MEĐUNARODNO REGIONALNO SAVETOVANJE O ELEKTRODISTRIBUTIVNIM MREŽAMA

REGIONAL CONFERENCE AND EXHIBITION ON ELECTRICITY DISTRIBUTION

Crna Gora, Herceg Novi, 5 - 8. oktobar 2004. / ***Montenegro, Herceg Novi, October 5 - 8, 2004***

* *

THE MONITORING OF POWER QUALITY IN THE TRANSMISSION AND DISTRIBUTION INTERFACE

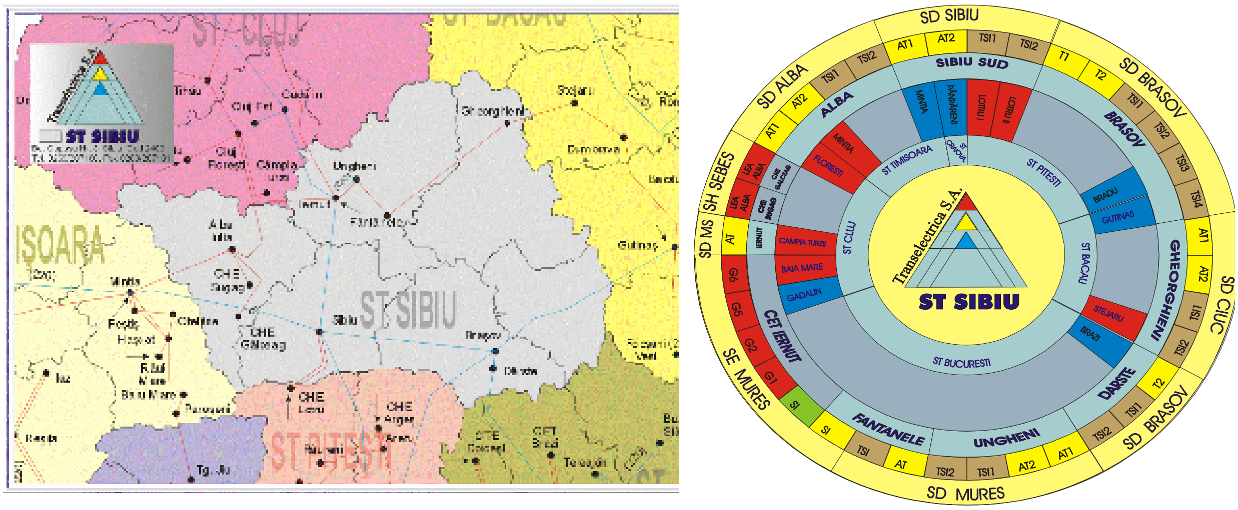
S. Gal – CN Transelectrica –ST Sibiu, ROMANIA
F. Balasiu – CN Transelectrica – ST. Sibiu, ROMANIA
St. Gheorghe –SC. Electrica SA- Bucharest, ROMANIA
C. Chimirel – CN Transelectrica – OMEPA, ROMANIA

INTRODUCTION

On The Romanian Electricity Market there are few important players: generation companies (hydro, nuclear, termo power plants), transmission company, distribution company and electricity suppliers.
Transelectrica is the transmission company from Romania, that includes The Transmission System Operator. Electrica is the Distribution Company from Romania, that has divided in eights subsidiaries that are in the same time the suppliers for most of customers. Power Quality problems are very actual and important in activities of these companies.
The monitoring of power quality indices in The Common Coupling Point (CCP) of the transmission system and the distribution one, is the responsibility of the both companies: Transelectrica and Electrica.
One of Transelectrica main task is to accurate measure the energy flow between participants in wholesale market of electricity.
Energy transfer boundary for one subsidiary contains the participants, voltage levels and exchange metering points where the actual measuring of energy takes place.
In each exchange point we will find several measurement groups consisting of voltage transformers, current transformers and, of course, meters.
Exchange metering points are very important to determine the relations between the participants, the quantity of electric energy received from or delivered to other participants in the wholesale electricity market. It is also very useful to determine market position for each of them.

For Sibiu Subsidiary some exchange partners can be easily located using geographical map (figure 1a), but this type of representation cannot reveal all exchange partners and metering points.
So, energy transfer boundary for Sibiu Subsidiary (figure 1b) contains all the partners, all exchange points between subsidiary and other entities grouped according to substations site and voltage levels.

