

SmartControl SX

Alstom Hydro Control System

Open, intelligent and cost-effective solutions

THE BEST SOLUTION TO MEET ESSENTIAL HYDRO POWER PLANT NEEDS

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

- The SCADA 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. The system is highly flexible so it can be used in all types of hydro plants:

- new plants or retrofits
- full plant automation
- plant management and remote monitoring
- machine control including (speed governor and automatic voltage regulator)

Some of the many 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 & maintenance
- Application simulation before delivery
- Several operating languages available
- Process computation without additional platforms
- Additional options

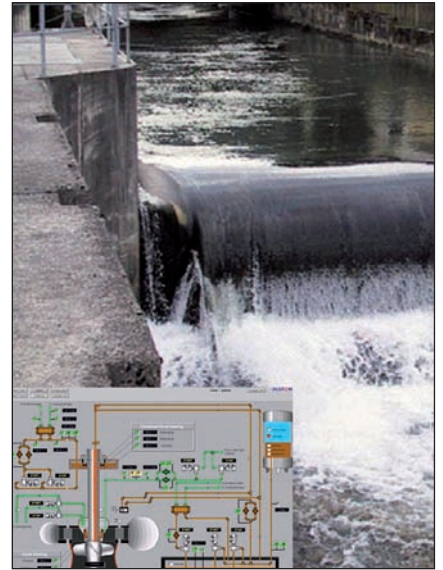
An Ethernet Local Area Network (LAN) 100 Mbps/s with industrial switches is used for the interconnection between both levels. This Ethernet network also enables data exchange between controllers.

The modbus standard communication is used to link the PLC equipment with local field equipment and devices, such as the automatic voltage regulator (AVR), the speed governor and the measuring device.

A COMPLETE CONTROL SOLUTION

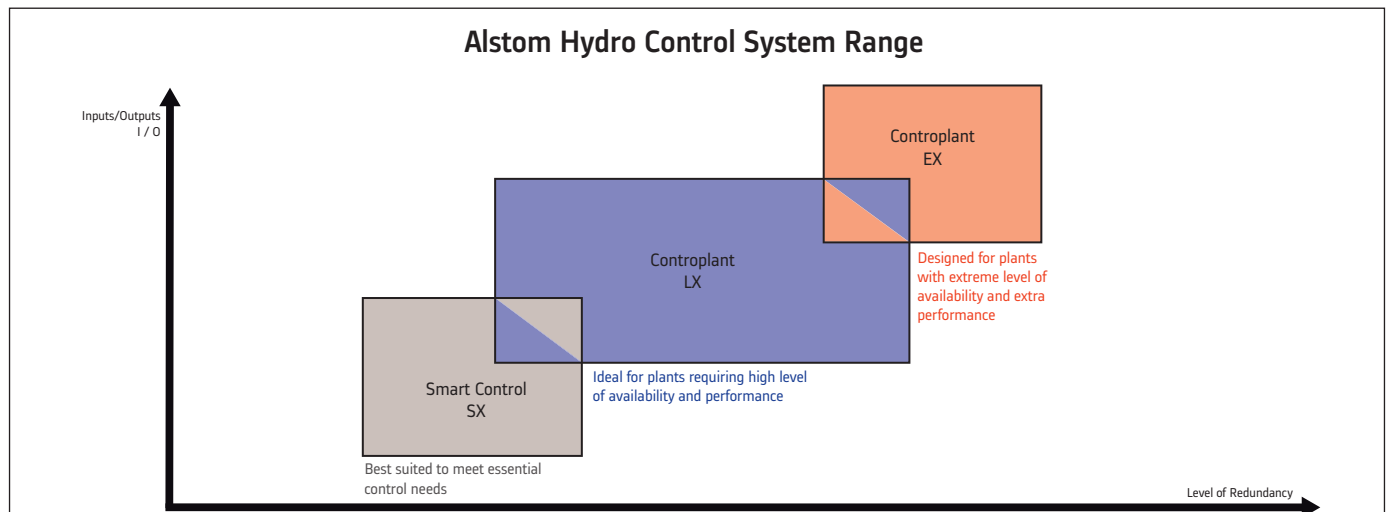
The ability to offer the broadest range of power generating equipment and systems enables Alstom Hydro to provide customers with complete solutions. These solutions include turbines and generators that produce electricity to control systems that make a power plant run reliably and efficiently.

