PANEL: STANDARDS, CERTIFICATION, REGULATORY FRAMEWORK AND PUBLIC POLICY

Scope of discussion, background and guiding questions

November 14th, Cuernavaca, Morelos, México
6. Standards, certification, regulatory framework and public policy
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6.1. Description

In this session will address the following topics:

- National and international standards applicable to the storage of energy.
- The new capabilities of the equipment used for interconnecting distributed generation and energy storage systems from the electric grid.
- Testing and certification of the equipment for the interconnection of the storage systems with electricity networks.
- The aspects that deserve a higher definition in national regulations (network code), the studies and criteria for the interconnection of energy storage systems, to remove barriers to their deployment.

The objectives of the working session are the following:

- Identify opportunities for improving standards and rules applicable to the energy storage systems and promote its implementation at the national level.
- Set the main guidelines to be considered in the Mexican regulatory framework that will allow us to take advantage of the full potential of the energy storage while maintaining the parameters of reliability of the electrical system.
- Propose research topics related to the capabilities of the systems and storage equipment, their interconnection and the new requirements of the electrical system of Mexico.

6.2. Background

6.2.1. Standards

For the energy storage technologies mature, such hydraulic pumping and lead-acid batteries, nickel cadmium, nickel metal hydride, lithium-ion batteries, and there are several IEC\(^1\) standards, which considered the technical characteristics, testing and integration of systems. For other storage technologies are the standards covering special topics.

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\(^1\) INTERNATIONAL ELECTROTECHNICAL COMMISSION.
In the case of the distribution networks the energy storage systems are covered under the concept of distributed energy resources (network).

**IEC 61850-90-7.** This part of the standard IEC 61850 describes the functions of the power converters for distributed energy resources, including photovoltaic systems (FT), storage batteries, charging systems for electric vehicles (EV) and any other resources distributed interconnected to the network through a power converter.

The standard IEC 61850-90-7 defines the following groups of functions of the power converters: control, management of Volt-Var's, administration of frequency-Watts, dynamic support of reactive power during abnormal operating conditions, functions for disconnecting or stay connected the converter, power factor management, management Voltaje-Watt's, setting parameters and reports.

**IEEE 2030.2-2015.** In this guide applies the interoperability process of the smart grid between an energy storage system and the power system. This guide provides to the electricity industry a set of definitions of the characteristics of the storage systems, applications and terminology that simplifies the task of specifying the requirements of the information and communications technologies.

Some examples of applications documented in this guide are the following: frequency regulation, support of Volt/Var, distributed energy services, integration of renewable energies, related services, etc.

IEC formed a Technical Committee (TC-120) to prepare policy papers related to Energy Storage Systems (ESS). The purpose of this committee is to prepare rules but not limited to application in networks of transmission, distribution, commercial, industrial, etc. The Committee's focus is toward the standardization of aspects of the ESS's more than the energy storage devices, as well as the interaction between the ESS's and electric power systems. As a result of the work of this Committee has generated the standard IEC 62933, which in the present year (2017) have published the following two parts:

**IEC 62933-4-1 TS.** This is a technical specification that describes the environmental characteristics associated to the systems of ESS's and represents a guide for assessing these impacts, as well as the impacts to humans.

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2 IEC 61850 IEC 61850-90-7: COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION - PART 90-7: OBJECT MODELS FOR POWER CONVERTERS IN DISTRIBUTED ENERGY RESOURCES (DER) SYSTEMS, 2013-02.


IEC 62933-5-1 TS\textsuperscript{5}. This part of the standard specifies the security considerations applicable to ESS's integrated systems to an electrical network. The main aspects considered in the standard are: the description of the dangers associated with a ESS based on the type, location, size, and the impact that produces the environment; assessment of the risks found in the previous point; and implementation of measures to reduce the risks based on the evaluation of the previous point.

This document provides criteria to encourage the safe application of energy storage systems of any type or size for embedded applications to the network.

6.2.2. Equipment Certification

The installed capacity of generation based on renewable sources is growing in the world, this represents different challenges to the operators of the systems. In this context the distributed resources have the ability to support the operation of the network through: support the voltage and frequency, by modulating the real and reactive power output, as well as tolerate the disturbances in the network. These resources can be activated via remote control.

These new capabilities are enabled through the application of advanced functions of inverters or converters. However, prior to the massive deployment of these capabilities is necessary to implement the required functions in inverters and test its functionality in laboratories.

The required functions are set out in some international standards and of USA. In the case of USA the applicable standard is IEEE 1547,\textsuperscript{6} which is in the process of revision to include the advanced functionality of inverters. In the specific case of California applies the "Rule 21" \textsuperscript{7}. From the point of view of test for the products of USA applies the test procedure UL 1741SA\textsuperscript{8}, which is a supplement to the standard UL1471 designed to validate the performance of the advanced functions of inverters, and converters. Currently these functions are not covered by the IEEE 1547.1\textsuperscript{9} In which applies for distributed energy resources, including energy storage.

