THE CERTIFICATION PROCESS OF THE TECHNICAL CONFORMITY OF GENERATORS CONNECTED TO POWER DISTRIBUTION GRID – COMPATIBILITY WITH THE EUROPEAN REQUIREMENTS

PROCESUL DE CERTIFICARE A CONFORMITĂȚII TEHNICE A GENERATOARELOR CONECTATE LA REȚEAUA ELECTRICA DE DISTRIBUȚIE – COMPATIBILITATE CU CERINȚELE EUROPENE

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Abstract: *The operator of the electricity distribution network has, in accordance with the National Regulatory Authority orders in force, well-specified obligations in terms of establishing the technical conformity of synchronous generators and generation modules of category A, B or C, up to 20 MW, connected to low or medium voltage. This activity is regulated by ANRE orders, related to European standards based on the European Commission Regulation no. 631/2016 (RfG code). ANRE Orders no. 51/2019, 208/2018, 72/2017 approved with subsequent completions to transpose the RfG code. The contribution of the paper consists in highlighting procedural elements of the certification of generators at the DSO level for a photovoltaic power plant and a synchronous generator.*

Keywords: certification, technical compliance, electrical distribution network

Rezumat: *Operatorul rețelei de distribuție a energiei electrice are, în conformitate cu ordinele ANRE în vigoare, obligații bine precizate în ceea ce privește stabilirea conformității tehnice a generatoarelor sincrone și a modulelor de generare de categoria A, B sau C, până la 20 MW, conectate la tensiune joasă sau medie. Această activitate este stabilită prin ordine ANRE aferente standardelor europene în baza Regulamentului Comisiei Europene nr. 631/2016 (cod RfG). Ordinele ANRE nr. 51/2019, 208/2018, 72/2017 aprobate cu completările ulterioare pentru transpunerea codului RfG. Contribuția lucrării constă în evidențierea elementelor procedurale ale certificării*

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generatoarelor la nivel DSO pentru o centrală fotovoltaică și un generator sincron.

Cuvinte cheie: certificare, conformitate tehnică, reţea electrică de distribuţie

1. Introduction

The practice of the certification activity of the groups and the generation modules implies the analysis of their extensive documentations in order to establish, in conditions of traceability, the characteristics required by the norms. The compliance of the documents provided by certified companies or European laboratories and, also, various test reports, has to be examined. The evolution of the network with an increased share of renewable energy sources integrated in the electricity distribution network is inevitable, being absolutely necessary for DSO to have the capacity to assess the conformity of generators operating in parallel with the energy system, regardless of their type.

It is necessary, to the highest degree, to internalize European and national regulations so that the DSO addresses optimally and covers its obligations in terms of certification of technical conformity of producers. The tests report that appear after tests are key stages in which the performance and behavior of the equipment are verified. An essential step in this process is also the preparation of a detailed technical compliance report of the plant or group, a document that summarizes the work of the authorized companies, proposing the final assessment for granting the certificate of conformity under permanent or in temporary conditions. Cases of category A or B power plants are presented in a simplified way. There may be important undesirable consequences for the operation of the network outside the quality parameters of electricity, which, under the conditions of the performance standard, means damages paid to the customers.

2. Case study - Photovoltaic Power Plant on roof

Photovoltaic power plants often use the existing space on the roof of industrial facilities. Their power is conditioned by the size of the available

surface. Another possible condition may result from the expertise of the construction specialist regarding the possibilities of loading the roof structure. If a factory or another facility has a square or rectangular roof, ideally, having a south-east orientation (Figure 1), it can be used for electricity generations.

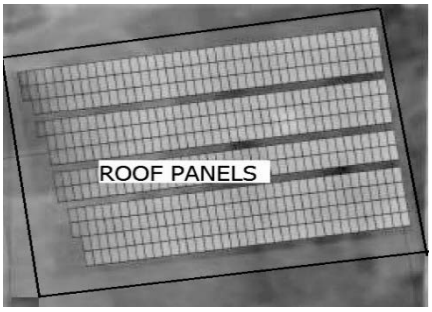

Figure 1. Solar panels for an A category plant on roof (e.g.)

