Software and Hardware Equipment Power Quality Monitoring Inside a Transelectrica High Voltage Power Station

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***Abstract*— This paper presents a dedicated software (as well as the associated hardware) used for power quality analysis. Power quality is one of the important objectives of the transmission and distribution network allover the world. Several aspects concerning the PQ monitoring interface between the transmission network and the distribution network are revealed for a 110 kV voltage level. This is a case study for the current situation and for the perspective. The system used for the power quality monitoring parameters (software and hardware) is described as applied on a representative substation within the Romanian Power System (Iernut substation).**

I. INTRODUCTION

Software quality for a certain application is a major aspect of today engineering, even when it's used for Power Quality assessment. Power Quality (PQ) is a complex and controversial issue, whose importance in proved by role that the electric energy has within the contemporary society. In 1985 the European Commission Directive 85/374 EC, established that the electricity is a "product", requiring clear definition of features. A perfect electricity supply service is characterized by the fact that it is always available, providing the voltage and frequency values within the admissible limits and an almost perfect sinusoidal voltage without any "noise".

This paper presents several aspects of the computer based PQ monitoring interface between the transmission network (TNE) and the distribution network (DNE), for a 110 kV voltage level, in order to check the current situation and perspective. The permanent or temporary PQ monitoring is made in the common point of connection (CPC), where the system operator/provider has the obligation to provide power according to the quality contract, and the supplier/consumer is required to limit the perturbations induced within the National Power System (NPS) below the quota.

In order to know the exact situation in the TNE buses and sources of disturbance, there is a complex program of measurements, using acquisition and processing equipment dedicated to the private TNE-DNE interface.

All the incidents that occur in the TNE, defective insulation, shape-discharge and puncturing caused by over-voltages, are producing large variations in voltage, goals, interruption for short and long term, leading to disturbance in power service supply to end consumers. Quality of electricity in DNE is affected both by voltage values outside the admissible range and the distortion of the voltage and power curves. Inside DNE, power quality monitoring involves tracking buses within the network and the joint connecting users and setting for each user connected level disturbance generated.

II. POWER QUALITY INDICATORS

Power Quality is the major objective of the transmission and distribution network. In this sense, there is an intense interest in defining a clear set of indices to assess the power quality, setting limits accepted by employers, their development of methodology for allocation of the disturbance, setting a strategy for detecting perturbed buses, disturbance sources, the design of specific solutions to improve the power quality and the establishment of damage that may occur in offense against the limits of quality indices [2].

Depending on the place where the disturbances occur, indices are divided into the main PQ indices, which are based on particular activities in the field of production, transmission and distribution of electricity. There are also established the secondary indices determined primarily by the operation of the disturbing consumers. The assessment and the monitoring activity are made in the common coupling point, representing a bus within the supply network, not specific to a particular consumer [1],[2], [3].

The main PQ primary indices are:

- the frequency of supply voltages (controlled by the power adjustment P-f);
- voltage magnitude on the supply buses (controlled by adjusting Q-U and adjustment and electrical transformers, autotransformers within the existing network);
- temporary and transient over-voltages (limited and controlled by over-voltages protection system and surge-arresters);
- voltage gaps (limited by the protection relay or other means);
- interruptions, cut-outs (short and long term) indices of quality service (Power Supply), as set by the supplier together with the consumer, according to its requirements.

The PQ secondary indices are the followings one [9]:

- harmonics and inter-harmonics (nonsinusoidal schemes);
- rapid fluctuations of voltage;
- slow voltage fluctuations (flicker effect);
- nonsymmetrical wave forms.

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III. POWER QUALITY CONTROL SYSTEM

This paper presents a system used for power control simulations which is made of hardware and software described in Table 1.