\textsuperscript{5} IEC TS 62933-5-1 ED1. Electrical Energy Storage (EES) systems - Part 5-1: Safety considerations related to grid integrated electrical storage (EES) systems


\textsuperscript{8} UL Standard 1741 SA (Supplement). Underwriters Laboratories. "Supplement for Grid Support Utility Interactive Inverters".

These advanced capabilities will enable enterprises to operate the facilities, among other features: apply functions of rail, cut power and other traits of control based on real-time capabilities of network.

At the international level IEC 61850 in its part 90-7 describes the functions applicable for inverters in the interconnection of distributed resources to the electrical network, focused on the conversion of DC-AC and DC-DC. This standard include photovoltaic systems, storage batteries, charging systems for electric vehicles and other inverters controllable.

To ensure the functionality of the inverters should check and test parameters and modes of operation of the inverters. With this purpose we have created a series alliances between international laboratories, how is the project ISGAN\textsuperscript{10}. Some of the entities participating in this project are: Sandia (Sandia National Laboratories) in the USA and CanmetENERGY of Canada. These alliances are generating tools to perform the tests to the inverters in an automatic way.

6.2.3. National Regulations

At the national level the market fundamentals\textsuperscript{11} establish that the systems of storage should be recorded under the figure of a power plant and will be able to make offers for all services to be able to produce in the same conditions as any central generation.

In the same way when a storage equipment is part of the National Transmission Network or General Distribution Networks, observe the strict legal separation between the generator that represents the equipment in the Wholesale Electricity Market and the carrier or distributor that use the equipment for the Public Service of Transmission and Distribution, in the terms that define the Energy Secretariat. In addition, these generators, transporters and distributors shall be submitted to the tariff regulation set by the regulator.

The operator must acquire the related services required for the reliability of the national electrical system in terms of the Network Code and its operative provisions issued by the regulator. Related services required are:

(A) Primary Regulation
(B) Reserves
(C) Voltage Control and reactive power
(D) Emergency start-up, operation in island and dead bus connection system

\textsuperscript{10} ISGAN. International Smart Grid Action Network Annex 5: Smart Grid International Research Facility Network (SIRFN)
\textsuperscript{11} Foundations of the Electricity Market. September 2015.
All units that are connected to the national electricity system must participate in the primary regulation, such as a mandatory service that will not be payed by the regulator.

The power plant of the type A (less than 500 kW) needs to activate his control over the active power in response to a condition of high frequency. This control must be activated from 60.2 Hz, with a selectable control characteristic between 3 % and 8 %.

La planta de energía del tipo B (≥ 500 kW y < 10 MW del Sistema Interconectado Nacional), además de la condición del párrafo precedente, debe activar el control de potencia activa en respuesta a una condición de baja frecuencia. Este control debe activarse desde 59,8 Hz, con una función de regulación en el rango de 3% a 8%. In addition the plant must have the primary control of active power response to the frequency, which must respond to the frequency from the ceiling of regulation to the minimum limit of regulation and vice versa in a maximum time of 15 minutes.

The regulation has the following guidelines:

(I) As needed to maintain the frequency and exchanges programd, the operator will send signals to the Central Electrical Units with the frequency of operation of the automatic control of generation.

(II) Only the units that have offered secondary regulation to the market and whose bid has been accepted will receive instructions for regulation in the real-time operation

(III) The instructions for regulation will be distributed to all eligible units depending on their individual characteristics regardless of cost or restrictions of transmission via the Automatic Control of Generation of the operator, regardless to the National Interconnected System, the Interconnected System Baja California and Baja California Sur.

(IV) The units must have the capacity and infrastructure to be incorporated into the Automatic Control of Generation of the operator, complying with the technical requirements that the operator to set in order to offer the service of regulation to the market.

The Wholesale electricity market do not include the following services:

(I) Reactive Reserves.
(ii) Reactive Power.
(iii) Emergency start-up, operation in island and dead bus connection to the system.
The settlements of these services shall be determined by the regulator using the regulated tariffs.

According to the Network Code\textsuperscript{12}, the power plants of type C and D can participate in the market of the secondary regulation and in compliance with the requirements of voltage and reactive power, this represents the following capabilities:

| The National Interconnected System | 10 |
| Baja California System             | 5  |
| Baja California Sur System         | 3  |
| Mulegé In                          | 1  |

The emergency boot capacity is not mandatory and the regulator may request if it considers that the security of the system could be at risk. In the same way, the operation in island will be requested by the system operator to a plant.

6.2.4. International trends in regulations for energy storage systems

At the international level\textsuperscript{13} there is a marked interest in removing barriers for that the small distributed resources can participate in wholesale electricity markets. For this purpose rates for these resources should be established for selling their capacity, energy and related services to the wholesale electricity markets through aggregators. At this point, the trade barriers and transactions of participation in the markets of distributed resources should be addressed. Among these barriers are the costs to participate in the market, such as: the measurement, telemetry and communications equipment.

