2018 Reliability Technical Conference

Tuesday, July 31, 2018

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Panel I: The Changing ERO Enterprise, Standards, and Reliability Presentations: The Electric Reliability Organization (ERO) Enterprise, including the North American Electric Reliability Corporation (NERC) and the Regional Entities, has undergone significant changes in the past year and embarked on new initiatives. Panelists will be asked to address the following:
Last year, NERC signed a memorandum of understanding (MOU) with the Comisión Reguladora de Energía and the Centro Nacional de Control de Energía to establish a framework for a cooperative relationship between Mexico and NERC. How is that partnership developing? What reliability efforts are underway as a result of the MOU?

Commissioner Marcelino Madrigal

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Prepared Statements

I. Mexico Power Sector is Undergoing a Fast, Deep, and Wide Transformation Towards a More Competitive and Cleaner Energy Sector. In this reform Context, CRE became the Reliability Authority in Mexico.

Mexico is going through a major restructuring in its energy sector, as a result of the Constitutional Energy Reform in 2013 and the issuance of various laws that govern the operation of the hydrocarbons and electricity sectors in 2014. Particularly, the Energy Reform intended to transform the sector into an open market, with increased competition from private players and accessibility to national and foreign companies for the first time since 1938. Its goals are to lower electricity and fuel prices by increasing efficiency, share the benefits with society and increase the amount of clean energy, all in a transparent manner.

Regarding the Electricity Sector, the Electric Industry Law aims to transform the vertically-integrated power sector, in which generation, transmission, and distribution were handled by the national electric utility Comisión Federal de Electricidad (CFE), to an unbundled sector that divides the three functions, as well as the Electric System Control and supply, promotes private investment, and enhances regulatory oversight. At the same

time the package of reforms in the power sector included clean energy targets whose goal is to achieve a 35% share of these sources by 2024, with an aspirational target of 50%. Results on the renewable agenda has been specially encouraging with renewable energy prices beating most expectations.

The **Energy Regulatory Commission (CRE)** grew stronger with the reform as the federal agency responsible for issuing the new regulatory framework granting open access to transmission and distribution networks based on a not-unduly and equitable treatment for all those interested in developing energy projects. CRE is also responsible for regulating and issuing permits for generation, determining the tariff methodology and general terms and conditions for energy services, issuing the market rules, monitoring the recently created Mexican Wholesale Electricity Market. **Particularly, in the reliability arena, CRE is now the authority in Mexico** with specific powers conferred in the Electric Industry Law to issue the reliability regulation, monitor and enforce compliance with the power to impose penalties. The Ministry of Energy issues related policy regarding long term adequacy of supply criteria.

II. Since the energy reform act in over less than four years, CRE has successfully undertaken is newly given role of reliability authority issuing important regulations on reliability, supervising its compliance, reporting on the status of reliability, and initiating the improvement process.

Since 2016, CRE has issued various regulatory instruments to establish the rules on electrical reliability defining the responsibilities of all stakeholders involved within the electric sector such as our Independent System Operator (CENACE), transmission and distribution companies, generators, loads, and load serving entities. In this sense, **the following milestones have been reached**:

1. The Grid Code: a pure-technical document issued in 2016, which defines the efficiency, quality, reliability, safety and sustainability criteria for the Mexican Power Sector. The Grid Code defines an "Adequate Level of Reliability" for the Mexican Power Sector. The Grid Code is meant to explain and determine the minimum technical requirements that have to be met in terms of system operation and control, planning of the expansion strategies, and interconnection of generators and loads. It also includes important topics such as cybersecurity and interoperability.

3. The emergency protocol: a set of guidelines issued to CENACE that include a process to follow in order to acquire reliability products through expedited and transparent procurement process based triggered based on a permanent monitoring of reserve margins. The Protocol has been used only once during the summer of 2016 for the Region of Baja California in the north part of the country to tackle pre-reform legacy supply situations.

