SMARTCONTROL SX

HYDRO CONTROL SYSTEM

POWER

we are shaping the future

ALSTOM

OPEN, INTELLIGENT AND COST-EFFECTIVE SOLUTION

The ability to offer the broadest range of power generating equipment and systems enables Alstom to provide customers with complete solutions.

These solutions include turbines and generators that produce electricity to control systems that make a power plant run reliably and efficiently.

SMARTCONTROL SX is designed for power control applications in hydropower plants. It deals with the requirements of all aspects of power production such as open and intelligent system solutions for hydropower control, as well as integrated hardware and software solutions for remote control and dispatching of grids for all types of plant operation. It can implement standard off-the-shelf products and integrates both DCS (Distributed Control System) functions and plant management functions for operation and maintenance optimisation.

A complete control solution

To meet objectives and to ensure the optimised control of the power plant, Alstom's system is based on two main levels:

- The SCADA (Supervisory control and Data Acquisition) level for supervisory control
- The Control level for the process automation.

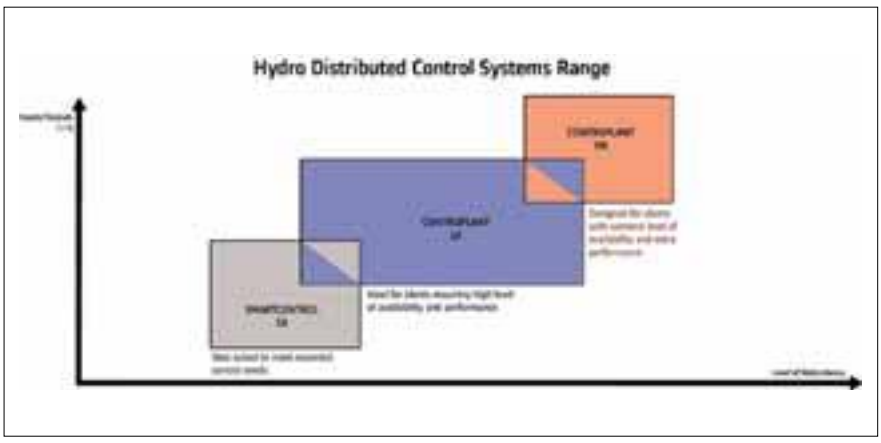
Both have been specially built for demanding real-time industrial environments for operation in a full-distributed configuration.

An Ethernet Local Area Network (LAN) 100 Mbps/s with industrial switches is used for the interconnection between both levels. This network also enables data exchange between controllers. The Modbus standard communication is used to link the PLC (Programmable Logic Controller) equipment with local field equipment and devices, such as the automatic voltage regulator (AVR), the speed governor and the measuring device.

The system is highly flexible so it can be used in all types of hydropower plants, be it new or retrofit, full plant automation, plant management and remote monitoring or machine control including speed governor and automatic voltage regulator.

Some of the features and benefits for the plant owner and operator include:

- A fully open and distributed architecture
- Safe technology with a safety ensured design
- More efficient operation and maintenance
- Application simulation before delivery
- Several operating languages available
- Process computation without additional platforms
- Additional options



Global leader

With more than 25 per cent of the world's installed power generation base, Alstom is a global leader in power generation, setting the benchmark for innovative technologies that provide clean and efficient power solutions for its customers.

Alstom designs, manufactures, supplies, installs and services the broadest range of systems for power generation and industrial markets, with a portfolio of products that extends across the entire energy value chain for all fuel types, from fossil, biomass to nuclear and renewables.

Alstom can supply these products as single components or as complete turnkey power plants, which, through its Plant Integrator™ approach and smart grid solutions, are optimised to deliver maximum value for the customer throughout the lifetime of the plant.

Alstom's specialists have developed extensive experience in engineering, procuring and constructing new plants as well as retrofitting, servicing and modernising existing power plants.

Operating in more than 70 countries, Alstom is always close to the customer to ensure rapid response with the right level of service excellence.

Key Benefits

Latest product designed by the world leader in hydropower generation
SMARTCONTROL SX integrates the latest technologies with a new HMI (Human-Machine-Interface), new automation cells with compact and higher performance PLCs and fully open and distributed technology.