Alstom Hydro offers both standardised and customised solutions in response to all possible hydropower generation needs. The broad product range covers complete



electromechanical and hydro-mechanical equipment for new hydro plants, as well as rehabilitation of existing plants and services.

Alstom Hydro is the world leading hydro power equipment supplier and service provider, possessing all relevant hydro power generation technologies and with manufacturing facilities in all the key hydro markets in the world. Alstom Hydro can provide customers with complete solutions, from components to turnkey power plants, from water to wire.



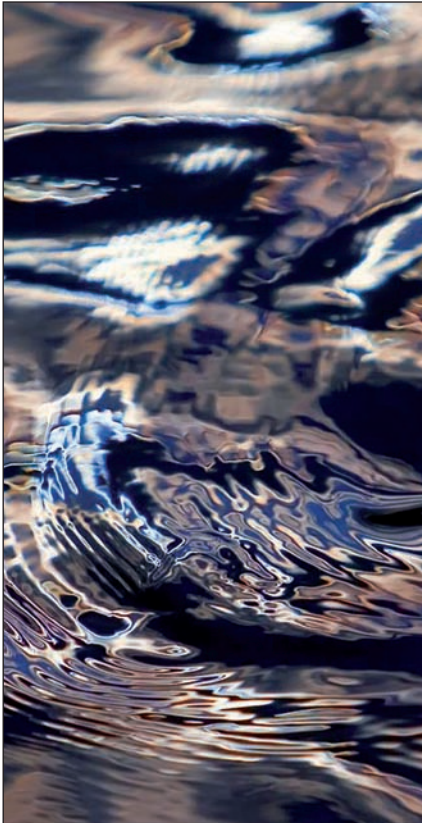


**A control system solution
for the whole life cycle of the hydro power plant**

A CONTROL SYSTEM FOR BOTH NEW AND RETROFIT PLANTS

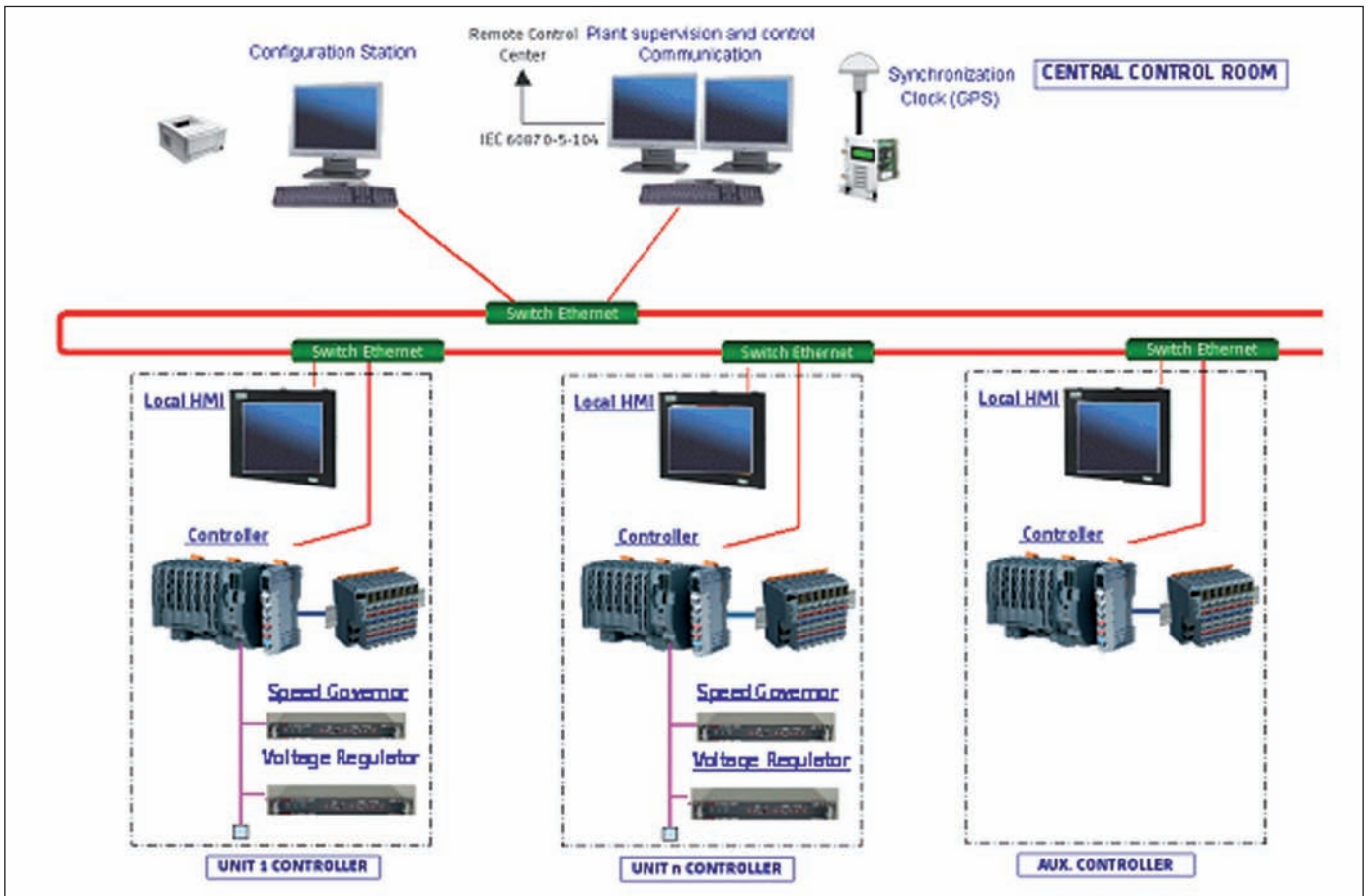
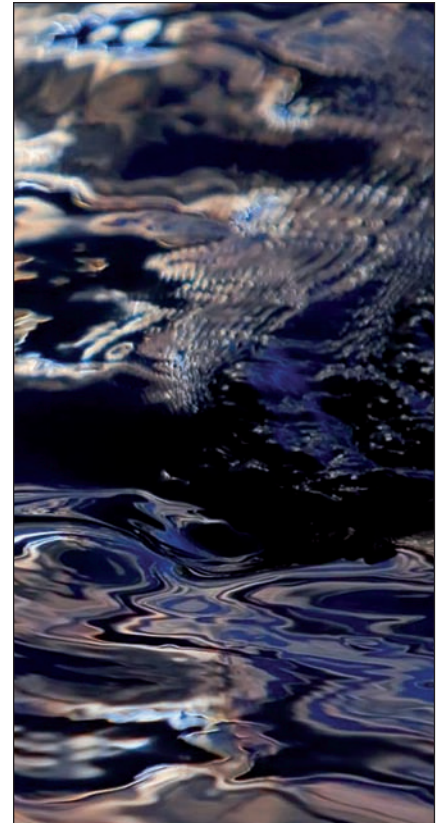
- SmartControl SX is designed for power control applications in hydro power plants. It deals with the requirements of all aspects of power production.
- Open and intelligent system solutions for hydro power control.
- Integrated hardware and software solutions for remote control and dispatching of grids can be supplied for all types of plant operation.
- SmartControl SX implements standard off-the-shelf products.
- A plant automation system integrating both DCS (Distributed Control System) functions and plant management functions for operation and maintenance optimisation.
- Redundancy implemented at main supervisor level in communications provides system availability.





Smart control SX ON EPT

- The integrated control system for hydro power 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 controller panel dedicated to the management of the common facilities and/or centralised supervision station (if control required by the client) from which all the units and facilities can be controlled.
- It is 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 MMI (Man machine interface) in a standalone configuration or the remote supervision station.





