zenon and straton work together for the highest level of reliability

The utilization of some of the most advanced industrial automation technologies has enabled the automation, protection, control and supervision of the entire energy production and distribution network in the Italian Primiero Valley. This has given the proprietor company the ability to control the entire system from a single location using tools that reduce the response and resolution times for malfunctions and keep electrical power service interruptions to an absolute minimum.

The integration of different systems including PLCs, Ethernet interface protection, wireless communications and supervision systems has facilitated the creation of a single complete environment for the ACSM SpA power production and distribution network in Primiero, Italy.

The production complex is made up of two hydroelectric stations (2x 5MVA and 2x 2MVA) which feed both the medium voltage (MV) distribution network (managing one part at 20 kV and another part at 10 kV, with 92 substations and 110 km of lines) and the high voltage (HV) network (60 kV and 132 kV) and therefore provides power to the electrical system that begins in the Community of Imer in the Primiero Valley and goes on up to the Rolle pass.

The vast geographic area the system covers (including mountain sites that are tens of kilometers distant) and the variety of the equipment installed for the automation necessitated significant scrutiny regarding the choice of SCADA system for control and supervision, of which particular performance and

adaptability are required. The choice fell to zenon from COPA-DATA: a stable product, suitable for large applications, with the capability of communicating with a multitude of distinct pieces of equipment, thanks to its many integrated drivers.

SCADA SYSTEM PERFORMANCE

The nature of the processes to be controlled, which range from the production of electrical energy to its localized distribution right on up to the individual family/utility in the valley, made it necessary to pay particular attention to the development of the system. It must guarantee continuity of service under any conditions, even if the Primiero ACSM SpA grid is separated from the national grid at the level of the 132 kV substations.

THE REQUIRED SCADA IDEALLY HAD TO DELIVER THE FOLLOWING FEATURES:

- Stability
- Continuity of service
- Native management of command policies
- Saved data security
- Expandability
- Native capability of interfacing with different equipment, such as Siemens PLCs and protection relays, GE protection relays and Remote Telemetry Units (RTUs)
- Modification of the application also by remote
- Remote connection to the system
- Possibility of implementing logic systems, even complex ones, in order to realize functions such as plant production management or load reductions
- Interoperability with other development environments such as VBA or VSTA, SQL and .NET framework.
- Frame work

The new system also needed to operate with the existing automation infrastructure. However, the integration with the existing infrastructure turned out to be particularly complex because the selection of equipment and communication protocols had developed over time, using an ad-hoc approach that had not ensured a homogeneous system.

PROPOSED SOLUTIONS

Based on the needs set out above, an approach was envisioned whereby a plant server, dedicated to the autonomous management of the same site, for each critical site (production stations and distribution substations) was considered suitable and two "global servers", with backup redundancy between them, set up for the acquisition of all system data, status visualization and command management. The structure adopted was a certified native redundancy system from COPA-DATA which enables two machines to be synchronized, aligned and active – one as the active server and the other as stand-by – both of which communicate contemporaneously with the periphery. It is proposed that this double method of data acquisition will be deployed again in the field equipment command system: so that any malfunction of one command system will result in it being immediately replaced by the other in stand-by. The redundancy may be implemented either horizontally or vertically, guaranteeing not only the operation of the centralized control workstation for the entire system, but also the operational autonomy of the plant server in the remote sites in the event of local site server malfunction.In the global supervision system, a policy for the guarantee of the unicity of the command emission source was implemented based on both the SCADA native command privilege management, and on the physically present selectors in the automation and control switch panels. The SCADA system is expandable, not only in terms of tag size but also in terms of the network, which is centrally controlled by the two redundant servers. Indeed, within this system the inclusion of a new hydroelectric plant connected by way of ADSL has been anticipated for the near future. The zenon Editor enables the ACSM engineers to make changes to the system, both of a graphical and/or functional nature, on a PC and then to download these to the entire system network without requiring the restart of the Runtime application. By way of the integrated remote

Energy distribution control screen

Simplified diagram of the Ethernet supervision system network

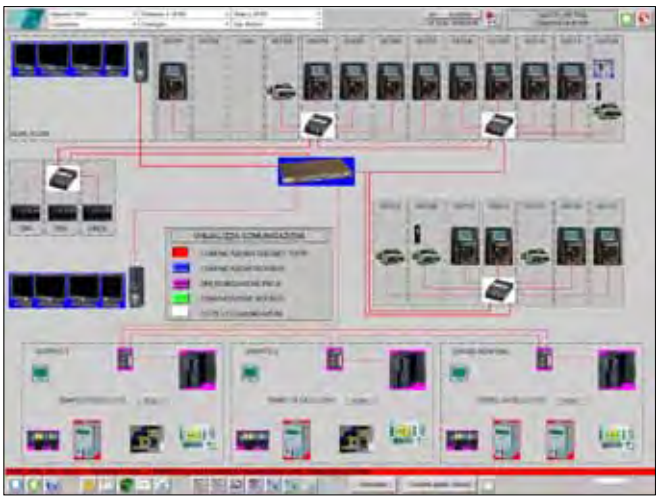
controller in the Editor, it is possible to check the operation of the sites remotely - a function which makes assistance by the same developer possible even from a remote workstation. The use of a simple internet connection and browser enables the users to view a GUI with functionality appropriate to their purpose and security permissions. straton, zenon's integrated soft PLC, was used for the development of the logic systems. straton's framework supports the development of automation code compliant with the IEC 61131-3 standard, and which also supports a redundancy mode. At the end user's request, certain external tools were developed in the VBA and .NET environment. These functions, able to converse with zenon, enable bespoke customizations for the production management of the hydroelectric plant and the compliance with Electrical Energy Authority resolutions 333/07 and 341/07 and their subsequent amendments for the detection of interruptions to supply.

