Remote control of HV stations and MV substations in Milan
Stefano Barbieri *

Summary
The Italian scenario
The Italian energy market is passing through the main phases of the deregulation process. New types of customers and new power quality needs are pushing companies to abandon previous approaches and to focus on customers satisfaction.

Aem Elettricità SpA
Aem Elettricità is part of Aem Group, a former multi-service power utility located in Milan, Italy. Following the market evolution, Aem Group is undergoing a period of deep changes, too. The major one derives from the achievement of the city distribution network previously owned by ENEL. Indeed, AEM and ENEL have shared the distribution in Milan since 1962. Now, according to the deregulation laws, the local companies must become the only city power company.

The process
Aem Elettricità SpA receives electric power from HV national grids and manages the distribution by means of 4 primary substations (HV/MV), 13 secondary substations (MV/MV) and about 2500 distribution substations (MV/LV). This quantity doesn’t include ENEL network.

Primary substations remote-control
Primary substations remote control is obtained by means of a SCADA, some RTUs and a private telephone network. Following the changes in the distribution ownership, Aem and ENEL control rooms are probably going to merge in the next few months.

Remote control of MV/LV substations
After having realised a pilot control system, Aem is now purchasing a DMS, with the potentiality to become the control system of the whole, unified, network. The RTUs have quite significant characteristics, due to the harsh environmental conditions. In particular, they will have advanced batteries management, to obtain sure indication about batteries state-of-charge or end-of-life.

The integration needs
Each level of the control hierarchy is pushed to become part of an integrated “energy remote control system”. Due to the needs of data about power quality, outages and so on, each device must be integrated and must communicate with the others. A soft-approach to the integration problems can help to solve them quite easily.

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Abstract
The fast moving Italian scenario is pushing companies and technologies to move even faster. The document highlights the main evolutionary trends of the control systems and the growing integration needs.

The Italian scenario
The Italian energy market is presently facing the main phases of the deregulation process. A completely new customers category has born recently: the so-called “free customers”, allowed to buy electric energy at best prices, either from producers or traders. Due to the progressive lowering of the thresholds on per-year energy usage, the number of “free customers” is rapidly increasing. Like in many other countries the availability of different suppliers is not obtained by laying new cables and lines, but by means of commercial agreements. A seller, a carrier and a customer are the minimum set required by this type of agreement. The minimum technical conditions (power quality, continuity, etc), expressed as part of the commercial agreements, represent new challenges for the companies. Power quality standards too are progressively increased on a per-year base, pushing companies to do their best and continuously improve their organisational and technical assets.

The HV lines management is transferring from the owners to the GRTN (national HV grid managing company), within the next few months.

As these changes are going farther and farther, Italian Power Utilities are changing as well. Mainly, multiservices utilities are splitting in smaller companies, each focused just on one part of the power process: production, transmission, distribution, energy trading. The traditional “plant-focused” approach has been replaced by a “customer-focused” approach and many old ideas have been abandoned. In this new scenario, even the remote control systems have gained new aims.

Aem Elettricità Spa
Aem Elettricità Spa is part of the Aem Group, a former multi-service power utility. Aem Group operates mainly in the areas of Milan and Lombardy and manages electric power production, transport and distribution, natural gas distribution, district heating, telecommunications, street lighting and traffic light systems.

Aem Elettricità Spa deals with distribution and sale of electric power to customers located in Milan. In 1999 the company, which employs 400 people and supplies 430,000 customers, recorded a turnover of approximately 420 billion liras (approx 217 million Euro).

Since 1962 Aem and ENEL have shared the distribution in Milan (approx. 50%-50%). The government laws for the deregulation have stated that, in order to maximise distribution efficiency, in each town there must be only one distribution company. The preference was accorded to the local companies instead of ENEL to maintain a larger number of competitors on the energy market. For AEM this meant the duty (and the opportunity) to become the only utility in Milan. At the time of this paper, Aem Elettricità and ENEL are arguing about the technical and economical conditions of an agreement, in order to state which plants and how many employees should be transferred from ENEL to Aem and the associated economical values.