S. Gal - Tel :+40 269-207111; Fax : +40 269 – 207101; e-mail : gal@sts.ro



a) Figure 1 b)

A synthesis of exchange metering points for Sibiu Subsidiary is presented in Table1.

Participants	Partners	Exchange metering points		
		220kV	110kV	MV
SC ELECTRICA Transilvania Sud SA	1.Alba Subsidiary 2.Brasov Subsidiary 3.Mures Subsidiary 4.Ciuc Subsidiary 5.Sibiu Subsidiary	-	12	15
SC ELCEN Bucuresti SA	Mures Subsidiary	4	-	2
SC HIDROELECTRICA SA	Sebes Subsidiary	2	-	-
	TOTAL	**6**	**12**	**17**

Table 1

The energy flow over the boundaries of subsidiary determines the energy used in operation by the high voltage network. With this amount we can calculate the performance for network and measurement group.

Sibiu Sud substation contains two high voltage exchange metering points between transmission and distribution located on the 110kV side of two autotransformers.

REGULATIONS

The power quality conditions in The Common Coupling Point (CCP) between transmission system and distribution system are regulated by The Electricity Transmission Grid - Technical Code (ETGTC) that issued by Romanian Electricity and Heat Regulatory Authority (ANRE) (1). In the same time, The Electricity Distribution Grid - Technical Code (EDGTC) has issued by ANRE and it is in force for distribution system (2).
According to ETGTC, the power transmitted from the transmission system to the distribution system, must correspond to the following technical parameters: power frequency, the magnitude of the supply voltage in CCPs, voltage quality (regarding to voltage harmonics and supply voltage unbalance) in CCP.
Power Quality indices are review and have included in WG report (4) for transmission system and a distribution one.
The IEC has published “Testing and measurement techniques – Power Quality Measurement Methods” (3), that is vary useful for all power quality measurements.

MEASUREMENTS and RESULTS

The measurements of Power Quality Indices has been done according to The basic wiring diagram for power quality management presented in Appendix 1.
The measurements have done according to IEC (3) for three Power Quality Indices that has monitored and presented in this paper:

- o Power frequency;
- o Magnitude of the supply voltage in CCPs;
- o Voltage quality (regarding to voltage harmonics) in CCP.

Basic measurement performance of the power quality analyzer are shown below (6):

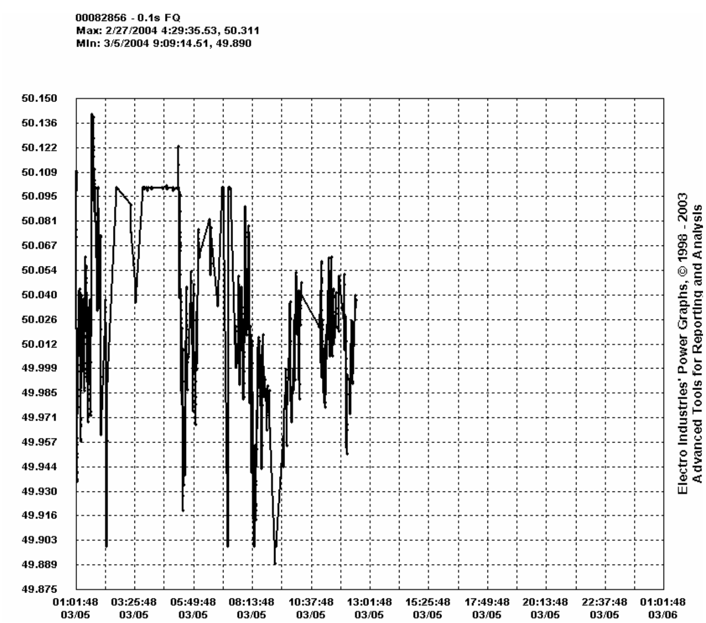
Parameter	Accuracy (% of reading)
Voltage (L-N)	0.01
Voltage (L-L)	0.01
Current	0.025
Frequency	0.001 Hz
kW @ Unity PF	0.04
kW @ .5 PF	0.1
kVA	0.08
VAr	0.08
PF	0.06
Harmonics	0.1

Main features of Power Quality Analyzer are (6):

- Waveform and fault recording – the unit records up to 512 samples per cycle. All voltages and currents are recorded using a 16 bit A/D converter providing high waveform resolution;
- Measure and record harmonics – the unit measures harmonics up to the 255th order for each voltage and current channel. Real-Time harmonics are resolved to the 128th order and percent THD and k-Factor are calculated;
- Independent CBEMA Log plotting – independent CBEMA Log for magnitude and duration of voltage events;
- Phasor analysis – management of phase angle between voltage and current channels;
- Flicker analysis, Inter-Harmonics Analysis, Communication features.

