TECHNICAL CONDITIONS FOR CONNECTING ELECTRICAL INSTALLATIONS TO THE DISTRIBUTION NETWORK IN A COMPETITIVE SUPPLY MARKET IN FRANCE: THE NEW REGULATORY REQUIREMENTS

Philippe CRUCHON
Ministry of Economy, Finance and Industry - France
philippe.cruchon@industrie.gouv.fr
Michel GARRIGUES
Ministry of Economy, Finance and Industry - France
michel.garrigues@industrie.gouv.fr
Jean-Marc KAHAN
Ministry of Economy, Finance and Industry - France
jean-marc.kahan@industrie.gouv.fr

As required by the directive 96/92/EC of the European Parliament and of the Council of December 19, 1996, the general provisions necessary in order to create in France a competitive market in electricity have been established by the law of February 10, 2000 pertaining to the modernization and to the development of the public service of electricity supply.

According to this law, the public service of electricity supply is responsible for a balanced development of production of electricity, for the development and operation of public grids and for the supply in electricity everywhere in France.

In addition to the rules concerning the public service, this law establishes a set of rules concerning the authorization for construction of new power plants and the system of access for eligible customers. The Commission de régulation de l’énergie, which has recently replaced the Commission de régulation de l’électricité according to the law of 3 January 2003 pertaining to the markets of gas and electricity and to the public service of energy supply, has been designated as the competent dispute settlement authority.

In France, the option of a regulated system of access has been chosen as the means to open a competitive market in electricity. The law then establishes new regulatory procedures for the connection of new installations to the public grids in order to ensure the safety, the security and the quality of operation of the electric system considering the connections both to the distribution grids and to the transmission grid.

The overall organization and interactions of those regulations are presented in detail in the first part of this paper. The second part is dedicated to a general description of the specifications pertaining to the connections to the distribution grids.

* * *

1. The general organization of the statutory texts and the general rules
   a) The statutory texts

The law of February 10, 2000 takes into consideration the transmission grid, which is operated by RTE, the distribution grids, which are operated by EDF or by local public bodies, the interconnection lines on the borders with other Member States of the European Union, the production sites, the customers’ sites and the direct lines.

According to article 14 of the law, a decree must establish the general technical prescriptions under which the connection to the transmission grid shall be designed and operated for each new installation. Those prescriptions should apply to each new connection (i.e. a power plant, a customer’s site, a distribution grid). They should also apply when an existing connection is to be upgraded to allow an increase in capacity or to take into account a significant modification of the electrical specifications of the existing installations.

Three different orders will describe more thoroughly the main specifications pertaining to the power plants, to the consumer’s sites and to the distribution grids. The prescriptions pertaining to the electricity generators located on a consumer’s site will be mentioned in the order describing the specifications of consumer’s sites, taking into consideration the fact that the most sensitive loads on those sites may have priority.

According to article 18 of the law, a decree must establish the general technical prescriptions under which the connection to the distribution grids shall be designed and operated for each new installation. Those prescriptions should apply to each new connection of a power plant or of a customer’s site. They should also apply when an existing connection is to be upgraded to allow an increase in capacity or to take into account a significant modification of the electrical specifications of the existing installations.

Two different orders will describe more thoroughly the main specifications pertaining to the power plants and to the consumer’s sites. The prescriptions pertaining to the electricity generators located on a consumer’s site will be mentioned in the order describing the specifications of the consumer’s sites, taking into consideration the fact that the most sensitive loads on those sites may have priority.

Special provisions pertain to the connections of the production plants to the distribution grids which are not
connected to the interconnected European transmission grid. As it should be expected, special care has to be taken in order to coordinate those different regulations and to avoid unnecessary costs both on the part of the system users and of the grid operators.

The operator of the public network allows for a clarification of the technical conditions of realization and of the suited modalities of exploitation. These specifications are then detailed in the appropriate contractual documents.

2. The general technical prescriptions pertaining to the connection to a distribution grid
   a) General prescriptions for all users

In application of the article 18 of the law of February 10, 2000, the provisions concerning all new connections to the public distribution networks are gathered in a decree which is completed by two orders clarifying the conditions of connection of small power plants and of consumer’s installations.

These texts are not applicable to the connections of user’s installations on small isolated networks (overall rated production capacity lower than 20 MW).

According to the terms of the law, these texts do not contain provisions pertaining to the connections of distribution networks to each other. The general conditions of construction and operation of the public distribution networks are specified by an order of May 17, 2001.

In France, the public distribution networks are generally made of low and medium voltage networks (voltage lower or equal to 50 kV). A few distribution networks also contain some electric lines in high voltage (voltage superior to 50 kV). However, the technical regulations hereafter described do not apply to connections to those high voltage networks. Any new connection to a high voltage network should be designed and operated as a connection to the transmission network.

The decree obliges the operator of the distribution public network to guarantee to every local user the possibility to connect his installation to the public distribution network in the range of voltage equal to or lower than the reference voltage corresponding to the user’s installation.

At the user’s request, a connection at a higher voltage can be used, especially when the user's installation generates important disturbances in the quality of electricity or when the user asks for particular performances.

To be able to answer to the connection request, the operator of the distribution network has to verify, according to the information provided by the user, that the new connection will allow to respect the following points:

- to respect the maximal intensities on the electric lines and the substations.
- to respect the breaking capacity of circuit breakers and the thermal threshold of lines and electric devices as well as their mechanical threshold during electrodynamic efforts.
- to respect the limit values of the electric voltage and eventually to avoid an electric voltage collapse.
- to maintain detection and elimination capacities of

---

**Figure 1: The general organization**

b) How are the operational specifications established

When considering the connections to the transmission grid, the operator of this public network, RTE, must establish and publish a general document, called référentiel technique, in order to explain how the regulation will be applied, taking into consideration the conditions of a particular application to connect a new installation. This document will specially focus on the quality of electricity at the connecting point, on the design and operation of the electrical safeties and communications and on the technical design of the installation in order to contribute to the ancillary services.

