IMPLEMENTATION OF AN ACTIVE DEMAND MANAGEMENT PROCEDURE THROUGH OF AUTOMATIC LOAD CONTROL AND MANAGEMENT OF PROSUMERS DEVELOPED UNDER THE CONCEPT OF SMART GRIDS.

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ABSTRACT

Analysis of aggregate demand curves of the electrical system of Santa Fe province - Argentina, we see that their behavior imposes permanent increase infrastructure transformer capacity at the points of interconnection between the transmission system and the subtransmission / distribution.

The objective of this work is to implement Active Demand Management techniques (ADM) applied to electrical system in the smart grid framework. This is an important resource for improving efficiency in the planning and operation of transmission and distribution networks. Both objectives require analysis aimed at determining the relationship between power flows through the lines and transformers, against the demands that define these levels. It also presents the results of the application of ADM with the main objective to have in the Control Center Operations a tool to prevent unplanned outages.

INTRODUCTION

Looking at the period of time within the time band of peak demand in the summer 2011-2012 was higher than in the same period of summer 2010-2011, we conclude that this situation occurred about for 80 hours. Likewise, the difference between the maximum peak of summer 2010-2011 and 2011-2012 was about 171.5 MW. When analyzing the mean values in consumption peaks, the difference falls to 57 MW. When analyzing the mean values in consumption peaks, the difference falls to 57 MW.
First conclusion is that while there is a growing need for infrastructure, the growth rate could be reduced if procedures are in active demand management (ADM). This contributes to the planning efficiency, but mainly to operational efficiency.
Now, a smart grid (SG) is the combination of traditional grid with modern information technologies and communication. It allows to integrate data from different points of the electricity chain, from the generator to the end user, and turn it into information and actions that lead to improved management. It aims to increase the efficiency, reliability, sustainability, quality of service and product to meet the new challenges of multiple generators and various consumer styles.
The ADM requires for its implementation the technological framework defined under the SMART GRID concept.

ACTIVE DEMAND MANAGEMENT (ADM)

It is the set of actions that are aimed at improving the efficiency of an electrical system acting on demand without compromising on their usefulness or quality of use. The concept of ADM, includes those demand management techniques that require some direct or indirect control of consumption for your application.

From the point of view of planning, helps in reducing and delaying investments by eliminating non-permanent restrictions on the network. Moreover, considering the programming process of the operation, ADM aims to introduce some system loads as “control variables” in the management of technical restrictions.
This paper proposes to implement a coordinated operation strategy based on:

a. Automatic Load Control (ALC)

• Real Time Operation (emergency or abnormal apartment of the forecasts): implementation through automatic interruptibility of a set of loads previously identified.

For short-term operation, above mentioned, could be complemented shifting the periods of consumption peaks to the valley periods.

These actions are aimed at segments of medium and large customers, for which we implemented a mechanism analysis of demand in terms of:

• temporal behavior, where considered factors such as workability, temperature sensitivity, etc..

• spatial behavior, since in terms of the network configuration, the geographic location does not change but it can change the electrical location.

In this way, it's defined the consumptions sensitive of being remotely managed, manual or programmed, in order to reduce electrical system demand.

b. "Prosumers" management (PM)

• If we define prosumer as one end user (understood by a

consumer of residential, commercial, and industrial services) capable of generating electricity, which excess is delivered over the network, the proposed procedure involves taking advantage of the injection power capacity to reach the crushing of the curve sought.

For reasons related to the reliability of media communication available (connectivity) and for being almost exclusively, the only segment with this possibility, will be included in the procedure, just to large industrial customers.

In general terms, the physical structure required to implement both ADM mechanisms are achieved by:

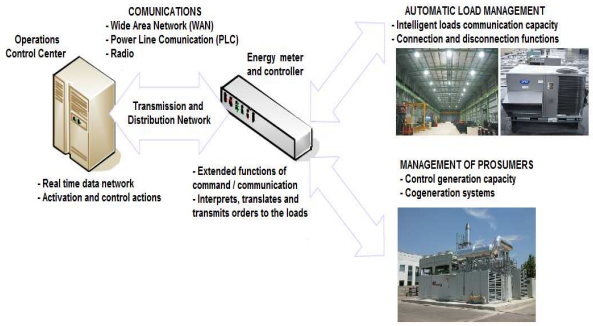

Figure 1. ADM Concept

ANALYSIS LOAD CURVES

The analysis of the demand requires fundamentally find the correlation between load profiles of the network elements with possibility of saturation in some tipical days and load profiles of the set of consumers with electric influence on that element. This allows to identify the relative weight that has the individual demand of each consumer with respect to the total aggregated demand of the parsed node.

The above should be done in consideration of the behaviors of short term such as:

• seasonal aspects (summer and winter),

• influence on workability,

• and geographic location..

The latter is a very important point. The demand must belong all the time of the year to the same point of supply. Otherwise there is a risk that a change in the network topology is affecting demand not supplied from the node affected by the saturation.

