CLP 500 PAS

Hydropower Plant Automation Systems

Overview

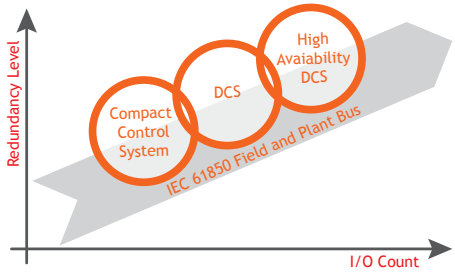
The latest Efacec automation platform for hydropower plant automation, **CLP 500PAS** is a unified, flexible and scalable distributed control system featuring multiple communication, I/O and HMI options as well as user programmability that drives reliable operations, optimizes plant energy yield and requires minimum staff for plant O&M.

From generator unit control, through intake and discharge control, to plant and auxiliary services, substation automation and remote communications, **CLP 500PAS** provides a single automation solution for the entire plant independently of plant configuration, turbine or generator type and manufacturer.

By adopting international standards and unified engineering **CLP 500PAS** provides an open future-proof and straightforward solution that can integrate multi-vendor products and scale according to the needs of each project. **CLP 500PAS** is one of the first solutions on the market to support IEC 61850 as a field/plant bus and engineering infrastructure.

Systems can be deployed in different architectures from compact solutions targeting small hydro to distributed control solutions for large hydro applications. **CLP 500PAS** also includes several redundancy and high availability options which enable the system designer to select the best fitting solution by balancing cost and performance in light of the characteristics of each system.

The field-proven and reliable **CLP 500** platform is complemented with a full range of services from training and product support to engineering, commissioning and maintenance that enable the required continued support throughout the whole system life-cycle.



Key Features

- Field-proven library of hydropower plant automation functions
- Multiple standard communication protocols and I/O options
- Modular, scalable and secure architecture
- High-availability hardware and communication options
- IEC 61850-enabled
- Several HMI options including external mobile and web access
- IEC 61131-3 user programmability
- Unified control system engineering tool from programming to HMI design
- Strict conformance to industry standards

Customer Benefits

- Optimized plant utilization
- Consistent automation technology over the power plant
- Open and versatile plant automation solution
- High expansibility and adaptability enabling step-by-step evolution
- Reduced engineering effort
- Seamless integration with third party products and systems
- Low total cost of ownership without compromising reliability
- Integration of IT solutions

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Hydropower Plant Automation

From small to large hydro, conventional or reversible systems, turbine type or manufacturer, each hydropower plant has specific automation requirements ranging from user interface to control algorithms, through different scale, performance and reliability levels or communication requirements. Efacec **CLP 500PAS** solutions can adapt to any system specification by matching platform flexibility with engineering experience and know-how. Through our experience Efacec has developed multiple control functions from generator unit control, tele-regulation control, dam and water-flow systems control, plant services and auxiliary services control as well as protection and substation integration. Such experience allows secure and reliable local or remote plant operation in either normal or emergency situations, taking into consideration applicable technical limits and operational regulations.
Efacec hydropower control library programs include (i) multiple operating modes such as manual, semi-automatic or fully automatic; (ii) step progression including sub-program control steps, condition verification and control final state validation; and (iii) return to failsafe state upon exception occurrence. In addition to the full power of the IEC 61131-3 programming environment, Efacec AGR programming system also features a simplified program logic and parameter adjustment system that enables end-users to easily setup and modify control logic.
With a long tradition of systems integration and power system control and protection, Efacec **CLP 500PAS** solutions can integrate any turbine/generator controller, synchronization, excitation or protection system of any vendor. By applying a single comprehensive automation solution, component cost as well as systems engineering and maintenance costs can be minimized without hindering system performance, functional expansion and integration options.

Flexible User Programmability

All Efacec controller families fully support IEC 61113-3 programming through the same integrated programming and debugging tools, fully integrated within the Automation Studio unified engineering environment, sharing user-code libraries and programming principles. This enables **CLP 500PAS** logic control functions to be adapted to any system architecture or automation requirements.
Supporting deterministic cyclic execution and multi-event scheduling, the optimized logic processor engine and large memory capacity of all Efacec controllers enables extensive user-defined algorithms and state machines to be deployed, including boolean, integer and floating point logic and arithmetic together with the full range of standard, mathematical, statistical or user-defined function blocks.