5. Reliability auctions: a competitive mechanism conducted by CENACE to obtain generation capacity in which different technologies may participate based on their technical performance and cost-effectiveness. The rules for conducting this type of auctions were issued in 2018.

2. The Electric Reliability Committee: a formal committee created with the purpose of reviewing and proposing updates to the Grid Code. This Committee was created by CRE in 2018 and it is intended to gather technical experts from the industry, academia, and private sector to analyze the convenience of developing or adjusting the technical criteria within the Grid Code. This Committee is very similar to those Committees conducted by NERC to develop and update reliability standards in the United States that are later submitted to FERC requesting authorization.

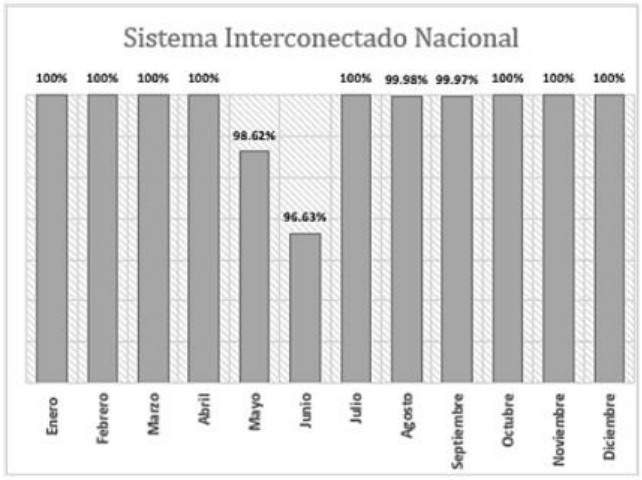
3. The First Reliability Report: a document published by CRE in 2018 informing the condition of the Mexican Power Sector in terms on reliability. This is the first report ever made in Mexico that publicly report on the status of reliability and presenting an objective assessment of the electric infrastructure for 2016 – 2017 using well-known performance metrics such SAIDI, SAIDI, Not Served Energy; it also includes information about the main disturbance events occurred in the transmission network.

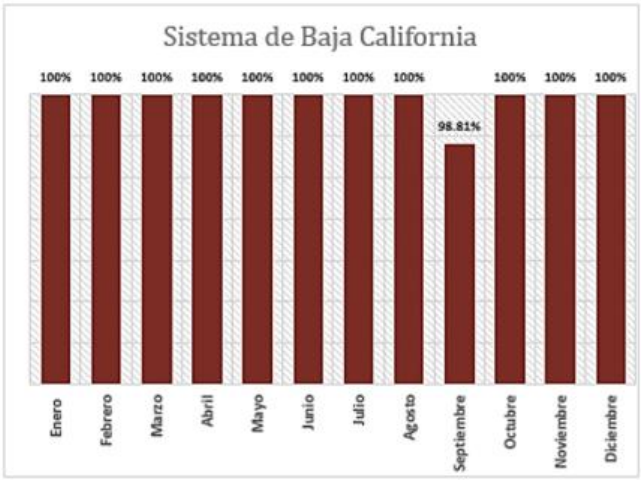
III. Reliability Performance of the Mexican Power system in the period 2016-2017 was adequate, with some areas for improvements identified in our fist reliability report.

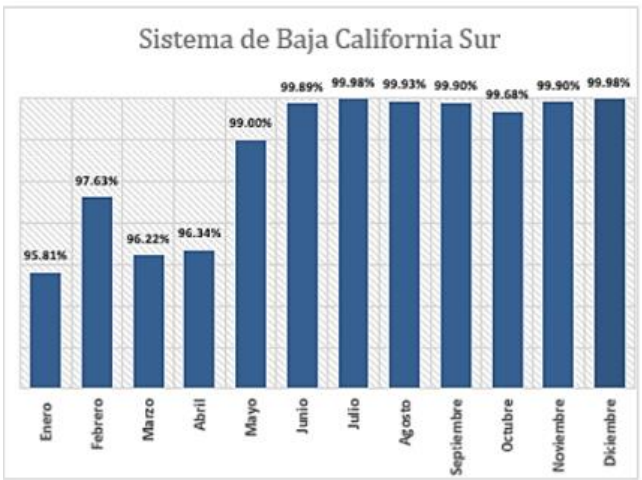
The Mexican Power System, as any other system in the world, faces different challenges that have been identified in the Reliability Report elaborated by CRE. Among the main findings we highlight the following:

