

HyCon™ Control System



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A Voith and Siemens Company

VOITH
 Engineered Reliability

Voith Hydro is one of the global leaders in hydropower plant equipment and services for both new and modernization projects.

Our reputation for excellence in products and services is based on reliability, trust and commitment in long-lasting, partnering relationships with owners and operators around the world.

This applies to overall plant engineering as well as to single component and system design in electrical and hydraulic machines, including the entire range of hydropower plant control concepts and systems. We offer hydro automation

from a single source to ensure complete service and to ensure seamless availability for your hydropower plant and all of its components and systems.

Our automation solutions are based on a variety of subsystems that ensure a safe, reliable and cost-effective operation through our long-term process know-how and control system expertise in hydropower applications.

From these systems, the control system is the central interface between the operator and the hydropower generation process. Our HyCon Control Systems offer perfect solutions for safe and reliable hydropower control.

At a glance

The HyCon Control System family is tailor-made to meet the specific requirements of each hydropower plant. It thus provides second to none reliability, functionality and safety.

Proven technology meets highest quality and reliability standards

Voith offers its portfolio of automation solutions under the name HyCon.

The HyCon Control System family is based on the Siemens SIMATIC world which represents the worldwide most accepted, widely-spread and well established industrial standard characterized by:

- Highest quality and reliability
- Worldwide availability of spare parts and support
- Approved technology applied in a wide range of industries with highly demanding requirements

To reach the goal to deliver a hydro specific solution fulfilling all demands of the control and supervision of a hydropower plant Voith developed specific Hydro library solutions that are in line with market and customer necessities.

Seamless Integration

Today integration and smart handling of assets is becoming more and more important. Integration of all digital and mechanical systems within the hydropower plant into one control philosophy is a must. Within the HyCon family all subsystems are fully integrated into the control system. This includes not only turbine governor and voltage controller, but also electrical and mechanical protection. This is an invaluable advantage for our customers with regard to maintenance and spare part management.

HyCon is an uniform solution with seamless integration of all systems.

Tailor-made Solutions

The HyCon object library with functions tailored to the hydro process deliver plenty of advantages including:

- Flexibility for project specific modifications
- Slim and modern design
- Voith Hydro ownership
- Direct support up to third level

Voith guarantees and ensures an outstandingly high and constant quality level for all projects due to our centralized intensive system- and integration tests for all supported configurations.

The HyCon Control System family is divided in two main releases fitting to different requirements in hydropower automation.

HyCon 300 Control System Family

The Voith Hydro HyCon 300 control system solutions are offering complete and comprehensive SCADA functionality for hydropower plants environment and are intended for use in Small-Medium hydropower plants.

Our HyCon 300 solutions are running on HyCon Controllers based on Siemens high industrial quality devices and WinCC HMI components. Third party SCADA systems can also be implemented via IEC communication protocols.

The main advantage of HyCon 300 is its effective working environment. Therefore we have defined an engineering tool and pre-configured templates to guarantee high efficiency and speed of project implementation. The function scope is adapted to fulfill the requirements of the Small-Medium hydropower plant environment.

The HyCon 300 solutions are using our hydro specific library of objects and therefore are fitting perfectly to hydro applications.

HyCon 400 Control System Family

The Voith Hydro HyCon 400 control system solutions are offering complete and comprehensive SCADA functionality for all power plant environments.

Our HyCon 400 solutions are based on the Siemens industrial S7-400 and WinCC products as well as PCS7 standards.

The main advantage of HyCon 400 is the full flexibility we guarantee in the engineering tool, and HyCon 400 is prepared to fulfill all requirements of hydropower controls.

The HyCon 400 solutions are also using our hydro specific library of objects and therefore are fitting perfectly to hydro applications.

Our solutions are scalable over a wide range of applications, from single station to distributed systems with different levels of redundancy.

HyCon Control System, the intelligent choice.

Investment protection

Voith wants to ensure the maximum benefit from your HyCon Control System installation. As there is a discrepancy between the life cycle of the power unit and the control system and an even more significant discrepancy between the lifetime of the PLC and the operator stations respectively the servers of the control system, Voith is investing into clear strategies to protect your investments. To handle these discrepancies in a technically feasible and economically intelligent way we offer a clear migration and upgrade strategy to keep your control system efficiently up-to-date. This helps you to protect your investments.

