The Transmission System - Electricity's Highway

by
Patricia Nussbaum, Engineer

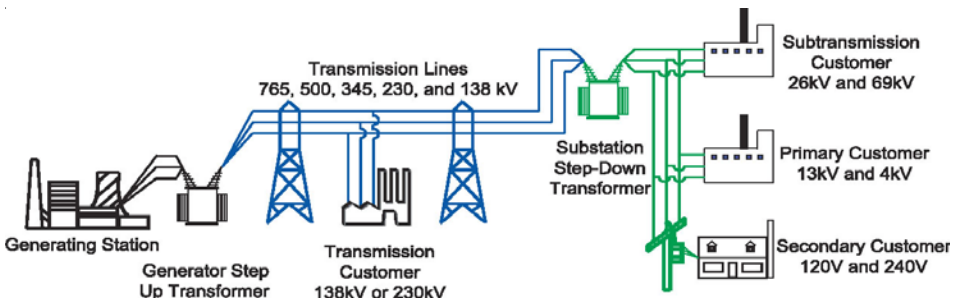
Electricity is not a commodity that can be stored easily. The transmission system acts as an interstate highway that takes electricity to market. The result of a problem on the transmission grid is the loss of the commodity, not just a delay in its delivery.

Our economy relies on electricity and that reliance grows as we become more and more information based. The transmission lines are owned and operated by the larger utilities, but the move toward deregulating the generation sector has opened the transmission lines to greater use. The existing transmission system was not designed to meet today's growing demand for electricity. The reliability of the system is no longer a certainty.

> "On August 14, 2003, large portions of the Midwest and Northeast United States and Ontario, Canada, experienced an electric power blackout. The outage affected an area with an estimated 50 million people and 61,800 megawatts (MW) of electric load in the states of Ohio, Michigan, Pennsylvania, New York, Vermont, Massachusetts, Connecticut, New Jersey and the Canadian province of Ontario. The blackout began a few minutes after 4:00 pm Eastern Daylight Time (16:00 EDT) and power was not restored for 4 days in some parts of the United States. Parts of Ontario suffered rolling blackouts for more than a week before full power was restored. Estimates of total costs in the United States range between $4 billion and $10 billion (U.S. dollars)."
>
> (U.S.-Canada Power System Outage Task Force, "*Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*," April 2004.)

The transmission system was built by vertically integrated utilities that owned the generation and transmission infrastructure. The utilities produced electricity at large generation stations and used the transmission infrastructure to move the electricity to customers. The 1920s were a period of consolidation for the electric utility industry as larger and more efficient steam turbines were developed. Electric utility ownership consolidated into large utility holding companies. The 16 largest holding companies controlled 75 percent of the generation capacity. The growth of the industry beyond city limits brought with it state regulation. The states expanded the roles of the railroad commissions to include electricity. However, the growth continued beyond state lines and Federal regulation soon followed as the electricity industry was recognized as a natural monopoly in interstate commerce.

Figure 1. Key Elements of the Electric Power Grid



Source: U.S.-Canada Power System Outage Task Force, *Final Report on the August 14, 2003, Blackout in the United States and Canada: Causes and Recommendations*, August 2004.

Assuming there is a local interest in local utilities, the Public Utilities Holding Company Act of 1935 (PUHCA) limits the size of utility holding companies by limiting their geographic region. PUHCA requires utility parent companies to incorporate in the same state as the utility it owns. This would place it under state regulation. A company that owns utilities in more than one state is subject to federal regulation by the Securities and Exchange Commission (SEC). The SEC requires the utility holding companies to divest their holdings leaving them with only those businesses consistent with being a single integrated utility.

In 1978, in response to the Arab oil-producing nations ban on oil exports to the United States the Public Utility Regulatory Polices Act (PURPA) was adopted. PURPA requires electric utilities to allow a qualifying facility (QF) to connect to the transmission system and to purchase whatever capacity they produce at the utility's avoided cost (what it would have cost the utility to generate the power). The qualifying facilities are co-generators and the small power producers that use renewable resources. Most QFs are exempt from regulation by the SEC under PUHCA.