Due to the limitation introduced by the surface, the generated power may not exceed 200-300 kW. In our example, as a simplified calculation, we can choose an amount of power of 180 kW, meaning 480 solar panels (0,375 kW/panel). Several types of three phase inverters system can be used, each one having an installed power from 30 to 100 kW, the facility may have from 2 to 6 inverters (Figure 2). The power plant will be of A category, according to ANRE Order no. 79/2016 [7]. The aspects regarding this article are related to the ascertainment of the conformity of the power plant with the Commission Regulation 2016/631 (RfG). In our country, the technical regulation for modular power plants are is the Order no. 208/2018 [3] which fully include the European requirements.

The Order 51/2019 establishes conditions before issuing the test approval (NPT – Power-On Notification). The conformity of the generating units to be energized with applicable technical requirements must be demonstrated by equipment certificates. The protection settings are established by the operation convention between user and DSO. If the SCADA integration was considered necessary must be proved as functional.

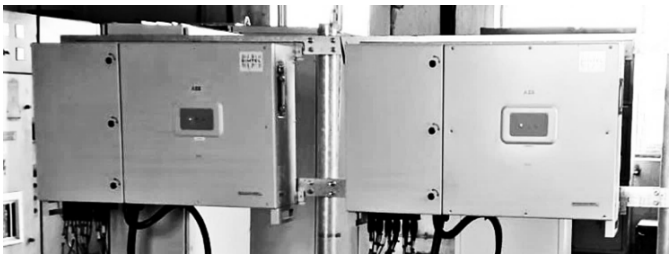

Figure 2 Inverters for A category photovoltaic power plant

However, one of the most important work of the DSO is to examine the validity of the certification of the generation equipment (inverters, in our case study). European certification bodies issue certificates of compliance with standards that include RfG requirements, following test reports. These standards must be EN 50549-1 and 2:2019 [5,6], which contain the provisions of the European regulation for connection in parallel with the low voltage network (first part of the standard) or the medium voltage network (in the second part). The above European Standards relates both to the RfG Regulation and technical market needs. The purpose is to give detailed description of functions to be implemented in products, therefore the conformity certificates and tests to these standards are essential.

Another important issue to be established are the disturbances introduced from the point of view of the quality parameters of the electricity, according to EN 50160 [10], communicated by the manufacturer of the generating unit through tests reports issued by laboratories certified at European level or measured, at the connection point, by DSO or an economic operator with certificate type A3 (A3 - power plants tests level). The electricity quality measurements are completed by a measurement report, with the data extracted from the class A quality analyzer.

The certification of the conformity for a power plant integrated in the electrical distribution network is a process consisting in documents verification and participation at field tests and also a dialogue between the owners (users), the certified companies and DSO. As the Commission Regulation (EU) 2016/631 states one of its principles [line (5)]: “Secure system operation is only possible if there is close cooperation between power-generating facility owners and system operators.”

3. Compliance of Gas Synchronous Generators

A power plant having a B category according to Order 79/2016 (from 1 to 5 MW, bellow 110 kV) can have a synchronous generator powered by an engine fueled by APG (Associated Petroleum Gas) or flare gas. A generator that usually can have 1.5 MW, for giving an example (Figure 3).

Figure 3. APG power plant with synchronous generators P_i = 1.5 MW each

Now in our country is active a top company with extensive experience in using APG gas for electricity generation (Figure 3), using high quality equipment manufactured in prestige factories from Europe. The poor quality of the some APG can prevent the use directly in the generator group, such as high H_2S, high-water content or low methane content. In most cases, these can be overcome with engineering capabilities which include a variety of technologies adapted for small space applications.