- o The monitoring of the Power Quality indices has done for long period of time in CCPs - at 110kV level of autotransformers in Sibiu Sud substation. The results of the measurements are presented below.

Frequency
[Hz]



time

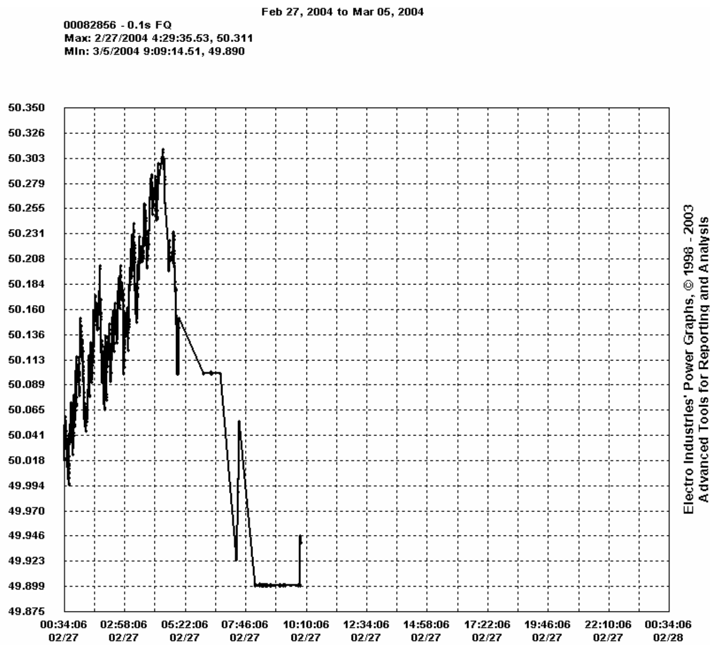
Figure 2. Frequency deviation from rated range (49.95-50.10 Hz)

Based on the results power frequency of voltage curve, according to [1], was achieved as follows:

- 100 % of one week (required 95 %) was within range (49.50-50.50) Hz;
- 91.67 % of one week (required 90 %) was within range (49.90-50.10) Hz.

Frequency deviations from regular 2 limits were recorded only in two days and the diagrams are shown in Fig. 2 and Fig. 3

Frequency
[Hz]

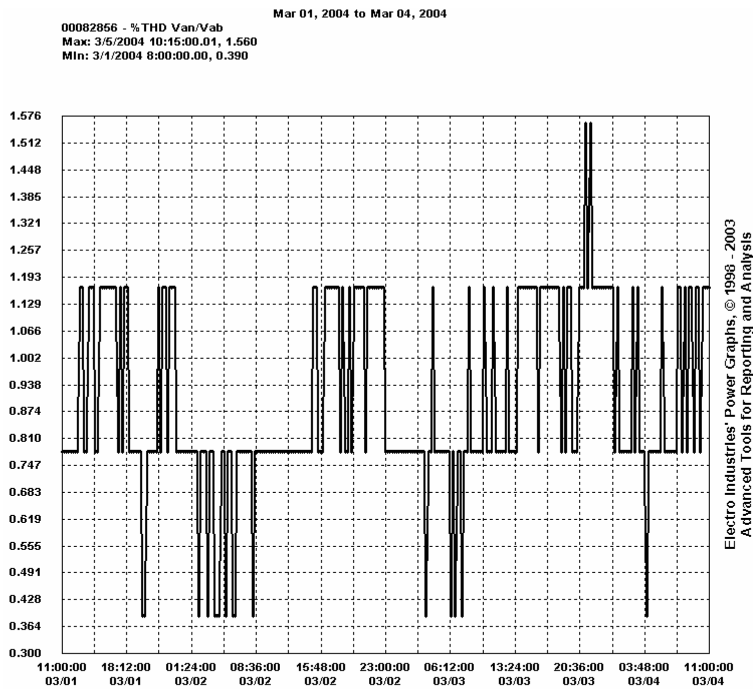


time

Figure 3. Frequency deviation from rated range (49.95-50.10 Hz)

The THD observed during the same period of time was well below the requirement of 3%. An example of THD evolution for voltage curves is shown in Fig. 4.

