Electrical Grid Reliability Regulation

An Online Continuing Education Course for Engineers

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Table of Contents

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Introduction

This course explains how electric reliability of the bulk electric system is managed and governed and describes the roles of various entities involved in the process. Electric utilities have historically self-governed electric reliability and worked together through a series of voluntary requirements to ensure everyone worked together maintain a reliable electric system. As a result of several large scale blackouts in the early 21st century the US Congress intervened to mandate oversight of electric reliability in the United States.

This oversight is performed through the Federal Energy Regulatory Commission (FERC). In order to understand electric reliability it is useful to first understand the basic structure of how the bulk power system operates. Therefore, the course begins with an explanation of fundamental concepts and functions related to power system operations. The course then discusses FERC's authority under section 215 of the Federal Power Act (FPA) with regard to reliability and how FERC has implemented that authority, primarily focusing on the oversight of the development and enforcement of mandatory Reliability Standards.

Reliability Standards impose requirements on the users, owners and operators of the bulk power system to assure that they fulfill their responsibilities in reliable grid operations, consistent with the basic engineering functions and concepts discussed in the course. Finally, the role of the FERC-certified electric reliability organization or "ERO" and its relationship to FERC and electric industry stakeholders is discussed.

Under Part II of the FPA, FERC historically has regulated certain economic aspects of the public utility industry, such as the rates for sales by one utility to another in interstate commerce. Pursuant to the Energy Policy Act of 2005 (EPAct 2005), Congress expanded FERC's role and jurisdiction under the FPA by adding a new section 215 pertaining to electric grid reliability. While FERC had previously addressed electric grid reliability in an indirect manner, such as allowing the cost recovery of public utility expenditures that address discrete reliability matters, new section 215 of the FPA tasked FERC with a direct role over an entire new field of activity.

Section 215 of the FPA also differs from other provisions in the FPA because it defines FERC's jurisdiction in terms of users, owners and operators of the bulk power system. This term includes numerous entities that are excluded from most FERC economic regulation, such as federal power agencies, municipal utilities, and rural electric cooperatives. As a result, many entities typically not regulated by FERC had to familiarize themselves with the 2005 reliability legislation and comply with the new requirements. One commonality, however, with other provisions of Part II of the FPA is that section 215 delineates FERC's jurisdiction in terms of the bulk power system, and expressly excludes facilities used in local distribution from the new reliability scheme.

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Congress gave FERC authority to certify a non-governmental entity, referred to as the *electric reliability organization*, to develop and enforce mandatory Reliability Standards. Congress gave FERC the role of reviewing the Reliability Standards the electric reliability organization develops to ensure they are just, reasonable, not unduly discriminatory or preferential, and in the public interest. FERC must approve the electric reliability organization's Reliability Standards before they can take effect in the United States. Section 215 of the FPA requires independence of the electric reliability organization from the users, owners and operators of the bulk power system. Yet, the statute also requires the electric reliability organization to assure fair stakeholder representation in selecting the electric reliability organization board of directors and other aspects of the electric reliability organization, such as committees.

FERC has promulgated regulations defining the structure of the reliability program, certified the North American Electric Reliability Corporation (NERC) as the electric reliability organization, approved eight "regional entities" that serve as regional compliance authorities, approved over 100 mandatory Reliability Standards that address many facets of maintaining and improving bulk power system reliability, issued directives and ordered standards to be developed as well as reviewed thousands of electric reliability organization compliance and enforcement actions.

Emerging reliability issues require a dynamic program that takes a proactive stance in ensuring ongoing grid reliability. Thus, in addition to maintaining vigilance on fundamentals of grid reliability - such as real-time balancing of load and resources, operating equipment within defined limits, adequate operator training, and tree trimming - emerging areas of concern such as cyber security and changes in the nation's resource mix continue to require attention.

In enacting section 215 of the FPA Congress realized that FERC, the electric reliability organization or anyone else guarantee that blackouts will not occur. However, applying current knowledge and resources, participants strive to implement its authority over the electric reliability organization and the Reliability Standards in a diligent manner to reduce the possibility of blackouts on the bulk power system.

In the course, some material is repeated in different sections and references are provided to other parts of the course where a concept is addressed in greater detail. More information on NERC's functions as the electric reliability organization can be found at www.nerc.com.

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Chapter 1

Overview of the Electric Power System

Modern society has come to depend on reliable electricity as an essential resource for national security, health and welfare, communications, finance, transportation, food and water supply, heating, cooling, and lighting, computers and electronics, commercial enterprise, and even entertainment and leisure - in short, nearly all aspects of modern life. Providing reliable electricity is an enormously complex technical challenge: it involves real-time assessment, control and coordination of electricity production at thousands of generators, moving electricity across vast interconnected networks of transmission lines, and ultimately delivering the electricity to millions of customers by means of extensive distribution networks.

It is these complexities that make the North American electric system such a great engineering achievement. This infrastructure represents more than $1 trillion in asset value, more than 211,000 miles of transmission lines operating at 230 kilovolts and greater, over 1.1 million megawatts of generating capability, and nearly 3,500 utility organizations serving over 334 million people whose total electricity demand exceeds 830,000 megawatts.

Structure of the North American Electric Power System

Each interconnection in the North American electricity system is essentially one large machine and comprises three main functions: generation, transmission, and distribution, each of which is discussed below. Electric generation (supply) creates electricity using various generating technologies with specific operating characteristics. The transmission system connects and transfers large amounts of power from generators to the distribution system, delivering electricity to population centers. The distribution system then routes electricity to individual customers, which are referred to as load. Together, these system parts are connected and operate in an electric balance. See Figure 1.

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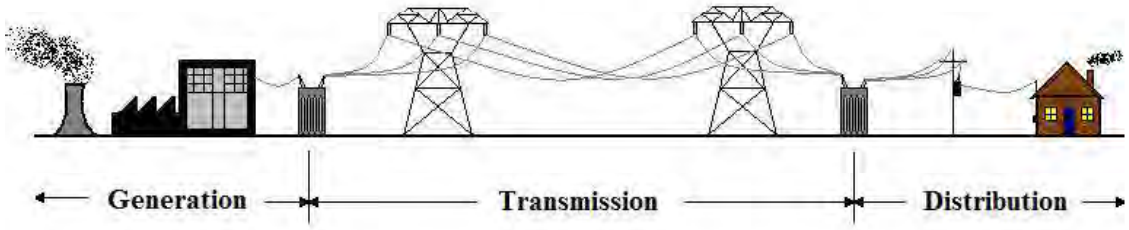
Electric Power System Components



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The East…States and Canada f…stem is also reco…g systems. …al United States (excludin…ish Columbia, and a portion of Baja Calif…Reliability Council of Texas (ERCOT) interconnec…most of the state of Texas. The four interconnections are electrically independent from each other except for a few small direct current (DC) ties. Within each interconnection, electricity is consumed the instant it is produced, flowing over transmission lines from generators to loads.

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