Table 1. Federal Legislation Prior to EPACT 2005

Public Utility Holding Company Act of 1935 (PUHCA) PUHCA was enacted to break up the large and powerful trusts that controlled the Nation's electric and gas distribution networks. PUHCA gave the Securities and Exchange Commission the authority to break up the trusts and to regulate the reorganized industry in order to prevent their return. **Federal Power Act of 1935 (Title II of PUHCA)** This Act was passed to provide for a Federal mechanism, as required by the Commerce Clause of the Constitution, for interstate electricity regulation.
Public Utility Regulatory Policies Act of 1978 (PURPA) PURPA was passed in response to the unstable energy climate of the late 1970s. PURPA sought to promote conservation of electric energy. Additionally, PURPA created a new class of non-utility generators, small power producers, from which, along with qualified cogenerators, utilities are required to buy power.
Energy Policy Act of 1992 (EPACT) This Act created a new category of electricity producer, the exempt wholesale generator, which narrowed PUHCA's restrictions on the development of non-utility electricity generation. The law also mandated that FERC (Federal Energy Regulatory Commission) open up the national electricity transmission system to wholesale suppliers on a case-by-case basis.

Source: EIA (http://tonto.eia.doe.gov/FTPROOT/electricity/056296.pdf/April 4, 2006).

The Energy Policy Act of 1992 reformed PUHCA by creating a new category of non-utility generators called exempt wholesale generators (EWG) that were exempt form PUHCA requirements. FERC was given the mandate to open the transmission grid for wholesale power transactions on a case-by-case basis. This meant that FERC could order the utility that owned the transmission infrastructure to provide transmission service at a rate that FERC determined was reasonable.

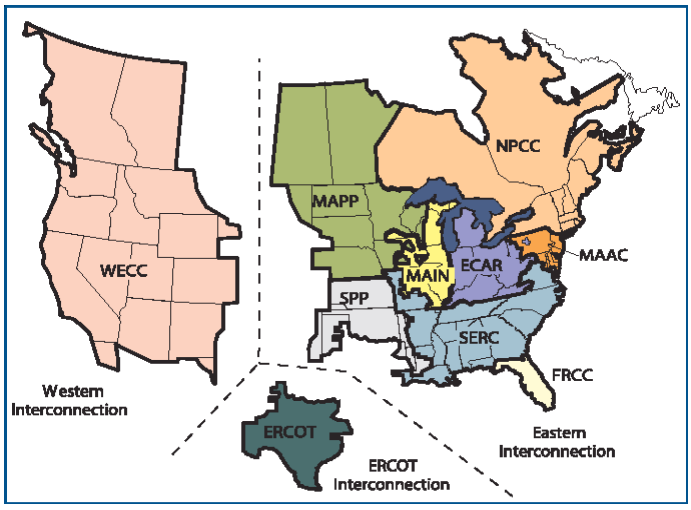
Table 2. Public Utility Regulatory Polices Act (PURPA) Qualifying Facilities

PURPA was designed to encourage the efficient use of fossil fuels in electric power production through cogenerators and the use of renewable resources through small power producers. Because of amendments to PURPA in 1990, the term "small power producer" is now a misnomer. The amendments eliminated the original size criterion for all energy sources except hydroelectric, while maintaining the criterion for the type of energy used. (Under PURPA provisions, both cogenerators and small power producers cannot have more than 50 percent of their equity interest held by an electric utility.	
Cogenerators	**Renewables**
Cogenerators are generators that sequentially or simultaneously produce electric energy and another form of energy (such as heat or steam) using the same fuel source. Cogeneration technologies are classified as "topping-cycle system, high-temperature, high-pressure steam from a boiler is used to drive a turbine to generate electricity. The waste heat or steam exhausted from the turbine is then used as a source of heat for an industrial or commercial process. In a typical bottoming-cycle system, high-temperature thermal energy is produced first for applications such as reheat furnaces, glass kilns, or aluminum metal furnaces, and heat is then extracted from the hot exhaust stream of the primary application and used to drive a turbine. Bottoming-cycle systems are generally used in industrial processes that require very high-temperature heat.	A renewable resource is an energy source that is regenerative or virtually inexhaustible. Renewable energy includes solar, wind, biomass, waste, geothermal, and water (hydroelectric). Solar thermal technology coverts solar energy through high concentration and heat absorption into electricity or process energy. Wind generators produce mechanical energy directly through shaft power. Biomass energy is derived from hundreds of plant species, various agricultural and industrial residues, and processing wastes. Industrial wood and wood waste are the most prevalent form of biomass energy used by non-utilities. Geothermal technologies convert heat naturally present in the earth into heat energy and electricity. Hydroelectric power is derived by converting the potential energy of water to electrical energy using a hydraulic turbine connected to a generator.
For a non-utility to be classified as a cogenerator qualified under PURPA, it must meet certain ownership, operating, and efficiency criteria established by FERC. The operating requirements stipulate the proportion (applicable to oil-fired facilities) of output energy that must be thermal energy, and the efficiency requirements stipulate the maximum ratio of input energy to output energy.	For a non-utility to be classified as a small power producer under PURPA, it also must meet certain ownership and operating criteria established by FERC. In addition, renewable resources must provide at least 75 percent of the total energy input. PURPA provisions enabled non-utility renewable electricity production to grow significantly, and the industry responded by improving technologies, decreasing costs, and increasing efficiency and reliability.

