Power Quality problems diagnosis for the industrial sector in Bogotá DC. Phase 1.

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Abstract.

This article introduces phase 1 on the power quality problems diagnosis for the industrial sector in Bogotá, Colombia, developed by Universidad de Los Andes. For this project was selected a group of industries, to which the survey was applied.

Key Words: Power Quality, survey, transients, harmonics, interruptions, sag, swell, electro magnetic compatibility.

I. INTRODUCTION

Because of the spread use of non-linear loads and sensitive equipment in the industrial sector in Colombia, is very important to identify, analyze, and develop technical and economic solutions, for power quality problems. Nationally power quality has become an issue in conferences, courses projects and specific solutions offered by company specialized on it. Although it has not been identify yet, power quality problems, not the effects has been measured or losses it caused in the productivity of the industrial sector. This is the reason why Universidad de los Andes and National Industrials Association (ANDI), is interested in the study of this problem for the industry. In the first part of this study a survey was designed and developed, which results will be complemented in the second phase (measures) of this study. The survey was based on power quality survey model, and complemented and checked by national and international experts.

For this study a hundred companies were selected in the industrial area of Bogotá. Based on this information a diagnosis for power quality problems was made and the impact it has in the productivity of the industries in Bogotá.

II. DEVELOPMENT AND APPLICATION OF THE SURVEY.

In the survey it was take into account, Power Quality aspects that affect the productivity. The survey has nine sections with specific questions about some aspect that may have been affecting the company. Sections:

- 1. Company Identification.
- 2. Characterization of the electric service.
- 3. Characteristics of the company's electric system.
- 4. Protection Schemes.
- 5. Reliability.
- 6. Harmonics.
- 7. Voltage regulation.
- 8. Current and voltage unbalance.
- 9. Energy management programs.

A. Industries Selection.

This study is focused on Bogotá's industrial sector. The industries contacted in the first place were the ones associated to the National Industries Association (ANDI). First at all, industries with bigger loads were chosen, such as Bavaria S.A., Colceramicas S.A. and Refisal. Also the study involves medium and small companies that need a continuous service, because they have critical process and sensitive loads. Figure 1 shows the participation of each sector in this study.



Fig. 1 Participation (%) of the industrial sectors in the survey

B. Survey Applying

The first contact was made by, email, phone or fax, in this contact was presented the description of the project with focus on the technical and economic importance of using this tool in their industries to and inform the engineers and technicians about power quality. Through this approach it was settle and appointment with the person in charge of the electrical operation and maintenance for the company.

C. Data Base Development.

To process and analyze the information collected in the survey, it was developed into a database in Microsoft Access ® following the parameters established in the survey.

D. Results Analysis.

Once the information is gathered and organized, it was analyzed looking for patterns, which lead to the identification of the main problems for the industrials, in relation with power quality. It is important to notice that with this sample, we can achieve global results and conclusions about power quality in the productive sector in Bogotá. This first analysis helps identify the sectors more affected by bad power quality, and the companies that are more interested in solving them and know more about this issue.

E. Survey General Results.

• The economic crisis in the last few years affected the industry growth, This caused a lot of companies to invest little in new equipment and tools to reach standards in legislation or improve the maintenance departments, to improve in reliability, and power quality. Figure 2 shows the growth expectation in the surveyed industries.



Fig. 2 Expected Installed Load Growth in the industries that answered the survey.

• The issue that concerns and affects most of the industries is the frequency and duration of the interruptions caused by the network. For every industry this is an issue that needs special treatment and they think this should be a priority when energy companies try to sell their services (See Figure 3).



Fig. 3 Reliability level (1: High levels, 4: Low levels)

• Most of the industries have not applied any energy management program because of their high costs it represents. Although they show interest to involve these projects in their short term improvements.

F. Sectors Results.

From this sample it is worth it to stand out Commercial, Financial and Corporation buildings and construction material sector, because these sectors are about 70% of the companies included in this study and the ones that has more knowledge about power quality problems.

Commercial, Financial and Corporation buildings Sector

• The load of these sectors is mainly of sensitive equipment like computers, control systems, communications equipment and other office machines. Therefore they are those that have greater interest in the programs of energy and power quality management and

solutions focused in preventing damages in these equipments. (Approximately 75%).

• Problems caused by harmonics and voltage regulation are those that affect most the operation of the equipment. Of the companies 90% count on UPS as back up system to avoid loss of data caused by sags and interruptions. For this sector, frequency between interruptions is their more important concern.

Construction Material Sector

- The companies of this sector that have problems with harmonics are those whose great part of the load is DC motors, which inject harmonics to the distribution network.
- Reliability is also important to this type on industries, but unlike the others they are more concerned about long interruptions because long interruptions may damage their raw material and some machines.
- This sector, due to the type of loads, has technical departments, which have more knowledge about power quality and apply with regularity preventive maintenance programs to avoid internal or external disturbances. Because this disturbances may jeopardize the trustworthiness and quality of the service of energy. Approximately 50% of these companies already count on programs of energy management looking for to make an efficient use.

G. Future Research

Based on the obtained results in this first phase it is necessary to extend the sample of the productive sector in Bogotá and the rest of the country, with the purpose of making a national diagnosis.

Through this diagnosis the government, energy suppliers and users will have the opportunity to identify clearly the situation in power quality of the productive sector. Also, users in different sectors will be able to settle down the situation of their companies in power quality as compared to the rest of the companies in their sector, and also undertake joint programs to obtain economic and efficient solutions.