Main Features
include process computation without additional platform, remote I/O capability, 1ms time tagging, user friendly touch screen for local HMI, large number of selectable operating languages, reporting, alarm management by SMS or email, etc...

Open
All networks are Ethernet-based. Our architecture supports a large set of international protocols and provides gateways to connect third party equipment.

Scalable
Our control system is applicable to a variety of customer projects for small to medium, new or retrofit plants, in simplex configuration.

Easy & Low maintenance approach
Includes compact flash memory card for PLCs, fan free PLCs, I/O slice system, push'in principle (tool free wiring), part coding, hot pluggable electronics and separate "Terminal–Electronic–Bus" design allowing pre-writing and fast repair.

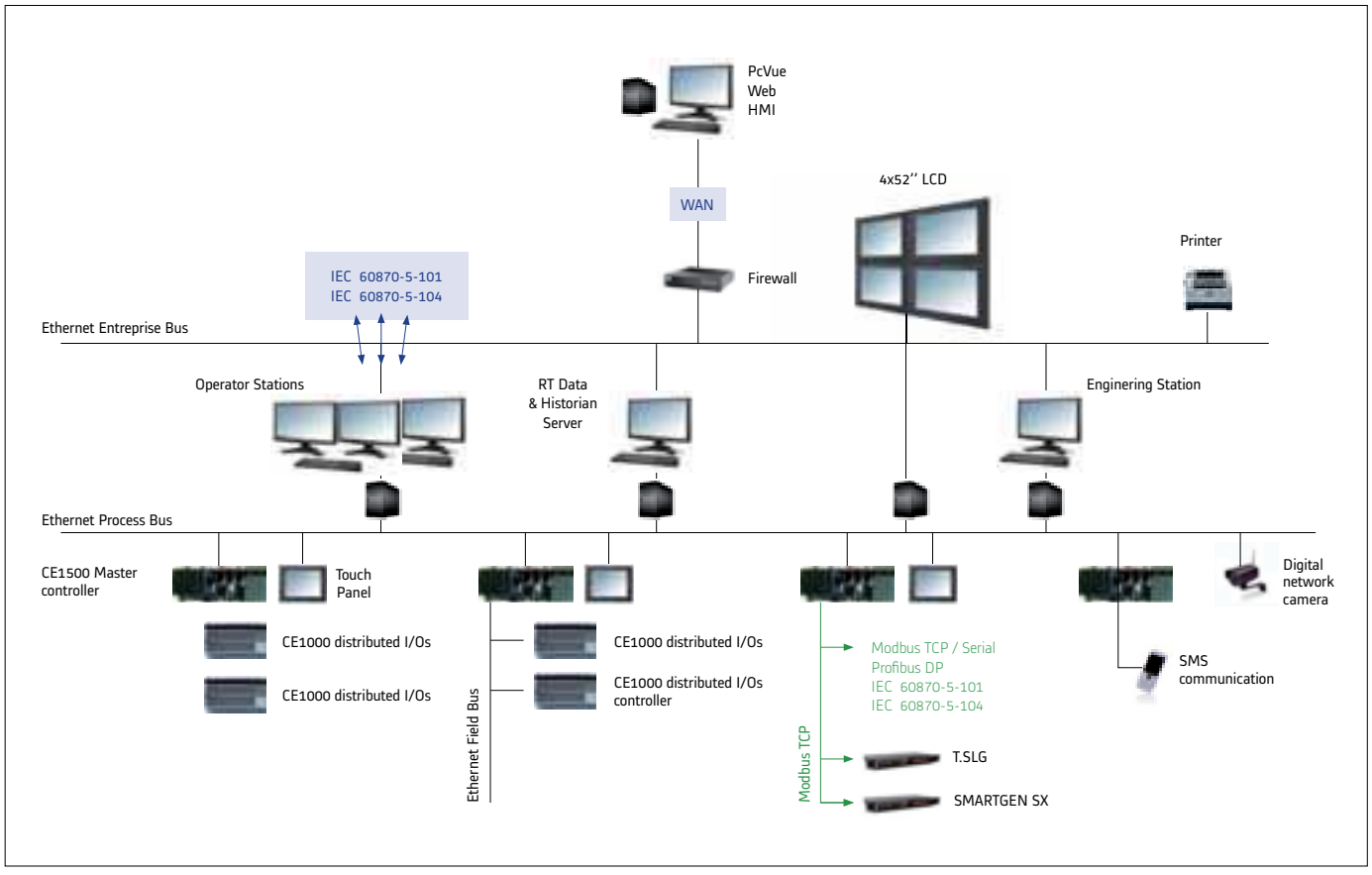
Long term support
We customise our maintenance contracts to best meet our customers' operational needs. Basic and advanced courses are available at Alstom's regional training centres. Alstom's Hydro PlantLife™ programme proposes a large set of services for plant owners to help them manage, protect and maximise their investment during the lifetime of their equipment.