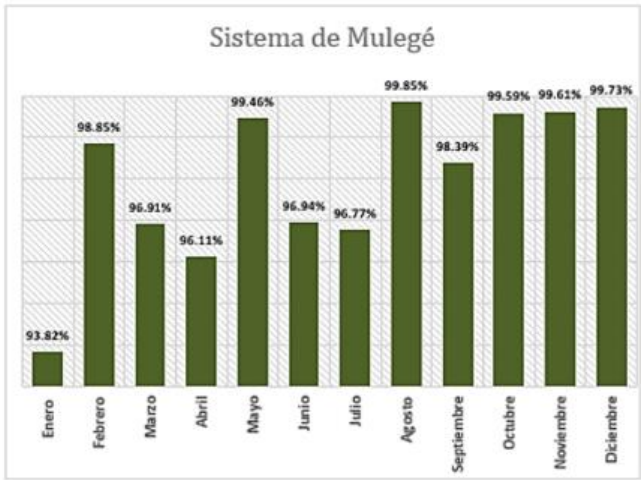
1. **Reserve Margin** (RM) is a reliability metric and targets issues in the Grid Code (aligned with the supply adequacy policy issued by the Ministry of Energy) to determine the available resources in the System to serve load considering spinning and non-spinning reserve. According to the Grid Code, RM must be at least 6% to consider the System is operating under normal conditions; if RM is lower than 6% the System is considered to operate under alert or emergency conditions. In general terms, as described in the first reliability report in 2017 the RM met the goal of 6% the vast majority of the time (% hr.) as indicated in the Figure below facing challenges mainly during summer season.

Fuente: Elaborado por la CRE, con información del CENACE.

