilä 34SG gas engines, each rated at 6350kW. The site usually parallels the grid in baseload mode and power factor control. The controls communicate to each other to perform active and reactive load sharing while in island mode.

Project Overview

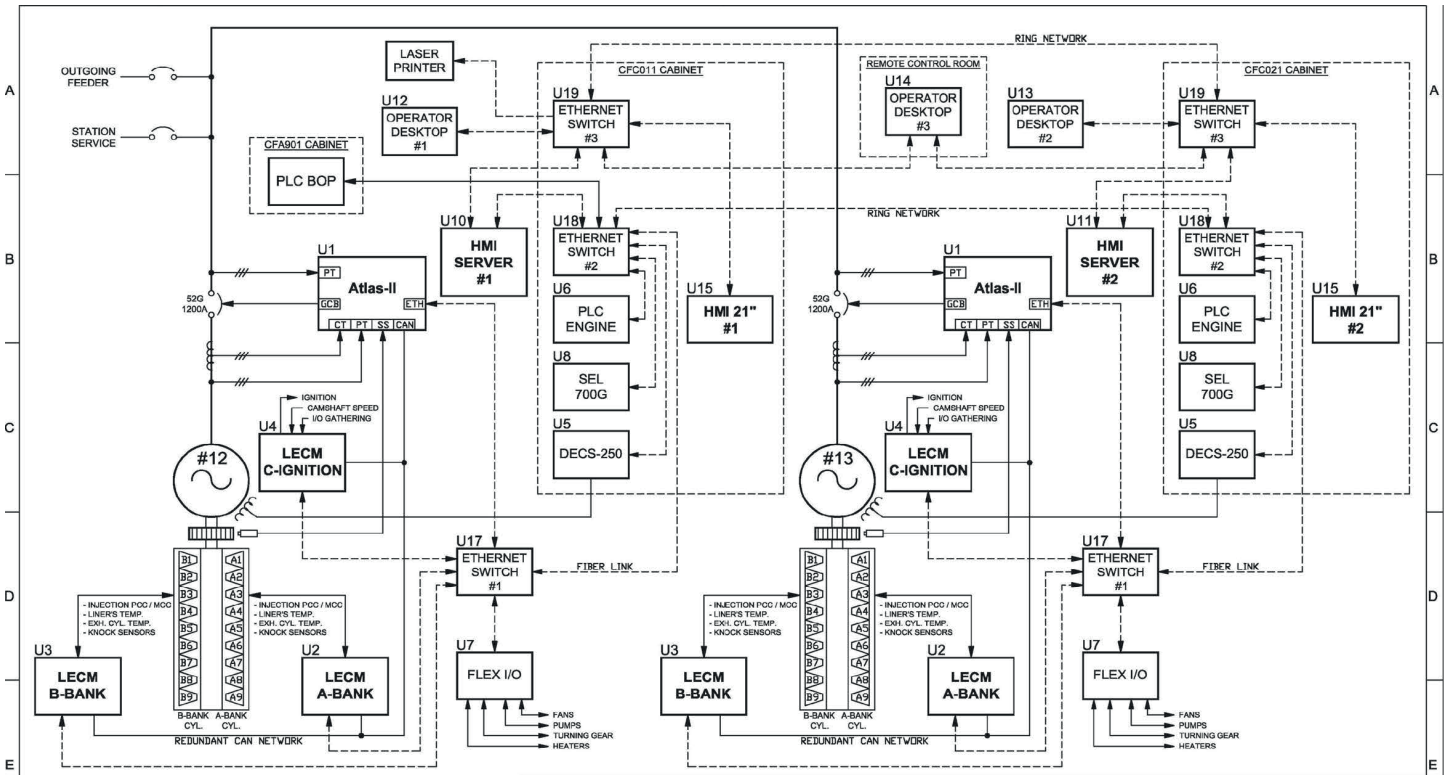
MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), designed and supplied the solution including control cabinets with LECM A-bank, LECM B- bank, LECM C-ignition, and Atlas-II as well as replaced the Siemens PLC S7-300s with state- of-the-art Allen Bradley Control Logix PLCs. The voltage regulator was modernized to Basler DECS 250 providing advanced communication and logging to the monitoring and control system. The generator protection relay was upgraded to SEL 700G.

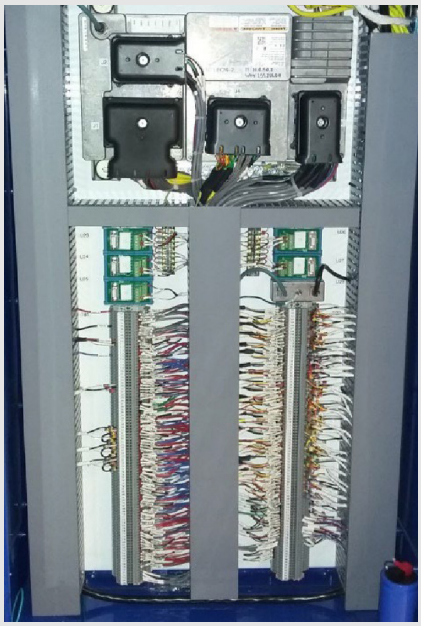
The new controls solution installed by MSHS PPG ISS provides automatic start sequence, synchronization, active/ reactive load control, engine safeties, auxiliary controls, and comprehensive control and monitoring systems including 5 thin-client HMIs and 2 HMI servers. This improves the availability of the power plant with more reliable energy production.

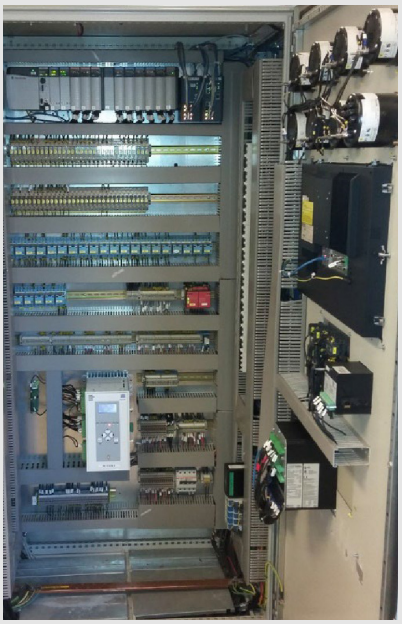
The new control system provides many more tools for engine testing and calibration: PCC and MCC SOGAV actuation, LECM Coil/Spark Plug test, waste- gate actuator stroke test, and manual cylinder temperature balancing. This gives operations far superior interrogation and diagnostic tools to keep the plant at optimum performance.

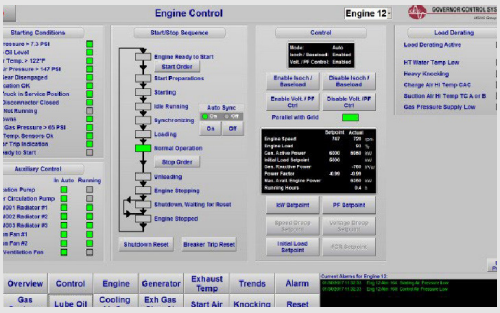
Gas And DF 4-Stoke Engine

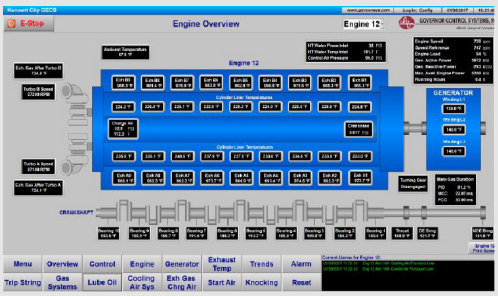
Designed & installed by MSHS PPG ISS for the Upgrade of Wärtsilä 34SG Gas Engine Controls











Integrated Fuel Blending

Improving Legacy Controls

Problem

The engine control system didn't allow for real-time fuel blending, leading to inefficient operation.