HYDRO CONTROL SYSTEM
THE CONCEPT

The integrated control system for hydropower plants is organised around high-performance automation cells that carry out all the controlling, regulating and operating functions. In principle, one automation cell controls one hydro turbine/generator unit.

The required configuration is of modular type, from a single unit configuration in a stand-alone panel to a more complex configuration for power stations with more than one unit. In the case of multi-unit power plants, it may also be necessary to propose a control panel dedicated to the management of the common facilities and/or centralised supervision station from which all the units and facilities can be controlled.

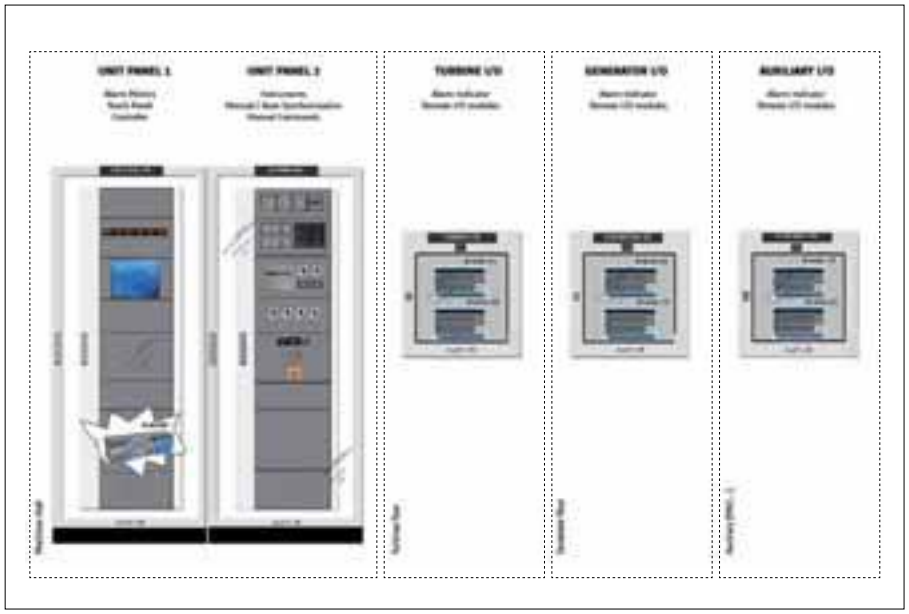
It is even possible to control the units off site from a dispatching centre. In this case, the link for this remote control is installed at the highest control point of the system, i.e. the local HMI in a standalone configuration or the remote supervision station.



All hydropower plants, regardless of the size of their generating unit, require the installation of:

- A generator excitation and automatic voltage regulation system
- A turbine automatic speed regulation system
- An automatic synchronising system
- An automatic system for start/stop sequences and logic control
- An alarm system
- Generator electrical protection system

In most cases, implementing an automatic control system is enough, as it integrates the previously mentioned functions in one single system. The software is adapted to the actual conditions on site and is configured accordingly. The need for remote control and for transmitting selected data to remote supervision and control systems, by means of cellular phones or e-mail, is becoming increasingly important.