Smart Control SX CONTROL SYSTEM

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

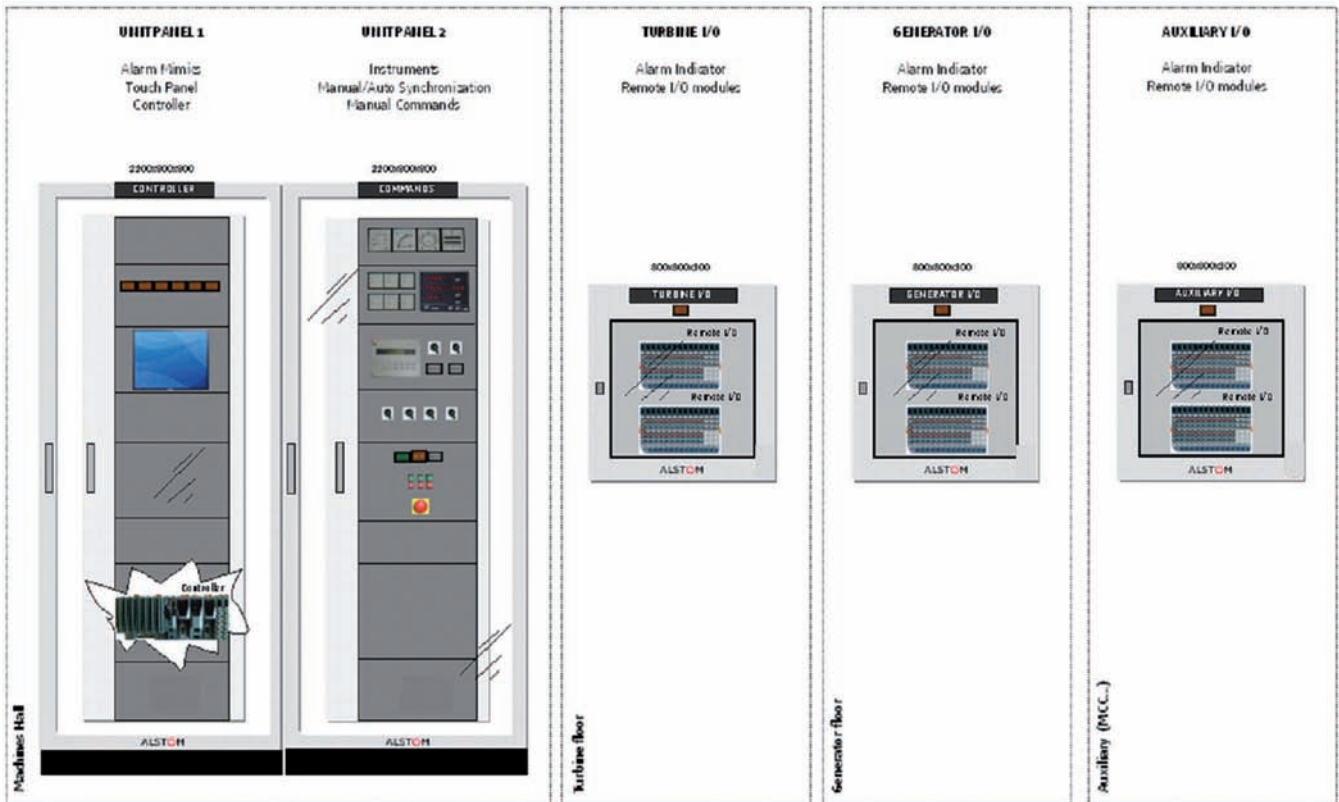
- a generator excitation and automatic voltage regulation system
- a turbine automatic speed regulation system
- an automatic synchronising system
- an automatic system for start/stop sequences and logic control
- an alarm system
- generator electrical protection system

In most cases, implementing an automatic control system is enough, and this integrates the functions previously mentioned 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 systems, is becoming increasingly important

Main functions :

- Plant supervision and control man machine interface definition
- Communication

- Plant network and interface with others (Dispatching, remote connection for maintenance control and supervision...)
- Process interface: Input/output definition, including remote configuration
- Hydro group sequential control: Application program using SFC (Sequential Function Chart) programming language
- Hydro auxiliary control and protection: Application program using FBD (Function Block Diagram) programming language
- Switchyard control and protection: Application program using FBD programming language
- Hydro process function: Application 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: Hardwired link connection to dedicated electrical protection equipment (Modbus communication protocol)



ALSTOM HYDRO INTRODUCES 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 depending on the project requirements.

The main features are:

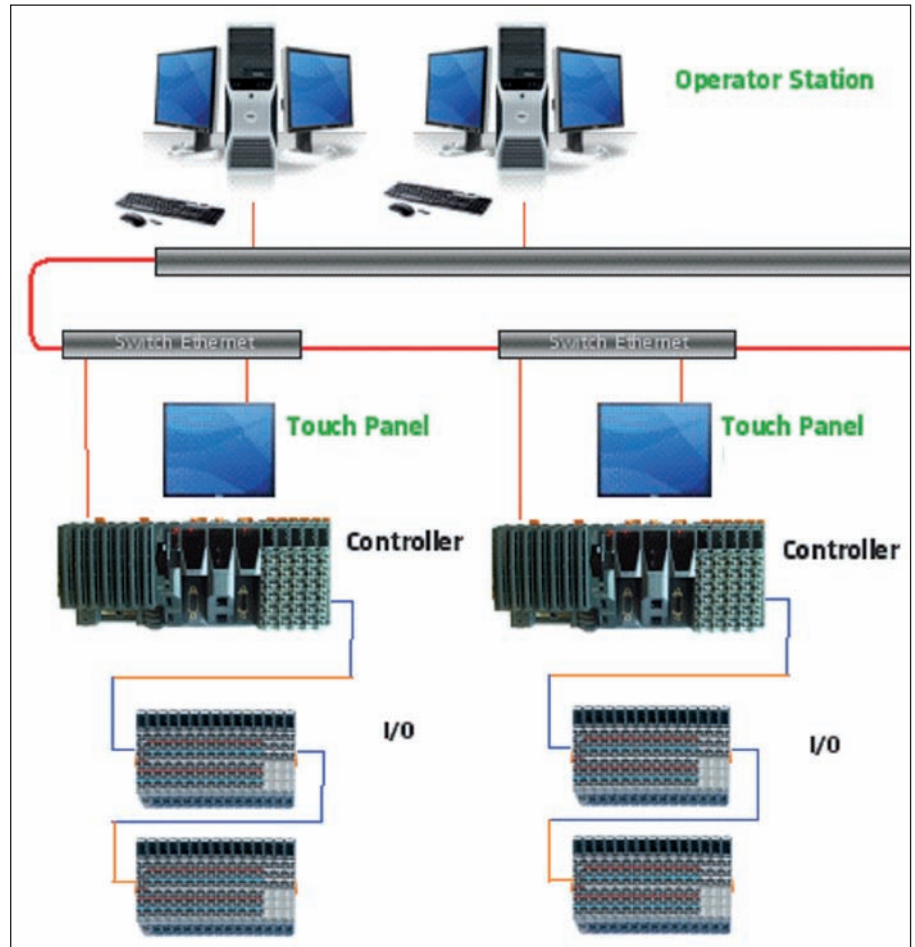
- I/O slice system for the highest granularity (minimal number of channels per module for most economic solutions)
- Extremely compact with 12 pin terminal block (highest component density requiring minimal space and very ergonomic)
- Push-In' principle (tool free wiring and clearly assigned terminal functions)
- Connection cross sections (up to 2.5 mm² for solid wires, up to 10A, 230 VAC)
- Coding (factory coding prevents dangerous mix-ups)



Easy to use

Separate: Terminal – Electronic – Bus.
Pre-wiring of terminal strips, hot pluggable electronics and free bus slots for options. Each bus module is an activate bus station, even without the electronic module. 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 using cable

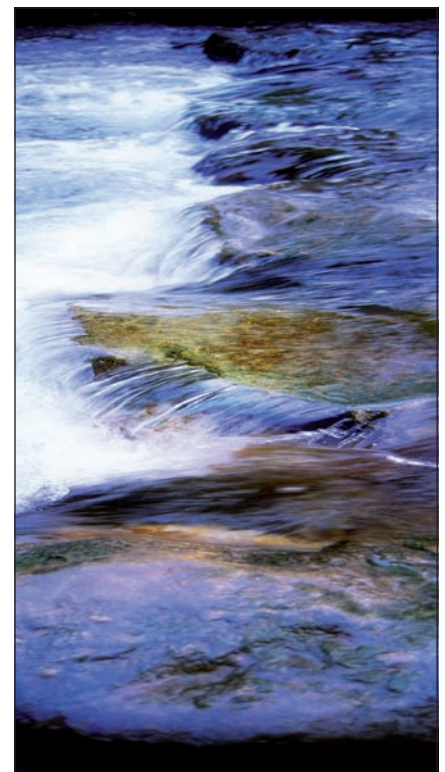
The CPU uses an Intel Celeron 650/400 Performance, Ethernet TCP/IP Modbus.T.SLG, Ethernet Powerlink (EPL) and 2 integrated memory stick connections. Its interface can be expanded with communication modules (serial or Ethernet links). It is fan free and extremely compact.



Local MMI

The local MMI is used for the local SCADA dedicated to each controller supervision.

- 15" XGA colour TFT display with touch screen (resistant)-CompactFlash 2048 MB
- Microsoft Windows XP Embedded
- IP 65 protection, 24 VDC
- ETH 10/100, RS 232, 2xUSB;
- This local MMI operates independently of the operator stations, but works with the same SCADA software system.