Solution

An MSHS PPG ISS-designed drop-in kit that allows for real-time fuel blending between digester gas and natural gas permitting the engine to run at full rated load continuously with improved startability, performance, and emissions compliance.

Application

Food Production Facility

For Power Generation the engine is run base-loaded to the utility to maximize load output of the engine and use of digester fuel produced on-site.

Prime Mover

Caterpillar G3520C

Gas Engine-Generator Rated at 1600 kW

Fuel Type

The engine utilizes a blended mixture of digester gas and pipeline natural gas. The fuel is actively blended in real-time at a mixture ratio based on the available fuel from the digester.



Project Overview

Prior to the new system installation, the plant only produced enough digester gas to run the engine at part load for one to two days per week. This led to an under- used engine and inefficient operation. The objective of this project was to enable the engine to consume all available "free" digester gas produced at the site, while actively blending pipeline natural gas to keep the unit running at full rated load all the time regardless of digester gas availability. The Woodward LECM control system was utilized as the OEM control system did not provide the ability to blend fuels in real time. The plant automation system can now adjust the fuel blending ratio to maximize fuel usage based on digester pressure.

For this project, the design approach started with our proven standardized "kit" that has been applied and installed on other G3520C/E engines of the same vintage. MSHS PPG ISS developed and packaged the system as a drop-in replacement for the OEM control system. Our OEM design approach led to a system that has been quickly installed on several G3520C/E engines. The system utilizes the original factory-provided throttle and turbo compressor bypass valves and actuators as well as the OEM ignition coils. The majority of OEM on-engine sensors are also re-used. The system features dual Woodward TecJet mass-flow metering valves which fully replace the OEM Raptor fuel valve. In addition, the Woodward Easygen generator controller is integrated on CAN bus and also communicates to the SCADA system via ModBus TCP along with the LECM for display of vital system information to the plant network and remote operator terminals.

Improving Legacy Controls

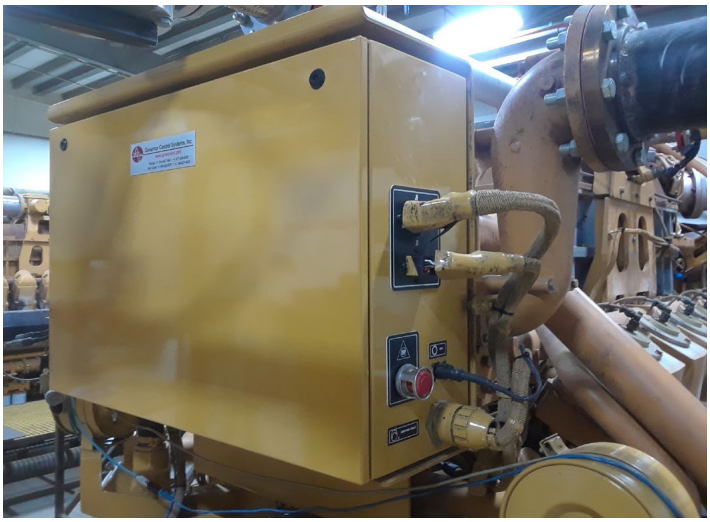


Figure 1: *MSHS PPG ISS Designed and Built LECM Enclosure*



Figure 2: *Dual TecJet Valves and Gas Trains Replace the OEM Raptor*

Standardized Design Approach

Since the system is designed to be a repeatable kit for the G3520C/E engines, components can be installed and the retrofit completed in a relatively short timeframe. MSHS PPG ISS packaged the LECM control into a new enclosure of the same size and from the same manufacturer as the one provided by the OEM. The new enclosure uses the same connectors, same mounting, and is finished in Caterpillar yellow to match the engine. This allows the new enclosure to be installed in the exact same location on the engine. The factory harnesses plug into the same connectors eliminating the need to change any wiring on the engine.

Series Of Custom Adapter Harnesses

In the cases where the LECM system required a sensor signal to be converted or a component changed, MSHS PPG ISS designed a series of custom wiring harnesses to adapt the factory harness to the new devices. These adapter harnesses simply plug into the connectors on the factory harnesses so no cutting or splicing of wires on the engine is required. These harnesses are provided as a standard part of the system kit and complete the plug-and-play approach to the design.

Easygen Integration

The Woodward Easygen generator control was installed in the switchgear. This control performs the generator's automatic synchronization to the utility source as well as controls the base loading operation between the control room and the engine. MSHS PPG ISS integrated the Easygen control into the LECM system via CAN Bus.

Adding a single cable between the devices allows for data exchange the OEM system was unable to provide. Now, a whole host of engine parameters are visible on the Easygen screen in the switchgear along with seamless integration of control and status signals that would otherwise be hardwired analog or digital requiring a separate cable for each.

EMCP-2 Removal

The integration the new system provides also allowed for the complete removal of the Caterpillar EMCP-2 control from the generator. Since the unit no longer provided valuable function, MSHS PPG ISS was able to remove the control along with the entire enclosure and associated wiring through the generator end of the machine. This simplifies the system wiring leading to easier troubleshooting in the future.

Summary

MSHS PPG ISS was able to successfully address the customer's need for an efficiently operating engine that could be utilized to its potential by providing a purpose-designed fuel blending system based around the LECM. The Raptor fuel valve is replaced with dual TecJet valves, which are more readily available and cost- effective. The new controls integrate with the site SCADA system via an industry-standard ModBus TCP connection in order to provide a level of access for the operators that were unavailable with the OEM system. In addition, the new system achieves improved startability, performance, and emissions compliance while maintaining as much OEM serviceability as possible due to the nature of the design.

Double Extraction / Steam Turbine Generator

Steam Turbine Control

Problem
Original OEM mechanical speed control, difficult to maintain, poor dynamics and control response. Parts no longer available and support almost impossible to find.

Solution
New modern speed, voltage and load control system, providing far superior dynamics and control response. Maintaining steam pressures and load while minimizing PRV operation.

Application
Paper Mil

Prime Mover
General Electric package rated for 30 MW @ 3600 RPM

System Components
Woodward MicroNet
Steam Turbine Digital Control System for speed control (governing), extraction control, turbine protection, and monitoring. MicroNet features redundant power supplies and CPUs.

Woodward ProTech TPS
Independent Total Protection System Device with two-out-of-three voting

Woodward easYgen 3400
Generator Synchronizer and Load Control

Woodward VariStroke actuators
with H-Block test

HMI System
Dual touch-screen terminals in the plant control room and control cabinet door and one desktop HMI in the control room for monitoring and control of the system including remote access.