Synchronous generators must meet the conditions of the Order no. 72/2017 for approval of the Technical Norm regarding the technical requirements for connection of the synchronous generating groups with modifications brought by the Order no. 214/2018. However, the certification is also made after Order 51/2019, so in this matter there is a formal consistency. The RfG is also the unique European reference regulation. The DSO evaluates the conformity of the documentation and participate in the tests, then, following a compliance report, it will issue a certificate, as an official document of technical conformity of the plant (synchronous group). This “certificate” is specific only for categories B and C of generators. The tests that the DSO must participate are the reconnection after the voltage returns due to an interruption and the response to the power reference levels. The tests cannot be organized in the absence of documents related to the

protections verification and SCADA/DMS integration and are performed under the Local Dispatcher control.

As mandatory points, the certificates/test reports issued by the European bodies must contain clarifications about the operation of the generating unit in the frequency range (47.5 ÷ 51.5) Hz, at a frequency variation rate of 2 Hz / sec, for a time window of 500 ms, of 1.5 Hz / s for a window time of 1s and 1.25 Hz / s for a time window of 2s. Also on the reduction of active power compared to the maximum active power produced in case of frequency decrease below the value of 49.5 Hz and 49 Hz, respectively, the ability to ensure limited response at frequency increases above the nominal value of 50 Hz [3]. The ability to keep the mobilized active power constant regardless of frequency variations, within the power provided by the primary source, the ability to automatically reconnect the generating unit to voltage variations of (0,85 ÷ 1,1) U_n it's another important feature [3].

The certification of a category B generating unit is significantly more complex than that of a category A generator, especially for synchronous generators. The documentation of the unit needs to be much more extensive, we have more test and modelling information (reactive power, short-circuit currents, dynamic models behavior). These are requests regulated by ANRE in the orders mentioned above and must be adequately addressed in the compliance report.

4. Conclusions

The Implementation of distributed electricity generation from renewable energy sources in the DSO network must be made in accordance with the european network code on requirements for grid connection of generators (RfG code). Accordingly, with this code there are European standards and orders of ANRE specified in References. The internalization of these documents involves the DSO's ability to adequately address the technologies and types of generators whose certification as power producers is required. Sometimes it is necessary to insist on the accuracy of the protection bulletins in compliance with the provisions for adjusting the protections issued by the dispatcher. Electricity quality is a component of certification that must be planned, verified in situ and analyzed accordingly, having a great importance in the subsequent behavior of the network.

To certify the conformity of the power plants, experienced technical personnel is needed, having communication skills, able to realize accurate and detailed technical reports. As the European Regulation [1] states: "Secure system operation is only possible if there is close cooperation between power-generating facility owners and system operators." The future belongs to distributed generation and its integration into electricity distribution networks is a no-return path. Therefore, the best policy is to create its own staff with experience in this category of problems. Inadequate treatment of the conformity of the generating units that connect to the distribution networks can have disastrous consequences for the performance and safety standards of the operations. This article provides an overview of this activity, the contribution of the paper being the presentation of some relevant cases resulting from authors expertize.

R E F E R E N C E S

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[2] *National Regulatory Authority*, Order no. 51/2019, Notification procedure for connection of generating units and verification of compliance of generating units with the technical requirements for connection of generating units to electricity networks of public interest;

[3] *National Regulatory Authority*, Order no. 208/2018, Technical norm regarding the technical requirements for connection to the electrical networks of public interest for generating modules, power plants consisting of generating modules and power plants consisting of offshore generating modules (located offshore);

[4] *National Regulatory Authority*, Order no. 72/2017, Technical Norm on the technical requirements for connection to electricity networks of public interest for synchronous generators;

[5] *CENELEC*, EN 50549-1, Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network - Generating plants up to and including Type B;

[6] *CENELEC*, EN 50549-2, Requirements for generating plants to be connected in parallel with distribution networks - Part 2: Connection to a MV distribution network - Generating plants up to and including Type B;

[7] *National Regulatory Authority*, Order no. 79/2016, Approval of the classification of generating units and power plants;

[8] *CENELEC*, EN 50160:2010, Voltage Characteristics in Public Distribution Systems;