Electric Power Monitoring Device

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Abstract: - This paper describes an Electric Power Monitoring Device for low voltage (127/220 Volts) distribution network. A small sensor box makes an automatic phone call when an outage occurs at the costumer residence. An automated Call Center identifies the device and generates an acknowledge signal to the calling device. Many Power Utillities uses the Call Centers not only for customers complains [1] but also as a way to register outages [2][3]. Currently most of the outages in feeders or branches of electric power distribution in Brazil is detected and registered from costumers' phone calls to the Utility Call Centers (generally a reserved phone number 196 for this function) [3]. When a feeder outage happens (that causes generalized outage), thousands of phone calls are originated causing a bottleneck at the Call Center. Usually most of those calls are not completed. Increasing the number of attendants to handle 100% of the claims is economically impracticable. On the other hand only through the phone call the Power Utility can receive the information about outages in feeder branches, after a key fuse for example. Using the device presented here, the Power Utility can receive a higher number of pone calls and have more information about outages in a shorter time and with better accuracy.

Key words: - power quality, Call Center, distribution operation *CSCC'99 Proceedings*, Pages:4691-4694

1 Introduction

Among the problems that compromise the quality of suppling electric power, the not programmed interruption of the supply is the one that brings more problems and damages to the costumers. All interruption has as cause a defect in the electric network and one can divide the defects in distribution networks in two basic types: defects that causes a restricted outage and defects that causes generalized outage. For generalized outage we understand that the protection equipment at the substation operates and all the costumers who depend on that feeder are left without power. For restricted outage we understand that only one branch of a feeder is left without power, either for disruption of cables, either for operation of local protection equipament (fuse, recloser), either for defect of a distribution transformer [12][13][14].

Currently the outage in feeders or branches of electric power distribution in Brazil is detected and registered from costumers' phone calls to the Utility Call Centers (generally a reserved phone number 196 for this function). By occasion of a feeder outage (that causes generalized outage), thousands of phone calls are originated provoking a bottleneck at the Call Center. Usually most of those calls are not completed. Increasing the number of attendants to handle 100% of the claims is economically impracticable. On the other hand only through the phone call the Power Utility can receive the information about outages in feeder branches, after a key fuse for example. Using the device presented here, the Power Utility can receive a higher number of pone calls and have more information obout outages in a shorter time and with better accuracy.

2 System Description

The system is composed by devices called "DOG-LIGHT" that carry through the functions of sensing the outages and originating phone calls.

These sensing units are plugged to the low voltage electric power network, at the costumers' residences or poles, just after the power transformers. A non-operated Call Center is responsible for the functions of automatic attendance of the phone calls made by the sensing devices, receiving and identifying the costumer phone number, generating the information about the physical location of the branch or feeder under outage, as well as the information about the feeder normalization after repair. Through the automatic receiving unit it is created the figure of the virtual attendant, capable to take care of up to 15 calls per minute per trunkline.

All information about the feeders and branches under outage are automatically generated, or either, it was created the figure of the virtual costumer, extremely objective and efficient in giving the information about an outage or return of electric power at its residence. The probability of a bottleneck at the Call Center is drastically reduced because dialogue between people doesn't take place, but only a data communication between an intelligent sensing device and an automatic reception system. The costumer identification method is based on the caller ID function used and regulated by the Brasilian Secretary of Telecommunications, also known as "BINA" (B IdeNtify A). A DTMF coded signal having the caller phone number is sent by the Phone Utility and this signal is used by the automatic call center to identify the caller number and direction from a look-up table, thus locating the power line under outage.

The technologies used in the development of the sensing devices and in the Reception Unit involve microprocessors RISC (Reduced Instruction Set Computer) and DSP (Digital Signal Processor).

3 Sensing Device

The sensing devices are responsible for the detection of outages and return of electric power in low voltage (127V/220V) and to transmit this information to the automated Call Center. Four (4) distinct models of sensing devices had been developed to know:

1. Single-phase residential unit (Fig. 1).
2. Single-phase residential unit inside a phone set (Fig. 2).
3. Indoor three-phase unit (Fig. 3).
4. Outdoor three-phase unit (for pole instalation) (Fig. 4).

Single-phase models 1 and 2 and three-phase model 3, Fig. 1, 2 and 3 respectively, are for indoor installation using the costumer´s private phone line as communication medium. This solution presents the advantages of easy installation and low operational cost. An agreement is signed between the costumer and the Power Utility, where some discount on the power tariffs are offered.

Three-phase models 3 and 4, illustrated in Fig. 3 and 4 respectivelly, are used to monitoring the 3 phases in a simultaneous way, with the same sensing device. This solution presents the advantage of using fewer devices and fewer phone lines than using the single-phase models, however they need an more elaborated installation design. The three-phase model (Fig. 3), was developed for urban installation in residential or commercial buildings, and is to be installed in the box of internal distribution, after the transformer.