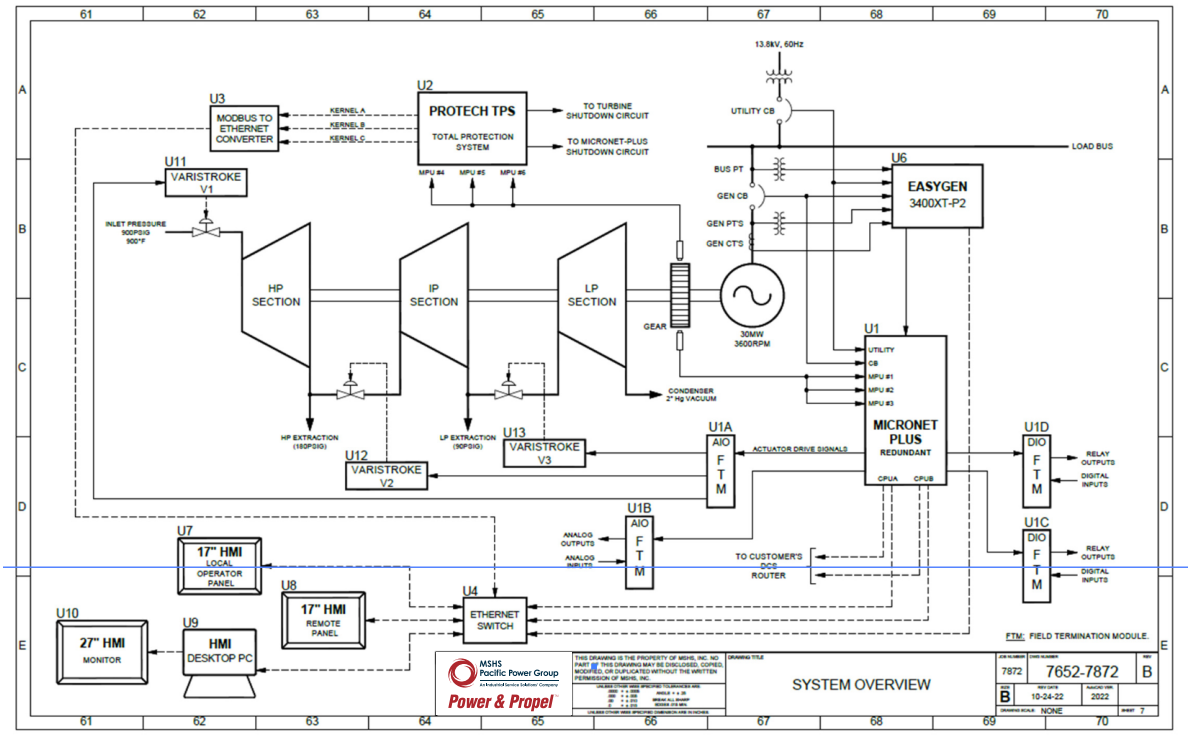
Project Overview
MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), has supplied a turbine-generator control, monitoring, and actuation system for a large paper mill. The plant utilizes multiple turbines including this General Electric package rated for 30 MW @ 3600 RPM. The plant is run in parallel to the local utility in a droop base load mode. The control system features the MicroNet Digital Turbine Control Platform with custom application software performing functions including automatic turbine start and stop sequencing, speed control, double extraction control, and turbine protection. The MicroNet hardware includes redundant power supplies and CPUs. In the event of a power supply or CPU failure, the control will automatically transfer control to the secondary CPU or power supply in a bump-less fashion enabling the turbine to continue to run until the appropriate module can be replaced. The system also includes an electronic over-speed protection device completely independent from MicroNet. This device utilizes three independent speed probes that trip the turbine only when two out of the three modules agree (2-out-of-3 voting). Like the MicroNet hardware, the modules in this device can be changed while the turbine is online. MSHS PPG ISS has included an automatic synchronizer with the system and packaged the controls in a single free- standing control cabinet.

Central monitoring and control are performed via a custom HMI system featuring dual touch-screen terminals and one desktop-based HMI. The HMIs provide the operator with complete system control including starting and stopping of the turbine, synchronization, inlet steam valve control, and extraction valve control.

The turbine control includes an Inlet Pressure Control and a Load Limiter. It also permits the operator to hand the control of all three valves to an overall header pressure management system operated by the DES company. DES can position the valves subjected to the constraints of the MicroNet ratio/ limiter logic, that keeps the valves inside the limits of the steam map.

The HMI and the MicroNet software include features like Automatic Warm-Up of the turbine chest, H-Block Test, MSV (Main Stop Valve Test), Actuator Stroke and Overspeed Test.

Steam Turbine Control



Control System Features

Control System Cabinet

- Double door Freestanding Enclosure (60” W x 38”D x 75”H)
- Door Mounted T ouch-Screen HMI
- Redundant AC Power Supply Feeds
- Redundant DC Power Supplies
- Dedicated Hardwired Safety Trip System

Turbine Control: *Woodward MicroNet System*

- Speed Control / Governing
- Automatic Start / Stop Sequencing
- Extraction Control (V2 and V3 Valves)
- Process Limiting
- Manual Valve Limiter Adjustment
- Critical Speed Range Avoidance
- Protection and Alarm Handling
- Ethernet Network to HMI System
- Redundant Power Supplies and CPUs
- Hot-Swapping of Modules with Turbine On-Line

Over Speed Protection: *Woodward ProTech TPS*

- Protection Independent to MicroNet System
- Two-out-of-Three Voting – Three Separate MPUs
- Hot-Swapping of Modules with Turbine On-Line
- Modbus over Ethernet Network to HMI System

Generator Synchronization: *Woodward easYgen 3400*

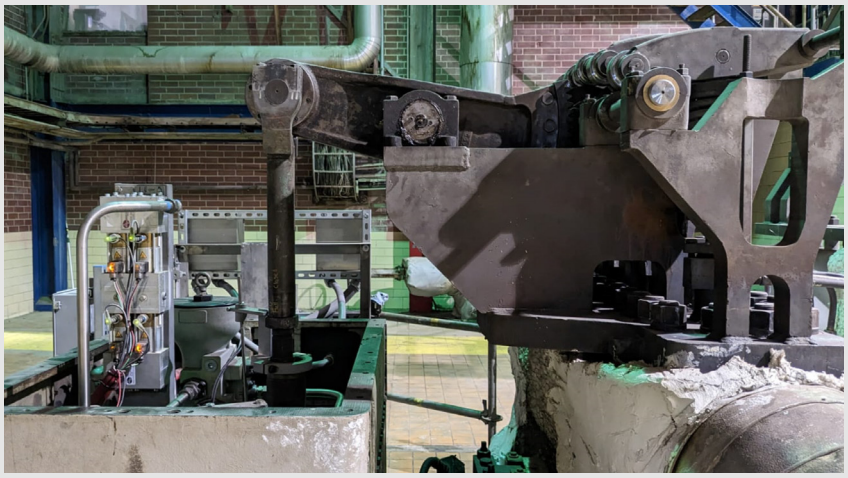
- Dead Bus Control or Live Bus Synchronizing
- Interface to Automatic Voltage Regulators
- Ethernet Network to HMI System

HMI / SCADA System

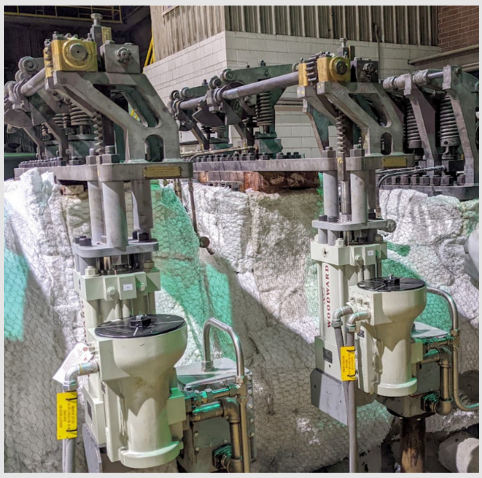
- Control Room Mounted T ouch-Screen HMI
- Second HMI Mounted in Control Cabinet Door
- Third HMI based in a remote desktop in the control room
- System Monitoring and Control
- Control System Integration
- Alarm Handling and Performance Data Trending
- Multiple User Access Levels
- Available Remote Access via the Internet via a brick PC installed in the control cabinet

Double Extraction Steam Turbine Generator

The existing actuation system has been upgraded to the modern Woodward VariStroke for each one of the control valves, V1, V2 and V3. V2 and V3 have direct actuation on the valve cam while for V1, the VariStroke acts on the existing cylinder due to its extension. An H-Block valve test permits the trip solenoid to be tested without tripping the turbine.