When considering the connections to a distribution grid, the operator of this public network, EDF or a local public body, must also establish and publish a general document to explain how the regulation will be applied, taking into consideration the conditions of a particular application to connect a new installation. This document will specially focus on the quality of electricity at the connecting point, on the design and operation of the electrical safeties and communications and, when necessary, on the technical design of the installation in order to contribute to the ancillary services.

For every new connection, the user of the public network sends to the operator of this public network an application form containing the necessary technical information specified by the operator of the network. Within a delay of three months, the latter realizes a study of the connecting conditions and establishes an initial project taking into account administrative and technical constraints. The results of this study are passed on to the applicant accompanied with a financial proposition.

After agreement, a joint study realized by the user and the
electric faults.
- to respect the quality of the electricity supplied.
- to avoid disturbances in the transmission of tariff signals.

The operator of the network makes a study to determine the connection solution. He takes into account the characteristics of the installation to be connected, the characteristics of existing or already planned equipment on the grid as well as the characteristics of already connected installations. He analyzes the different modes of operation of the electric system (under normal conditions and in different cases of disorder). He determines the technical provisions to be implemented (i.e. the replacement of equipment in technical constraint or the reinforcement of electrical lines) so that the projected connection is possible.

The study of the projected connection is conducted in an objective transparent and non-discriminatory manner. The general methods and the hypothesis that are used are made public by the operator of the public distribution network.

The operator of the public distribution network presents all the results of the study to the user, providing for rules of confidentiality.

The operators of the installations that are to be connected to the public distribution network have to design and construct these installations in such a manner that they can bear disturbances related to the exploitation in normal regime of this network and face disturbances that can be generated during exceptional regimes (low frequency, high or low voltage, etc). These installations must be also equipped with protection devices to eliminate defects resulting from electric faults inside the installation or on the public distribution network.

The orders establish different prescriptions pertaining to the quality of electricity, measured at the delivering point of the new installation, in order to allow the operator of the distribution network to fulfill his obligations. These prescriptions take into account harmonic currents, voltage unbalance and fluctuations.

b) Specific prescriptions for consumer’s sites

In order to connect consumer's installations, the reference voltage is determined according to the table below:

<table>
<thead>
<tr>
<th>Range of voltage</th>
<th>Consumption capacity limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triphase Low Voltage</td>
<td>250 kVA</td>
</tr>
<tr>
<td>Medium Voltage (the lowest of the two values)</td>
<td>40 MW, 100 / d (in MW)</td>
</tr>
</tbody>
</table>

Table 1: Ranges of voltage for consumer’s sites

To avoid disturbances in the transmission of tariff signals. The connection agreement of the installation specifies the ratio between reactive and active energy consumed by the installation.

c) Specific prescriptions for generation plants

In order to connect small power plants, the reference voltage is determined as a function of the maximum power generation capacity according to the table below:

<table>
<thead>
<tr>
<th>Range of voltage</th>
<th>Capacity limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monophase Low Voltage</td>
<td>18 kVA</td>
</tr>
<tr>
<td>Triphase Low Voltage</td>
<td>250 kVA</td>
</tr>
<tr>
<td>Medium Voltage</td>
<td>12 MW</td>
</tr>
</tbody>
</table>

Table 2: Ranges of voltage for power plants

Micro-power plants connected in low voltage do not have to absorb any reactive power.

For small power plants, connected in medium voltage, with a total generation capacity lower than or equal to 1 MW, every generator must be able to supply an amount of reactive power equal to 40% of its rated nominal generation capacity (in MVA).

For power plants with a total generation capacity superior to 1 MW and lower than or equal to 10 MW, every generator must be able to supply an amount of reactive power at least equal to 50% of its rated nominal generation capacity and to absorb an amount of reactive power equal to 10% of its rated nominal generation capacity.

For the power plants with a total generation capacity superior to 10 MW, every generator must be able to supply an amount of reactive power at least equal to 60% of its rated nominal generation capacity and to absorb an amount of reactive power equal to 20% of its rated nominal generation capacity.

In order to avoid or reduce voltage jolts, any generator must comply with special provisions when the installation is started and linked to the grid. Special provisions apply also when the production of an installation is increased or decreased.

d) Specific prescriptions for power plants connected to isolated networks

Some important distribution networks are not connected to the interconnected european grid (i.e. Corsica, Guadeloupe, Martinique, French Guyana).

Connection of a power plant to these networks must comply with more stringent provisions in order to allow a smooth operation of these distribution systems.

In particular, the generators must be able to operate on a larger range of frequencies (as low as 44 Hz and up to 54 Hz) during short periods. They must also be able to contribute to the adjustment of the frequency and of the voltage according to the specific needs of these networks. Thus the power plants...
operators must be able to communicate with the distribution network operator in a permanent and reliable way.

3. **Transparent and non-discriminatory common rules for more effective technical choices**

The regulatory procedures thus established are funded on a balanced approach of the needs of the new user’s connection and of the distribution network. The limits established in these regulatory requirements must be considered as general safeguards and allow specific local improvements and technical optimization.

The operator of the distribution network and the operator of the new plant have to determine together the best means that need to be implemented in order to comply with this new regulation. Both parties must bring their share of knowledge in order to optimize the connection equipment and to ensure a smooth and reliable operation of the plant, of the connection and of the grid.

The results of this shared study have to be written down in a contract and the operational procedures have to be implemented, each partner taking his share of responsibility.