Plant and System Functions

CLP 500PAS solutions integrate plant SCADA, station historian, consoles, web-based or mobile user interfaces featuring 2D vector graphics, alarms management, reports and alerts and trending through the **HMI 500** platform. From context-menus to easy navigation, state-of-the-art operating principles deliver a concise view for operational purposes, system management and data analysis in a single user interface solution across the plant.
CLP 500PAS also provides conventional telecontrol options including digital, measurement, events and control processing, including control interlocking, hierarchical authority, and select-before-operate execution. Different clock synchronization options from GPS, NTP, IRIG-B or telecontrol protocol enable precise time stamping of data and events. Full self-diagnostics and troubleshooting tools, including system records and SNMP monitoring, are also included to enable simplified systems management.

Multiple Communication and Integration Options

Enhanced communications with real-time Ethernet are complemented with over 50 different serial or IP communication protocols including IEC 60870-5, DNP, OPC, Profibus and Modbus. This enables the integration of any controller, protection relay or measurement unit for both real-time monitoring and control, condition monitoring and diagnostics, as well as for non-real-time data extraction and storage such as sequence of events or disturbance records. Multiple serial or IP channels and redundant links with simultaneous multi-protocol support enable straightforward connection with any remote control center, energy trading system or generation dispatch center. Not only by adopting standard industrial communication protocols but also modern operating systems, databases and SOA adapters, **CLP 500PAS** also enables the integration of external systems and IT solutions such as plant optimization software, maintenance and asset management systems.

High-availability Configurations

Both **UC 500** and **DCU 500** controllers can be deployed in standard or high-availability configurations. The **UC 500H** and **DCU 500H** variants provide built-in redundant power supplies, CPU and communication boards as well as active redundancy management ensuring that no control steps are lost during failover.
The all-in-one high-availability hardware supports hot-swappable board replacement and also full duplication of Ethernet plant and field busses using state-of-the-art PRP parallel redundancy protocol, that ensure full system availability in the presence of network or device component failure or during maintenance.

Key CLP500PAS Components

HMI 500

Station SCADA

Plant SCADA software featuring full vector graphics, alarms, historian, trending, statistics and reporting including full-featured web-based HMI.

HMI 500 TOUCH

HMI Console

Local HMI consoles featuring multiple display options including touch-screens. Sharing the same user interface principles of the plant SCADA software, **HMI 500TOUCH** enables a uniform user experience across the entire plant.

UC 500

Unit Controllers and Servers

Unit or plant control PLCs and multi-protocol servers available in different hardware platforms from standard industrial PC to embedded units with high availability/redundancy options.

DCU 500 **DCU 500H**

Programmable controller and I/O unit

Field PLC and I/O unit featuring modular and flexible hardware configurations with up to 300 I/O points per unit. **DCU 500** provides field-replaceable I/O modules and optional redundant CPU and power supplies.

DCU 220

Programmable controller and I/O unit

Field PLC and I/O unit featuring modular and flexible hardware configurations with up to 208 I/O points per unit.

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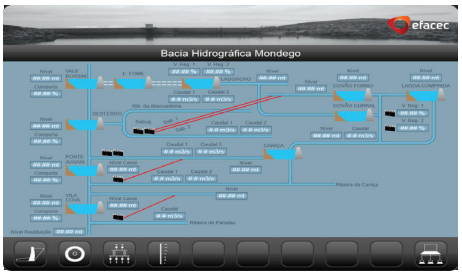
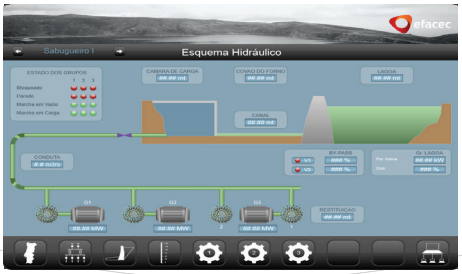
Integrated Engineering Tool

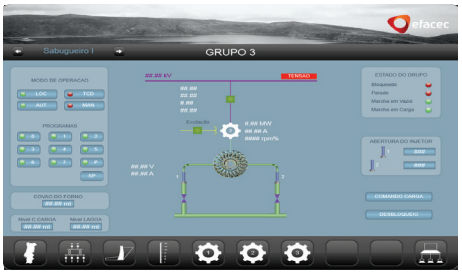
An "all-in-one" easy to use software that provides an open and productive life-cycle engineering environment for the whole distributed control system from programming and HMI design to configuration and management.





