USE OF RECLOSERS IN SUBSTATIONS 132/33/13,2 KV

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ABSTRACT

This paper describes a review of existing practices and a change of constructive standards and cost savings should be obtained in new 132 kV substation constructions.

The main outcome of the study was a decision to replace MV Indoor Switchgear with Automatic Reclosers as the new standard in ENERSA, as well as its benefits since it saves cost in construction and maintenance, also facilitates fast actions in emergencies.

There is also a description of the developments needed to maintain required functionalities of control, metering and protection, by using new architectures of distributed control and digital communications.

INTRODUCTION

The significant changes in the economy registered in the last decade and the current possibilities of financing expansions in power electric systems, implies the search of possible change in constructive standards to achieve the ultimate purpose of reducing project cost.

By this reason several analyses were realized in existing practices and internal standards in ENERSA involved in design & construction of new 132 kV substations.

One of these analyses shows the economic and practically convenience replacement of MV indoor switchgear witch automatic reclosers.

For maintain required functionalities of control, metering and protection, this new standard implies the use of new architectures of distributed control and communications capabilities, using innovative technology, the first of its kind in the region.

BACKGROUND

ENERSA (Energía de Entre Ríos S.A) is an electrical utilities company that transport and distributes electric energy in Entre Rios province, Argentina. Nowadays provides electricity to about 291.000 customers.

The ENERSA electricity system had a maximum demand of 570 MW at the end of 2010. The network which is owned by ENERSA contains twenty two 132 kV stations and more than eighty 33/13,2 kV substations. The historical transformation ratios to distribution voltages are 132 / 33 /13,2 kV and 33/13,2 kV.

In recent years has undergone a rate of economic development with demand for electricity growing continuously. The average rate of load growth since 2006 has been of the order of 6 % and this rate of load growth is still continuing at present. Meeting this load growth has required a corresponding network development effort from ENERSA.

During this period two new 132kV stations have been built and others two was refurbished. The ongoing construction programme includes the construction of up to one 132 kV station per year.

Existing standard designs

ENERSA designs new substations 132 / MV kV with certain standards and practices, as follows:

- 132 kV: Double busbar with air insulated equipment (AIS). The station is laid out and equipment rated where appropriate for an ultimate development of two 30 MVA transformers.

- 33 kV or 13,2 kV: the medium voltage section based on indoor Single busbar metal-enclosed switchgear rated for operation at 13,2 kV and / or 33 kV levels with space for an ultimate capacity of 16 and 4 feeders respectively.

The HV equipment is installed outdoors. Protection relays, Meters, control and others intelligent electronic devices (IED) are installed in a control room, using conventional parallel copper for wiring them to the switchgear

The main MV equipment is installed indoors, inside of power room. Metal enclosed are equipped with internal arc flash protection. Control and protection functions are implemented with bay controllers, located in a control room.

The initial station development is frequently in the form of a one 15 or 30 MVA transformer with a small number of MV

feeders.

Cost Reductions

To meet these requirements a comprehensive cost reduction study was undertaken. This study covered various issues associated with the substation construction project.
One particular item showed that the civil works represent a great percentage of the total cost.
In that sense, the initial stage of the study identified the following areas as being the most promising for cost reduction:

1) Reduction in Buildings/constructions dimensions
2) Reduction in construction time
3) Reduction in engineering costs

The process began with a research phase to identify possible options. At this time we began to focus on reduction in cost by the use of a new standard in MV substation yard.

Economic Comparative

For economic analysis we began with the construction cost of a feeder in each MV's level's adopting it as a reference cost, as seem in Table I.

TABLE I. Reference MV Indoor Type

Description	Cost (p.u.)
Investment on 13,2 kV	**1 (reference value)**
Investment on 33 kV	**1 (reference value)**

Comparative cost estimates were produced using budget prices from suppliers (where available) or cost information from ENERSA records or experience.

The study showed that the cost of new MV Outdoor standard is lower than the Indoor solution:

TABLE II. Estimated cost for MV Outdoor Type

Description	Cost (p.u.)
Investment on 13,2 kV	**0,82**
Investment on 33 kV	**0,61**

TABLE III. Reference

Description	Indoor	Outdoor
Civil	**1 (reference value)**	**0,34**
Electromechanical	**1 (reference value)**	**0,79**

TABLE III shows a comparison of savings civil and electromechanical items.

By example, considering the construction costs of a new substation equipped with 2 transformers of 30 MVA, 16 feeders in 13.2 kV and 4 feeders in 33 kV, with the MV Outdoor against the traditional Indoor we found that the saving obtained is approximately the 23 %.

Functional comparative

ENERSA experience with the two types of installation may be summarised as:

INDOOR Advantages:
- Reduction in site dimensions
- Reduced visual impact
- maintenance/repair works in best conditions
- Not expose to vandalism

Disadvantages :
- increase in maintenance complexity
- necessity of more part supplies stock
- increase project cost.

Fig. 1 view of 13, 2 kV Indoor Single busbar metal-enclosed switchgears.