To support this strategy Voith is offering a wide range of services tailored for HyCon Control Systems like:

- Spare parts handling and supply
- Modification of system functionality
- Telephone hotline support
- Service contracts
- Remote diagnosis support
- Regular maintenance of the equipment on site: e.g.
 - Back-ups, check of all alarms, etc.
 - Start-up support after unit overhaul

Reliable operation

The proven operation philosophy applied in HyCon systems has been successfully implemented in hydropower plants of all types and sizes all over the world. A cornerstone of this concept is the fully object-oriented hydro block library using state-of-the-art faceplate technology for the operator station's displays.

This technology and other features, like the sophisticated sequence representation with special monitoring functions, make sure that the operator always has the overview on the status of the process even in difficult situations requiring special attention. Another feature to make the process transparent to the operator is the advanced fault tracking capabilities via picture tree and loop-in alarm.

Intensive factory testing in our automation center



HyCon Control System, the better choice.

Built-in Plant Safety

The control system provides reliable operation and is a key factor for plant safety. Our hydro block library is designed to meet the high level of safety standards embedded in all Voith hydro products to guarantee an optimum of safety for the user, the capital equipment, and the environment.

The mechanical protection is implemented in PLC (Programmable Logic Controller) technology. A sophisticated trip matrix concept allows high flexibility to define finely graduated responses to any abnormal events in mechanical subsystems.

IT Security

For all components of HyCon Control Systems measures are taken to safeguard protection from cyber attacks and system hardening. This includes that all functions not necessarily required for the operation of the system are deactivated or deleted (e.g. USB ports). Functions accessible over the network are reduced to a minimum and are individually adapted to the project specific needs. Thus the relevant international standards (like DIN ISO/IEC 27002; DIN 27009, IEC 62351, NERC CIP-007-4) are met by our HyCon Control System family.

The HyCon Control System family features

- IT security included, for example firewall and virus scanner
- Flexible remote access solutions
- Web interface
- Messaging system support, for example pager and SMS
- Control room equipment
- Hierarchically structured access control
- Parameter access and change without engineering tool
- Ergonomic screen design based on international standards like IEC 60073 and others
- Multiple language support (online switchable)
- Hard and software diagnosis in the PLC controller
- Powerful trend and archiving system
- Central engineering tool with one central database
- Historian functionality
- Multi screen
- Multi server
- Multi clients

HyCon Control Systems

Selected Highlights

Sequences – Plant Operation

The sequences build the brain of the control process of the hydropower plant operation. With the help of the sequences the power units are started, stopped and operated. Here not only the technological know-how of Voith to operate hydropower units is required but also the best-in-class programming to ensure safe and reliable operation in all operating modes.

- The documentation and definition of the sequences is done in one step, this avoids mismatches
- The definition of the sequences is done graphically
- There is an enhanced display of the transitions according to the parameterization
- Signal information within the sequences is shown as plain text and signal status
- In case of a failure the signal states are stored for later on diagnostics

Event Matrix

- Any signal can be integrated in the event matrix
- Up to 32 responses can be defined (freely configurable without programming)
- In case of an event the causing signal and the response is highlighted
- The causing signal is stored and must be reset manually

Independent local Operation

State-of-the-art control systems ensure high reliability of the central control system level especially if the servers are provided as a redundant solution. However, the capability for local operation, for example at the unit control cabinet, which is completely independent of the central server, is a real added value in each hydropower plant, for example for commissioning, re-commissioning after maintenance work and in emergency cases. All HyCon Control Systems provide independent local operation using operation panels or panel PCs.

Open Communication

Open communication standards are an absolute must for a modern power plant control system. HyCon supports a wide range of open interfaces including IEC 60870-5-101/103/104 and IEC 61850. The Profibus DP is the preferred solution to communicate to decentralized I/Os, and is the most widely used field bus system with more than 28 million installations worldwide.

Voith is delivering highest quality. This includes certification for open communication standards to allow you a seamless integration of our solutions into your existing environment. The IEC protocol implementations provided by Voith have been certified by KEMA/ TÜV Sued.

