Standards: Transnational Aspects

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Significance
Part 2 – Development of standards
Part 6 – Tutorial reviews

A tutorial review of the process of development of standards, in particular in the power quality area, presented at an international conference.
Describes the various types of standards: national, regional, transnational, and international in the context of emerging treatment of electric energy being considered a product, hence subject to specifications and contracts.

PQA 91

A-3 : Standards : Transnational Aspects

A-3 : Normes : Aspects Transnationaux.

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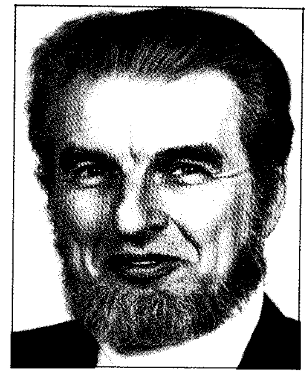

ABSTRACT - *Mass-production of electrical and electronic equipment for the world market requires a system of standards of world-wide applicability. The development of such standards is a complex task, involving various national, regional, transnational, or international organizations. This paper presents a review of the standards-writing process, in particular in the area of Power Quality.*

RESUME - *La fabrication massive de matériels électriques et électroniques, ainsi que leur diffusion dans un marché mondial s'accompagne d'un système de normes, lui aussi à caractère mondial. La rédaction de ces normes est une tâche complexe, mettant en jeu des organismes nationaux, régionaux, transnationaux, ou internationaux. Cette communication en donne un aperçu, en particulier au sujet de la qualité de la tension.*

The general need for standards

Mass production of electrical and electronic equipment for the world market requires standard of world-wide applicability. Such standards are reference documents that provide solutions to technical or commercial problems in relations between contracting parties concerning products, goods or services. Thus, a standard is a foundation to any contract. Compliance with a standard is not necessarily mandatory, but it is generally considered as '*règles de l'art*'. To make this implementation mandatory, a law, regulation, ordinance, etc. is needed. Examples are French government decrees, European Directives, and ordinances in U.S. cities. A new aspect of the European Directives is the position that electricity is a product, therefore subject to product standards.

This position gives an added importance to the development of rational, realistic, and cost-effective standards on Power Quality. These three criteria for useful standards must be kept in mind at all stages of the process of standards development. An unfortunate effect of selecting the term 'Power Quality' is its misinterpretation as a one-sided issue for which the utilities would be solely responsible.

National, regional, transnational, and international standards

There are some clear and some less clear characteristics that can be identified to differentiate all the types of standards encountered in international transactions. There is no universal 'standard' that regulates the development of these many standards. A simplified classification might be as follows:

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National standards include several types:

- Voluntary consensus standards where a balance is established in the committee among the producers, users, and independent parties.
  Type: ANSI standards, Normes Françaises ...
- Industry standards, developed within one industry, where a balance is established among competitors.
  Type: NEMA Standards, PEG Standards, Spécifications EDF, ERA Recommendations ...
- Regulatory standards:
  - Developed and promulgated by government agencies within their jurisdiction.
    Type: MIL Standards ...
  - Developed by independent organizations, adopted by national or local governments
    Type: UL, NFPA, OIML Standards ...
  - Internal standards, perhaps more correctly called specifications, within one company, that can sometimes become de facto national standards.

Regional Standards are developed by a process similar to that of national standards but shared among regional groups of nations. The need to comply within that region can force multinational manufacturers to adopt these regional standards, thereby making them de facto international standards.
Type: CENELEC ...

Transnational standards fall in two categories:

- Standards developed by transnational organizations and adopted explicitly or by osmosis into local or national standards. Compliance with these standards might not be required, but their existence is recognized and influences the process of developing other standards.
  Type: IEEE Standards, Normes UNIPEDE ...
- Internal standards developed by multinational firms, becoming de facto standards within the market of that firm.

International standards are characterized by the fact that they are developed by consensus among delegates from member countries, then approved by national committees. These national committees in turn may be appointed by a voluntary process or by government action, depending on the country. The resulting standards may be formulated as recommendations, but become de facto regulatory standards as purchasers require compliance through their contractual agreements, or as governments mandate compliance.
Type: IEC Standards, CCITT Standards ...