Frequency
[Hz]



time

Figure 4. THD for voltage curves

The Figure 5 below shows an example of waveform of voltage curve.

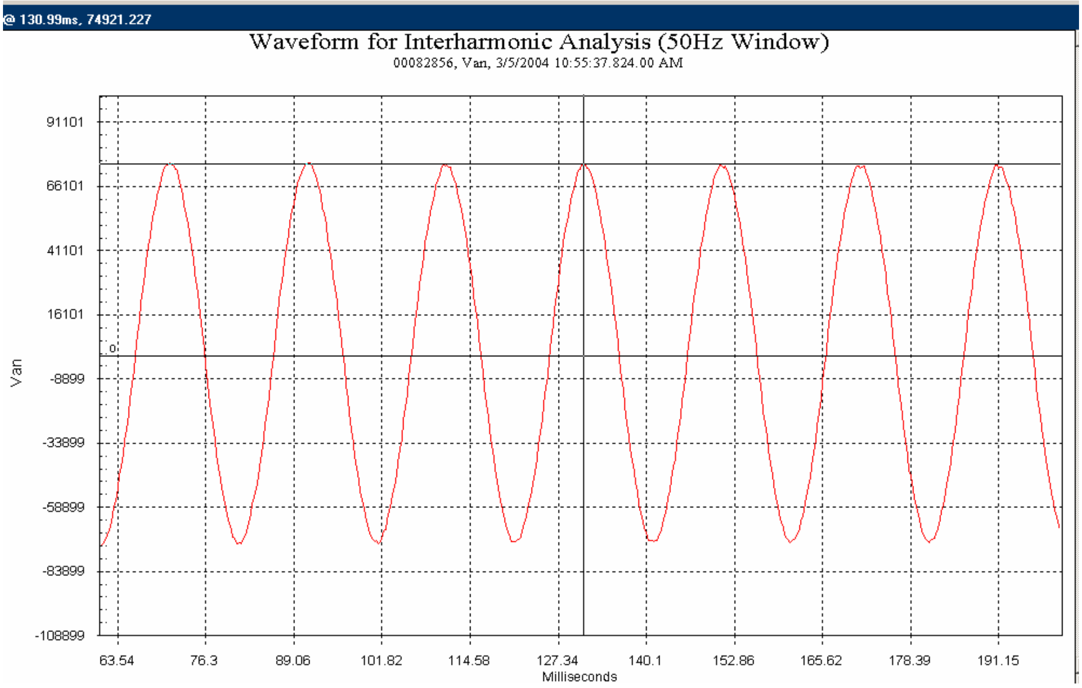


Figure 5. Waveform of voltage curve

CONCLUTIONS

Starting from this study case it is necessary to develop new functions for Power Quality Monitoring System (voltage unbalance, CBEMA Report regarding to the swells, sags, interruptions). In the same time, two of the most important problems are:

- the monitoring period of time - permanent monitoring is very expensive. The scope of monitoring is to verify the contractual requirements in CCPs between the transmission and distribution systems;
- the study of current and voltage transformers, especial for harmonics. It is known that some types of transformers have nonlinear transfer functions between output and input signal on different harmonic spectrum.