Fig. 1 - Single-phase residential unit

Fig. 2 - Single-phase residential unit inside a phone set.

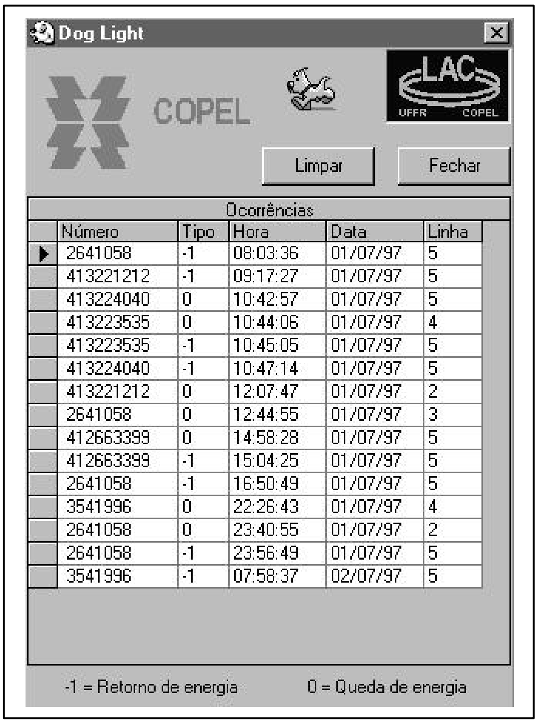
Fig. 3 - Indoor three-phase unit

Fig. 4 - Outdoor three-phase unit (for pole instalation).

The outdoor three-phase model, Fig. 4, can be installed in any pole with 3 phases and neutral, supllied direct by the distribution transformer. Its advantage is an easier installation comparade to model 3. Its disadvantage is to present a higher cost than the indoor three-phase model, therefore it is conditioned in a weather resistant box. All models are compatible among itself, in other words, use the same protocol. It is possible, then, to use units of any model in any quantity, simultaneously. The expansabiliy of the system is total because units do not have internal codes that differentiate them, or either, the units are interchangeable among them. This fact makes the maintenance more simplified and economical.

4 Automatic Call Center

The Automatic Call Center has as function to receive the phone calls generated by the units sensing an outage, to generate the acknowledge signal that puts the calling units of transmission in standby state, after a successfull communication. The Automatic Call Center has two trunklines for incoming calls. A trunkline is used to receive the calls when an outage is sensed by an unit at the customer's residence. The other trunkline is used to receive the calls when the electric power returns. The quantity of trunks depends on the number of sensor units in the region, as well as on the time desired to receive 100% of the monitored area. With a modified software, this System can be used by Regulatory Agencies to monitoring some customer's of the cities, and evaluate the perfomance indices of outage rates (AIDI – average interruption frequence and AIFI – average interruption frequence index) informed by local utilities. In Fig. 5, one screen of Automatic Call Center can be observed showing the events of outage and return of electric power.



Número	Tipo	Hora	Data	Linha
2641058	-1	08:03:36	01/07/97	5
413221212	-1	09:17:27	01/07/97	5
413224040	0	10:42:57	01/07/97	5
413223535	0	10:44:06	01/07/97	4
413223535	-1	10:45:05	01/07/97	5
413224040	-1	10:47:14	01/07/97	5
413221212	0	12:07:47	01/07/97	2
2641058	0	12:44:55	01/07/97	3
412663399	0	14:58:28	01/07/97	5
412663399	-1	15:04:25	01/07/97	5
2641058	-1	16:50:49	01/07/97	5
3541996	0	22:26:43	01/07/97	4
2641058	0	23:40:55	01/07/97	2
2641058	-1	23:56:49	01/07/97	5
3541996	-1	07:58:37	02/07/97	5

Fig. 5 - Screen of Automatic Call Center showing the events of outage and return of electric power.

5 Tests And Results

In the period from March to July of 1997 a pilot test had been performed with 80 (eighty) sensing units of type 1 (Single-phase Residential) strategically distributed in the metropolitan area of Curitiba, Paraná. The voluntary costumers for the tests had been chosen among employees of the COPEL - Companhia Paranaense de Energia (Parana Electric Power Utility). Each costumer simulated many controled outages and returns of electric power in its residence according pre-defined schedules. The results had been observed in real time through the screen of the automatic call center, as seen in Fig. 5, and registered automatically in daily files. At the end of test period, the outages and returns had been compared, with the registered in the Automatic Call Center. Due to the positive results in the test pilot, 500 (five hundreds) more sensing units for pole, Fig. 4, had been installed also in the region of Curitiba. Currently this system is being installed in the city of Cascavel-PR.

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