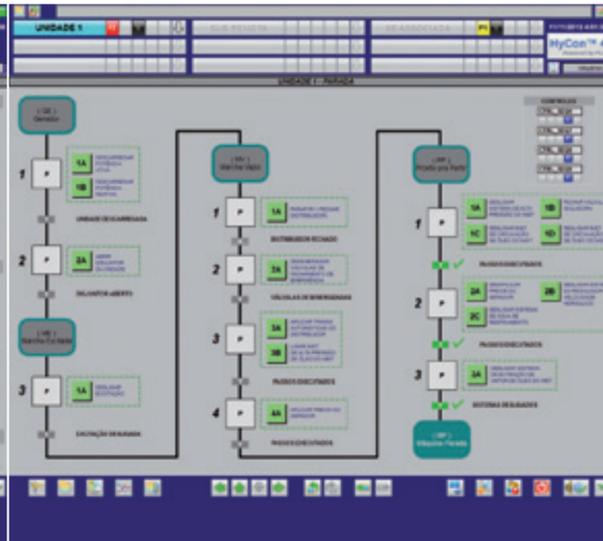
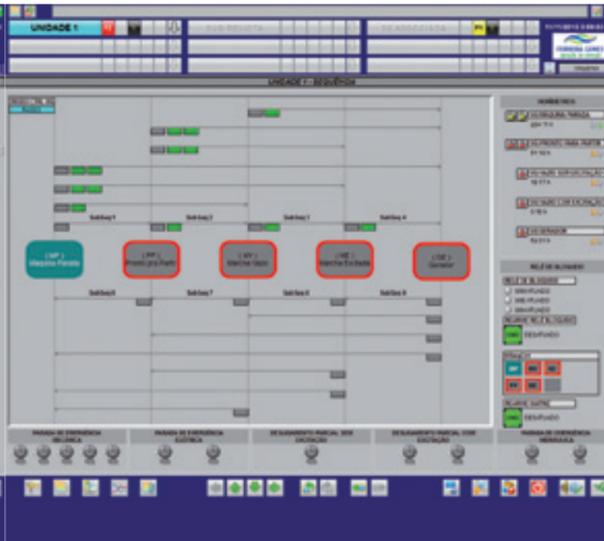
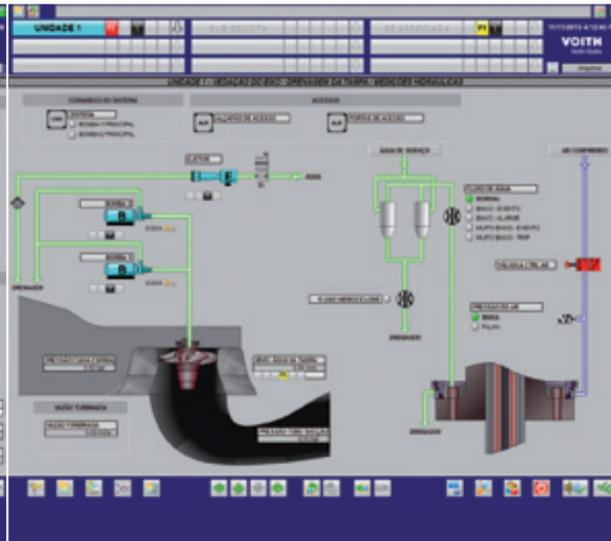
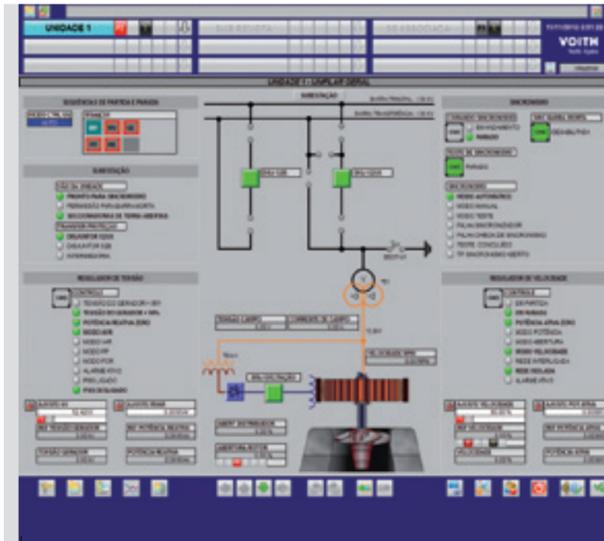
Overview Screen for electrical unit presentation

Auxiliary Turbine Systems

Sequence Overview

Typical Single Sequence

Local Operation



Built-in Flexibility

Even though HyCon automation products are designed to provide an integrated overall automation system, all components may be used as stand-alone systems as well. HyCon Control Systems have been delivered for all types of hydraulic machines and generators. Due to the flexible concepts and the process expertise of Voith, the systems can be used for new plants as well as for modernization projects. HyCon Control Systems can be perfectly matched for any existing power plant in the world. It is our mission to have a solution for any challenge in hydropower automation. Several add-on functionalities can easily be integrated into our control system helping you to optimize the plant output.