In our case, demands identified as "manageable" that make up the matrix of interruptability belong mainly to the industrial sector. This have a weight of almost 25% of the total energy consumed in the system (Figure 1.). However this disaggregated analysis of the demand arises that the industrial sector is insensitive to one of the factors which in the short term, have greater influence on demand: the temperature.

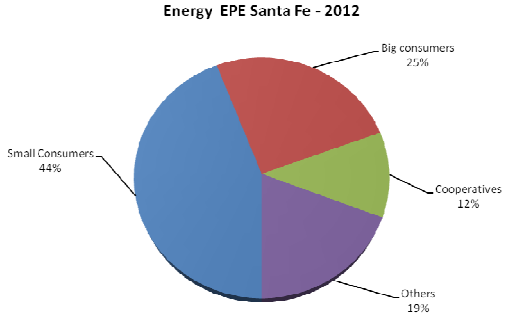

Figure 2. Billed Energy (2012)

Considering that the "small consumers" are very sensitive to temperature and that they constitute 44% (Figure 2.) of the energy of the system, some mechanisms of "management of air conditioning" as additional tool will be explored.

AUTOMATIC CONTROL OF LOADS (ACL)

Interruptibility

This mechanism is based on the concept of "interruptibility", which is considered as a tool of demand management to respond quickly and efficiently to the needs of the electrical system in emergency situations. Is to disconnect loads previously agreed with consumers in response to a given reduction order from the Control Center. Given that large industrial customers are monitored from the control center via the SCADA system, not only with the ability to monitor electrical variables but also to execute commands, it is simple to route control actions on equipment previously identified and agreed to form all the interruptible loads.
Nevertheless for those consumers belonging to manageable set of demands that are not supervised by the Control Center through SCADA simple technological solutions are implemented, such as economic and safe, p.e. GPRS.

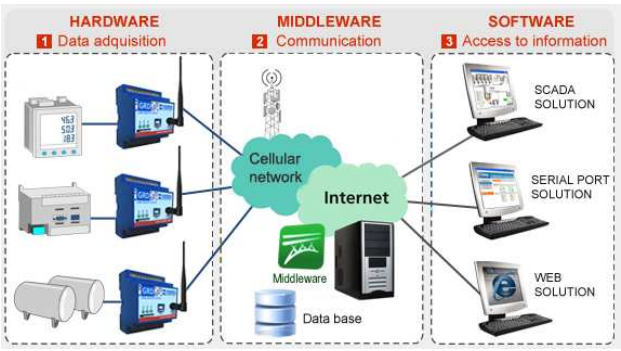

Figure 3. Supervisory and Control Solution

During the short term operations programming process could appear potentials saturations on transformers or lines in the system.

This gives the ability to communicate, in advance, to industrial customers will need to apply the load interruptibility mechanism.
Also in the real time instance, in control center, may appear alarms showing the need to interrupt early consumption giving the possibility that this is accomplished through manual actions.
In cases in which saturation will occur as a result of contingencies in network, loads interruptibility take place automatically. These actions will result in orders issued by algorithms that are at all times by sensing analog and digital values from field.
The algorithms must be robust enough to ensure that there are no unwanted trips.
The loads to which they are addressed the opening orders form a matrix that is defined priority levels.

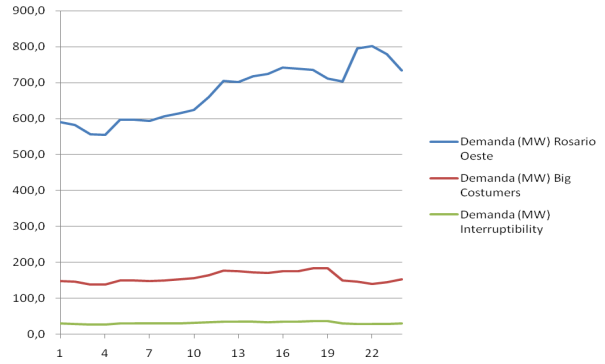

Figure 4. Rosario Oeste Load (Decembre 20, 2012)

"PROSUMERS" MANAGEMENT (PM).

In the same way as ACL case are evaluated characteristics of each consumer demand, "prosumers" management (PM), is to identify those consumers with possibility to generate their own demand in some percentage

Under the concept of Virtual Power Plant (VPP "virtual power plant") the Control Center operates a group of distributed generation facilities thus having a certain amount of MW that could, in concert, used similarly to a conventional plant, working in the crushing of peak flow in the elements with concrete possibility of saturation but significantly improving resource utilization.
Virtual power plants are part of the idea of "smart grid". Control Center is that through information networks and defines oversees operational actions on the system.

It is considered necessary to know the resource availability of distributed generation for what should be minimally monthly and weekly programming. From this, the modules should be placed power available to avoid saturation in transformers and interconnection lines.
This resource will be used with the primary objective of reducing consumption during peak system.

