MITIGATION OF LEVEL OF INCIDENCE AND FREQUENCIES FOR SHORT CUTS

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ABSTRACT

This work describes the service improvement or disturbance mitigation achieved respecting the occurrence of short cuts in the networks of the electric power distribution utility Energía San Juan SA, Argentina, by means of analyzing said occurrence rates under the light of the information supplied by a SCADA system, and with the referencing aid of an Electrical GIS. The analysis has allowed adjusting the strategy for trimming the street trees branches to lessen the disturbing effects, as well as in redefining the coordination strategy of electrical protections installed throughout the networks.

INTRODUCTION

The quality standards to which the Power Distribution Utilities of Argentina are subjected establish a number of requirements to render a good quality service to their clients. A number of these factors are analyzed for one of such utilities, namely, Energía San Juan S.A., concessionary company for Electric Power Distribution in the Province of San Juan, Argentina.

The Concession Contracts stipulate the quality levels that the appointed utility company should meet, as well as the compensation to clients whenever such levels are not met. The compensations (penalties or fines upon the distributing utility) stand as a signal for the company such that the quality level becomes the result from costs optimization between investments, operative and maintenance costs and user compensations (penalty fines).

As regards technical service quality (service interruption, i.e., power outages), the Concession Contracts establish the limits for power outage occurrence and duration, as well as the minimum lapse to be considered as service interruption: 3 minutes. No penalty is set for service interruption lasting less than three minutes, including the Short cuts, namely, service interruptions lasting just few seconds. This type of interruption, however, is a nuisance to some clients, besides causing ageing of protection equipment. Therefore, its mitigation is particularly important for distribution utilities.

Short cuts are mostly introduced by protective systems using automatic reconnection, since in those distribution systems which are exposed to transitory contingencies produced mainly by weather conditions, vandalism, tree branches contact and fall-off, and other factors, the use of such protective equipment has allowed companies to maintain continuity in their service when faced with transitory failures, at the expense of having clients perceive minor power interruptions in their service.

Energía San Juan S.A. has made a major investment in their Protections System, by replacing all of their relays by state-of-the-art digital equipment, thus incorporating automatic re-connection systems and circuit breakers, in addition to implementing a SCADA system that allows to remotely monitor, command and supervise all HV/MV and (26) MV/MV transformer stations, as well as most recloser and (60) sectionaliser installed throughout the mid-voltage distribution network.

The implementation of a SCADA system allowed obtaining a series of data on the operation of feeders reclosers and sectionalisers, with which to perform an analysis of the number of operations of the various protective devices.

This paper describes the improvement or mitigation attained as regarding short cuts in distribution networks of Energía San Juan S.A., by analyzing the occurrence of disturbances in said networks, and taking into account the information from the SCADA system. This analysis has allowed making an adjustment to the strategy for branch trimming of street trees, as well as a re-statement of the coordination strategy of electrical protection equipment.

The paper presents the results of the study on the occurrence reduction of short cuts, as well as a brief analysis and work conclusions.

ELECTRICAL GIS AND SCADA SYSTEM

The combination of a complex electrical system and the high quality standards imposed by the concession contract call for incorporating state-of-the-art technology to manage he distribution networks, either under normal operative state or under contingency. In such a context, Energía San Juan S.A. has implemented the project Telemeasuring and Telecontrol of the electrical system to perform the operations of both the sub-transmission and the distribution systems, aiming at improving the service quality rendered to the utility's clients, as well as at optimizing the operative and maintenance resources.

This Project considered installing telecontrol equipment in all 26 HV/MV/MV (132, 33/13.2kV) Transformer Stations of the Interconnected System of the Province, along with all the software needed to remotely operate the equipment, as regard equipment mounted on poles of the 13.2 kV distribution network

Said total equipment is composed of a Control Center, 34

Remote Terminal Units, Telecommunication System – where telecontrol is performed on all interrupter, reclosers and sectionalisers of the system.

The Telecontrol SCADA system meets the standards for Open Systems. It features two server nodes (one of which performing as a SCADA server and the other as History Server, and both under Hot-Standby configuration), and two operation consoles, integrated in a double LAN of modular, distributed architecture with expansion capabilities. Historic data filing is through an array of history discs of SCSI technology connected to both servers. The operative system is UNIX, and the workstation architecture is RISC. Communication with the RTUs is via radio links operating in UHF bands.

Since 1998, Energía San Juan has started working in implementing a software-based solution that allows satisfying the needs for network operation and maintenance, along with additional factors such as costs and business requirements, satisfying users claims, engineering and works planning and scheduling, and other. The above solution has been combined with an Electrical GIS capability to satisfy the needs for geo-referential information as regards the users and their behavior, as perceived by the electrical system, specifically the LV networks.