Joint Control

The HyCon JC – Joint Control is an integral part of the HyCon Control System library. It allows you to distribute the active and reactive power to all units within the power plant. The calculation of the optimal unit configuration is based on efficiency curves stored and processed in the PLC. This allows easy and safe operation of the complete plant. There are several additional features included like definition of a spinning reserve as a constraint.

In mixed mode not all units must be assigned to the Joint Control (however units in manual mode are considered in total power balancing).

HyCon Plant Optimization

An intelligent add-on extension of the HyCon Joint Control is our HyCon PO – Plant Optimization module which is offering a highly sophisticated method for optimizing and increasing the plant efficiency. The HyCon PO optimizes the load distribution between several units in a plant or even in a multi-plant model in that way, that the efficiency is at its maximum.

HyCon Water Management Control

Another valuable extension of the HyCon Control System family is the HyCon WMC – Water Management Control, an intelligent river control module.

Operation

The Voith control system family is always pursuing one goal: We want to provide a comprehensive operation functionality for reliable control of the hydropower plant process.

We reach this goal by providing an intuitive and flexible navigation for fast information access, e.g. you can jump from group alarm display straight to graphical representation and therefore have all information available on one click.

Intelligent Alarm Management

An intelligent alarm management helps to keep cool when there are unforeseen events. Our intelligent alarm management delivers the right alarms to the right person at the right time. We can ensure this by several options:

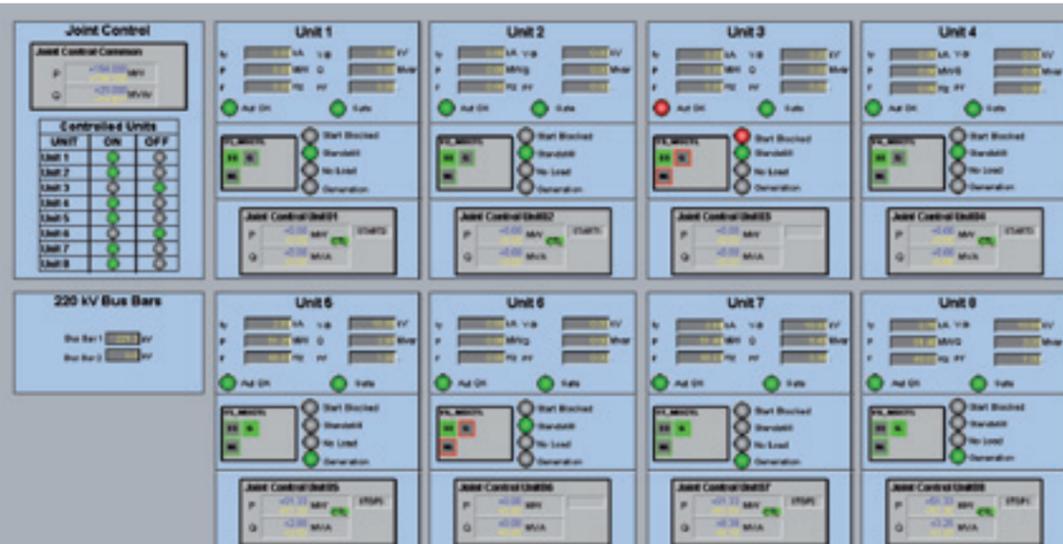
Intelligent Limiting of Active Alarms

- Removes “non-relevant” alarms
- Filters “nuisance” alarms
- Suppresses alarms without defined “operator reaction”