System Architectures

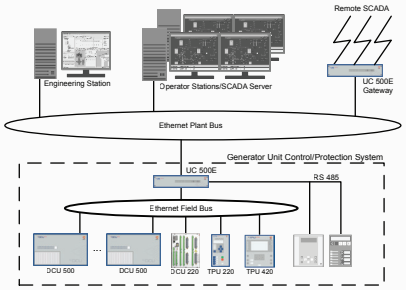
Supported by either IEC 61850 or IEC 60870-5-104 distributed buses, **CLP 500PAS** solutions can be deployed in different physical architectures. By featuring PLC programmability at field, unit and plant levels and by adding peer-to-peer communication capabilities (GOOSE or Efacec-own Distributed Database Protocol), **CLP 500PAS** allows unprecedented flexibility for adopting any control philosophy.



CLP 500PAS Architectures

Compact System

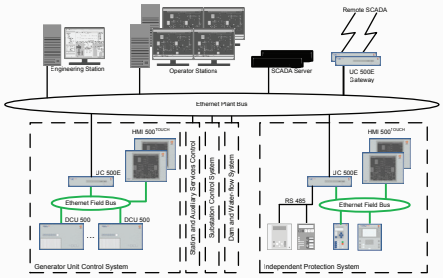
- SCADA workstation and engineering station
- Single gateway for multiple remote systems
- Integrated compact unit automation and protection systems



Multi-level DCS

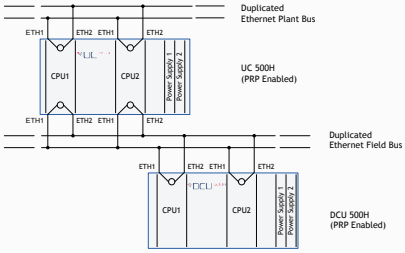
Local control room, Engineering Stations and Gateways for remote SCADA, teleregulation and energy trading system.

Plant Automation System featuring independent unit/field-level buses:
- generator unit control and protection system
- station services
- auxiliary services
- dam and intake system
- discharge system
- substation automation system



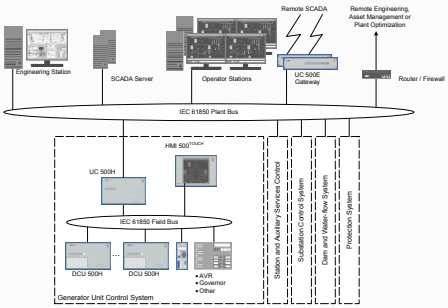
High-availability DCS Variant

Use of fully-redundant controllers and communication systems for maximum reliability and availability.



Ready for Full-IEC 61850 Systems

Efacec **CLP 500PAS** technology is future-ready and prepared for seamless integrated systems according to IEC 61850.



Unified Engineering Software

While providing high flexibility and scalability of a distributed system, configuration and management is performed in a single integrated tool so that engineering is not hindered by system architecture or application size.
Automation Studio provides point-based engineering but also template and object based tools for SCADA database, communications, HMI screens and IEC 61131-3 user-programming that, together with intuitive interface, provide a straightforward engineering experience. The toolset includes simulation, debug/monitoring and system management features to support the system from design to operation.
Automation Studio can also be deployed with advanced features such as and import/export tools, comparison tools and integrated configuration history server to effectively track configuration versions and changes.

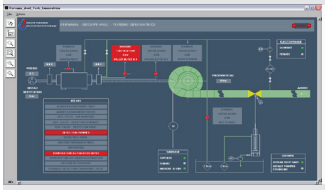
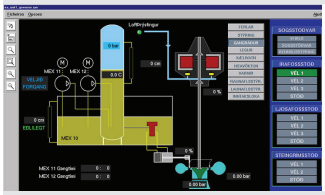
System Integration

Recognizing that hydropower automation is not an off-the-shelf product, Efacec solutions offer the flexibility to meet the demands of each individual system. This means not only adaptable technology but also engineering services. In addition to a product solution, Efacec also provides certified cabinets and enclosures such as the **CSC 5000** control system cabinet, including automation devices, communication equipment, electrification and power supply.
By combining proven plant engineering know-how with large experience in modern digital control systems and communications Efacec solutions allow users to benefit from a complete automation solution in full confidence, including integration of automation systems, electrical and mechanical equipment.