V1 actuator and the H-Block trip valve



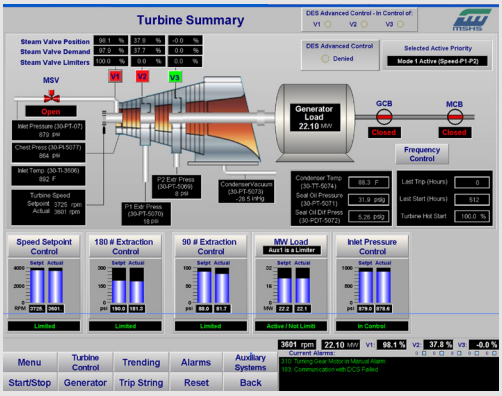
V3 (left) and V2 (right) actuators



Turbine control Cabinet – external view



Turbine control Cabinet – internal view



Extraction/Admission Steam Turbine Generator

Steam Turbine Control

Problem
The customer needed an integrated custom control system that could connect and run parallel to the local utility in a droop-base load mode.

Solution
A custom integrated control, monitoring, and actuation solution for additional safety, reliability, and automated operation.

Application
Paper Mill

Prime Mover
GE Steam Turbine Generator
Single Extraction / Admission
Inlet Pressure: 1500 psig
Admission/Extraction Press: 600 psig 28.7 MW, 13.8 kV @ 3600 RPM

System Components
Woodward Micronet
Steam Turbine Digital Control System for speed control (governing), admission / extraction control, turbine protection, and monitoring. Micronet features redundant power supplies and CPUs.

Woodward ProTech GII
Independent Over-speed Protection Device with two-out-of-three voting

Solenoid Trip Assembly
Triple-Modular Redundant (TMR) turbine trip assembly

Woodward DSLC-2
Generator Synchronizer and Load Control

Woodward UMT
MW Load Transducer

HMI System
Dual touch-screen terminals in the plant control room and control cabinet door for monitoring and control of the system including remote access.

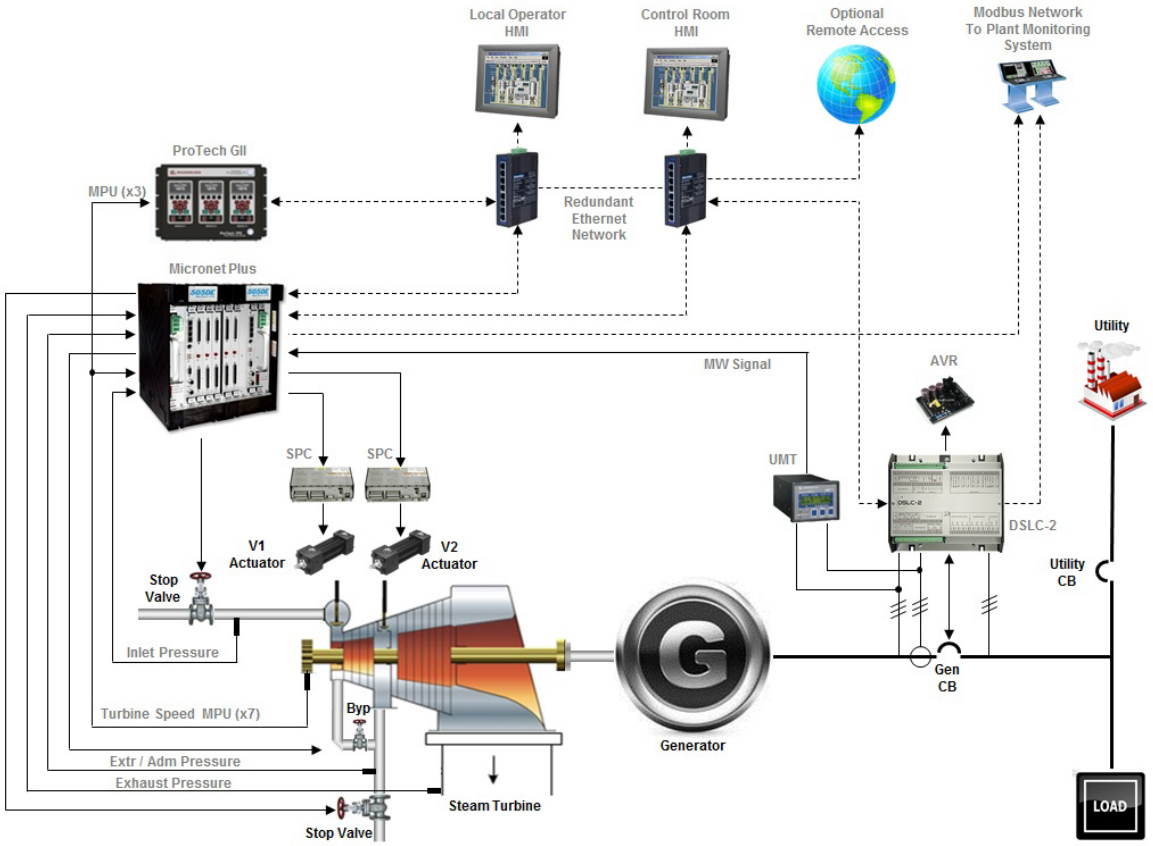


Project Overview
MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), has supplied a turbine-generator control, monitoring, and actuation system for a large paper mill. The plant utilizes multiple turbines including this General Electric package rated for 28.7 MW @ 3600 RPM. The plant is run in parallel to the local utility in a droop base load mode.

The control system features the Micronet Digital Turbine Control Platform with custom application software performing functions including automatic turbine start and stop sequencing, speed control, admission/extraction control, and turbine protection. The Micronet hardware includes redundant power supplies and CPUs. In the event of a power supply or CPU failure, the control will automatically transfer control to the secondary CPU or power supply in a bump-less fashion enabling the turbine to continue to run until the appropriate module can be replaced. The system also includes an electronic over-speed protection device completely independent from the Micronet. This device utilizes three independent speed probes that trip the turbine only when two out of the three modules agree (2-out-of-3 voting). Similar to the Micronet hardware, the modules in this device can be changed while the turbine is on-line. MSHS PPG ISS has included an automatic synchronizer with the system and packaged the controls in a single free- standing control cabinet.

Central monitoring and control is performed via a custom HMI system featuring dual touch-screen terminals. The HMIs provide the operator with complete system control including starting and stopping of the turbine, synchronization, inlet steam valve control, and admission / extraction valve control.

Steam Turbine Control



Control System Features

Control System Cabinet

- Single Freestanding Enclosure (36”Wx36”Lx84”H)
- Door Mounted T ouch-Screen HMI
- Redundant AC Power Supply Feeds
- Redundant DC Power Supplies
- Dedicated Hardwired Safety Trip System

Turbine Control: Woodward Micronet System

- Speed Control / Governing
- Automatic Start / Stop Sequencing
- Extraction / Admission Control (V2 Valve)
- Process Limiting
- Manual Valve Limiter Adjustment
- Critical Speed Range Avoidance
- Protection and Alarm Handling
- Ethernet Network to HMI System
- Redundant Power Supplies and CPUs
- Hot-Swapping of Modules with Turbine On-Line

Over Speed Protection: Woodward ProTech TPS

- Protection Independent to Micronet System
- Two-out-of-Three Voting – Three Separate MPUs
- Hot-Swapping of Modules with Turbine On-Line
- Modbus over Ethernet Network to HMI System

Generator Synchronization: Woodward easyGen 3400

- Dead Bus Control or Live Bus Synchronizing
- Interface to Automatic Voltage Regulators
- Ethernet Network to HMI System