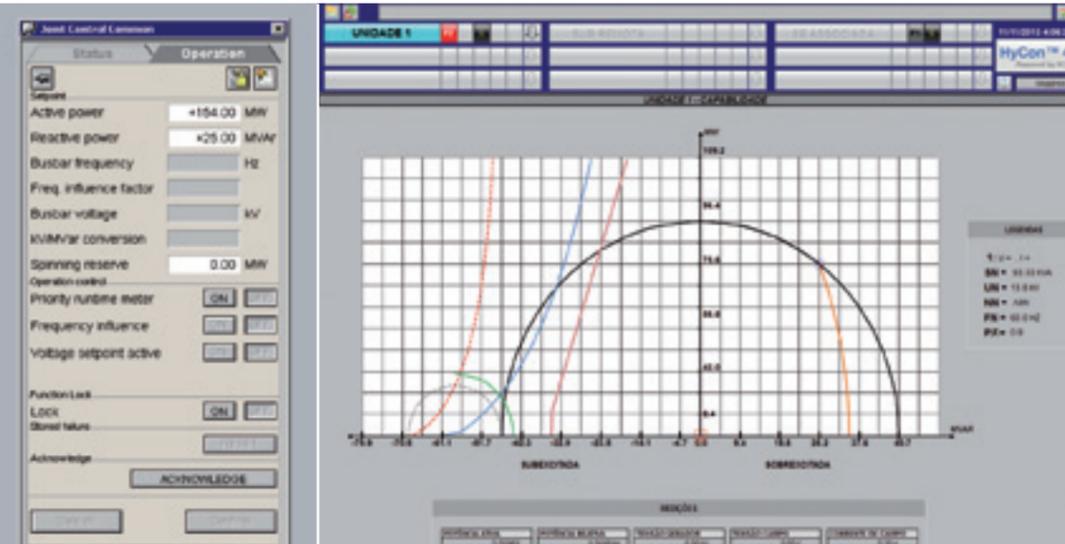
Alarm Prioritization

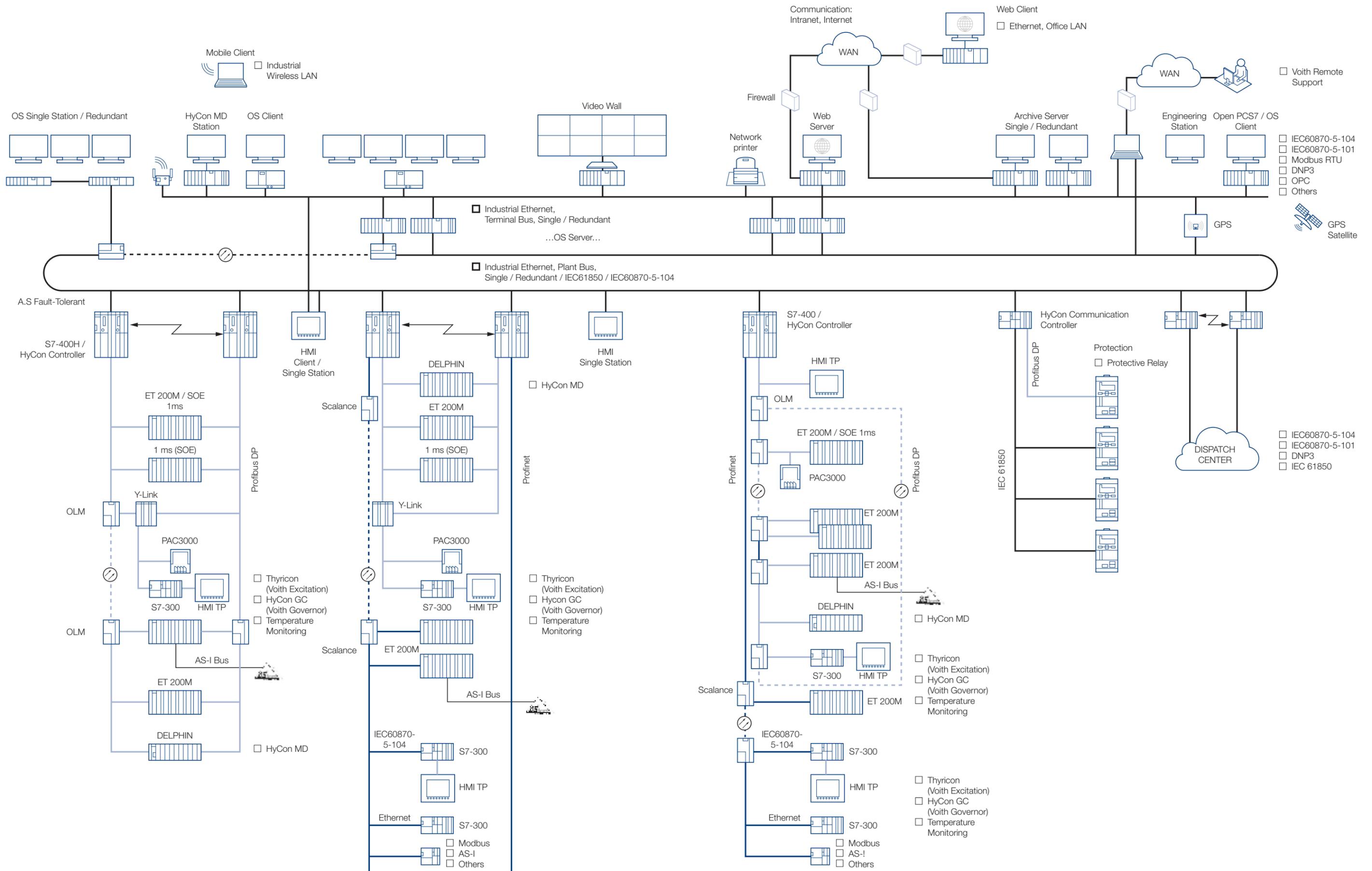
- Important alarms are always shown in the alarm line first
- A warning of the generator is more important than an alarm from another plant item