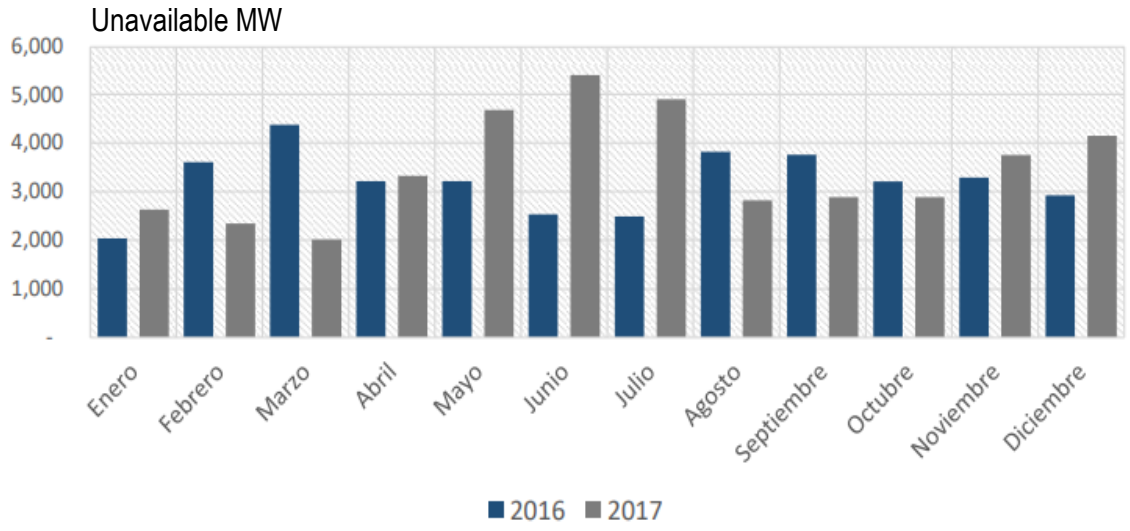




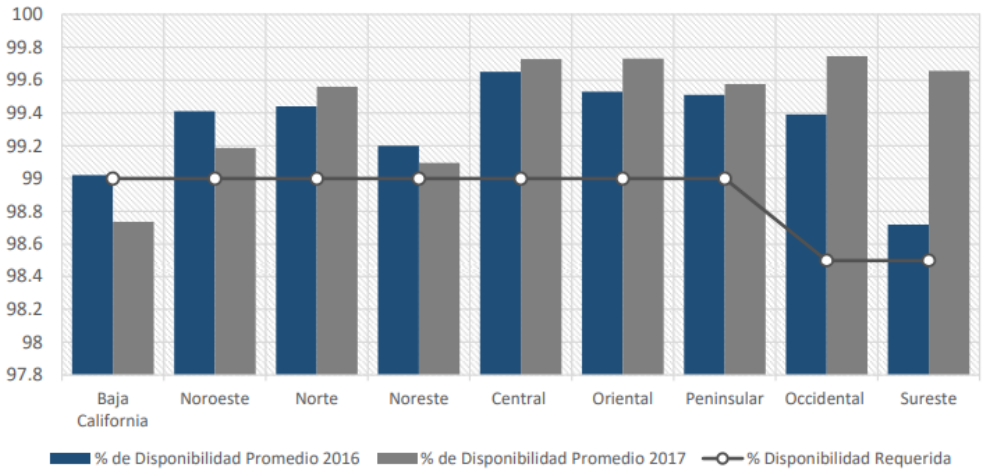




2. **Generation and Transmission availability**. The Reliability Report identified that Forced Outage Rate (FOR) of generation plants showing that in 2017 the FOR increased compared to 2016. The main causes identified of the FOR in 2017 were: generator/turbine failures, momentary lack of fuel (mainly natural gas) and maintenance periods with larger than expected durations.



Regarding transmission infrastructure, the Mexican regulatory framework imposes availability metrics for different regions in the country considering all infrastructure from 69 kV up to 400 kV which would be the equivalent to the definition of Bulk Power System used by NERC. In general terms, our transmission grid had more that 99% of availability during 2016 and 2017. Challenges related to congestion are still being addressed by CENACE and the Transmission Company CFE. Cotinued demand growth, penetration or renewables, and reliability are the factors largely influencing the needs for transmission. The report identified the need to improve the transmission construction process in some high demand areas so that new investments are put in operations on time.



3. **Main events in the Mexican Power System 2016 - 2017.** Three events with load interruptions above 1,000 MW occurred in this period, two events triggered by high temperatures and demand, and others still under investigation. One major event occurred during the September 19th earthquake where service was restored successfully.

Event	Location	Cause	
Transmission Line Outage 400 kV (2016)	Southeast, Tapachula	Mechanical stress in transmission towers	Interrupted load 68.2 MW
Emergency Protocol applied by CENACE (2016)	Baja California	Generation Capacity shortage	CENACE managed to obtain 310 MW during summer season. No load shedding was required
Transmission Line Outages 400, 230 and 130 kV (2017)	Northeast, Nuevo León	Meteorological event	Interrupted load 950 MW
Transmission Line Outage 400 and 230 kV (2017)	Peninsular	Uncontrolled fire	Interrupted load of 1,635 MW
Substation Outage (2017)	Northeast, Nuevo Leon	Under Root Cause Analysis	Interrupted load of 5, 306 MW
Load Shedding (2017)	Central Region	Eartquake 7.1 Richter degrees	Interrupted instantaneous load 10, 000 MW

4. **SAIDI and SAIFI in Distribution.** Regarding Distribution, the regulatory framework measures reliability according to internationally-used metrics such as SAIDI (System Average Interruption Duration Index) and SAIFI (system Average Interruption Frequency Index). This is particularly convenient to develop

benchmark studies with other utilities in different countries. CRE has imposed performance metrics for the Distribution Company CFE in terms of SAIDI (maximum of 50 minutes per year not including Major Event Days) and SAIFI (maximum of 0.94 interruptions not including Major Event Days).

