ANTIFRAUD SERVICE DROP CABLE IN LOW VOLTAGE AERIAL DISTRIBUTION

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INTRODUCTION

Power losses were one of the main problems that Distribution Companies found in Argentina when the process of privatization started.
This task describes principal characteristics of the adopted solution and obtained results with its application.

LOSSES

When private companies took over the distribution system, losses amounted for company EDESUR a total level of about 26% ; 10% for technical losses and 16 % for non-technical losses. Taking as an example EDENOR, the other distribution company in Buenos Aires, figures reached 30% ; 10% for technical losses and 20% for non-technical losses.
Technical losses are the ones which are caused due to their own conditions of installation, handling and energy transmission. Basically, these losses are produced by the circulation of electrical current through the electrical system of distribution. Its extent depends on the characteristics of the nets and the loads connected. They are unavoidable, but they must be limited providing an optimization between the required investments to reduce them and the benefit obtained for the power sale.
Non-technical losses are all the financial ones sustained by the company from the moment the energy is effectively consumed, but is not invoiced or charged. The illegal energy usage is found within this group, that is for the sake of its usage, company material and equipments are unlawfully taken. One of the most important abnormality is the illegal connection to the low voltage net. This deed was mainly carried out in shantytowns.
Due to this situation , distribution companies decided to plan a set of actions by developing strategies, policies, advertising campaigns and also new concepts and products for the system, lowering total losses to around 10% for Edesur (fig.1) and 13% for Edenor (fig.2).
Within technical measures the change to less vulnerable distribution nets was taken into account. These are distribution nets with preassembled cables ,suitable accessories, poles and watthour meters, and the replacing of traditional service drops by antifraud cable.

Example of antifraud system implementation (Edesur)

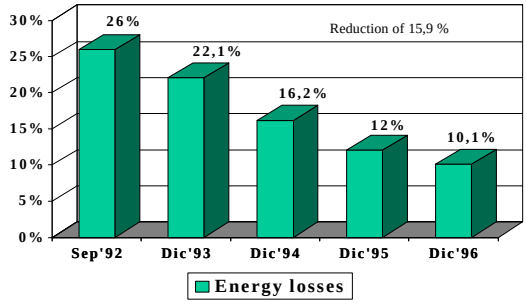

figure 1

Example of antifraud system implementation (Edenor)

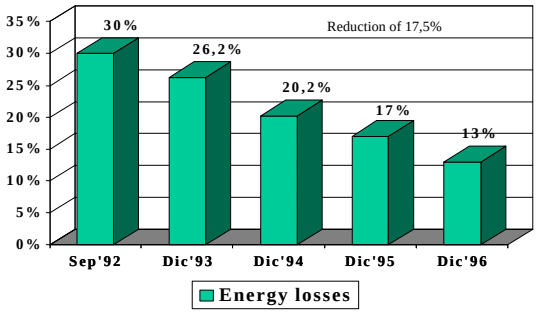

figure 2

The highest usage of low voltage preassembled cables produced a considerable reduction in power theft by illegal connections since they are insulated twist cables. Before the distribution was made by means of bare or PVC insulated cables flat arranged mounted on insulators which let carry out illegal connections easily.

However, connections to consumers were the weak point of this system due to its easy access. To sort it out, in more critical areas the traditional cable to connect the consumer was successfully replaced by antifraud cable, avoiding the access to the phase conductor by means of piercing or cutting the insulation.
By the concentric cable pattern, the phase conductor remains protected by the neutral conductor, which surround the insulation.
Before any illegal connection attempt a cable short circuit is produced interrupting the consumer service.
To allow the clandestine connections to be detected, it's necessary the usage of protections or fuses placed in inaccessible sites, like at high level near the principal line.
In most of the cases this cable is used for single phase feeding, but whenever it's necessary it's also used for a three phase feed by means of three cables.

CABLE DESIGN

First cables of this kind were made with PVC insulation and external PE sheath.
The current cable design consist on a central conductor used as a phase, elaborated in one wire o seven copper wires with XLPE insulation. Upon the insulation it is applied a concentric conductor formed by helical copper wires that cover the whole of the insulation. This shows the same section of the central conductor. Under and over the concentric conductor a polyester film separator is applied.
Finally this cable possesses an external black weather resistant XLPE sheath.
The XLPE insulation advantages the PVC insulation in a greater current capacity both in normal service and in short-circuit condition since it is a thermosetting material, bearing over the conductor 90°C in continuous service and 250°C in short-circuit condition.
The cable nominal voltage is 600 V being specified by main distribution country companies based upon IRAM 2178 and IRAM 2263 national standards.
Conductor section used range from 4 mm² to 16 mm².
Working with maximum tension that do not exceed 25% the breaking load of conductor, it's possible to save spans up to 35 m.