Electromagnetic compatibility standards in the electrical industry

The performance of electrical equipment can often be described in fairly simple terms. Therefore, the subject of ratings, dimensions, tolerances is readily addressed by product standards developed by the manufacturers or by the purchasers, working jointly or separately. However, performance of equipment can be impacted by electromagnetic disturbances and, conversely, the operation of equipment can emit disturbances that impact other equipment. Avoiding electromagnetic *interference* (EMI) became an important field of engineering, but all too often it has become a process of correcting problems, rather than anticipating and preventing them. The successful approach, both from the point of view of sound engineering and from connotations of semantics, was to develop the concept of Electromagnetic *Compatibility* (EMC).

The International Electrotechnical Commission (IEC) has developed a hierarchy of standards to be observed by the various committees involved in the area of EMC standards:

- Basic EMC Standards, providing general and fundamental concepts such as terminology, description of phenomena, test methods. etc.
- Generic EMC Standards, providing specification for a limited number of requirements and tests applicable to all products operating in a particular environment.
- Product EMC Standards, providing specific requirements and test procedures dedicated to particular products.
- Product Family Standards, applicable to a group of similar products.

EMC standards are fundamental to the satisfactory operation of electrical equipment. The issue of Power Quality may be considered as a subset of the broader domain of EMC, so that it is useful to approach the subject of Power Quality Standards along the same, well-developed path of electromagnetic compatibility. That approach can be summarized in one directive that can be applied to many other aspects of human activities:

> *... thou shalt operate satisfactorily in thine environment, but thou shalt not degrade it.*

An interesting aspect in the European context is the interpretation that electrical energy is a product, therefore properly the object of standards, hence the increased interest in power quality issues.

Power Quality Standards

In general, power quality issues have arisen from several aspects: increasing dependency on sophisticated electronic systems that may be affected by the quality of their power supply, competition among energy suppliers, and last but not least, the explosive development and deployment of disturbance recorders with graphics capability that print out records of disturbances for everyone to see.

From a handful of surveys of transient disturbances in the sixties and seventies, we now witness a multitude of large scale monitoring programs. An unresolved issue at this point, is the translation (transformation) of objective measurements of electrical disturbances into a subjective statement of 'good power quality' or 'poor power quality' - the statement that typical decision-makers desire, but that engineers have difficulty in defining.

Defining standards for the quality of the electrical energy produced and distributed by the utilities without considering the needs of the load equipment would be the first mistake in standards development. The term *Power Quality* has now gained too wide an acceptance to be changed, but it fails to convey the concept of reciprocity between the parties. A debate at a recent meeting of the IEEE Standards Coordinating Committee on Power Quality pointed out that a more accurate description of the Committee's scope would be Power Compatibility - but the committee resolved, with regrets, to go along with the entrenched usage.

A second mistake would be an attempt to enforce one-sided standards based on narrow interests. International as well as national standards bodies generally recognize this possible problem and make earnest attempts at providing a balance of interests among the writers, reviewers, and sponsors of product standards. The consequence of this concern, however, is an agonizingly slow process in reaching sufficient consensus to ensure acceptance of the standards. Even the top-down approach taken by the European Community has met that difficulty in the process, to wit the delay in application of the EMC Directive.

Satisfactory operation of electrical equipment requires an acceptable quality of the delivered electrical energy, but agreeing on criteria of what is acceptable is at the heart of the debate. The other important requirement is that, in turn, the equipment connected to the power system must not degrade the quality of that power system.

A power system is a dynamic entity, at every instant, phenomena occur and produce disturbances that propagate throughout the system, impacting the connected equipment as well as the elements of the power delivery system. There is a wide range of phenomena, characteristics, coupling and propagation modes, and consequences. The IEC Technical Committee 77 on Electromagnetic Compatibility is in the process of describing and classifying the electromagnetic environment [1], [2]. These documents provide guidance on the nature of the disturbances and classify them in a limited number of types, making possible a rational approach to emission control, withstand capability, and mitigation when necessary [3].