GOVERNOR REGULATOR, AUTOMATIC VOLTAGE CONTROL AND ELECTRICAL PROTECTION RELAYS

Speed Governor NEYRPIC® T.SLG

The governor is the brain of the hydraulic turbine. It has to managee

- quick start-up and fast coupling
- stable control of speed in order to ensure both high quality of the electrical network and to manage an isolated grid.
- accurate power control to avoid instability

The NEYRPIC® T.SLG governor controls a large range of electric-oil components, including well known Alstom Hydro actuators

- designed for a wide range of pressure levels, from 15 to 160 bars
- accepting low filtration levels between 40 to 70 microns
- very long lifetime (over 25 years)

The NEYRPIC® T.SLG governor is designed to control the full range of hydraulic turbines. This advanced technology combines:

- multi-processor structure
- high resolution tachometer
- a colour graphic MMI
- an oil power pack and a pressure tank control
- a multi-positioning device structure

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

Automatic Voltage Regulator (AVR)

The AVR is integrated in the Alstom Hydro compact control system, specifically designed for the excitation regulation of AC (Alternative Current) generators.

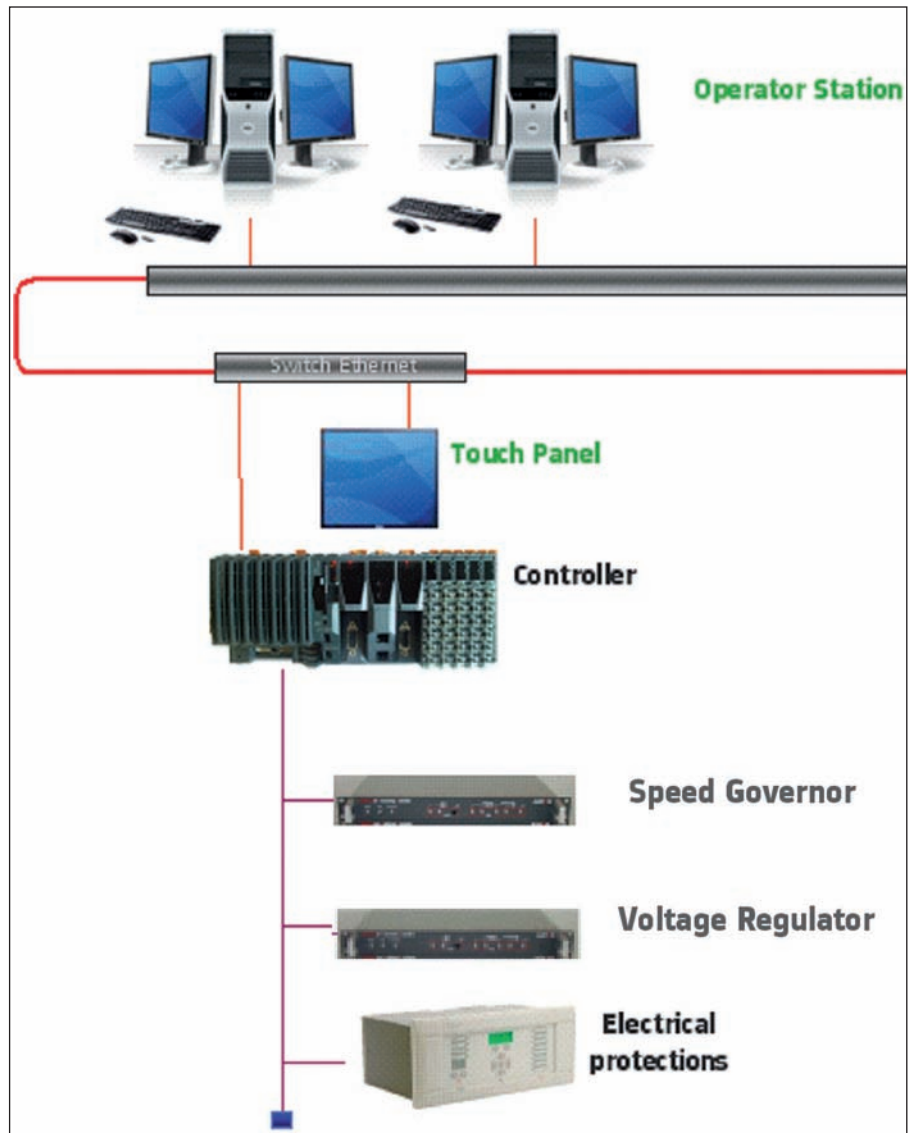
Designed to manage all types of excitation schemes (static, compound, brushless, DC (Direct Current) exciters), the AVR can be applied to hydropower generation units for small machines.

