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TurbineSentinel™

Turbine Protection and Control System

2022

DESCRIPTION

MCL Control keeps developing **TurbineSentinel**, a comprehensive integral solution targeted to satisfy the protection and control requirements of gas turbines, which combines specific safety, monitoring, sequence & high speed control strategies, with machines integration, production strategies, facilities monitoring, information supervision and centralization requirements.

The global concept of **TurbineSentinel** offers answers that reach all production related areas (operation, maintenance, supervision, management, administration, etc.). Based on current API, ISA/ANSI, and IEC safety standards requirements, **TurbineSentinel** complies with the concept of having Safety and Control separated in independent Modules as described below. Further more, **TurbineSentinel** is based upon commercial Programmable Logic Controllers (**PLCs**) platforms for both control and sequencing, and upon IEC-61508 compliant TÜV certified Programmable Electronic Systems (PES or Safety PLC) for process safety.

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The architecture of a **TurbineSentinel** system can be adjusted to comply with the required *Safety Integrity Level* (**SIL**) and availability for your process. **TurbineSentinel** also offers the flexibility of combining both control and protection of the machine in the same controller (**PLC**) when allowed by applicable regulations and standards .

BENEFITS

Platform independence: Based on the *IEC-61131 standard*, **TurbineSentinel** can be adapted to many PLC platforms with a minimum effort.

investment: High Benefits/Costs relationship.

Reduced Differed Production Costs: These are totally proven solutions that guarantee the availability of a machine completely operational in minimum time.

Reduced Maintenance Costs: Overall costs are decreased through a lower maintenance time compared to conventional PLC based solutions for the Safety Module that make necessary very frequent system manual diagnostics, additional diagnostics programs to fulfill *API, IEC 61511 & IEC 61508* requirements, and tests demanded by current practices, in order to achieve fail safe plant shutdown.

Package Benefits:

- Open architecture.
- Redundancy available for Safety and Process Control.
- API and *IEC 61508 / 61511* compliant solution for Safety.
- High speed control strategies.
- High Benefits/Costs relationship.

The implementation of state of the art automation technologies provides valuable data that can be used as a main source of information for preventive maintenance plans, reducing the risk of undesired shutdowns and system failures that can affect the plant.

Engineering tools: Turbine Toolbox Configuration software running on portable computers in order to configure control and safety strategies and tune process units up independently of Centralized HMI.

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FUNCTIONALITIES

Start up and Protection sequences: This is implemented on Control Modules based on the latest versions of PLCs or Hybrid Controllers by major manufacturers depending on customers' best interests and preferences. The I/0 modules can share the chassis with the processor, or use the distributed I/0 concept (located near the process) in order to reduce installation costs, thus preserving system reliability and logic execution time.

Speed/Fuel Control: Speed is controlled by a PLC based Control Module. Machine acceleration rate and exhaust gas temperature (**EGT**) are limited in accordance with manufacturer's recommendations. In order to diminish interaction effects, decoupling with any other controlled interacting variable is included.

Over-speed Protection: This is one of the Safety Instrumented Functions (**SIF**) implemented in this product. The standard configuration of the **Turbine**Sentinel uses triplicate speed sensors connected to the Safety Module (**SIS**).

Turbine Protection: All required protections (**SIFs**) are included in the Safety Module (Safety Instrumented System, **SIS**), which are implemented within a dedicated TÜV certified Safety PLC or Programmable Electronic System (**PES**). Some of the protections might be implemented using independent modules to monitor temperature, vibration, and electrical parameters, in which case they will be integrated into the Safety Module. **MCL Control** standard **PES** solution is based on diagnostics technology, but can be replaced by **TMR** technologies under customer requirements. This **PES** can be expanded in order to do gas and fire detection/extinction functions. This system offers fault tolerance flexibility in order to increase its availability, thus improving productivity by avoiding unnecessary machine shutdowns.

Vibration Monitoring System: Included and executed within the Safety Module or by a Vibration Monitoring System, its integration to the supervisory system will be done via a secondary communication network.

Performance Calculations: Yield, efficiency, fuel consumption, and N0x emissions estimations in accordance with appropriate standards are included at no additional cost, avoiding special engineering or annoying configurations. .

Comprehensive solution: As a global solution for a group of plants, **Turbine**Sentinel can be integrated with a distributed control system or any other supervisory system, providing concentration of information and operational data from the different subsystems that monitor and control the individual plants, besides handling the control loops related with Plant production, advanced process control strategies, such as optimum turbine operation, thus maximizing availability and benefits.

Flexibility: Easy adaptation to the specific requirements of any turbine.

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OPERATION

Human-Machine Interface:

All Operations Schematics are included. Special emphasis was made in developing an interface composed with friendly displays and commands, based on the operator's point of view, making him or her feel part of the automation process and allowing them to carry out their work with a minimum of stress and mistakes, while using the tools offered by the supervisory software, such as security and access level, alarm management, graphics presentation, etc. This can be implemented in a local station close to the machine or in a PC in the control room.