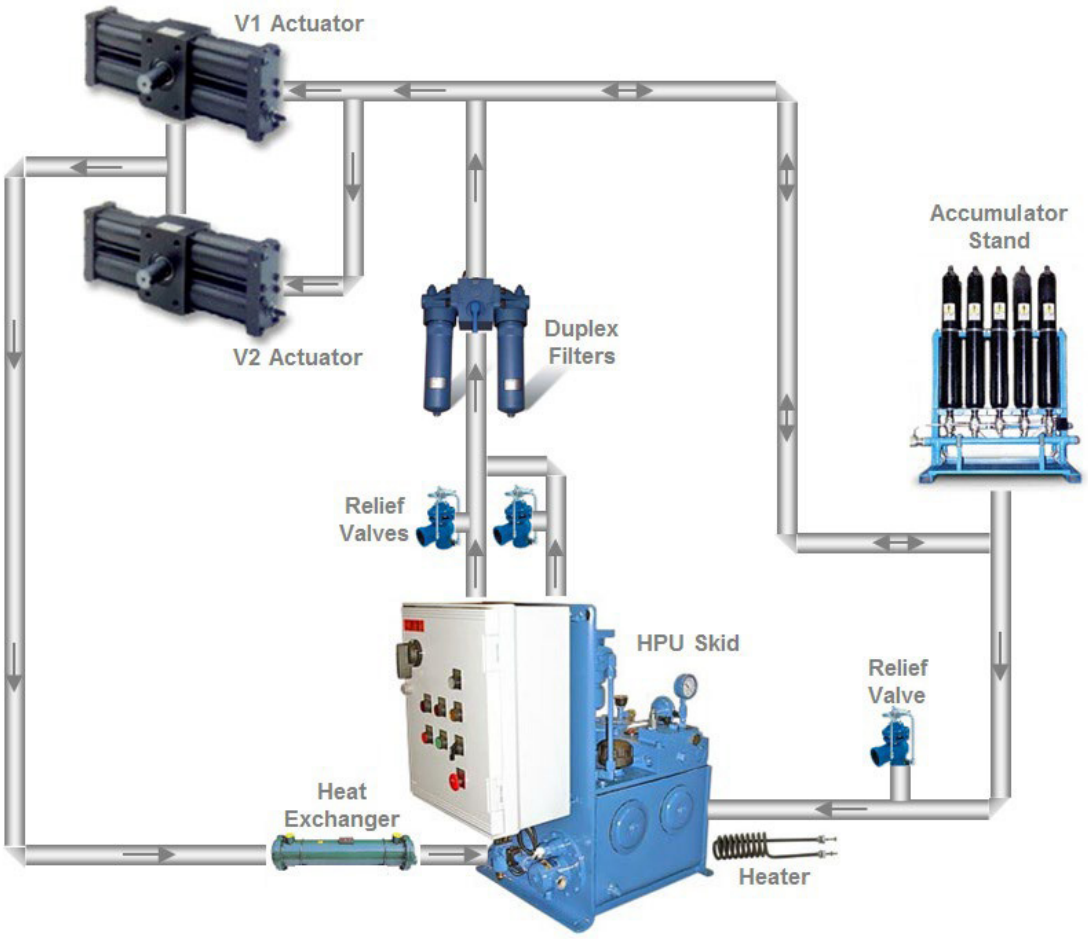
HMI / SCADA System

- Control Room Mounted Touch-Screen HMI
- Second HMI Mounted in Control Cabinet Door
- Redundant Ethernet Communication Network
- System Monitoring and Control
- Control System Integration
- Alarm Handling and Performance Data Trending
- Multiple User Access Levels
- Available Remote Access via the Internet

Steam Turbine Control

Hydraulic Actuation System

In addition to the control system, MSHS PPG ISS has also supplied a new hydraulic actuation system for this turbine. This system includes a hydraulic power unit (HPU) skid, accumulator stand, rotary actuators for both V1 and V2, and accessories.



Actuation System Features

Duplex Hydraulic Power Unit (HPU)

- Dual7½HPPumpsRatedat5GPM&1500psig
- Pressure Switching for Lead/Backup Arrangement
- Thermostat Operated Heater
- Oil to Water Heat Exchanger (Cooler)

Accumulator Stand

- Four 15 Gal Gas Bottles with One 4 Gal Booster
- Pre-charged to 1000 psig
- Full 4 Gal of Oil Available to Operate the Actuators

Hydraulic Rotary Actuators: *Parker HTR150*

- Dual Rotary Actuators for Turbine Valves V1 & V2
- Voice Coil Servo Valves
- Directly Coupled to Turbine Camshafts
- Integral LVDT Feedback Devices
- Full 360 Degree Stroke
- Full 100% Rotation in Less Than One Second

System Accessories

- Duplex Hydraulic Oil Filters
- Oil to Water Heat Exchanger
- Pressure Relief Valves

Steam Turbine Control

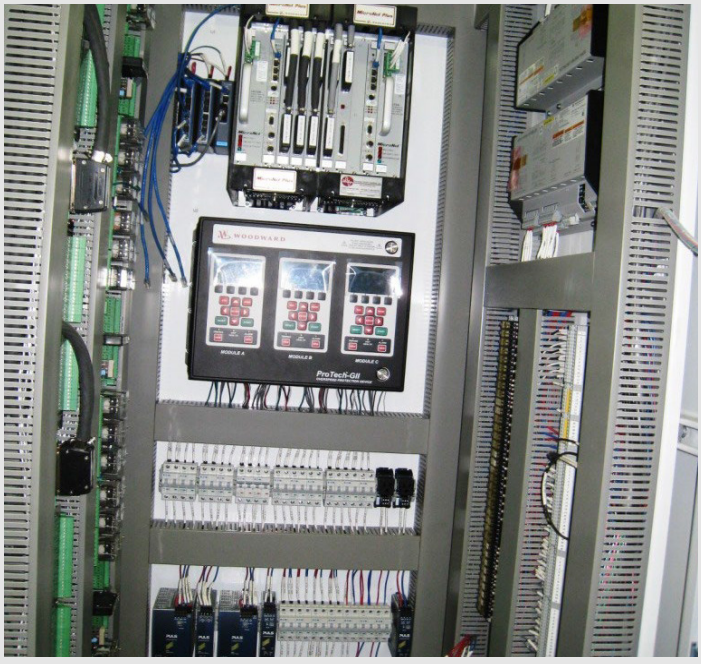
Triple Modular Redundant (TMR) Safety Trip System

Control System Safety Features

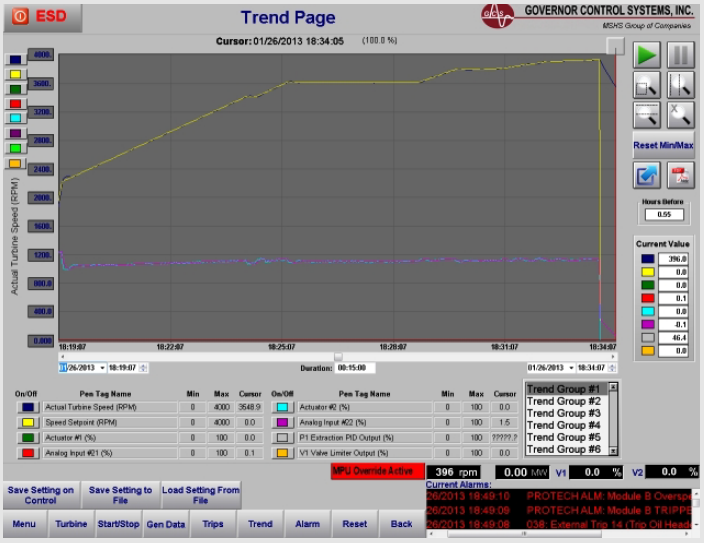
- Hardwired Relay Shutdown System Integrated into Control Cabinet
- Heavy-Duty Industrial Grade Trip Relays
- Triple Redundant Signals to Turbine Trip Valve
- Independent ProT ech 2-o-3
- IEC61508 SIL-3 Certified
- API670 & API612 Compliant
- Micronet Integrated Internal Turbine Protection
- Interface to HMI System for Alarm and Shutdown Reporting Including First-Out Detection

TMR Trip Valve

- Triple Independent Solenoids Integrated On-Valve
- 2 out of 3 Voted Design
- 24 Vdc Solenoids (110/220 Vac Available)
- 50 – 300 psi Operating Pressure



Cabinet post installation



HMI Screen: Micronet Overspeed Test

Speed and Load Control with System Monitoring

Hydroelectric Turbine Control

Problem
Current critical control systems were obsolete and in need of an upgrade.