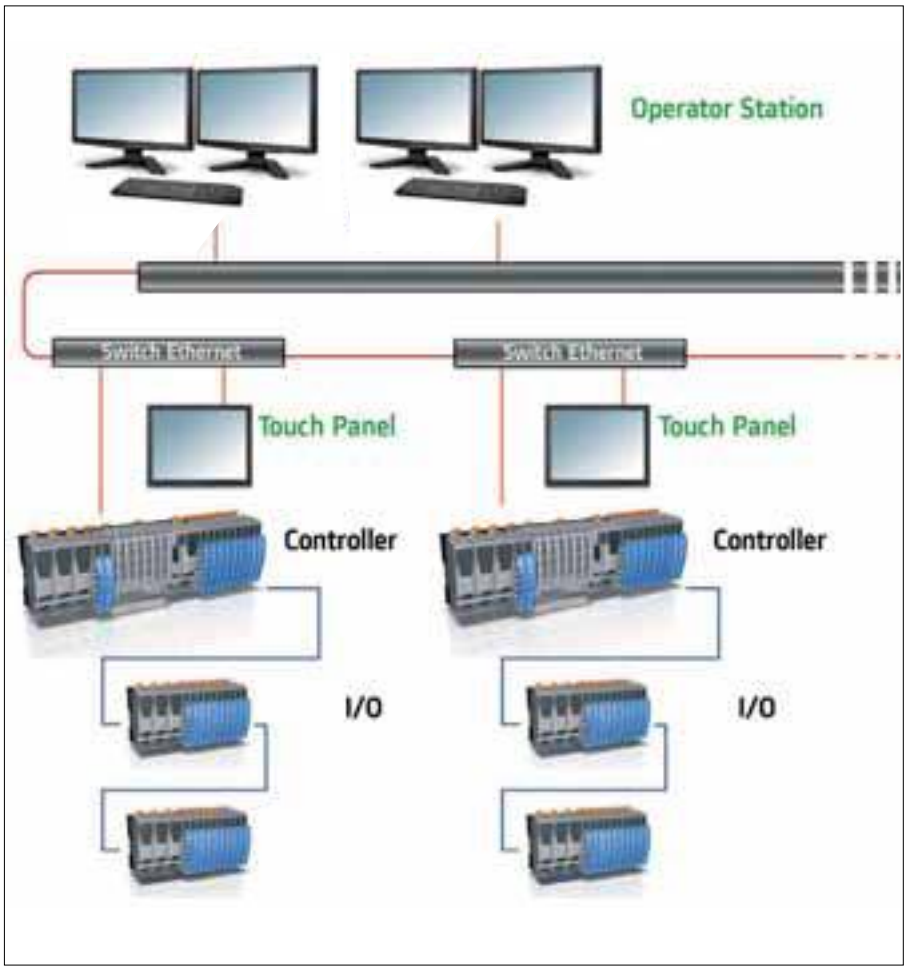
Main functions

- Plant supervision and control HMI definition
- Plant network and interface with others (Dispatching, remote connection for maintenance control and supervision...)
- Process interface: output definition, including remote configuration
- Hydro control (group, auxiliary, switchyard): program using SFC (Sequential Function Chart) programming language
- Hydro process function: program using C language
- Interface with the generator excitation system (based on Modbus protocol)
- Interface with the turbine speed governor (based on Modbus protocol)
- Interface with synchronising system
- Interface with electrical protection systems: link connection to dedicated electrical protection equipment (Modbus communication protocol)
- Communication openness: Modbus (serial and TCP/IP), Profibus DP, Ethernet, IEC60870-5-101, IEC60870-5-104

A NEW **AUTOMATION STANDARD**

Developed based on experience gained from applications all over the world, the SMARTCONTROL SX system is the new control command solution for hydro-power plants.

With well thought-out details and a sophisticated ergonomic design, it is more than just a remote I/O system, it is a complete control solution, making it possible to combine the exact components necessary, adapted to each project's requirements.