Prosumer	MW Offered
Noble	25
Cargil	8
Molinos SLO	25
General Motors	5
Buyatti	5
Molino SUR	1
Terminal 6	6
TOTAL (MW)	**75**

Table 1. Prosumers in Rosario Oeste – MW offered

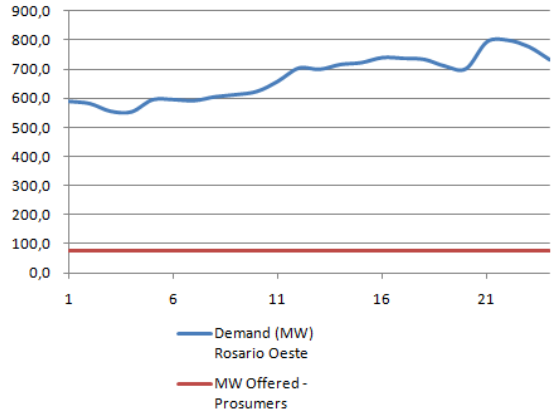

Figure 5. Demand Rosario Oeste vs. MW Prosumers

ACL and PM SERVICES

ADM measures are already being implemented in a while. The best known of all sectors are efficiency measures and energy savings that aim at reducing the area below the load curve. These are measures that have great importance in the national and regional energy balances, but can not achieve the effect of flattening of the curve in certain network elements operating in extraordinary situations

A marked difference between peak and valley makes them less efficient use of the system's infrastructure and forcing it to size the peak demand forecasts. The industrial sector tariff is applied by time band signals so in general terms the processes are adapted to introduce greater efficiency with respect to energy cost has in each segment, achieving discourage consumption in peak periods.

This paper describes two actions in the framework of the ADM aimed at reducing consumption in peak hours the system or in emergency situations through the interruptibility demand generation ACL and those consumers with generating capacity PM.

It is proposed to consider both cases as a paid service. For

ACL, you must agree in advance the levels of demand reduction and economic recovery thereof. All this is formalized through a contract with the system operator.

Furthermore, in the case of PM is proposed netmetering mechanism. This means that the service provider will recognize a purchase price equal to the sale for the energy generated. This is proposed despite the difference is very large due to the existing subsidy policy in Argentina, especially if the generation is based on liquid fuels.

For some energy consuming sectors as a result of current economic policy have incomes above the national average, it appeals to the concept of corporate social responsibility as a commitment mechanism for participation in this plan of ALM.

CONCLUSIONS:

The ADM is a change of perspective in the energy concept, because until now, the idea was that they should adapt always the generation and transforming infrastructure to supply the demand with a profile hardly changeable.
The proposed implementation, is an operational tool that allowed, in active way, adapt the demand to the available infrastructure transformation, achieving greater efficiency in planning and in operative processes of the network, especially in situations of emergency or extraordinary demand peaks.

In the case studied Rosario Oeste node, was obtained interruptibility forecasts of demand by about 4,7% (average).In the case prosumidores management, power injection 75 MW reached a value which approximates MW 11% of the total demand node.

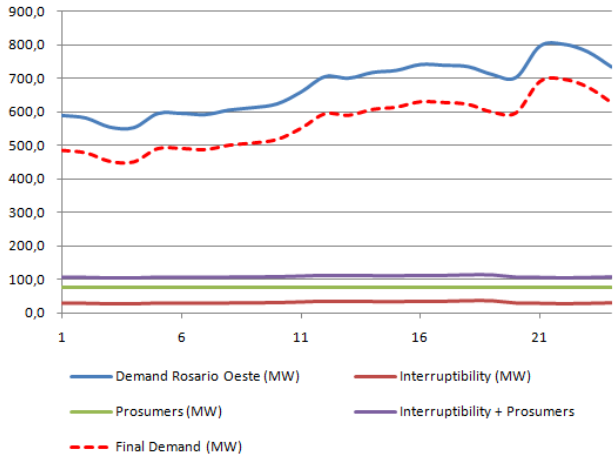

Figure 5. Rosario Oeste Demand – ADM (applied all day)

This allows operation without restrictions to the application, as it prevents transformer saturation and increasing lines deadlines which must be realized in the infrastructure needed to increase capacity and delaying the corresponding investments.

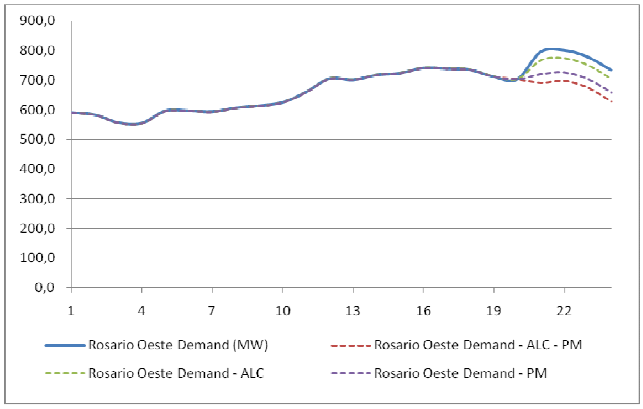

Figure 6. Rosario Oeste Demand – ADM (applied only in the peak)

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