Solution
Replaced the Woodward Windows NT CPU with Woodward Cybersecure Motorola MPC5200 CPUs for greater security, reliability, and redundancy in a week.

Application
Hydroelectric Pumped Storage Facility

Prime Mover
4x Reversible Pump Turbines
- Generating: Rated for 400 MW at 300RPM
- Pumping: 3850 ft3/sec with TDHof 1000 ft at 300 RPM

System Components
Woodward Micronet Plus:
Turbine control system with custom-designed software performing Start/Stop Sequencing, Speed Control, Gate Valve Control, Load Control, and System Monitoring. The upgrade also includes redundant CPUs and Power Supplies with bumpless transfer.

Woodward RTCnet Modules:
Distributed I/O modules with redundant CAN communication, providing reliable operation in areas with high temperatures and vibration.

MSHS PPG ISS Provided Services:
- Verification of complete system with wiring revisions and necessary software and component upgrades
- In-house design validation with a complete functional test prior to on-site commissioning
- Detailed inspection and documentation of actual cabinet assembly prior to teardown
- Demolition, installation and pre-commissioning checks done in a timely manner to meet customer's scheduling needs



Project Overview
MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), upgraded the Woodward MicroNet Control System on a set of hydroelectric turbines to the Woodward MicroNet Plus Control System. The site contains 4 separate reversible pumps/turbines capable of producing up to 400 MW each. As a system critical component to the utility grid, these units are commonly used to stabilize the production of other utility plants.

MSHS PPG ISS replaced the Woodward Windows NT CPU with Woodward Cybersecure Motorola MPC5200 CPUs. With redundant CPUs, the control system can perform a bump-less transfer to the secondary CPU if the primary CPU should fail, allowing the unit to stay online in steady operation. Each CPU has a dedicated connection to the customer's SCADA and auxiliary systems via Modbus TCP/IP. MSHS PPG ISS also upgraded the obsolete IO Field Terminal Modules and Combo AIO Card to increase component reliability and ease of replacement.

The Woodward 5200 CPUs are controlled by Woodward GAP 3 software whereas the NT CPUs operated on GAP 2 software. Since GAP 2 function blocks are fully compatible with GAP 3, MSHS PPG ISS was able to convert the software while maintaining the existing parameters/tunables for automatic start and stop procedures, speed control, load control, and gate valve position control. This ensures that the core control software remains the same as before, effectively limiting commissioning time.

Hydroelectric Turbine Control

MSHS PPG ISS replaced the Woodward Linknet RTD and AIO Modules with Woodward RTCnet RTD and AIO Modules. These modules are responsible for transmitting system critical data (bearing temperatures, oil levels, etc.) to the Woodward MicroNet Plus control via redundant CAN networks. Using the Woodward GAP 3 software, each of these inputs can be individually monitored and programmed to customer specifications.

With two technicians on site, MSHS PPG ISS was able to complete the demolition, installation, and pre-commissioning checks for a single unit in five days.



MSHS PPG ISS Upgrades:

- Woodward MicroNet Chassis
- Woodward Microsoft NT CPUs 5200 CPUs
- Woodward Linknet Modules
- Woodward GAP 2 Software
- Woodward MicroNet Plus Chassis
- Woodward Cybersecure Motorola
- Woodward RTCnet Modules
- Woodward GAP 3 Software



Gas Turbine Power Generation

Gas Turbine Control

Problem
Turbine-generator control systems were outdated and at the end of life.

Solution
Retrofitted the control, monitoring, and fuel metering system with custom application software for new automation capabilities while also offering enhanced reliability and redundancy.

Application
Paper Mill
Prime Power Generation
Utility Paralleled in Droop Base Load and Black Start Isochronous

Prime Mover
Rolls Royce Olympus Gas Turbine Dual Fuel Injection (Gas and Liquid)
Inlet Fuel Pressure: 250 psi
28 MW, 13.8 kV, 0.8 PF @ 60 Hz

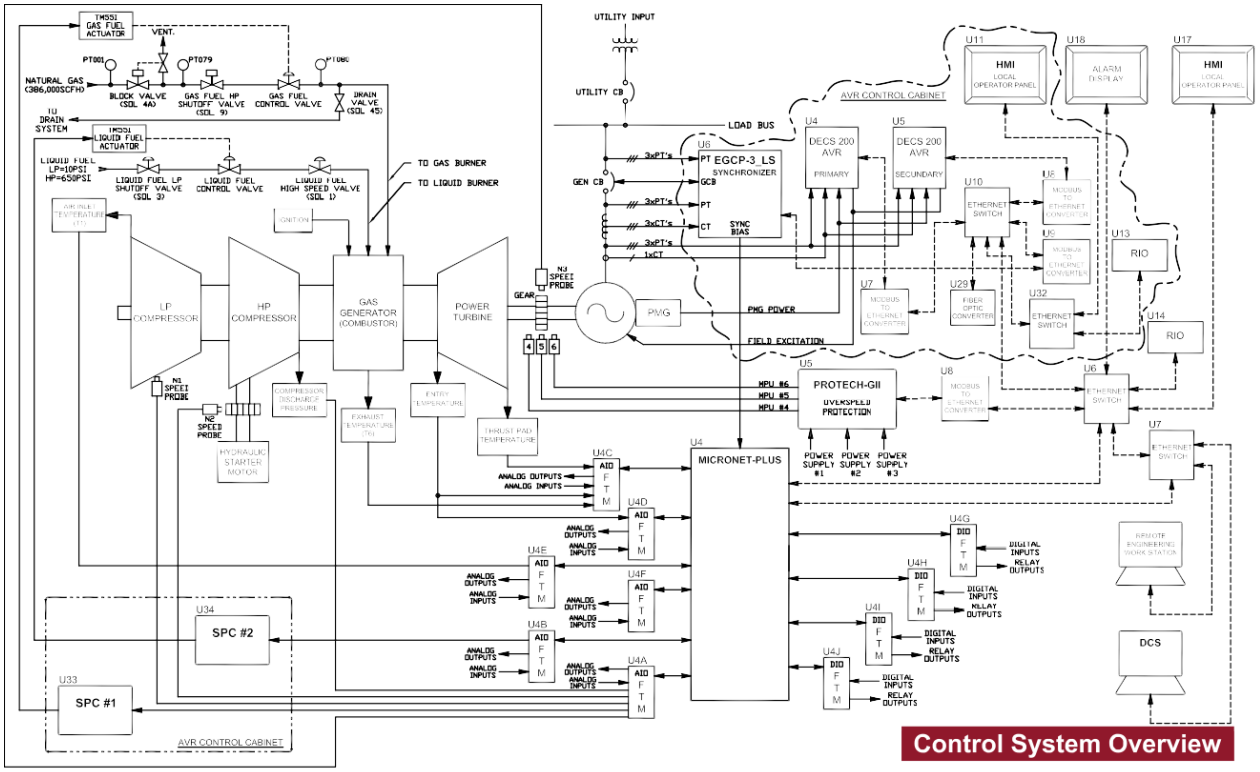


Project Overview
MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), has supplied a gas turbine-generator control, monitoring, and fuel metering system for a large paper mill as a retrofit package on an old outdated control system. The plant utilizes multiple turbines including this Rolls Royce Olympus SK-30 package rated for 28.0 MW @ 60 Hz. The plant runs in parallel to the utility in baseload mode, additionally it is capable of performing black start up in isochronous mode.