According to our Reliability Report, in 2016 we identified annual values of SAIDI of 30.19 minutes (compared to 128.61[1] minutes in US utilities average) and SAIFI of 0.706 (compared to 1.299[2] interruptions in US utilities average as well). These indicators shower good performance.

IV. The relationship with NERC has been useful to inform some of our decisions and results outlines, it has also helped increase our capacity in areas of increasing importance such as cybersecurity and operational reliability of systems with large shares of variable renewables.

In the sake of the creation of a robust reliability framework in Mexico, CRE and CENACE are working together with the North American Reliability Corporation (NERC) under the Memorandum of Understanding (MoU) signed in March 2017. The partnership with NERC reflects a clear, cooperative understanding, seeking to strengthen technical and regulatory capacities for the mutual benefits of our power grids.

Some results of the work by staff from NERC, CENACE and CRE under this MoU are as follows:

1. **Reliability Standards**: a comprehensive review of key NERC reliability standards than could be implemented in Mexico, some of the standards will be submitted to the Electric Reliability Committee created by CRE during the process of updating the Mexican Grid Code.

2. Reliability Assessment: CRE and CENACE learned about the State of Reliability Reports elaborated by NERC and the assessment of reliability metrics and event analysis in the United States. Particularly, CRE reflected the results of this group in the Reliability Report 2016 – 2017 identifying the main challenges for Mexico in terms of congestion, unavailability of capacity generation, fuel shortages, etc.

3. Operational Reliability: NERC witnessed and assessed the restoration process implemented by CENACE, the simulation exercises carried in Mexico at the facilities of the operation control center in Puebla was highly usefull to both parties. While the process was deemed of high standards some areas of improvement will be pursued by CRE in the next Grid Code update cycle.

[1] U.S. Energy Information Administration. Electric power sales, revenue, and energy efficiency Form EIA-861 detailed data files. https://www.eia.gov/electricity/data/eia861/
[2] U.S. Energy Information Administration. Electric power sales, revenue, and energy efficiency Form EIA-861 detailed data files. https://www.eia.gov/electricity/data/eia861/

4. Cybersecurity: CRE learned the best practices in terms of protecting infrastructure against cyber-attacks. Since 2015, CRE's staff has participated in the GridEx exercises coordinated by NERC in which we observed a cyber/physical attack simulation on critical infrastructure. Our Grid Code already includes general guidelines in terms of cybersecurity and based on the results observed in GridEx and the knowledge shared by NERC, CRE is pursuing to strengthen the regulatory framework in this regard and CENACE is already implemented some quick win actions and investments approved by CRE

V. With that we would like to take this opportunity to thank NERC for the collaboration up to this point and also extend or thanks to FERC. We believe the collaboration has been a mutually beneficial and will only help enhance the reliability of our gradually more interconnected grids.

The relationship has been fruitful under the current MofU and we hope we can continue at least in the short run under a similar model. As per the MofU CRE is willing to take reasonable steps to study a different expand model of participation in the Electric Reliability Organization (ERO), in accordance with Mexican legislation. The office of CRE's chairman will soon communicate with NERC and describe the roadmap or process of the steps CRE will take to find out if an expanded role is possible. This would be feasible only in the midterm since Mexico is under a federal government transmission period for most of the remained of the year, but we remain committed to look at all potential alternatives to continue our relationship.

We thank again NERC and FERC for the collaboration so far and for inviting us today to this important conference. We remain convinced that exchanging experiences and practices will only be of mutual benefit to our neighboring and under constant transformation power grids.