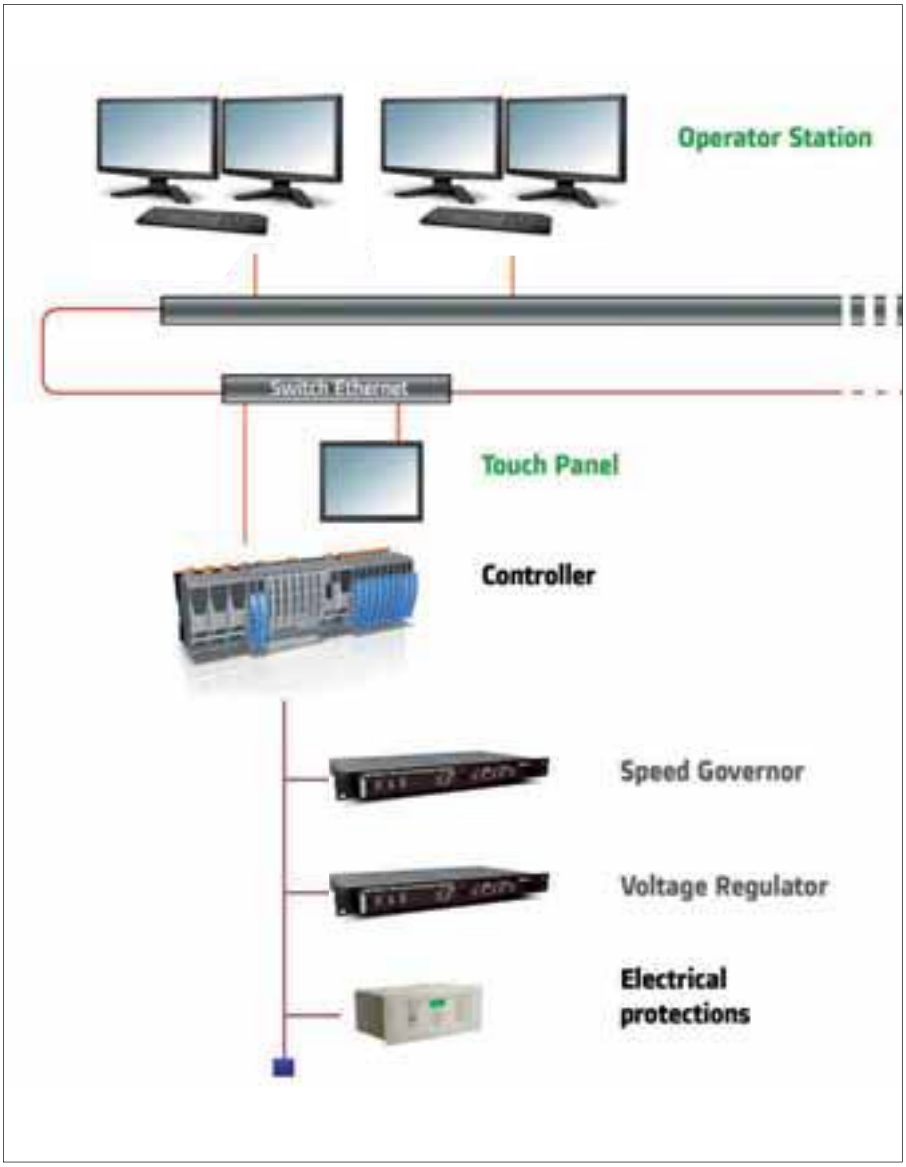


It features a I/O slice system for the highest granularity, offering a minimal number of channels per module for most economic solutions.
The extremely compact and ergonomic design with a twelve pin terminal block allows for highest component density requiring minimal space. All terminal functions are clearly assigned using a tool free wiring Push-In' principle with connected cross sections up to 2.5 mm² for solid wires and up to 10A, 230 VAC. Plus, coding is supplied as factory coding prevents dangerous mix-ups.

Easy to use

Terminal, electronic and Bus are separated for higher flexibility.
Each bus module is an activate bus station, even without the electronic module. Pre-wiring of terminal strips, hot pluggable electronics and free bus slots for more options ensure highest flexibility.Different potential groups can be implemented with the appropriate arrangement of supply bus modules.
It is possible to decentralize the backplane, with distribution of I/O line sections anywhere within 100 meters.

The CPU uses an Intel Celeron 400 MHz processor, Ethernet TCP/IP Modbus or Ethernet Powerlink (EPL) and two integrated memory stick connections. Its interface can be expanded with communication modules (serial or Ethernet links). It is fan free and extremely compact.



