SMARTGRIDS ARRIVES AT THE LOW VOLTAGE DISPATCH CENTERS

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ABSTRACT

One of the greatest challenges of a Distribution System Operator (DSO) is to ensure continuous improvement in the quality of service, while improving efficiency and decreasing operational costs.

EDP Distribuição (EDP Group),Portugal is the Low, Medium and High Voltage Distribution System Operator in the country, with more than 6 million customers, over 400 HV/MV Substation and 60 thousand MV/LV Substations, including 80 thousand km of HV/MV network and about 140 thousand km of LV Network.

The management of LV network interruptions is supported by an Outage Management System (OMS) that receives the trouble calls from customers, tries to determine their scope and, therefore, make all efforts to quickly restore energy supply. This is essentially a reactive process since, typically, there is no LV network monitoring.

InovGrid, EDP Distribuição's project for Smart Grids, introduced new equipments and tools that allowed to rethink the management of outages in LV networks.

INTRODUCTION

In August 2011, EDP Distribuição started a pilot in the LV network Dispatch Center, in the geographical area of the city of Évora, and since then began to take advantage of the technological infrastructure that supports the InovGrid project.

This pilot, with duration of 9 months, had as its major objectives:

- to evaluate new procedures in LV network outages management, according to this new reality
- to estimate a potential reduction in operating costs
- to identify improvement areas, in terms of systems development and integration and field crews' performance.

Universe of this pilot: about 30,000 customers

DTC: Distribution Transformer Controller
EB: EDP Box (Smart Box)

In terms of operational cost reduction, it should be noted that LV network outage can be classified into two major groups:

- Outages where local intervention is necessary, of at least one crew, to repair elements of an electric network.

- Outages where, by difficulty in obtaining clearer information from the customer, one crew is allocated and later concludes that the cause of the outage is in the customer installation and therefore there is no responsibility from the DSO, EDP Distribuição, to do the repairing. This kind of outage, designated by customer installation malfunction, requires an unnecessary movement of a crew and represents about 22% of all LV outage (2011 data).

This second large group (customer installation malfunction) was the subject of analysis, within the scope of this pilot project, which tried to quantify the reduction of unnecessary crew´s activity it would have been possible to achieve.

FUNCTIONALITIES POWERON / SYSGRID

The constituent features of the InovGrid infrastructure allowed to immediately think of new solutions that could be integrated into the management activity of the LV electric network. These functionalities, which will be described below, were developed mainly in two systems of EDP Distribution:

- PowerOn: Outage Management System.
- SysGrid: InovGrid infrastructure support system, responsible for the communications between the EB and the central system.

Functionality 1 - Confirmation of power outages

Whenever a new trouble call of a customer with installed EB arrives at PowerOn, a set of questions are triggered to the SysGrid system through an automatic process.

Depending on the answers obtained, it may be possible to determine the origin and extent of damage of the electric network.

Furthermore the operator can complement the information obtained through a manual process:

Automatic process:
When a customer reports an outage, PowerOn, through

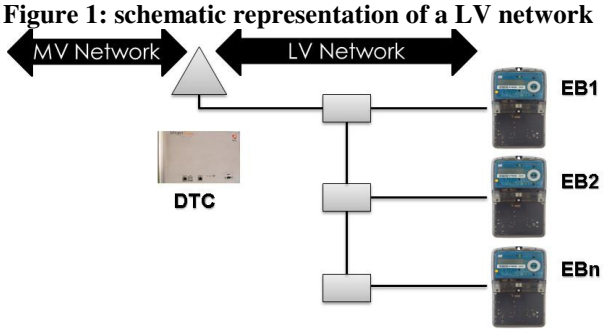
the interface developed with SysGrid, questions the EB on that customer's installation and may return the following information:

- EB commercially off
- EB with power (possible malfunction of the client installation)
- power not present at the EB

In this last case, an automatic process starts to question several EB in the same LV circuit, to determine the probable fault location.

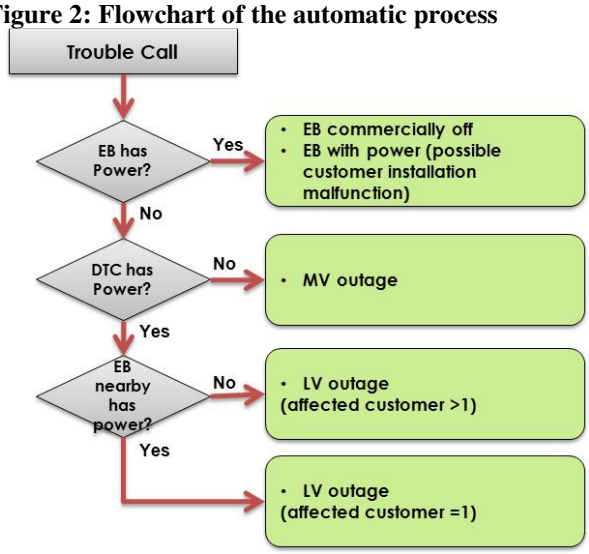
Once PowerOn has all the records of the electric network, i.e. it is known at what point of the electric network a specific EB is connected, Figure 1, the algorithm seeks to identify the most likely point of outage.

Figure 1: schematic representation of a LV network



This algorithm, Figure 2, questions the EB and DTC, in the form of web services, in order to determine whether the equipment in question detects the presence of voltage.