The new control system features the Woodward MicroNet Plus Control Platform with custom application software performing functions including automatic turbine start / stop sequencing, fuel control, exhaust gas temperature monitoring and turbine protection. The MicroNet Plus hardware includes redundant power supplies and CPUs. In the event of a power supply or CPU failure, the control will automatically transfer control to the standby CPU in a bumpless fashion enabling the unit to continue to run until the appropriate module can be replaced. The system also includes an electronic over-speed protection device completely independent from the MicroNet Plus. This device utilizes three independent speed probes that trip the turbine only when 2 out of 3 modules agree. MSHS PPG ISS has included a redundant voltage regulator for generator excitation in a primary / standby fashion following the same redundancy principle. The controls are packaged in two double-bay free-standing control cabinets.

Central monitoring and control is performed via a custom HMI system featuring dual industrial grade touch-screen terminals in the control cabinet door along with a second desktop workstation in the plant control room. The HMIs provide the operator with complete system control including starting, stopping, and synchronization of the turbine.

Gas Turbine Control



Control System Cabinet

- 2x Double-Bay Freestanding Cabinet (60”Wx36”Dx84”H)
- Door Mounted Touch-Screen HMI Dual AC Power Supply Feeds
- Redundant DC Power Supplies
- Dedicated Hardwired Safety Trip System



Original System



New System Installed



Interior of New Control Cabinet

Redundant AVR System with Negative Force

AVR System Upgrade

Problem

Obsolete AVR. Voltage control dependence on a single module in case of failure.

Solution

Upgrade current AVR system with 2 redundant Basler 250N, and a Horner PLC for operator interface.

Application

Generation

Prime mover

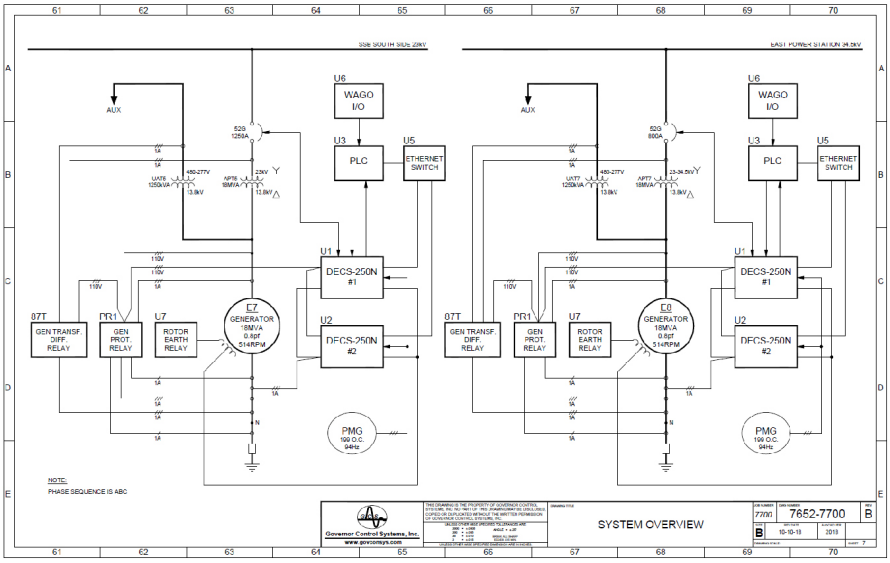
MAN B&W

Syste Components

DECS-250N – AVR with Negative Field Forcing Capability.

Horner PLC for system interface.
Redundant Power Supply

CERTIFIED LR ISO 9001



Project Overview

MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), was contracted to provide an AVR system to replace the old and obsolete voltage regulator on the MAN main gensets. The site was concerned about single equipment failure resulting in emergency downtime if they did not have redundant equipment. They also wanted to improve the voltage regulation dynamic. The control solution was a Basler 250N redundant with negative force and a Horner PLC interface. The new Basler solution and all the additional components (relays, circuit breakers, switches, pilot lights, redundant power supply, etc.) were contained in a 30x80x24 cabinet as can be seen in figures 1 & 2.

The 2 AVR's are programmed as Primary and Secondary. The secondary is always tracking the primary AVR setpoint, thus, a transfer to remove the failed system is always ready to be performed.



From the Horner PLC interface the operator is able to:

- Monitor alarms, history, and IO
- Analyze control trends
- Transfer from primary to secondary
- Transferfrom Auto Modeto Manual
- And more

Figure 1. Cabinet installed.

AVR System Upgrade

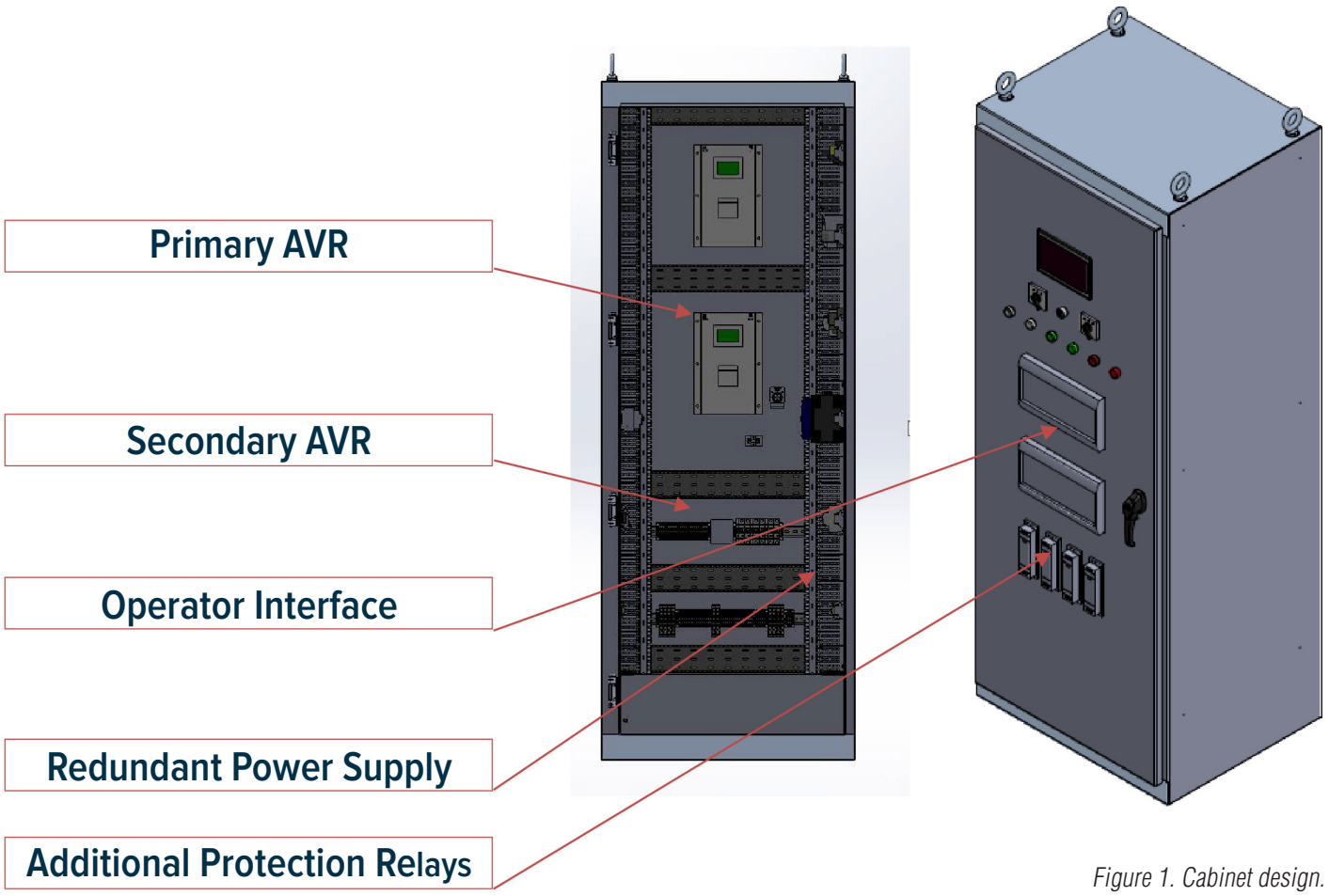
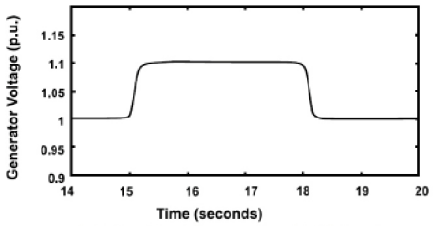
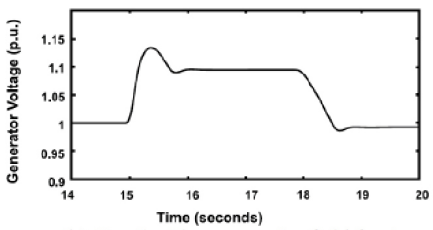


Figure 1. Cabinet design.