TurbineSentinel provides a series of already built in standard displays based on our experience with this type of applications. Also custom displays can be configured based on the client's requirements and special conditions existing in each application. The HMI is OPC compliant, allowing the integration of other systems with **Turbine**Sentinel. The screens listed below are part of our standard displays included with each **Turbine**Sentinel:

- **Overview:** Overview: Display main GT values, and allows navigation to detailed screens.
- **Turbine Control:** Provides access to the control strategies (Control Mode, Fuel Selector, Operating Set Points, among others).
- **EGT:** Provides details of exhaust gas thermocouples measurements (values, average, differences, status, trending).
- **Shutdown:** List all shutdown signals status and the first-out event.
- **Trends:** Allows the user to select up to 8 signals per trend.
- **Alarm summary:** Shows alarms details, online and history.
- **Auxiliary systems:** Including lube oil system, turbine starter, fuel supply pump (for liquid fuels), air dryer and others.

Remote Operation/Monitoring:

Available through portable wireless devices
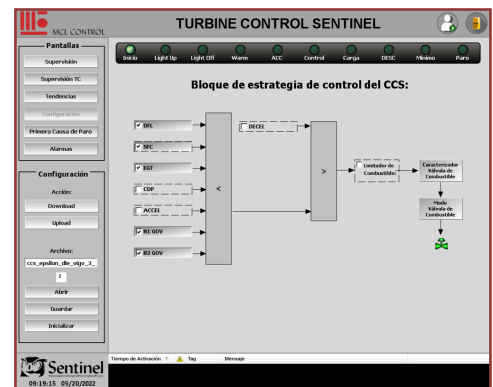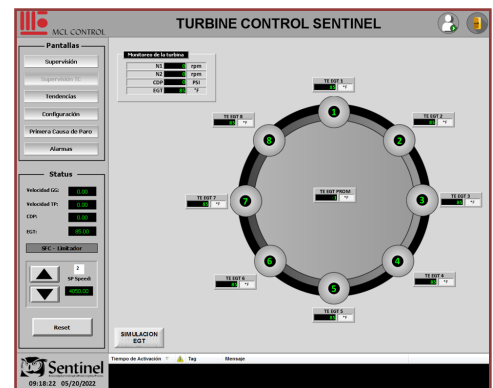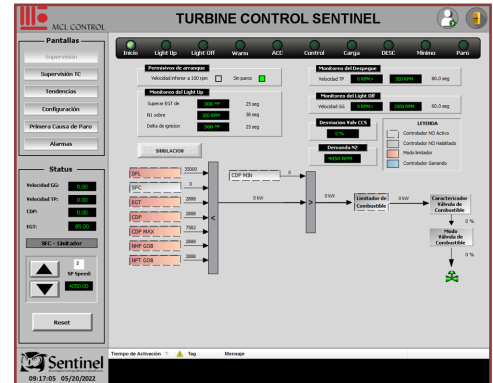
Typical HMI Displays

Remote Operation/Monitoring

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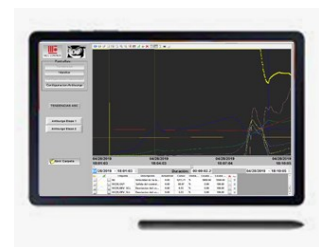
ARCHITECTURE

The architecture design uses the latest proven technology, following open networks market trends such as Ethernet-IP, OPC and Modbus, as shown in the figure below. In full accordance with current API, IEC, and ISA safety standards, the solution accounts for an independent safety system for each machine in order to implement the required Safety instrumented Functions (**SIF**) to achieve the required Safety Integrity Level (**SIL**). Each Safety PLC can be single, redundant, or **TMR**, depending on SIL and fault tolerance requirements.

Typically, a Diagnostics based safety **PLC** for **SIL** 2 non fault tolerant applications, and either a Diagnostics based safety **PLC** or a **TMR** for SIL 3 applications, are used to implement the Safety instrumented System (**SIS**) and Start-Up, Shutdown sequences.

For control loops such as speed control, a single or redundant PLC of practically any customer preferred commercial brand may be used (please see the "Experience" section below). Alternatively, and at customer's request, all the applications may be implemented in the safety PES.