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The process
Aem Elettricità Spa receives electric power from HV national grid in 4 HV substations. The main HV/MV transformers are located in these 4 HV substations. A MV transport network, thirteen MV/MV substations and two MV distribution networks (rated voltage: 23kV and 9kV), distribute the power with the required extension. The final transformation is obtained by means of about 2500 MV/LV substations.
Primary substations remote-control
HV/MV and MV/MV substations remote-control allows Aem to control the main plants of its own city network.
The first systems were installed in the early ’70. The present system is based on a recent SCADA and RTUs located in each plant. The oldest RTUs are now under renovation and the new ones will offer state-of-the-art functionality.
The telecommunication services are guaranteed by means of a directly owned telephone network. Aem is now considering to migrate RTUs communications to the new Wide Area Network (WAN). The decision will be made after quality-of-service evaluations.

The main features of the present control system are:

• SCADA located at one Aem Office in Milan
• Operating system: UNIX
• Number of RTUs: 17
• 16,000 real time items
• Data transmission on Aem’s phone cables

The system manages and controls:

• 4 HV energy reception and HV/MV transformation substations
• 13 MV/MV substations
• Oldest street lighting power lines (with serial distribution scheme)
• Supply points for ATM (Azienda Trasporti Milanesi) tramway lines.

Until now, Aem and ENEL had their own control room. Each company, by means of SCADA or field crews dispatching, managed its own network. Now Aem is starting evaluating how to unify the control rooms and the related systems.

Remote control of MV/LV substations
The MV network feeds about 2,500 secondary substations. At least some MV disconnectors, one MV/LV transformer, some LV breakers are located In each substation. The LV network supply the Company's 430,000 Customers.

In the last few years a pilot remote control system was developed, controlling 24 substations.
With the experience gained from this venture, Aem is now purchasing a DMS (Distribution Management System) with the potentiality for the control of the whole network. Its main features could be summarised as follows:

• SCADA functions, for a joint control of both the main stations and the secondary substations. The first step of the implementation will remotely control 100 MV/LV substations. Aem’s aim is to reach to 500-600 substations within few years.
• Sophisticated Human Machine Interface (HMI) to enable the topological management of the network. The system will be able to manage at least 200,000 items (alarms, states, commands and so on);
• Openness to the management of the LV network (by means of “manual dressing”);
• Use of standard communication protocols to assure system openness to subsequent improvements
• Peripherals with advanced battery management features, to obtain sure indications about either batteries state-of-charge or end-of-life. Indeed the batteries play a primary role during the switching activities subsequent to an outage. Due to the loads the batteries must feed, a failure is more probable and could compromise the achievement of restoration time goals.

Energy meters.
For both large and free customers Aem has recently installed new meters and a central managing system, which is able to collect automatically consumption and power quality data.
To comply with requirements recently defined by Italian Energy Authority Body, new meters must offer advanced features: load profile, event recording, pulse outputs, standard communication protocols. Therefore the
meters can play new roles. They are the most distributed “intelligent devices” and the closest to the final delivery point, so they can gather data about power quality and outages. This will allow Aem to collect customers data for commercial and technical purposes, too.

**The integration needs**
The fast changing scenario is pushing each level of the control hierarchy to abandon the traditional purposes and to become part of an integrated “energy remote control system”. The need of data about power quality, outages duration and extension, plants availability, predictive maintenance, could be efficiently satisfied by the integration of the whole range of “intelligent devices”, in some cases already present. Unfortunately, well known problems can arise from the presence of many vendors and many communication protocols and it can be impossible the get over those difficulties when dealing with real time data. Aem recognised the advantages of “soft approaches” to the integration problems.

This means:
- to use widely recognised standards for the interfaces between heterogeneous systems
- to minimise the number of interfaces between heterogeneous systems
- to implement each refurbishment/renovation with only one vendor, also avoiding over-specification when not necessary
- to guarantee the temporal coherence of the data using GPS synchronised local clocks
- to limit the real time functionalities just where they are really needed
- to take benefit of the “smooth” integration opportunities offered by standard software platforms. Indeed in some cases it’s possible to overcome the integration obstacles simply having PCs, standard software applications and time-stamped data. The integration that can’t be obtained at data source can be achieved by off-line batch processing
- to use diagnostic and event data from energy meters to monitor network events