Engineering Services

Ranging from systems specification and design, through integration, commissioning and training, up to maintenance and product support, Efacec provides a full set of engineering services either through its own engineering teams or local partners.
Efacec services are delivered by engineering and customer support teams with highly experienced and certified professionals and project managers, which are custom-fitted to each customer and ensure system deployment on-spec, on-time and on-budget as well as readily available support during system operation.

Case Studies

Example	Overview
Alqueva II Power Plant Automation System; Portugal / EDP	
	EDP Produção awarded Efacec Automation with a contract for the supply of the DCS for a power reinforcement project of the Alqueva Hydro Power Plant, already in operation since 2004. The system comprises the complete solution for power plant automation and is based on the latest **CLP 500PAS** platform in a high-reliability configuration to manage the two new 130MW units.
Power Plant Automation Systems; Tunisia / STEG	
	Efacec Automation provided Tunisian company with automation systems of 2 mini-hydro power plants, Fernana (8 MW) and Nebeur (13 MW), in the scope of a renovation project. The solution provided for each mini-hydro power plant is based on the **CLP 500** platform.
Power Plant and Remote Control Systems; Iceland / Landsvirkjun	
	Efacec Automation provided Landsvirkjun with new power plant automation systems for 3 existing hydro power plants. Replacing existing systems with state-of-the-art **CLP 500** systems improved operation of the Icelandic hydro power plants. The Regional Dispatch was also upgraded with a new SCADA system implemented, the communication protocol with the National Dispatch is IEC 60870-5-104, the standard TCP/IP-based telecontrol protocol.
Power Plant Control System Renewal; Tanzania / TANESCO	
	Efacec Automation was awarded by Tanesco with a contract to remodel the control and supervision system of the New Pangani Falls hydro power plant based on the **CLP 500 PAS** solution. By deploying modern programmable controllers, enhanced server units and improved local SCADA system, the plant operator will benefit from an efficient and reliable plant.

Summary of CLP 500PAS Features

Plant Functions
Local SCADA system (web-enabled)
Plant real-time data and control processing
Plant alarms
Plant historian, trending and reporting
Automation Platform
Plant, unit and field-level PLC controllers
Distributed I/O and Automation
IEC 61131-3 user-programming
Optional built-in redundant CPUs, communication interfaces and power supplies for PLC controllers
Console-based HMIs
Hydropower Plant Automation Specific Control Library
Generator unit control, including fully-automatic, step-by-step or manual control modes (unit start/stop, quick stop, emergency shutdown, black start, pump/generator modes, etc.)
Tele-regulation control (active and reactive power control)
Integration of governors, excitation regulators and synchronization units
Monitoring and control of supporting systems (cooling systems, vibration monitors, air and oil systems, etc.)
Substation switchyard, transformer and generator protection integration
Station and auxiliary services control including diesel group control.
Security installations monitoring and control (pumping systems, flood detection systems, fire protection systems, intrusion detection systems)
Dam, intake gate and discharge monitoring and control
Water level control including limits, discharge gradient flow and flood alerts
Production scheduling through pre-defined programs
Communication and Integration
IEC 618150 and GOOSE Ethernet Bus or IEC 60870-5-104 and DDP Ethernet Bus in several configurations including RSTP-protected rings
Fully-redundant PRP-enabled Ethernet bus for high-availability configurations
Remote control/dispatching center protocols (multiple protocols available including but not limited to IEC, DNP, OPC and Modbus)
Local device integration protocols (over 50 protocols available including but not limited to IEC, DNP, OPC and Modbus)
SQL, SOA or other adapters for systems integration
System Architectures
Compact control system for small hydro
Multi-level distributed control system
High-availability distributed control system
Full IEC 61850 architecture
Customer-specific architectures
Engineering
Single engineering software for configuration, programming, debugging and management

View the product on our website.

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