New OUTDOOR Advantages:
- facilitates fast actions in emergencies.
- Easy to maintain
- lower project cost.

Disadvantages:
- Increase in site dimensions
- greater visual impact
- Increase in maintenance complexity
- maintenance/repair works in poor ambient conditions
- Expose to vandalism

Fig. 2 view of 13, 2 kV Outdoor Single busbar with automatic reclosers.

Therefore, we conclude that the cost savings should be obtained in new 132 kV substation constructions with installation type outdoors.

New standard proposed for MV

As seem in Figure 2 the new standard replace Indoor Switchgear with MW Automatic Reclosers, switches and other Outdoor equipment.

Develop of new control architecture

In addition, was necessary the development of a new architecture communication-based to maintain required functionalities of control, metering and protection.

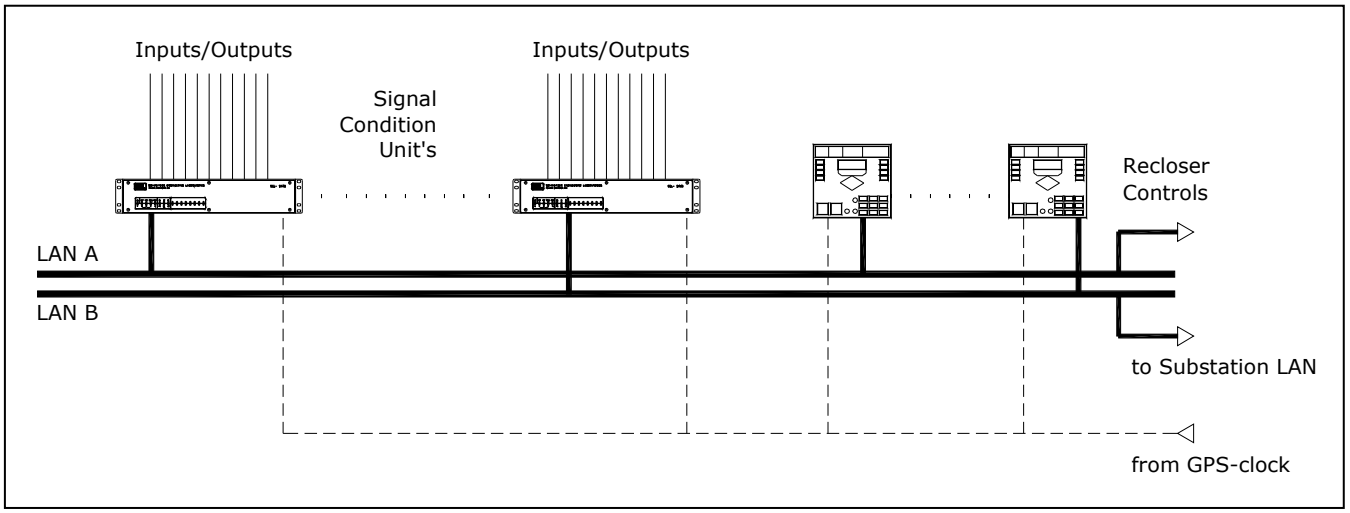

Fig. 3 simplified Outdoor connectivity of IED's

The system includes installation in MV substation yard of Microprocessor-Based recloser controls (witch Protection, Meter & control functions) and a cabinet with installed I/O interfaces devices for signal from MV switches, formed an architecture of distributed control, working exclusively with communications-based input and outputs.

All outdoor installed IED's was connecting to a fiber-optic based LAN permitting remote access, control capabilities, availability of data and integration to the protection and control functions of the substation (fig. 3).

The substation yard I/O cabinet also includes LAN devices. The gps-based time synchronization was distributed from this point to each IED in substation yard.

Integration to local control system, signalling and Interlock functions will be implementing using GOOSE messages (part of IEC61850 standard).

Reclosers Specifications

For proper operation in new standard proposed reclosers shall provide certain ratings and specifications requirements:

Main section: nominal voltage and current ratings with appropriate short circuit and making currents, vacuum-interrupting, oil free, solid isolation.

In applications where electrical ratings are exceeded, like coupler or capacitor banks, the use of outdoor interrupter must be considered.

Recloser controls: The microprocessor-based recloser control shall provide a combination of functions including protection, monitoring and automation in the same way that bay control used in indoor standard, including Ethernet multi-functionality access, allowed functions like: remote access, control capabilities, availability of data, high speed

data transfer, DNP 3.00 protocol encapsulated in TCP/IP, and others.

Conclusions

A full review of existing standards has resulted in design changes which are expected to produce cost savings in 132 kV substation constructions. These savings should be obtained without a need for any dramatic changes in operational practice.

As suppliers are continuing to innovate in this area it is expected that further savings will be achievable in the future. Further studies will be carried out before the next term contract enquiry to ensure that these savings are captured.

REFERENCES

[1] G. Balzer, B. Boehle, K. Haneke, H. Kaiser, R. Pölmann, W. Tottenborn and G. Vo□, Switchgear Manual. ABB, 9th edition, 1993.