KINDS OF SYSTEMS

This cable usage in Argentina has been basically seen in two different systems :

1) Medium voltage distribution (13,2 kV) with single phase pole transformers, use of interconnection boxes and service drops with antifraud cable. This system is appropriate for areas with low load density, with one or more low power transformation centers (5 to 10 kVA) conveniently placed in every block (fig.3).
From interconnection boxes the consumer connection can be made generally using 4 mm² section conductor , or another box can be fed using a 6 mm² or a higher section cable.

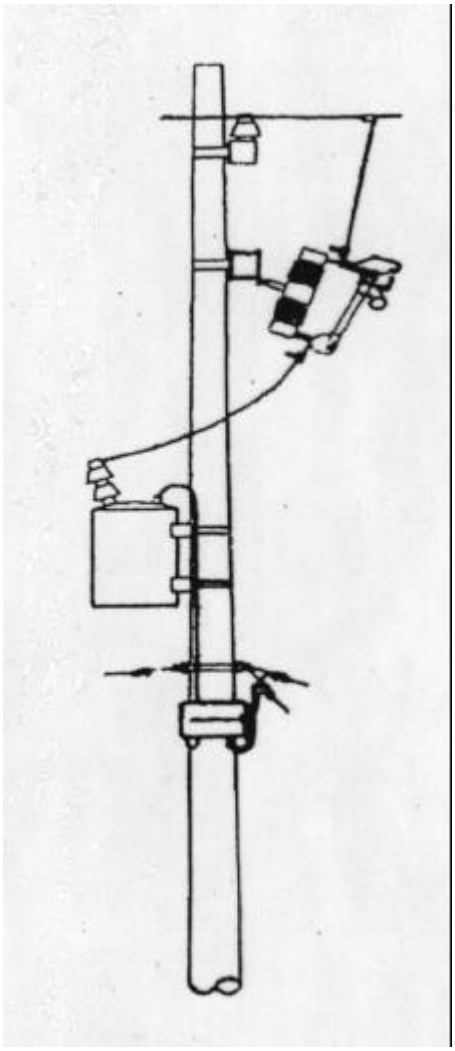

figure 3

2) Low voltage distribution with preassembled cables. Derivations to users with antifraud cables can be made or over the span (fig.4) or by means of interconnection boxes placed on the poles (fig.5) with 4 mm² cable.

This system is mainly used in areas with medium load density.

According to excellent results obtained in the usage of this cable, the use is being spreading to areas where energy theft risk is lower.
Besides, this cable shows a lower visual impact than traditional service drops.

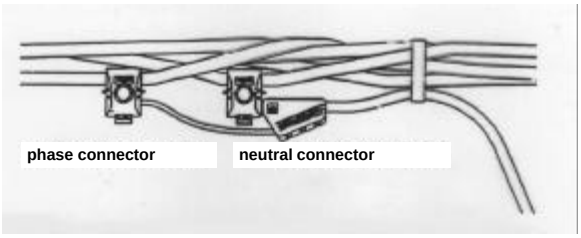

figure 4

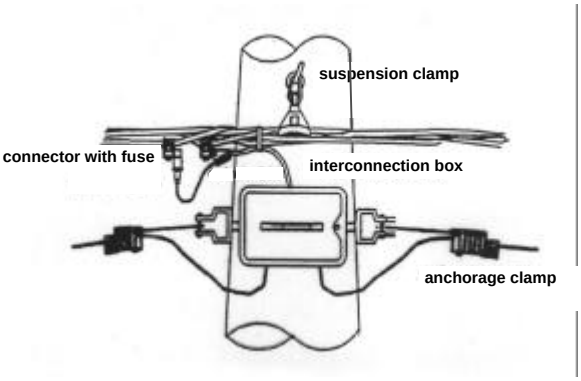

figure 5

COMPLEMENTARY ACCESORIES

Some accessories to make a service drop with antifraud cables exist, among these we can point out; auto-adjustable clamps , formed dead ends , derivation connectors with or without fuses, interconnection boxes, watt-hour meter boxes , etc.
We can also get in the market connecting kits which include all necessary accessories to carry out the service drop, simplifying the task in the moment to make the connection, since we take into account with all the necessary elements in only one packing.

CURRENT DEVELOPMENTS TO ENHANCE THE SYSTEM

Although the above mentioned antifraud systems have made it substantially possible to reduce losses due to energy theft through illegal connections, at the same time that the knowledge of this antifraud cable is becoming more widespread within the consumers , a certain system vulnerability is produced for the possibility to avoid, a careless cut of the concentric conductor, the short circuit with the central conductor and therefore avoid the illegal connection being detected.
In Argentina an antifraud patented system improvement is being experimented which makes the concentric service drop cable to be practically inviolable. It also provides a complete safety before short circuit dangers because of attempts of illegal connections.
The new system is based in the joining to the conventional antifraud cable of a second aluminium film concentric conductor that is connected with a high circuit breaker switched by a high impedance coil. Before the single attempt to cut the external cable sheath , a contact between the two concentric conductors is originated, made by the circuit breaker leading to a utility halt without the need that the short circuit with the phase conductor is produced.
This a highly sensible and a maximum safety system that do not make necessary the replacement of the cable if the access to the phase conductor has not been made.