System Failure- Texas Blackout of 2021

An Online Continuing Education Course for Engineers

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System Failure – Texas Blackout of 2021

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Information for this course was obtained primarily from, "The February 2021 Cold Weather Outages in Texas and the South-Central United States", which was produced by FERC, NERC, Regional Entities. November 2021. Other sources include, "The Timeline and Events of the February 2021 Texas Electric Grid Blackouts" which was produced by the University of Texas, Austin, and numerous industry and media reports.

Introduction

In February 2021, a massive winter storm with extremely cold temperatures and wintry precipitation impacted the central United States, resulting in almost ten million people being without power. This event was especially damaging in Texas, where extended periods of freezing temperatures impacted energy supply systems. During the Event, natural gas wellheads froze, power plants shut down, and wind turbines shut down due to ice accumulation, causing significant interruption to the power supply infrastructure. This resulted in food shortages, lack of heat and electricity, and impacts on the transportation infrastructure.

The Event cost the State of Texas over $130 billion dollars in economic impact and resulted in 4.5 million customers being without power. More importantly, over 100 people lost their lives.

> *"Running out of energy in Texas is like starving to death at the grocery store."*
>
> - Tucker Carlson, February 15, 2021

The 2021 Event was a cold weather event, but it did not set record lows for many parts of the state. The Event caused generations outages and loss of electric service that was many times more severe than other recent winter storms. With respect to recent storms, the 2021 Event had,

- The largest amount of generator unit outages,
- The largest amount of load shed,
- The largest number of customers impacted,
- The lowest system frequency,
- The largest amount of natural gas generation experiencing fuel shortages, and
- The longest duration of electric grid operations under emergency conditions.

In spite of these issues, the system worked as designed, and ERCOT avoided catastrophic system collapse, enabling utilities to return to normalcy much quicker than one has been possible if the system collapsed.

Due to the market design in Texas, some customers saw the electric rates jump from $0.12 per kWh to $9.00 per kWH for a few hours, which is a 7,500% increase! Natural gas prices increased from less than $5 per mmbtu to $400 per mmbtu.

Electric supply in Texas

Texas is the largest energy producer in the United States. It produces more natural gas than any other state and has the most wind power. Texas also has its' own electric grid, separate from the rest of the U.S. There are three grids in the continental United States and they are the Eastern Interconnect, the Western Interconnect, and ERCOT (Texas). See Figure 1.

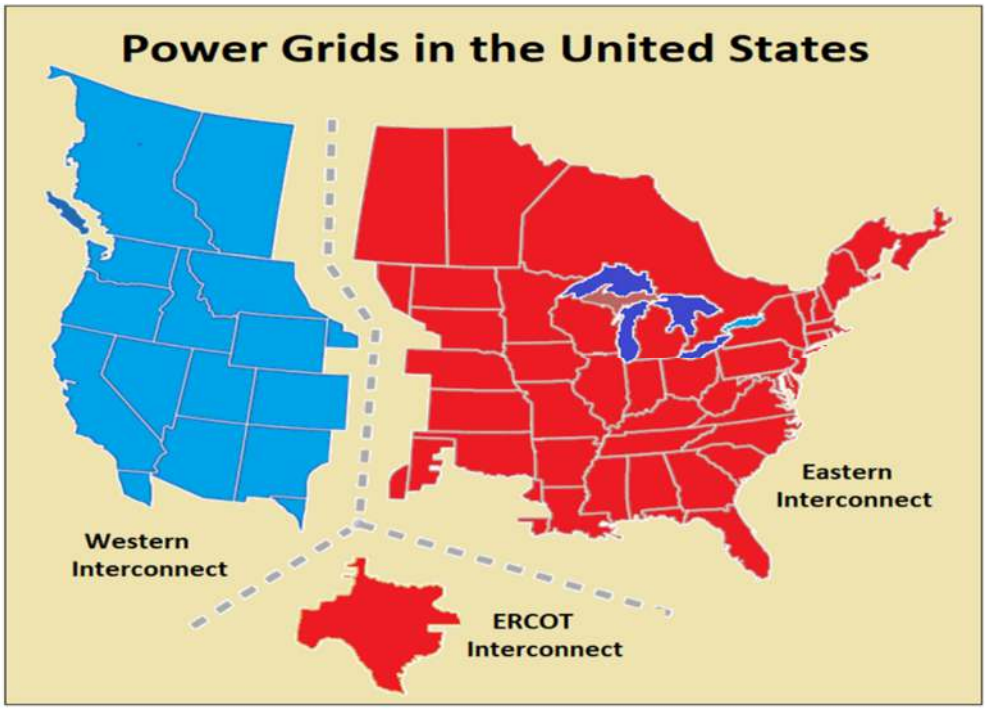

Figure 1

Electricity is provided to the majority of the state's consumers through an intra-state grid, managed by the Electric Reliability Council of Texas (ERCOT) as an independent system operator, with limited interconnection to the other two main electrical grids serving the U.S.

ERCOT Facts

Generation: 1,030 units

Transmission: 52,700 miles

Peak Demand: 75,000 MWs

People Served: 26 million

Limited federal regulatory jurisdiction within the ERCOT power region has permitted the development of a unique electricity system involving competition among generators of electricity in the wholesale sector and "customer choice" or retail competition in some areas of the state.

Natural gas has long been the leading fuel for the generation of electricity in Texas, although the state has significant renewable energy sources, primarily wind energy. Despite the interdependence of the state's natural gas and electricity industries, different state agencies have regulatory oversight over the two industries. While the Public Utility Commission of Texas (PUCT) oversees electricity services, the Texas Railroad Commission (RRC) regulates the natural gas sector. The PUCT's oversight over the electricity industry includes responsibility for overseeing the operations of the electric grid operator, ERCOT.

The unique arrangement in Texas has its roots dating back to the 1930s. In 1935, the Federal government moved to regulate the electric utility industry with the passage of the Federal Power Act (FPA). The Federal Power Act gives the Federal government authority to regulate utilities because it is considered 'interstate commerce.' The fiercely independent state of Texas

elected to isolate its' electric system from the rest of the U.S. so the Federal government could not assert authority over the Texas grid.

As a result of two major blackouts in the northeast in the late 1960s, electric utilities formed a voluntary organization – later mandated by the Federal Energy Regulatory Commission (FERC) – called the North American Electric Reliability Corporation (NERC). NERC is a council of seven regional electricity coordination organizations. Texas created its own regional electricity coordinating council known as the Electric Reliability Council of Texas or ERCOT.

Course Outline

This course explains what happened to the Texas natural gas and electric systems during this winter storm and the resulting lessons learned that may help minimize the impacts of future events. The winter storm of 2021 that impacted Texas is referred to in this course as the "Event." A much larger area of the Midwest was also impacted, and some references will be made to these other areas when it is pertinent to the Texas issues and, for clarity, are noted as the "Total Event." The course has five chapters: Chapter [illegible] describes the [illegible]ditions, planning, and preparation for winter events. Ch[illegible]ctric and gas facilities lea[illegible] issues for the period of Feb[illegible]scribing the activities duri[illegible] 14th through the 19th. Chapter F[illegible]nimize the impact of futur[illegible]