As a universal phenomenon, electromagnetic disturbances can be defined, described, and classified on a world-wide scale. However, when specific disturbances occurring on specific power systems are concerned, then the discussion must be carried among those sharing the same type of power system. For instance, Europe uses 220 V, 50 Hz for residential and commercial end-users; North American systems use 120/240 V or 120/208 V at 60 Hz; Japan uses 100 V at 60 Hz in some regions. Thus, it should not be surprising nor discouraging to have different standards evolve for these different systems. Nevertheless, the basic principles should be held in common and, therefore, a symposium such as this PQA 91 Conference offers an opportunity to work toward commonalty where possible, all under an EMC compatibility umbrella.

It is sometimes necessary to consider only national standards: the nature of the electrical stresses are dependent upon the nature of the networks, which are different among the countries and utilities. For instance, in France or in the United States where the population density is relatively low, the major part of the distribution system is built as overhead lines: there will be many occurrences of voltage dips. On the other hand, in a high-density country such as Holland where the distribution system uses underground cables, there will be few voltage dips. Another example of national differences is the different grounding practices for the neutral, requiring corresponding dedicated standards. An intermediate approach between national standards and international standards is that of regional or transnational standards. For instance, the countries of the European Community have sufficiently similar practices, with a common market for electrical equipment to motivate this approach.

Regional (transnational) standards

As early as 1960, Europeans created CENELCOM (Comité Européen de Normalisation Electrotechnique ....) with the task of developing European standards. This committee has now been replaced by CENELEC (Comité Européen de Normalisation Electrotechnique), the official standards organization of the European Community. Leading the development of these standards, several organizations contribute to the necessary data base: CIGRE (Conférence Internationale des Grands Réseaux Électriques), CIRED (Congrès International des Réseaux de Distribution), IEEE (Institute of Electrical and Electronics Engineers), UNIPEDE (Union Internationale des Producteurs et Distributeurs d'Énergie Électrique).

For instance, UNIPEDE has recently proposed a description of the voltage waveform [4]. This document describes the parameters characterizing the voltage waveform and the disturbances that may appear at the point of common coupling. Now, CENELEC is tasked with turning the UNIPEDE document into a European Standard, which may then be used by European utilities in the contracts with their customers. This standard will also provide equipment manufacturers with the necessary information for designing products with appropriate immunity levels.

Nature of the equipment

The nature of the equipment involved has an influence on the concerns. For instance, if waveform distortion results from its operation, questions arise on possible effects on revenue meters or on control systems.

Electrical and electronic equipment may be classified in two broad categories:

- Small equipment, mass-produced, installed and used by anyone: appliances, electronic systems, with a load current of less than 16 A (Europe) or 12 A (USA, on 15 A branch circuits).
- Large equipment, produced in smaller number, custom-installed and used by professionals, with load currents above 16 A.

For each of these two, the type of appropriate standard will be different:

In the first case, world-wide and comprehensive standards are necessary, specifying emission limits and immunity levels. The IEC publications series 555 are an example of such standards.

In the second case, Recommendations or Installation Guides may be sufficient. These documents may have an international basis, complemented as needed by local requirements.

Conclusions

Free circulation of electrical and electronic equipment requires the observance of some rules. The most important, of course, involve safety, which must not be placed in jeopardy by an insufficient level of immunity to the disturbances occurring in the environment.

Regulatory agencies have added a requirement concerning the electromagnetic environment, whereby the equipment shall not be the source of objectionable emissions, while being capable of operating amid a reasonable level of disturbances.

The proliferation of new technologies using higher frequencies, in particular in the 10-150 kHz band, requires the development and implementation of rules concerning the frequency spectrum and levels of emissions.

In general; all these rules are promulgated through standards, acting as reference documents generated by broad consensus or agreement among the parties.

Specifications, regulations or directives can then refer to the relevant standards. For instance, the European Directive will be more readily accepted as its effective application is made easier and in a timely manner. Unfortunately, the process of standards development remains slow, and several more years will be required to reach a set of generally-accepted emission limits, while there are practically no standards concerning the immunity levels. By making this forum available to many individuals involved in Power Quality issues, the process may be clarified and even accelerated.

REFERENCES

[1] IEC 77(Secretariat)103 - Description of the electromagnetic environment.

[2] IEC 77(Secretariat)108 - Classification of the electromagnetic environment.

[3] IEEE C62.41-1991 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

[4] DISNORM 12 - Definitions of the Physical Characteristics of Electrical Energy Supplied by Low and Medium Voltage Public Systems.