POWER QUALITY REGULATION AND STANDARDISATION – THE FRENCH EXAMPLE

INTRODUCTION

The deregulation of the electricity market in Europe obliges all the actors to publish in full transparency the rules, contracts between the Network operators and the users of the network. These rules and contracts shall be non discriminatory.

In France a Special Working Group, under the responsibility of the French Authority, has been established to publish the power quality part of the connection rules to the network. In other words this document will describe the rights and duties of all parties in order to provide a good quality on the networks.

The work is of course based on the European Directives, the French laws and decrees and the related standards.

The aim of this article is to describe the French views and how all the set of reference documents is organized.

State of the art of the European and French regulations

Directive 2003/54/CE of the European parliament concerning joint rules governing the internal electricity market has replaced directive 96/92/CE. This new directive defines organisational and operational procedures for the electricity sector, access to the market, tendering criteria and procedures and network authorising and operating. The deregulation of the electricity market in Europe imposes a clear separation of the generation of electricity, the commercialisation of electricity and the operation of the networks.

The measures in this directive have been incorporated into French law by means of changes to law n°2000-108 of 10 February 2000 and by means of law n°2004-803 of 9 August 2004 particularly as relates to the appointment of network operators and the establishment of organisational procedures aimed at ensuring their independence.

Some measures, particularly those relating to quality of electricity, are due to be incorporated into the law on energy current under discussion in the French parliament. Different aspects of quality of electricity have been the focus of numerous technical studies over the past years. At the request of the major electricity distribution companies, CENELEC has established norm EN 50-160 concerning low and medium-voltage electricity supply. However, due to opposition from producers of electrically powered equipment, the European Union has not as yet embarked on the process due to lead to the adoption of harmonized norms in this field. As yet the only document in France which could have a bearing on third parties is the ministerial order dated 29 May 1986 (called the “voltage order”) fixing nominal voltage for low-voltage supply and its permitted range of variation (230V, +6%/-10%), which is intended to contribute to harmonization of the nominal voltage for low-voltage supply. No measures (other than contractual) exist for medium-, high- and ultra high-voltage supply.

Work undertaken in 2000 by the Comité Technique de l’Electricité – CTE (Electricity Technical Committee), intended to provide technical support to the French ministry of industry responsible for these issues, to define by regulatory means the minimum criteria for high-voltage quality of electricity, was interrupted at the regulatory consultation stage due to strong opposition arising in 2001. Since then, several major players have again demonstrated their desire to see common regulatory bases established concerning quality of electricity.

The law on energy should establish the legislative basis for the government to be able to fix minimum levels for quality of electricity to which all supply network users could appeal.

Objectives of the French Ministry of Economy, Finances and Industry

Aside from existing regulations concerning nominal voltage for low-voltage supply, little recent data currently exists on the state of quality of electricity in France. Nor are there any consistent factors based on a structured technical and economic approach which would allow the needs of electricity users to be described in relation to quality of electricity (parameters, usage, technical context, etc).

In these circumstances and given the contradictions shown up by previous technical studies, the launching of a regulatory initiative concerning quality of electricity makes it desirable to undertake an in-depth technical evaluation of the challenges facing network operators as well as those supplied by them, along with a detailed examination of the current situation and the means required for regular monitoring of the parameters involved.

In addition, the question of quality of electricity broadly concerns the issue of standardization as has been shown by the observations made by the European Commission during
the regulatory consultation phase (as set out by directive 98-34) concerning decrees and orders relating to producers’ and consumers’ connections to electricity supply networks. In this context, it is desirable to ensure, from the initial discussion stage onwards, full recognition of European and indeed international constraints. This is the objective set for the CTE Special Working Group by the Ministry of Economy, Finance and Industry.