Source: EIA (http://tonto.eia.doe.gov/FTPROOT/electricity/056296.pdf/April 4, 2006).

The grid is an alternating current network that is divided into major interconnections – the eastern interconnect (the eastern two-thirds of the continental United States and Canada from Saskatchewan east to the Maritime Provinces), the western interconnect (the western third of the continental United States (excluding Alaska), the Canadian provinces of Alberta and British Columbia, and a portion of Baja California Norte, Mexico) and the ERCOT (Electric Reliability Council of Texas) interconnect that covers most of Texas. Very little power exchange occurs between the major interconnections. The problem of moving power between the interconnections is usually some combination of physical constraints and electrical bottlenecks.

Figure 2. North American Electricity Transmission Systems



Source: NERC (http://www.pi.energy.gov/pdf/library/TransmissionGrid.pdf/May 1, 2006).

FERC, as the regulator of the wholesale electric power markets, had no authority to enforce the North American Electric Reliability Council (NERC) transmission reliability standards. NERC is a not-for-profit company formed by the electric utility industry to promote the reliability of the electricity supply in North America. NERC consists of nine Regional Reliability Councils and one affiliate whose members are from all segments of the electricity supply industry. NERC is a voluntary organization that relies on a voluntary system of compliance with reliability standards.

This is not adequate for the needs of the current transmission system. One of the recommendations from the August 24, 2003 Blackout task force is to "make reliability standards mandatory and enforceable with penalties for noncompliance."

The Energy Policy Act of 2005 (EPACT-2005) is the first major energy legislation in 13 years. EPACT-2005 repeals PUHCA to encourage investment in the grid and establishes mandatory reliability rules for the transmission system. EPACT-2005 also requires DOE to issue a national transmission congestion study for comment by August 2006 and every three years thereafter. Based on the study and public comments, DOE may designate selected geographic areas as "National Interest Electric Transmission Corridors" (NIETCs). If the Secretary of the Department of Energy designates an area experiencing congestion as an NIETC FERC is authorized to issue permits for the construction and modification of electric transmission in the NIETC.

Historically, politics surrounds all aspects of electricity production and delivery and the Act increases the power of the federal government over electricity's interstate highway.

Selected Bibliography

Energy Information Administration, *The Changing Structure of the Electric Power Industry: an Update*, December 1996 (http://tonto.eia.doe.gov/FTPROOT/electricity/056296.pdf/April 4, 2006).

Energy Information Administration, *The Restructuring of the Electric Power Industry A Capsule of Issues and Events*, 1997.

ICF Consulting, "2005 Energy Act: The Impacts on Electric Transmission," (http://www.icfi.com/Markets/Energy/Energy-Act/electric-transmission.pdf/May 24, 2006).

Laurence D. Kirsch, *Long-Term Transmission Rights a High-Stakes Debate*, Public Utilities Fortnightly, March 2006.

Lynn Hargis, *PUHCA for Dummies: An Electricity Blackout and Energy Dill Primer*, Public Citizen's Critical Mass Energy and Environment Program September 2003 (http://www.citizen.org/documents/puhcafordummies.pdf/April 4, 2006).

National Council on Electricity Policy, *Electricity Transmission A Primer*, June 2004.

Robert Burns, The National Regulatory Research Institute, *Summary of H.R. 6 – Energy Policy Act of 2005*, August 2005.

The National Regulatory Research Institute, *Summary of H.R. 6 – Energy Policy Act of 2005 Title XII: Electricity*," August 2005.

U S Department of Energy, *National Transmission Grid Study*, May 2002.

U.S.-Canada Power System Outage Task Force, *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*, April 2004.

William F. Hederman Jr. and George D. Billinson, *FERC's Tough New Rules: Survival Skills for a New Era*, Public Utilities Fortnightly, April 2006.