Local HMI

The local HMI is used for the local SCADA dedicated to each controller supervision. 15" XGA colour TFT display with touch screen (resistant)

Speed Governor

The governor is the brain of the hydraulic turbine. It has to manage quick start-up and fast coupling as well as stable control of speed in order to ensure both high quality of the electrical network and to manage an isolated grid, while at the same time ensure accurate power control to avoid instability.

The NEYRPIC® T.SLG governor controls a large range of electric-oil components, including well-known Alstom actuators. Designed for a wide range of pressure levels, from 15 to 160 bars it accepts low filtration levels between 40 to 70 microns over a very long lifetime (over 25 years).

It is designed to control the full range of hydraulic turbines, combining multi-processor structure, high resolution tachometer, a colour graphic HMI, oil power pack and pressure tank control and multi-positioning device structure.

The NEYRPIC® T.SLG is connected to the main unit controller through the Modbus TCP network.

Automatic Voltage Regulator (AVR)

Alstom offers a full range of automatic voltage regulators. For small plants that need a simple and economical excitation controller, SMARTGEN is the perfect fit. It is fully compatible with SMARTCONTOL and shares common parts with the NEYRPIC T.SLG speed governor making the complete control solution extremely robust and cost-effective.

SMARTGEN is designed to work with brushless excitation system. It can deliver up to 20Adc of output current to the exciter. For medium and large plants, Alstom has the CONTROGEN solution.

SMARTGEN comprises two modules only that are very easy to install: the processing controller using the same technology as the T.SLG and the excitation power controller to generate and control the exciter field current.

Its highly compact design facilitates the optimum cubicle arrangement and its simple configuration, improves serviceability to keep maintenance time to a minimum.

SMARTGEN runs automatic self-tests and has advanced diagnostic functions for high reliability.

The configuration and maintenance software tool is common with the T.SLG. The user-friendly HMI has indeed the same look and feel, whereby the operator can simply select which equipment to visualise.

Electrical protections

All hydropower plants should be fitted with electrical protection relays to detect abnormal operating conditions or initiate shutdowns for major electrical faults in a generating plant.

In all cases, the electrical or mechanical protection relay sends a signal directly to a circuit breaker or security valve. Once the unit controller has received this signal it can then either initiate an appropriate security sequence, or inform the operator to rectify the situation.

- Used to interface the serial links of the protection relays (Modbus).
- Access to internal relay data for supervision purposes (logic data and measurements),
- Special link between protection relays and the associated configuration and observation software of each relay to debug and observe from a central station.
- Fast trip links directly wired from the protection relays.

ENGINEERING TOOLS

The integrated software development environment includes tools for all parts of an automation project, making it the foundation for applications of any size and scope.

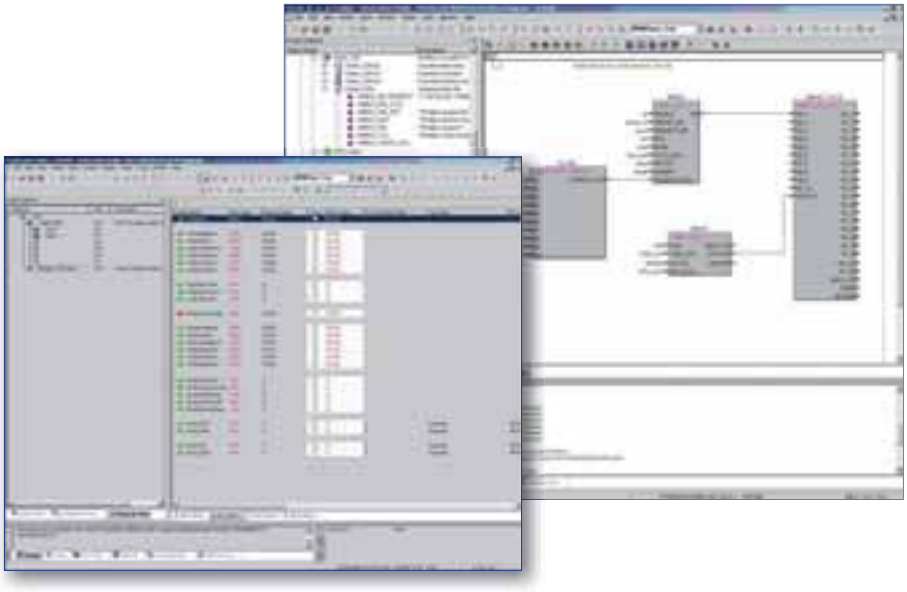
Regardless of which stage a project is at – planning, implementation, testing, production, commissioning, or service – this specific environment always interfaces with the machine.