(a) K_G=5 with negative field forcing



(b) K_G=5 with no negative field forcing

For generators with small machine time constants, the lack of negative field forcing is generally not an issue. However, as the size of the generator increases, performance expectations increase. A non-negative field forcing voltage regulator has limitations when asked to provide corrective generator voltage change in response to system disturbances. The lack of negative field forcing creates nonlinearity in the system when a fast response is desired, such as during system transients, because it limits the exciter field decay.

Enhanced Operational Safety For Engines

Splash Oil Monitoring Systems

Problem

The two generators needed to be upgraded with new enhanced monitoring capabilities due to their critical nature and lack of redundancy.

Solution

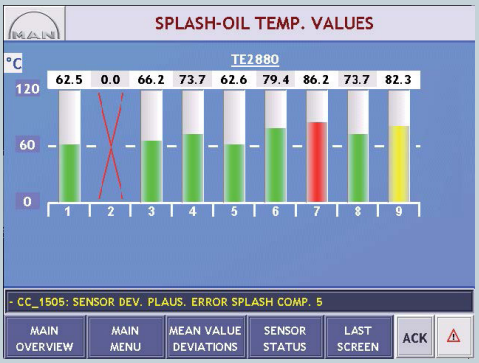
Install a Splash Oil Monitoring System to enhance the monitoring and protection of the connecting rod big end bearings while working along the standard generators' Oil Mist Detectors.

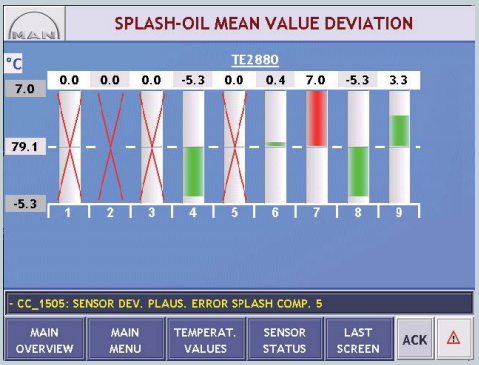
Application

Power Generation Station

Prime mover

MaK 8 M601





Project Overview

For the operator of a modern Diesel Engine Power Plant, safety, reliability, and availability of the engines as well as the protection of their investment are of utmost importance. This is even more valid for isolated island distribution grids with limited redundancy. MSHS Pacific Power Group (PPG), an Industrial Service Solutions® Company (ISS), has recently been requested to upgrade two MAK 8 M601 Diesel Generators with a Splash Oil Monitoring System to enhance the monitoring and protection of the connecting rod big end bearings.

Monitoring the crankcase environment is one of the most important safety measures for a large diesel engine. Traditionally, Oil Mist Detectors (OMD) have been used for this purpose, triggering an engine stop when components overheat and thus increasing the oil mist concentration in the crankcase. In our case, the MAK 601 engines were already equipped with such an OMD system. However, the downside of the OMD System with respect to the detection of connecting rod bearing failures is the significant delay between the occurrence of the failure and the detection. This delay is much shorter for the Splash Oil Monitoring System since the temperature of the lubricating oil originating from the connecting rod bearing is measured and monitored. Only a 3° C relative change in the temperature level of the lubricating oil originating from the conrod bearing will trigger an alarm for the operator. At a 5° C differential temperature, an emergency stop of the engine will be released through the safety system. In many cases of connecting rod bearing failures, the consequential costs of repair, downtime, and loss of revenue are immense, even though the OMD has functioned as intended. Very often even the crankshaft is a total loss and needs to be replaced. The Splash Oil Monitoring System with its rapid and reliable response is predestined to detect such failures in their nascent stage and way before the OMD can react.

It is highly recommendable to equip engines with both, the Splash-Oil Monitoring System and the OMD, as these two systems serve different purposes, though the overall goal is engine safety.

The Splash-Oil Monitoring System provides maximum protection of the connecting rod's big end bearings and thus the crankshaft. There have been occasions where the system detected even developing piston seizures at their early stage.

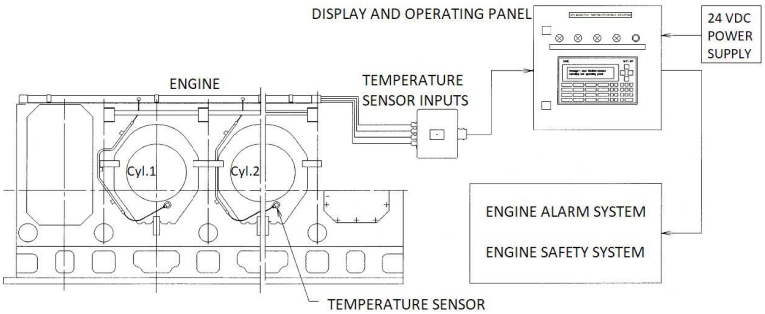
Splash Oil Monitoring Systems

The table below shows the major differences between the two systems.

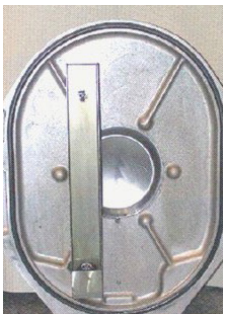
SPLASH-OIL MONITORING SYSTEM	OIL MIST DETECTOR
Continuously measures and monitors the oil temperature from the connecting rod bearings.	Monitors the oil mist concentration within the crankcase by measuring the opacity. The concentration increases when components inside the crankcase are seizing.
Very sensitive. Even small temperature changes are detected immediately.	Oil mist alarm is only triggered when the connecting rod bearing is already seizing and massive heat ingress into the crankpin occurring.
Designed to detect initiation of connecting rod big end bearing failures and to prevent total loss of a crankshaft.	Designed to prevent crankcase explosion.
Not sensitive to water condensation.	Sensitive to water condensation

The Splash-Oil Monitoring System is a highly advanced and almost maintenance-free system. It consists of a splash oil collecting pan mounted on the inside of each individual crankcase compartment cover for collecting the oil splashed from connecting rod's big end bearing. The temperature of the oil collected in the pans is constantly measured by temperature sensors before the oil is returned to the oil sump. The measured temperatures from all the individual sensors are then relayed to the PLC and mounted inside the Cabinet with an integrated touchscreen display and alarm indicator lamps. The system requires a 24 VDC power supply to operate and it is also interfaced with the engine alarm and safety system via dry contact outputs (binary contacts). On request, all data can be fed into the existing HMI system via an interface. The cabinet can be either installed locally close to the engine or integrated into the engine control room environment. The entire retrofit can be executed in a very short time frame, ensuring limited downtime for the customer. For marine applications, the installation of temperature sensors can be even accomplished during a regular stay in the port.

The Splash Oil Monitoring System is also available as part of the Crankcase Monitoring System which includes the monitoring of all main bearing temperatures as part of the retrofit. This is particularly valuable for engines where the main bearing monitoring is not already part of the OEM package.



Splash-Oil Monitoring System Installation Overview



Oil collecting pan installed on the crank- case cover



Temperature sensor installed on the crank- case cover



Display and operating panel installed near the engine



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