Plant Overview including Joint Control Status



Generator Capability Chart





HyCon 400

High-end solution to satisfy all your needs.

HyCon 400 is designed to fulfill ambitious requirements such as the automation of pumped storage plants with very challenging demands regarding safety, reliability and stabilization of the grid. These are features which are especially crucial for power plants contributing to the primary control of the grid.

The HyCon 400 control system is designed to cover a considerable range of requirements. For this purpose, HyCon 400 is extremely scalable and – due to the modular design – the system can grow with the demands. Starting from a cost-effective all-in-one concept up to distributed architectures and redundancy in all levels of the system, HyCon 400 is prepared to meet all your requirements.

Furthermore, a broad spectrum of standard interfaces allows the integration of existing components into the control system – this is especially valuable for modernization projects.

Major features in detail

- Based on Siemens SIMATIC PCS7
- Scalable redundancy (hot stand-by) for PLCs, network, server
- Distributed server configurations for multi-unit plants, very complex auxiliaries and others
- Transparent user guidance and intuitive operation using faceplate technology
- Ergonomically designed process screens which help to focus the user attention to what is most relevant
- Local operation completely independent of the central server using the same screens and faceplates like in the central control room. Local server functionality provided if central server or communication fails
- Powerful and highly flexible representation of step sequences (optionally branched) including special monitoring functions for failure analysis. This concept is designed in particular to handle complex transitions for pump-turbines