AUTOMATION SYSTEM ARCHITECTURE

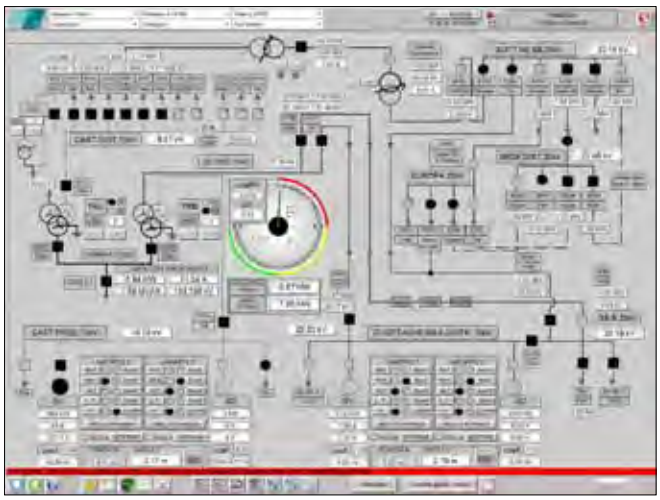
The detail of the architecture developed is as follows:

- two redundant servers with zenon local multi-monitors located in two independent buildings with a certain distance one from the other, equipped with horizontal "hot" redundancy (hot stand-by)
- one data server for the centralization of the SQL format server database
- two plant PCs with zenon for the Zivertaghe Station and the San Martino di Castrozza distribution network – wireless connected remote sites (these PCs have vertical redundancy with redundant servers)
- process automation by way of Siemens S7-400 PLC and operator panel with communication toward the decentralized periphery in Profibus DP, for the hydroelectric groups
- the automation for distribution and transmission stations as well as for MV and HV electrical safety devices, which communicate with both the PLCs and the SCADA system.

The "Global" redundant servers, besides collecting all of the data from the system servers, therefore carry out management functions for the whole system such as: interruption management (monitoring of the MV and LV utilities involved in any given malfunction), the reduction of loads, and management of the remote sites by way of the GPRS connections (Predazzo Municipality distribution network). The communication between the redundant servers and the plant servers are carried out with fiber optic lines or wirelessly over free frequencies with an encrypted proprietary protocol (maximum distance of 6 km). In case of a fault in the wireless bridge, an ADSL safety communications link has been implemented. Production and distribution service continuity is not affected either by the absence of one redundant server or by the absence of both. In fact, all of the information and the commands necessary for the management and protection of the entire system operate in the system either in a totally autonomous and direct manner or by way of the PLC automation system operating as another de facto functional redundancy. The same data exchange network with the field equipment was conceived with a doubled line (Ethernet and fieldbus). The plant server communications with the different



Detailed diagnostic and plant screen



Production and distribution management

equipment – PLC and protections – has been made by way of a ring network (Garret - dedicated switch), obtained with tracts in electrical and fiber optic cables (both mono-mode and multi-mode). The plant PLCs are directly responsible for the process and may be managed using the SCADA, by the operator panels or directly, by using the buttons on the automation panels. The "intelligent" elements in the system (SCADA, PLC, digital protection) are time-synchronized by way of GPS units so as to guarantee that the data acquisition produces coherent databases, which may be ordered temporally with a precision of one second. With the same system, the same safeties are synchronized to the millisecond (standard IRIG-b) in order to enable the comparison of alarm logs and event logs.

AUTOMATION SYSTEM FUNCTIONALITY

The designed and developed PLC automations enable the complete control both of the hydroelectric units and of the MV and HV networks. Furthermore, the CPU calculation capability has ensured that, for each group, both the speed regulator (third party supply) and the automation can be integrated with a single controller. The main functions performed by the PLC systems are:

- Start-up/shut-down logic of the hydroelectric groups and the safety logic systems
- Speed regulation logic systems, fault notification logic systems and the load reduction logic systems
- The 25 protection devices found on the MV and HV grid, in addition to their obvious function for line protection, are equipped with fault-recording functions and event recorders too

The files created by these two functions are picked up for archiving in the plant servers where they may be analyzed by the operators and the ACSM engineers. The system is flexible: analysis can be performed by the redundant servers, whilst the protections may be commanded by any of the controlling workstations. The automatic download of the fault recordings enables the malfunctions to be subsequently analyzed by a single centre without any overwrite problems of the files typical of multifunction protections.

ADDITIONAL FUNCTIONALITY INCLUDES:

- Wireless communication management
- Diagnostic screens for all wireless communications
- Diagnostic screens for all communications and automation systems
- Machine maintenance management
- Programming of the plant production as a criteria for the sale of the energy
- The management of the basins
- Events records management
- Command and security policy management
- Management of text messages from the management of remote sites by way of GPRS communication to the operators that are on call