Through the contact that has been established with the companies, Los Andes University has identified the main issues that are more important for industrial and solutions that most users should take in the productive sector, Such as specific courses on power quality, development of diagnosis methodologies and evaluation and solutions. In these studies it is recommended to include company measurements to support the diagnosis and to characterize the problems and power to improve research on solutions.

III. CONCLUSIONS AND RECOMMENDATIONS

• It was verified that in the productive sector the use of mnlinear loads and sensitive equipment has risen considerably. Under this condition, at the moment some companies recognize the relevance of power quality and therefore they show an interest in applying these concepts in its industries. This interest leads to the need of more detailed studies for each sector.

- The companies count on electronic equipment like computers, control systems and communications equipment, which are of great importance within the productive process. Because of the sensitivity to power quality problems on this type of equipment, the importance is evident that this subject must have an important place within the plans and strategies to be adopted by these companies. Although for equipments that is mainly administrative, UPS is used as a back up system during interruptions, but other problems, that are caused and affect equipment, such as harmonic and transients, are not dealt with the same importance.
- It is important that power quality aspects are considered in greater proportion, since due to the lack of knowledge, companies and factories incur unnecessary expenses, because damages of equipment and losses that are falsely attributed.
- Because the little knowledge that there is in the area of power quality, from people who handle the technical department of the companies, is necessary to promote updates and courses on the different aspects that affect and cause power quality problems and may be affecting the productive processes of the companies.
- Although companies in Colombia are open to these new issues and the need to implement procedures in energy management programs to diminish significantly its costs. There is no research that shows economic loss quantitative, so this problem cannot be numerically represented on the production. These data have been taken from studies in other countries.
- The problem which draws more attention is interruptions, since it is a visible problem that directly affects the production and the load, in addition is because this is the only aspect that is regulated in the Colombian legislation.
- In order to be able to display concrete results about the real situation of the companies, it is necessary to make detailed studies, with measurements by sectors and this way, characterize the problems, necessities, solutions and costs.
- Given the importance of not having long interruptions in this sector, the surveyed companies that have the

biggest loads, no regulated users, expressed counting on feeders transference as a strategy that guarantees a totally reliable provision to them.

• Los Andes University expects to continue with the second stage to make measurements and, to be able to extend this study looking for a national cover. There is interest as much of the university as of the productive sector and companies of distribution of energy

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Annexed: Survey On Power Quality For Bogotá Productive Sector

V. BIOGRAPHIES.

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UNIVERSIDAD DE LOS ANDES ELECTRICAND ELECTRONIC ENGINEER DEPARTMENT	SURVEY ON POWER QUALITY FOR BOGOTA FRODUCTIVE SECTOR
A. Identification	
No. Date Company Industry Type	Address Phone Number, E-mail Contact Person
B. Characterization of the company's electric service.	2. Dalita wakata wa
1. renson revers 2.rad Instatical (KW) abc 3.Peak load [KWh] abc 4. Monthly Consumption [KWh] abc	Company automation Company Childependent Generation Sprice (s/ KWh)
C. General Aspects	
1. ¿Does the company knows about Power Quality? Yes No N/A Comments:	9
2. Did you know you can control power quality aspects for USS 2000 (a) 3. Is there a growth prospect for the next years? Yes No N/A If positive in percentage Last 5.V	pproximately) Yes No N/A
Next 5 Y	'ears%
4. Consumption distribution (%) - Main Production Machines - High Consumption Equipment (Town, Large Conventer, Electrochen Tyre of machines: Power - Administration - Warehouses and Lighting System - %	iistry)%
SPand Machines Harmonic Distortion Concerners (Rectifiers, Equipment with tiristo Wed Equipment Equipment, Equipment Engines (without speed taps) Sensitive equipment (Control Systems, Computers, Communication Others (Newn, Hoaling Equipment)	ns)
6. ¿Does the production process requires a continuous service, witho consequences of the interruption? Yes No NA	ut any interruptions (short or long)? What are the
Comments:	
 Which of the following aspects have you had problems. (1=No p 1 2 3 4 5 	robens (D=Severe probens)
-Regulation	
-Sag	
-Swell	
-Variation Reliability:	
How many of these interruptions come from inside the company:	6
8. How much will the company Hill be willing to increase in the taril	Y to diminish Power Quality problems?

1.Does de company has:					YES	NO
	YES	NO	 Current Limit 	or Fuses		
 Instant Relays 			 Ground overco 	irrent protection		
 Time-lag Relays 			 Lighting Rods 			
 Explasion Pusible 			 Others(Tvss) 			
2. Is there a good protection	n when:					
-There is a failure inside	the company? Yes No	N/A				
-There is a failure in the	electricity network? Ye	s No N∕A				
When was the last time t	he company check all pr	otecritions?				
 Does de company has caj Camacita? (EVAR) 	pactor bank for power	factor corre	schong res No	NA		
Connected tension level?						
¿Fix or variable?						
Installation Date						
 Does the company have I Describe the problem. 	had any problems or in	terruptions	caused by the manet	werse of this ban	ks7 Yes N	lo NA
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5. Has these bank burnt of	ail sometime? How ma	ny times hay	e they've been chan	se on the last 5 w	ans	
E. Reliability						
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Has your company implemented any energy management program? Yes No N/A
 Implemented detail level.
 General
 By section
 By methics
 Which system do you use?

Is the company willing to implement any of this programs? Yes No N/A