A control system solution for the whole life cycle of the hydro plant

Engineering software

One single object oriented tool for:

- System Configuration
- Process logic programming
- Transparent Communication with OPC (Open Protocol Communication) server/client
- Test and on-line commissioning functions Man Machine Interface

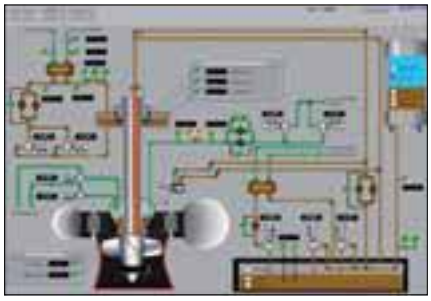


Human-Machine Interface

It is the SCADA level for supervisory control. Available for PC solutions, it is a multi station management programme, with hot standby configuration (native redundancy).

Based on Java technology :

- Up to 4 screens for each operator station
- Target-oriented configuration
- Import/export menu in CSV or XML formats available
- Simulation mode is available for mimic debugging test phases
- Provide access to SCADA from a web explorer
- Remote access with operation and supervision mode

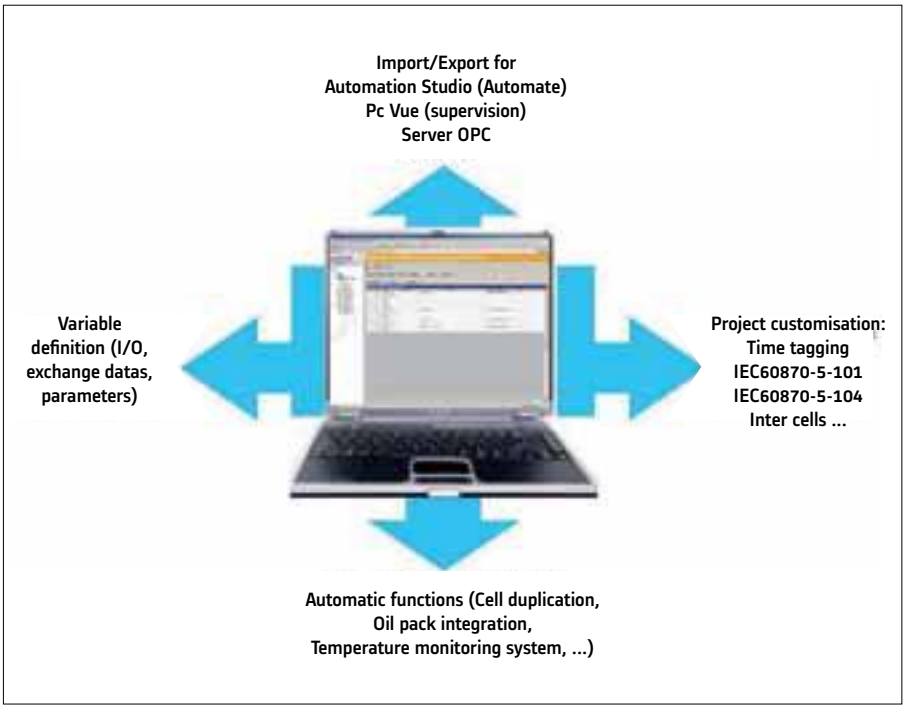


Signal Management Tool (SMT)

SMT is the software tool that manages hydro application databases. It centralizes the exchange variable definition and prevents multiple recordings for risk reduction and time improvement during the application engineering.

SMT provides the following functions to automation Studio and PcVue, by import/export capabilities:

- Declaration of input/output
- Developing of variable correspondence for MMI via OPC server/client
- Modbus, Profibus, IEC60870-5-101 & IEC60870-5-104 definition
- Inter controller definition
- Specific system management (time stamping) according to project customisation
- Hydro standard application integration
- Application documentation



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