When requested, MCL Control can supply both Central and Optional Local Panel Human Machine Interface (HMI), based on the best available industrial computers and software. Many features are included, and they are easily integrated with any PLC or stand alone systems via commercially available HMI software and specific communication drivers.
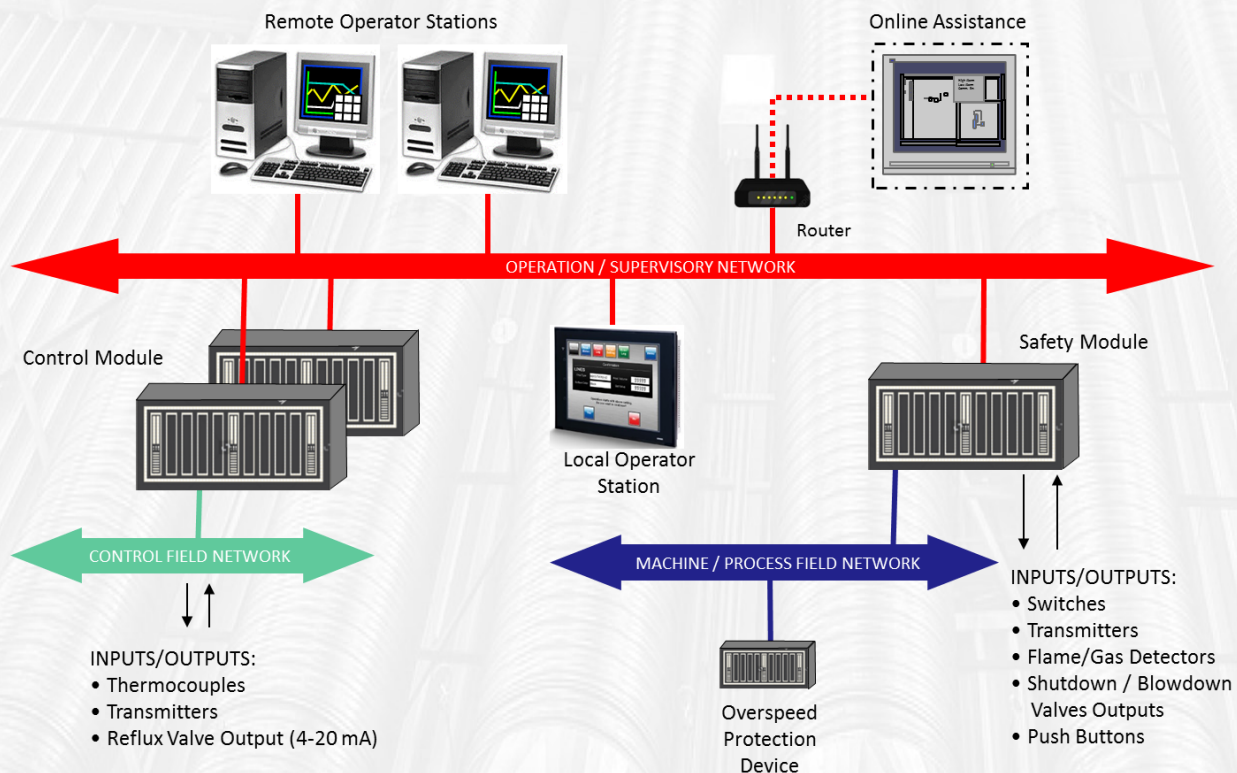
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SCOPE OF SUPPLY

Depending on customer's requirements, **MCL Control** is capable of supplying the whole range of the technical services required for this type of projects, starting from simple application configuration/installation in Customer's platform, all the way to a fully integrated system, including hardware (both PES/PLC and local/remote HMI) selection/sizing/configuration, cabinet design/procurement/assembly, field instrumentation (if requested by Client), operator/maintenance/ engineering training in accordance to Client's needs, integrated FAT/SAT, and system start-up assistance. Also, if required by the client, MCL Control can perform hazard and risk studies, including: HAZOP, SIL-LOPA, Safety Specifications (SRS), SIL verification, F&G detector placement studies.

SUPPORT

Documentation:
All necessary technical documentation for the engineering, operation, and maintenance is supplied in either English or Spanish. It includes all control strategies and protection sequences. When applicable, documentation for the supplied electronics will be included, and P&IDs, PFDs, and wiring diagrams, will be provided for the Client in AutoCAD® files to allow their modification at his/her convenience. An optional Internet based update service is offered to incorporate new developments and new hardware and software versions.

Post-sale Technical Support:
Local and on-line via Internet.

EXPERIENCE

MCL Control has been in the Process Automation and Safety business since 1989, becoming a solution provider for the Oil & Gas industry and specializing in processes related to combustion and heating such as steam generation and heating processes (including simulations of superheated steam boilers and the steam distribution network of one of the largest refineries in the world), Turbomachinery, and other safety areas like Emergency Shutdown Systems and Fire and Gas Systems. Particular references will be given upon request.

On the technical side, and as mentioned before, MCL Control's products are platform independent. In fact, this solution has been installed in, and integrated with, many platforms, as listed below:

PLC: Rockwell Automation, HIMA, GE Fanuc, Modicon, Siemens, and others
DCS: Honeywell TDC-3000 & Experion, Rockwell Automation ProcessLogix, Emerson Fisher Provox & DeltaV, Foxboro, and others.
HMI: Indusoft, Wonderware, Intellution, Wizcon, Simplicity, RSView, Visual Basic, and others.
Safety Systems: HIMA, Triconex, ICS Triplex, Siemens, and others.
Others: SCADA systems, Compressor Controls Corporation, Bently Nevada, Metrix, Prosoft Technologies, and others.

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