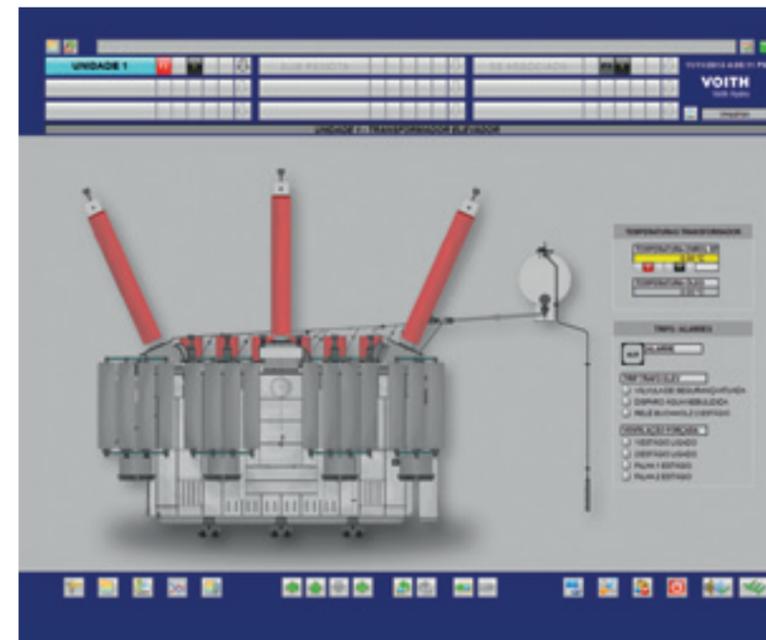
Selected features

- Scalable archiving system with separate archive server as an option
- Flexible reporting tool based on MS Excel®
- Central time synchronization server (GPS, Siemens optimized NTP synchronization)
- Alarm and messaging system supporting efficient disturbance analysis and fault tracking
- SOE for all messages like alarms and events
- Clear and transparent concepts for administration of user rights, interlocking of control locations and integrated alarm acknowledgement that is effective system wide

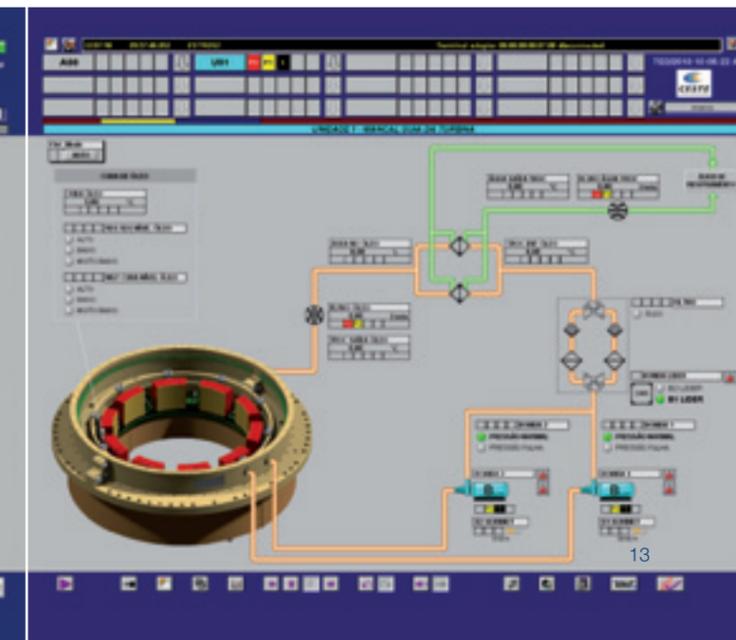
Redundancy Concepts

To increase the availability of the control system several redundancy concepts are available within the HyCon 400 control system family, such as PLC redundancy, OS redundancy and network redundancy.

Transformer Screen



Turbine Guide Bearing



HyCon 300

A complete system in compact design combining leading-edge technology with economic efficiency.

Our HyCon 300 control system not only sets new standards in terms of functionality, quality and reliability, but stands for an outstanding value for money. It can be seamlessly incorporated as a standard component in new plants and modernization projects alike. The basis is a preconfigured system which is basically running right out of the box.

HyCon 300 is a pre-tested system which guarantees highest quality.

Economic efficiency is assured by innovative, standardized concepts, which enable us to offer you an outstanding high-quality and efficient product due to the use of durable, reliable components, complying with exacting industrial standards. Advanced software engineering, systematic standardization and application of modular principles, as well as the specific focus on the requirements of hydroelectric power stations afford an excellent price performance ratio.

This simple, reliable and robust tool offers the following additional advantages

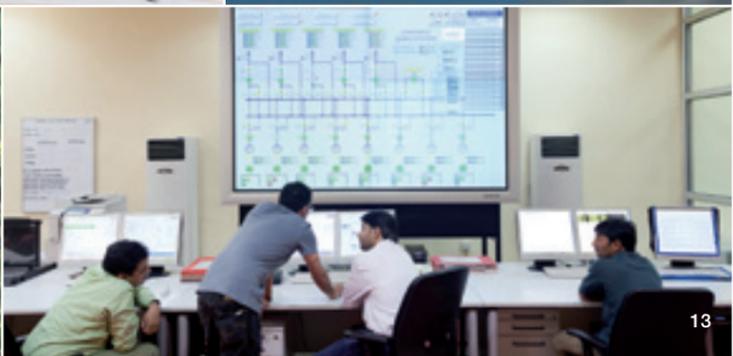
- Short delivery times
- Clearly defined scope of delivery
- Full pre-testing of the system before shipping
- Rapid commissioning
- High availability
- Flawless operation
- Easy maintenance