**Organisation of the work in France**

In order to meet the new need expressed by the French law, a Special Working Group, referenced GS25, under the responsibility of the French Authority, has been established to publish a document defining the levels of quality which should be provided by the Network Operators. The participants to this Special Working group are coming from all part of interested parties : manufacturers of electrical products, representatives of the users of the network, representatives of the different French Distribution Network Operators (DNOs), representatives of the French Transmission Operator (RTE), representatives of the French Authority, representatives of the Concessions, representatives of the Power Generation Industry, Representatives of the Standardisation, etc.

This WG will publish an intermediate report in March 2005 but this article describes the positions of the different interested parties as well as the expressed needs

**Definition**

There have been many different approaches to classifying the qualitative aspects of electricity supply, complicated further by the current practice of separating the functions of generation, supply, network operation, etc. For the purpose of this presentation, the following definitions apply, in line with the relevant contribution from CEER and IEC. Quality of supply can be separated in commercial quality, and power quality. And power quality can be separated in Continuity of the Supply and Voltage quality. The precise definitions are the following:

- **Commercial quality** — concerning the business relationships between suppliers and users with respect to how well the various services are delivered (The services concerned are not confined to network operation)

- **Continuity of supply** — concerning the extent to which customers find that their electricity supply is interrupted for various reasons

- **Voltage quality** — concerning the technical characteristics of the supply with respect to the voltage delivered to customers, i.e. its magnitude and frequency together with the potentially disturbing aspects.

Some technical inputs first to understand the issue

In 1985 a European Directive (85/374/EEC) declared that electricity is a product.

It is, however, rather a unique product because of its intangible and transient nature. Strictly, it is a product that exists only for an instant at a given point of delivery, comes into existence at the same instant at which it is being used and is replaced immediately by a new product with rather different characteristics. Its characteristics are different at each separate point of delivery. Moreover, it is a product whose quality depends not only on the elements that go into its production, but also on the way it is transmitted, distributed and being used by the equipment of multiple users.

Therefore, the quality control that is possible for more tangible and real products is not applicable in the case of electricity. All that can be attempted is some control of the conditions under which it is produced, transmitted and distributed and those under which it is used. In particular, the capacity of utilisation equipment to impinge on the quality of electricity, including that delivered to other equipment, must be recognised even if the network is designed and operated to minimize the impact on power quality.

Electrical equipment has become increasingly complex in terms of the functions it fulfils and the way in which it interacts with other electrical equipment. Frequently, that interaction takes place through the medium of the electricity network, which is the common energy source for all the equipment. It arises because the network, intended to be a common energy source, also provides a conducting path interlinking all equipment.

Actually, the electromagnetic phenomena arising from the operation of utilisation equipment are superimposed on the other characteristics of the electricity supply, and become part of the product that is delivered to the users. Phenomena arising from atmospheric and other external events or from the intrinsic response of a large electricity system to such events may also impact on power quality.

And it is very important to make a clear distinction between these phenomena because the solution to maintain the level of quality expected by the end-user is not necessarily provided by the network. Especially for voltage dips ans some of the short interruptions, the solution for the final end-user is to protect the most sensitive part of his installation which is generally the control part of the process (in an industrial installation) and the electronic devices (in domestique and commercial installations) with the adequate solution, which might be an UPS for example. These equilibrium is well known for many
years by all the interested parties and the solutions are provided and by different manufacturers through their catalogue of products.

In other words, the quality of electricity is appropriate when:

- The generation means are delivering a sinusoïde as pure as possible without interruption,
- the transmission network is correctly designed, maintained and operated,
- the distribution network is correctly designed, maintained and operated,
- the customer’s installation are properly designed, maintained and operated, taking into account the specific needs if any,
- the final equipment, e.g. fulfilling emission requirements of standards, are not injecting disturbances on the network and are designed to perform in the required environment that a electricity network is.