Controgen- VR features:

- Fully digital in design for all types of excitation systems
- Easy setting up and maintenance
- Combination of standard “off the shelf” modules with dedicated functions
- Communication with other control systems through a serial link (ModbusR) or Ethernet TCP/IP modbus pour T.SLG

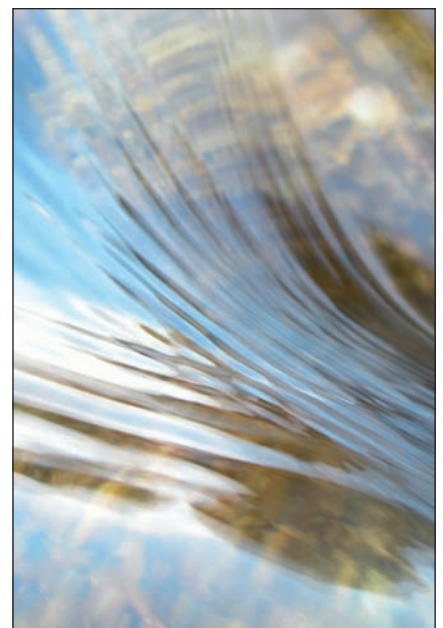
The electrical protections

All hydro power 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 also 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.



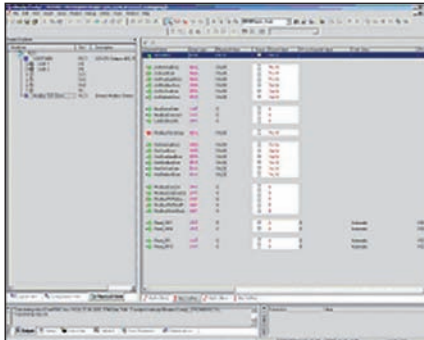
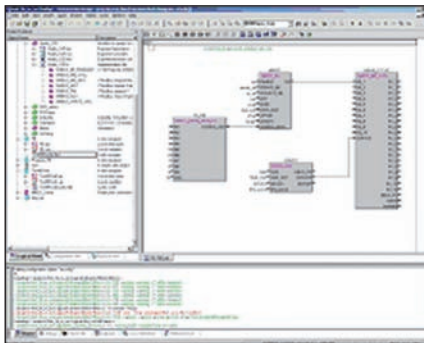
ENGINEERING TOOLS

Engineering software

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.

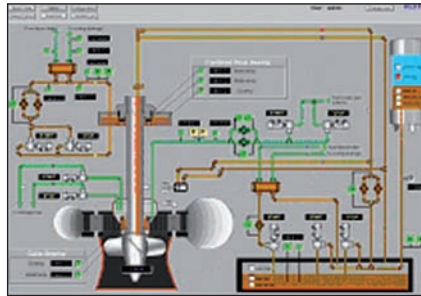
One single object oriented tool for:

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



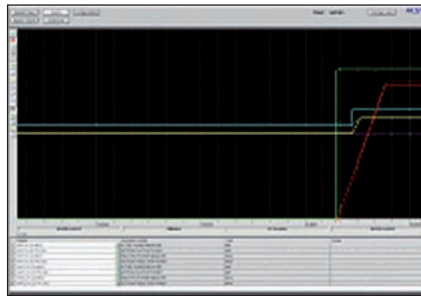
Man Machine Interface

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).



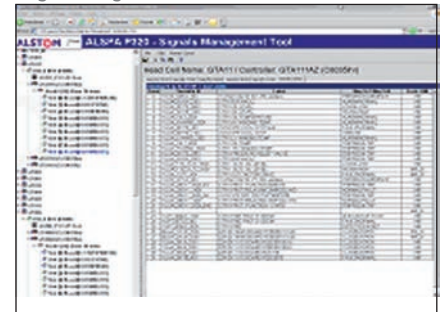
Based on Java technology.

- Up to 4 screens for each operator station
- Object oriented configuration
- Import/export menu in CSV or XML formats are 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 a 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 definition
- Inter controller definition
- Specific system management (time stamping) according to project customisation
- Application documentation