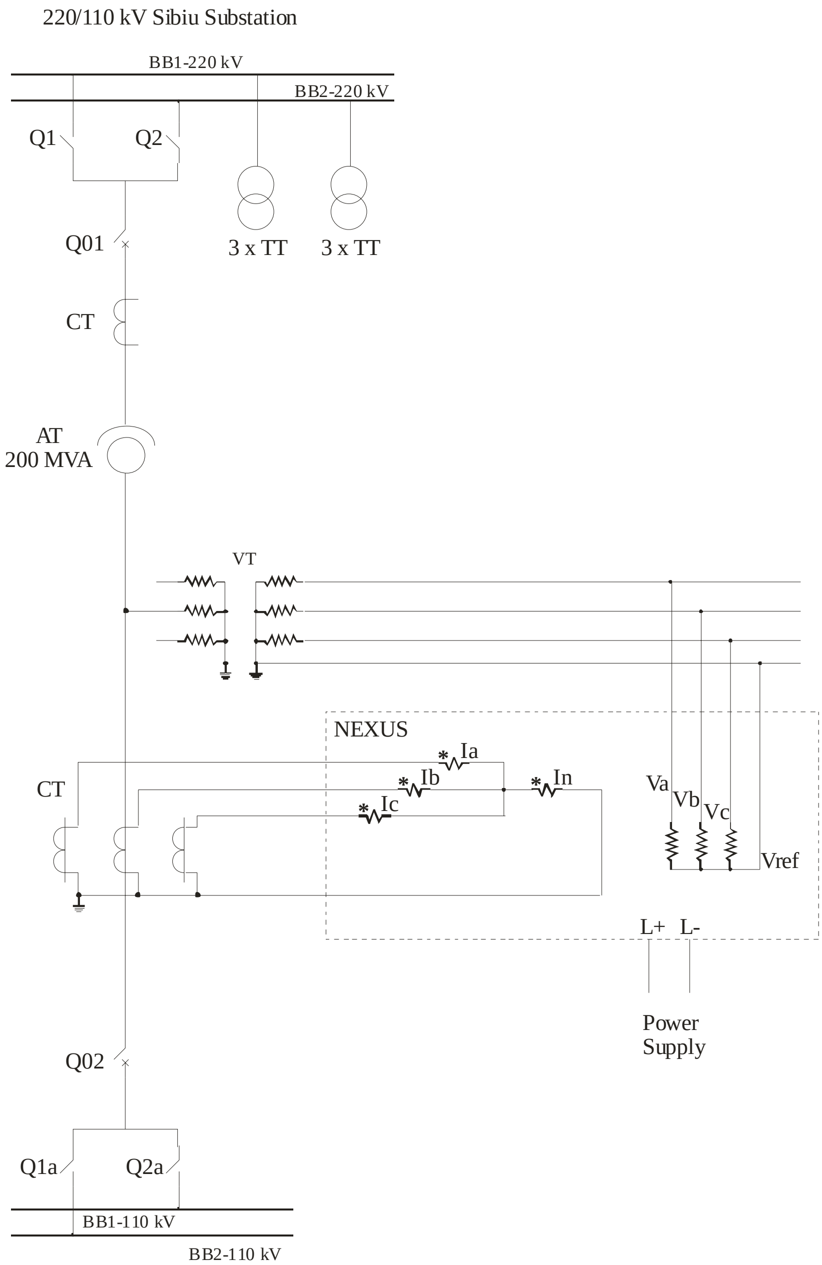
Other type of Power Quality Monitoring System has developed in distribution system according to (5) and Gheorghe (7)
Based on this study case and other research studies of these authors we can conclude:

1. The revising of the ETGTC and EDGTC and them correlation according to the objectives in distribution and transmission system is necessary. On this way the Power Quality Indices will be correlated starting from the CCPs between supplier and end user, and than in CCPs between the transmission system and the distribution system.
2. One of the goals of CN Transelectrica, the transmission and system operator, as well as SC Electrica, the distribution and supply operator must be maintaining the power quality indices in the CCPs between the transmission and distribution system within admissible limits.
3. The study case, performed at Sibiu Sud substation, demonstrates the existing possibilities of tracing the power quality indices with a dedicated equipment, as well as the transmitting of information to the regional dispatcher centres. There are available few types of Power Quality Analysers for power quality monitoring.
4. Monitoring the evolution of power quality indices at the interface between the transmission and the distribution system, allows the different levels of dispatcher to take the necessary measures for a proper correspondence with their admission limits.

LIST OF REFERENCES

1. ANRE, 2000, The Electricity Transmission Grid - Technical Code, www.anre.ro;
2. ANRE, 2000, The Electricity Distribution Grid - Technical Code, www.anre.ro;
3. IEC 61000-4-30, 2003, Power Quality measurement methods;
4. Joint Working Group CIGRE C4.07/CIRED, 2004, “Power Quality Indices and Objectives - Final WG Report”;
5. SR EN 50160, 1998, The Characteristics of The Voltage in Romanian Public Distribution System;
6. Electro Industries/GaugeTech – Nexus 1252 Leaflet, Technical documentation, www.electroind.com;
7. Gheorghe S., and all, 2003, “On-line Monitoring of Power Quality Indicators in a Distribution and Supply Company” , “Power Quality 2003 – Long Beach – USA”.

APPENDIX 1



Basic wiring diagram for power quality management