How the French Distribution Network Operators monitor the evolution on the quality

As to provide the best quality to the customers connected to the network, the distribution network companies calculate a few specific data to measure the evolution of the quality. These data are indicators which are used to decide where it is necessary to improve the networks. They are the following:

- system average interruption duration index (SAIDI) for the LV customers
- same data for MV customers (weighted by the power supplied)
- system average interruption frequency index (SAIFI)
  - for outages over than 3 minutes (LI: Long Interruption)
  - for outages between 1 second and 3 minutes (SI: Short Interruption)
  - for outages lower than 1 second (VSI: Very Short Interruption)
- number of customers affected, in one year, by:
  - 6 Long Interruptions
  - 30 Short Interruptions
  - 70 Very Short Interruptions
  - more than 3 hours of interruption.

All these data are collected by the operating crews. They are evaluated for the LV and MV customers. The calculation carried out gives:

- the national average
- the average for 4 customer density areas (between rural and urban density), so called EMERAUDE Zones.

As an example the national average data are provided below for a period between 1996 and 2002.

SAIDI decreased from 65 minutes to 45.6 minutes.

The MV customer interruption duration decreased from 32 minutes to 30.6 minutes.

During the same period, the improvement of the other criteria was of the same order of magnitude:

- SAIFI for LV customers
  - LI: from 1.55 to 1.15
  - SI: from 3.90 to 2.00
  - VSI: from 6.00 to 3.73
- Number of customers affected by:
  - Decrease from 338000 to 279000 customers for 6 Long Interruptions
  - Decrease from 303000 to 82000 customers for 30 short Interruptions
  - Decrease from 148000 to 25000 customers for 70 Very Short Interruptions.

Role of standardisation

The International and European Standardization bodies have taken in due consideration the need expressed by the market. To respond that need a new organization was put in place. An ‘old’ existing Technical Committee, TC8 of the International Electrotechnical Commission (IEC), was transformed in a new one by a complete modification of its title and scope. The new title is ‘SYSTEM ASPECTS OF ELECTRICAL ENERGY SUPPLY’ and the scope is the following:

‘To prepare and coordinate, in co-operation with other TC/SCs, the development of international standards and other deliverables needed to facilitate the functioning of electricity supply systems, in order to achieve the best balance between cost and quality for the users of electrical energy. The electricity supply system encompasses transmission and distribution networks including interfaces with user installations (generators and consumers)...’

The mains items are:
- Electrical system reliability
The Characteristics of energy supply as well as the connection practices are clearly identified as major issues for all interested parties.

The efficiency of TC8 is clearly dependant on its ability to organize the co-operation with other technical committees of IEC in charge of the items listed below. The main TCs concerned are:

- TC13: electricity meters
- TC 57: Communication
- TC64: Low voltage installation
- SC77A: Low frequency EMC
- TC82, TC 88, TC 105 …: Dispersed generation and renewable energy
- TC99: High Voltage installation

As the deregulation of electricity markets are different in the world, a European mirror technical committee was created in CENELEC: TC8X. This brand new CENELEC TC has a similar with the constraints to propose standards and normative documents that can comply with the European requirements.

The Standardization bodies are underway in order to provide with documents to be used by the parties involved in the electricity market as well as the National Authorities.

**The need expressed by the different participants**

The needs expressed by the participants are principally concerned with continuity of supply for customers on low-voltage networks and particularly for those in rural areas: brief outages (between 1 second and 3 minutes), micro-outages (< 1sec) and voltage fluctuations. Few questions seem to arise on the issue of waveform. Users sensitive to certain abnormal occurrences, such as business and professional users, already have within their contracts access to a raft of contractual undertakings as regards quality of electricity, either as standard or individually tailored, able to ensure the level of quality they require.

**The present orientation**

Work currently in progress has not yet reached a conclusion on the choice of criteria to be used in future documentation. However, reviews undertaken of the various existing standardising and contractual measures show that users who have access to supply contracts are assured of a level of quality guaranteed by the contract. Users who do not have access to such contracts must be able to benefit from a level of quality, particularly as regards continuity, which should ensure their needs are met and which should moreover be constantly upgraded. This quality of electricity guarantee must be based on a small number of easily quantifiable criteria and on regulatory minimum levels, their upgrading being fixed periodically by a contractual measure such as a “public service contract” between the state and network operators.