Figure 2: Flowchart of the automatic process



Manual process:
The operator has also available a set of actions that complement and enhance the automatic process, in particular:

- Events occurring in the EB and MV/LV transformer (i.e. no voltage)
- Nominal values of voltage and current in the EB and MV/LV transformer
- Charge diagrams of EB and MV/LV transformer
- Perform remote controls (connect and update configuration parameters of EB and DTC)

Functionality 2 - Process monitoring of outages

Periodically, at configurable time intervals, a system process analyzes all outages occurring. This process aims to monitor all faults that are ongoing in order to provide additional information to the operators, for example: ensure that operators are alerted to the duration of outages that have not exceeded the maximum allowable durations.

Functionality 3 - Reception of DTC events

Whenever a DTC identifies an absence of voltage, it notifies the PowerOn system through an event. The received information generates a new outage in PowerOn. This feature allows the monitoring of all MV / LV substations that have a DTC installed.

DESCRIPTION OF THE PILOT PROJECT

The traditional process of LV outage management in EDP Distribuição has the following steps:

- Call Center receives a trouble call from a customer and performs a first triage, using a script of questions to ask the customer.
- The LV network Dispatch Center receives the trouble call in PowerOn and seeks to identify the cause and monitor their resolution, recurring, whenever necessary, to a field crew.

The procedures for managing LV outages developed for this pilot took into account the features described in the previous chapter.

This pilot was developed in two phases:

- **Phase 1**: Aug/2011 to Dec/2011 – At this stage, only the LV network Dispatch Center changed its procedures to include the features described above.
- **Phase 2**: Jan/2012 to Apr/2012 – At this stage, the Call Center included in their procedures features of SysGrid.

In each of the stages it was attempted to quantify the reduction achieved by avoiding to send a crew to a customer installation malfunction versus classical triage procedures.

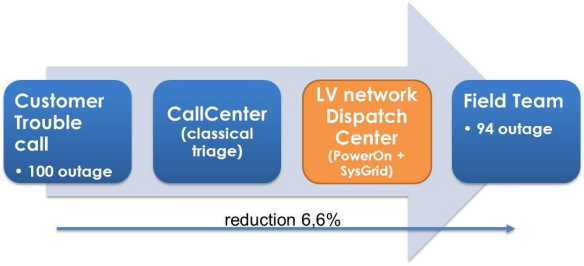
BENEFITS

The remote supply restoration and early identification of

faults and their scope, allowed to extrapolate a better crews' management, reducing energy interruption time and operating costs, leading to a greater customer satisfaction.

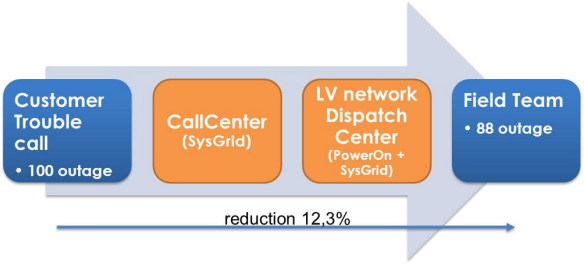
During the first phase of the pilot, the average value of complementary triage made by LV network Dispatch Center (without any crew was displaced to the customer's installation – cost reduction) was around 6.6% of total LV outages occurred in the city of Évora, Figure 3.

Figure 3: Phase 1 – Simplified flowchart of the process management of LV outages



With the introduction of the SysGrid system in the Call Center during phase 2 it was verified that in this period, the average value of triage made (without any crew being displaced to the customer's installation – cost reduction), reached a value of 12.3% of total LV outages that occurred in the city of Évora, Figure 4.

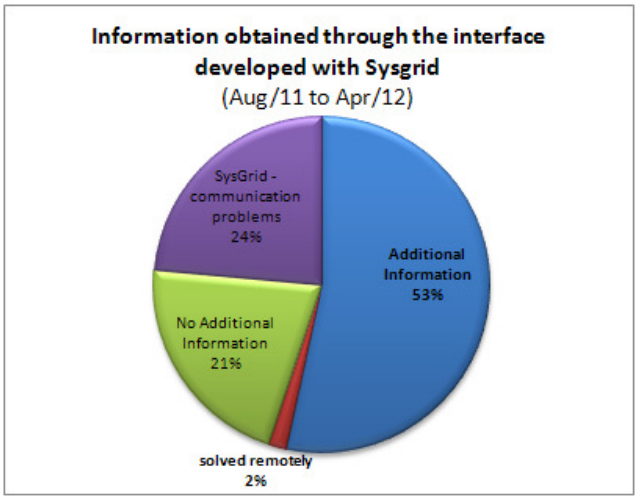
Figure 4: Phase 2 – Simplified flowchart of the process management of LV outages



The following graph shows the type of information obtained by the LV network Dispatch Center for all occurrences above which was identified as malfunction of customer installation. It can be stated that there is potential for improvement because the percentage of outages for which there is useful information available has shown an increase tendency, Figure 5.

- In 53% of outages, additional information of the network state was available to the operator, providing faster and targeted performances.
- 2% of the outages were solved remotely from the LV dispatch center, without sending any crew to the site.

Figure 5: Information obtain through the interface between PowerOn and PowerOn



Finally, SysGrid has allowed the LV network Dispatch Center obtaining complementary information, for example:

- Identification of failures in electric network.
- Identification of electrical circuits affected.
- Identification of voltage disturbances in the electric network.

NEXT STEPS

Based on the results obtained in this pilot and in the new ideas to improve and optimize the entire process of managing LV outages, the next steps aim to:

- Optimize the automatic process of detecting outages, by promoting the proactive resolution of LV outages.
- Increase the quality of relevant information available on PowerOn, using Smart Alarm system.
- Make available some of SysGrid features in PowerOn.

CONCLUSIONS

Data obtained during the monitoring period allowed to conclude that the remote solution of outages has become a reality and that the overall information available, for each outage, increased significantly, consolidating the large expectations in the strong impulse that smart grids are bringing to LV network operation.

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