The storage resources maybe able to recover their costs for the services offered through regulated rates but may also have other resources by services to the market. In this aspect we have the following comments: 1) may place the storage in an advantageous position with respect to other resources where the recovery of investment depend exclusively on the services of the market, 2) can create distortions in the market, 3) can put at risk the independence of the operator.

The FERC Order number 755\textsuperscript{14} sets out different approaches to the compensation awarded to the services of regulation of frequency. In this order a proposal is to provide a higher level of compensation to resources that provide regulation of frequency with greater speed.

\textsuperscript{12} Network Code: 8 April 216.

\textsuperscript{13} Docket Nos. RM16-23-000; AD16-20-000, FERC (FEDERAL ENERGY REGULATORY COMMISSION), Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, November 17, 2016.

\textsuperscript{14} Order No. 755, FERC (FEDERAL ENERGY REGULATORY COMMISSION), Frequency Regulation Compensation in the Organized Wholesale Power Markets, October 20, 2011.
ramp that is established as a minimum every 5 minutes. This is due to the fact that, commonly, most operators dispatch resources every 5 minutes.

The argument behind this is that the increased speed ramp based on the storage can offer fewer resources devoted to regulation, greater reliability of the system, especially in the case of greater penetration of distributed resources, and less environmental impact since they do not require fuel to stay in operation.

6.3. Guiding questions for the panelists in the workshop (specific)
### 14 November 2017. Table 6: Standards, certification, regulatory framework and public policy

**Topic: Standards**

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| 11:45 a.m.     | Intervention of the Leader                  | • National and international standards applicable to the storage of energy.            | • What aspects of the energy storage should be included at national and international standards?  
                                                                                                         • To what extent does the standardization constitute a barrier to increase the penetration of energy storage systems and renewable energy?  
                                                                                                         • What is the current status of the internal norms of CFE?  
                                                                                                         • What are the prospects of the normativity ANCE applicable to the storage of energy?  
                                                                                                         • The Grid Code sets a behavior of plants of type A (≤ 500 kW) of high frequency and a preset level of harmonics. Who does the testing and certification of these inverters?  
                                                                                                         • What are the rules of information technologies related to energy storage?  
                                                                                                         • Do you have any proposals for future research in the area of standards for Energy storage? |
| 12:00 a.m.     | Panelist 1. Presentation                     |                                                                                       |                                                                                                                                                                                                                                |
| 12:15 p.m.     | Panelist 2. Presentation                     |                                                                                       |                                                                                                                                                                                                                                |
| 12:30 p.m.     | Panelist 3. Presentation                     |                                                                                       |                                                                                                                                                                                                                                |
| 12:45 p.m.     | The leader’s questions to the panelists      |                                                                                       |                                                                                                                                                                                                                                |
| 13:00 p.m.     | Recess                                       |                                                                                       |                                                                                                                                                                                                                                |
| 13:15 p.m.     | Questions from participants                 |                                                                                       |                                                                                                                                                                                                                                |
| 13:30          | Discussion of the priority lines of research |                                                                                       |                                                                                                                                                                                                                                |
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<td>15:00 p.m.</td>
<td>Intervention of the Leader (Introduction)</td>
<td>• The aspects that deserve a higher definition in national regulations (grid code), the studies and criteria for the interconnection of energy storage systems, to remove barriers to their deployment.</td>
<td>International point of view of the interconnection of distributed energy resources: • How different are the interconnection studies for storage systems in comparison with those made for power generation? (California case) • What is the most important information that must contain the grid codes from the point of view of energy storage? Point of view of FERC (USA): • What is the process of implementation of the FERC directives in the field of energy storage? • The ESS's can be considered as resource despatchable? In the US it has proposed a minimum size for storage systems of 100 kW, this represents a barrier or a motivator for the deployment of the ESS's. The size is agree with the wholesale market in Mexico? • Have been discussed some directives for the aggregation of energy storage systems? • What are the outstanding issues from the point of view of the FERC on the theme of energy storage?</td>
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<td>15:15 p.m.</td>
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<td>15:45 p.m.</td>
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<td>16:00 p.m.</td>
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<td>09:00 a.m.</td>
<td>Intervention of the Leader (Introduction)</td>
<td>• The new capabilities of the equipment used for interconnecting distributed generation and energy storage systems to electricity networks.</td>
<td>• What are the advanced features most representative for inverters? • What is the procedure for testing and certification of advancedinverters? • Does the test procedure covers the whole range of inverters? • What is the experience in the implementation of the functions described in the protocols for testing and certification? • Who can provide the testing and certification services to inverters? • Can the test protocols be used for certification purposes? • How do you demonstrate the robustness and advanced inverters' ability to improve the network? • Do you have any proposals for future research in the area of testing and certification of inverters?</td>
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<td>Discussion of the priority lines of research</td>
<td>• The testing and certification of the equipment for the interconnection of the storage systems with electricity networks.</td>
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