INDICATORS FOR SERVICE QUALITY

The control of Tecnical Service Quality is established in Appendix 3 of the concesión contract. Measurement is perfomed through data bases kept by the Distribuiting company. They include information on contingencies that can be associated to the network topology data and their relation to commercial information of users which, in turn, allow attaining the outage indicators for each customer

The maximum admissible values for this stage, for each user, are:

a) Frecuency (rate) of interruptions:

HV/SV Users	: 3 outages/semester
MV Users	: 4 outages/semester
LV Users (small and mid-size demands)	: 6 outages/semester
LV Users (large demands)	: 6 outages/semester

b) Time of Power Outage (Interruptions):

HV/SV Users	: 2 hours/semester
MV Users	: 3 hours/semester
LV Users (small and mid-size demands)	: 10 hours/semester.
LV Users (large demands)	: 6 hours/semester

The non-supplied energy is value rated according to the following tariff rate table:

Tariffs 1-R	:	1,40 $/kWh
Tariffs 1-G and 1-AP	:	1,40 $/kWh
Tariffs 2 and 3-BT	:	2,27 $/kWh
Tariffs 3-MT and 3-AT	:	2,71 $/kWh

If, during the control semester, any user experiences longer outages (more than 3 minutes) than stipulated ones, or if s/he has no service for longer that the pre-established time, s/he shall receive from the Distributor company a compensating bonus (creditable discount amount to the bill)

The non-supplied energy to the user will be rated according to the duration of service interruption, time of day it occurs and the annual energy rate billed to the user.

DESCRIPTION OF THE ELECTRICAL POWER SYSTEM OF ENERGÍA SAN JUAN S.A.

The electrical system of the concession area of Energía San Juan S.A. is composed by an electrical network f 132, 33 and 13.2 kV levels, called Provincial Interconnected System (Sistema Interconectado Provincial), supplying power to about 180,000 users, and annual energy demand rates of about 1,005GWh. This system is fed through a transforming station 'ET San Juan' of the Trunk HV Distributor 'Distrocuyo', which is linked to the National Interconnected System of Argentina (Sistema Interconectado Nacional-SIN).

The SIP includes a network interconnected at 132, 33 and 13,2 kV levels in the Province's valleys of Tulúm (the most densely populated area of San Juan, with Sectors: Capital, Gran San Juan, Rauson, Pocito and neighboring areas, including the Departamentos (counties) Albardón, Angaco, Caucete, 25 de Mayo, Sarmiento and other areas), Ullúm and Zonda., as well as the recently incorporated Departments of Jáchal and Iglesia.

The SIP is composed of a 33 kV ring that links all 26 primary transforming stations that perform as Distributing Hubs from which the 13,2 kV feeders radiate out. These, in turn, feed the secondary distribution stations, i.e., mean and low voltage transformer stations

A point worth mentioning is that, out of 4,026 km of 13,2 and 33 kV network length, about 70% runs through street tree canopy.

SOURCE OF SHORT CUTS

Main sources for short cuts are the single-phase short-circuits caused by contact of MV feeders with branches of street trees, and the partial discharges arising during rain storms.

The Province of San Juan lies in an arid zone of Western Argentina, on the rain shadow side of the Andes, with very scarce rainfall rates. This is a constraining factor at the time of deciding the branch-trimming strategy and the electrical protection coordination as undertaken by Energía San Juan, which –nonetheless- strongly influences in mitigating the short cuts rates.

This short cuts mitigation is a critical factor, due to the annoyance and financial damage caused to the company's customers by said disturbances.

On account of San Juan's desert characteristics, the trees

along streets are considered a precious asset because of their shadow (cooling) and landscape beautifying features, as well as being an essential element in combating desert effects. The State, therefore, enforces a strict regulation on tree branch trimming and tree eradication.

The laws that regulate the trimming practice of public trees sets a radius of 1.5 meters around the electrical lines running on poles. This is a very narrow channel through canopy, because -mainly in summer- branches have grown back and touch the lines again.

Since it is not financially convenient to substitute the conventional overhead lines for protected or pre-assembled cable sets, Energía San Juan S.A. has opted for implementing a trimming plan with three rounds per year along all feeders of the network.

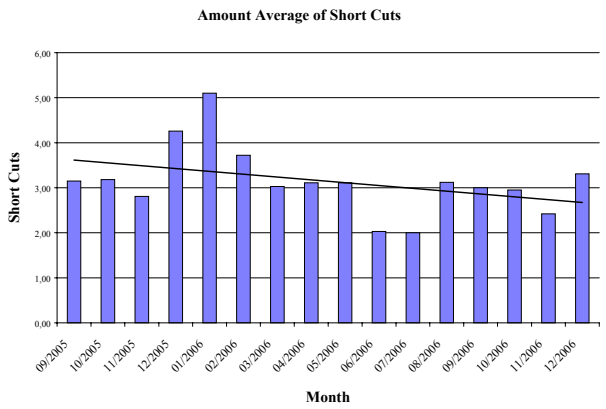
Through time, it was acknowledged that this strategy was not efficient enough, because the growth of branches in certain regions of San Juan was faster and greater than the planned trimming round rate.

On these grounds, it was decided to change the strategy by using the following information:

- Operation of interrupters, reclosers, etc through the SCADA system.
- Utilization of our Electrical GIS that allows pin pointing the geographical location of actuated protection devices
- Relation of each protection device with the street trees lying downstream the line.

By means of a periodic exercise of this strategy, the distributing utility issues a trimming recommendation which modifies the course of trimming rounds.

The next graph depicts the decrease in average short cuts ratings as per feeder, recorded from September 2005 until December 2006.



CONCLUSIONS

The improvement of technical service quality rendered to the user is a primary objective of Energía San Juan S.A. This is mainly achieved through a correct diagnosis of what happens throughout the network system, and with the corrective measures which imply a rapid identification and measures taken to overcome contingencies.

This work has presented a strategy aimed at mitigating the short cuts using the information supplied by the SCADA system, the Electrical GIS of the company and the branch trimming plan for street trees. The implementation of said combined strategy has enabled to decrease significantly the short cuts occurrences, as well as in optimizing the financial resources for mitigating such service disturbance.

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