The PQ Analyzer type 7650 ION, manufactured by Power Measurement, is a three phase measuring device, having advanced power quality analysis features, metering and several communication ports. The analyzer is configured by the manufacturer to perform all the functions for basic electricity monitoring, providing increased monitoring facilities, analysis and control of the PQ within the three-phase power networks. This analyzer has a modular structure and an open design for the development of function utilities. It adapts itself to virtually any specific application, provides flexibility and computing power required for a full monitoring process. In general it is used as a fixed assembly. The ION 7650 analyzer has multiple communication ports: Ethernet, RS-232, RS-485, port optical front. The link between equipment and personal computer can be a RS-485, using a modem connected sites on leased telephone lines or dedicated, fiber optic and/or radio link.

All pieces of equipment could be integrated into a SCADA system or network equipment for monitoring energy management thereof, is available as a large variety of network communication protocols [8],[7].

TABLE I.
HARDWARE AND SOFTWARE USED IN THIS APPLICATION

No.	Equipment	Produced by	Type
1.	Analyzer CEE	Power Measurement Canada	7650 ION™
2.	Modem PSTN	US Robotics	Courier 56K Bussines
3.	Data server	Hewlet Packard	Procesor Pentium 4
4.	Software licenses	Power Measurement Canada	ION Enterprise 5.5

PSTN modem is an U.S. Robotics Courier 56K Business dial-up telephone line switched on. 19.200 baud/s speed of communication is selected. This type of modem settings own store in case of accidental voltage power.

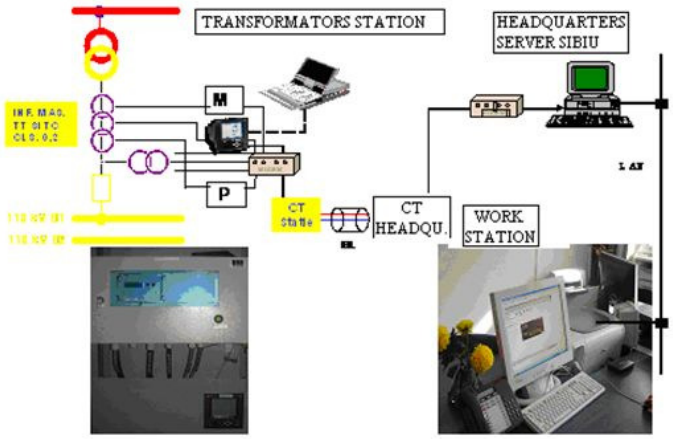

Figure 1. Implementation of the system

This system has to be simple and not expensive, portable and flexible. We don't use state of the art IT equipment, because there is no need for this [5].

The data server is a personal computer HP Intel P4, 3GHz. Due to the high volume of data recorded, for processing in their various forms of statistical, capacity storage 1024MB RAM, 120GB HDD Sata is used. Auxiliary power is provided by UPS. The server database use in this case has an LCD monitor 19" and also a color multifunctional A4 printing system. The analyzers communication with the system is effectuated connecting the server to external modem outlined above, the analog telephone circuit [6].

Microsoft Windows NT is the operating system. The PQ analyzer is compatible with software for monitoring ION Enterprise 5.5 company Power Measurement, installed on this server. Upon request to take data transmitted by light and automatically stored in a dedicated database. The system allows external storage of data transmitted through the built-RW and DVD while securing them. The whole database stored on the server could be accessed on demand for generating dedicated programs for data processing primary data listing, graphs, reports [10].

Figure 1 shows the system architecture, the simplified version that includes only one location from the field and the central point. At the measurement point, within a specific substation, the equipment is installed in a measuring protection cell or room protection. As seen in figure, analyzers have been installed in the assembly fixed on the closet Metering cell properly monitored. [6]

A database server and a dedicated application office SSCPA was installed at the central point of the Transmission Branch Sibiu, from the Romanian Power Grid Company, TRANSELECTRICA S.A.

IV. EXPERIMENTAL RESULTS

We will present experimental results from each point of measurement:

- schedule normal operation of the substation for conversion of electricity;

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