Integration into all automation strategies

- Various process busses are supported (Profibus, Ethernet, IEC, etc.)
- Non-proprietary communication standards:
 - PROFIBUS DP, PROFINET
 - IEC 60870-5-104
 - IEC 61850
 - OPC UA
- Communication to third party PLC's via HyCon communication standards

Typical all-in-on automation solution





- 1 La Muela II
- 2 Frades II
- 3 Cannelton
- 4 Ohio River
- 5 Willow Island
- 6 Rheinfelden
- 7 Herdecke
- 8 Foyers
- 9 Aimores
- 10 Peixe Angical
- 11 Estreito
- 12 Baglihar
- 13 Omkareshwar

Asia

- 2001** Baglihar, India:
HyCon 400
6 Francis units (6 x 168 MW)
- 2002** Tai An, China:
HyCon 400
4 Pump turbine units (4 x 250 MW)
- 2003** Cameron Highlands, Malaysia:
HyCon 400
for several plants
- 2003** Omkareshwar, India:
HyCon 400
8 Francis units (8 x 65 MW)
- 2009** Sarobi, Afganistan:
HyCon 300
2 Francis units (2 x 12.5 MW)

Africa

- 2005** Gilgel Gibe II, Ethiopia:
HyCon 400
4 Pelton units (4 x 125 MW)
 - 2008** Ingula, South Africa:
HyCon 400
4 Pump turbine units (4 x 342 MW)
 - 2012** Kakobola, DR Congo:
HyCon 300
3 Francis units (3 x 3.5 MW)
- Europe**
- 2002** Enguri, Georgia:
HyCon 300
3 Francis units (3 x 250 MW)
 - 2004** Foyers, United Kingdom:
HyCon 400
2 Pump turbine units (2 x 150 MW)

- 2006** Herdecke, Germany:
HyCon 400
1 Pump turbine unit (1 x 150 MW)
- 2007** La Muela II, Spain:
HyCon 400
4 Pump turbine (4 x 213 MW)
- 2008** Rheinfelden, Germany:
HyCon 400
4 Bulb turbine units (4 x 25 MW)
- 2010** Frades II, Portugal:
HyCon 400
2 VarSpeed Pump turbine units
(2 x 380 MW)

- 2010** Säckinggen, Germany:
HyCon 300
4 Kaplan units (4 x 18 MW)

South America

- 2002** Peixe Angical, Brazil:
HyCon 400
3 Kaplan units (3 x 169 MW)
- 2007** Estreito, Brazil:
HyCon 400
8 Kaplan units (8 x 138 MW)
- 2008** Amoya, Columbia:
HyCon 300
2 Pelton units (2 x 40 MW)
- 2009** Palo Viejo, Guatemala:
HyCon 400
2 Francis units (2 x 43 MW)
- 2010** Cubujuqui, Brazil:
HyCon 300
2 Francis units (2 x 11 MW)

- 2010** Indaia Grande, Brazil:
HyCon 300
3 Kaplan units (3 x 7 MW)

- 2010** Queixada, Brazil:
HyCon 300
4 Francis units (4 x 7.5 MW)
- 2011** Belo Monte, Brazil:
HyCon 400
18 Francis units (18 x 611 MW)
- 2011** Indaiazinho, Brazil:
HyCon 300
2 Kaplan units (2 x 6.5 MW)
- 2011** Teles Pires, Brazil:
HyCon 400
5 Francis units (5 x 370 MW)
- 2012** Alfalfal II (Alto Maipo), Chile:
HyCon 400
2 Pelton units (2 x 135.6 MW)

- 2012** Las Lajas (Alto Maipo), Chile:
HyCon 400
2 Pelton units (2 x 135.2 MW)

North America / Canada

- 2002** Conowingo, Maryland:
HyCon PCS7
11 Francis units (11 x 50 MW)
- 2008** Cannelton, Kentucky:
HyCon 400
3 Kaplan bulb units (3 x 29 MW)
- 2008** Smithland, Kentucky:
HyCon 400
3 Kaplan bulb units (3 x 25 MW)
- 2008** Willow Island, West Virginia:
HyCon 400
2 Kaplan bulb units (2 x 21 MW)
- 2013** Churchill Falls, Canada
11 Francis units (11 x 494 MW)