

DRAFT

Chapter 2. Official Transmission Data

1. Introduction

This chapter describes official data pertaining to electricity transmission. Official data is defined as information produced by the Federal and State governments, their agents and regulated entities, such as Independent System Operators (ISOs) and some data produced by the North American Electric Reliability Council (NERC). The sources of Federal transmission data are the Department of Energy- mainly the Energy Information Administration (EIA) and the Federal Energy Regulatory Commission (FERC)- and the Department of Agriculture's Rural Utilities Service (RUS). Only NERC data that are routinely and readily supplied to DOE, EIA and FERC are treated as Official data.

2. Transmission Technology, Industry Organization and Data Collection

Transmitting electricity over long distances is not new. As early as 1893, a hydroelectric generation plant was transmitting alternating current electricity from San Antonio Creek, California, over 40 miles to San Bernardino, California over a 10kV line.¹ These lines were not typically connected to lines owned by other generating companies. By the late 1920s, utilities realized that connecting to neighboring systems had economic benefits. Because of diversity in adjacent systems' peak loads and in generating plant outage times, interconnections permitted significant reductions in total installed capacity without reductions in overall service reliability.

Even before World War II, improvements in transmission technology, especially high voltage transmission lines, permitted electricity to be economically shipped hundreds of miles. In 1936 the Tennessee Valley Authority, for example, built a 230-mile, high voltage (154 kV) line linking Norris Dam near Knoxville, Tennessee with Wilson Dam at Muscle Shoals, Alabama.² This capability encouraged more utilities to interconnect. Following the East Coast Blackout of 1965, utilities banded together to form the North American Electric Reliability Council in 1968 to promote the reliability of the grid. The Federal Government promoted utility interconnections and regional planning as a means to protect system reliability and encourage economic growth.

Regional transmission planning and coordination is a challenge partially because of the size of the domestic industry and because of the variety and number of entities owning a piece of the grid. New England's grid delivers more electricity than does the United Kingdom's. Ownership of the grid is spread across 240 investor owned utilities, 2009 public utilities, 894 cooperatives and nine Federal utilities. Investor owned utilities sell about 74% of all electricity to final customers, publicly owned utilities sell about 16%, cooperatives sell about 9% and Federal

¹ U.S. Bureau of Reclamation, The History of Hydropower Development in the United States, July 13, 2003, www.usbr.gov/power/edu/history.

² www.newdeal.feri.org/library/r39.htm

utilities sell the remainder.³ Each operates in a different legal (regulatory) and economic environment. The interconnected electric transmission grid evolved over time in response to particular economic opportunities and common problems facing literally thousands of thousands of diverse entities. This diversity is reflected in the data.

Two Federal agencies and two Departments collect information on electricity transmission. The Federal Energy Regulatory Commission collects transmission information from investor owned utilities and other entities it regulates. The Energy Information Administration collects similar information from entities outside of FERC jurisdiction— Independent Power Producers (IPPs), cooperatives, municipal systems, Federal power and Texas. EIA also collects data from generators under FERC jurisdiction. The Department of Energy collects trade data with Canada and Mexico. The Department of Agriculture collects data from cooperatives having loans with the Rural Utilities Service.

Facility owners and system operators collect electrical data at specific points on the grid- generators, substations, and customer meters- to control and charge customers for using the system. This electrical control and associated company economic data are the building blocks for all other data collections and reporting. Data collection agencies aggregate owner and operator information up the hierarchies of electrical control- buses, to control area, to ISOs, to NERC regions to Interconnections-and ownership. The text box describes the electrical hierarchy.

Electrical Control Hierarchies: Definitions

Interconnection - a connected alternating current power grid that operates at the same frequency in synchronization. There are three interconnections in the U.S., the Western interconnection, the Eastern interconnection and Texas (ERCOT). Because, by definition, these are not synchronized with each other, AC power lines cannot connect them. DC lines can, but, because DC lines are expensive and because the physical separations are often large, the connections between interconnections are very weak.

ISO- an organization approved by FERC that oversees, and can control, the operation of generators, transmission companies and markets within the ISO's area. ISOs can function as super control areas to control power flows into and out of the ISO's area.

NERC Region- a voluntary association of interconnected transmission systems and generators that jointly plan, schedule and operate to ensure system resources and procedures protect reliability. NERC regions include multiple control areas and can include more than one ISO.

Control Area – an electric system consisting of one or more electric utilities capable of regulating their generation to maintain a schedule of electricity flows.

Bus- any place where wires come together or connect equipment such as generators, transformers, capacitors and sub-stations to the grid.

³ EIA, Table 1. Selected Electric Utility Data By Ownership, 2000. The table is available at www.eia.doe.gov/cneaf/electricity/public/t01p01p1.

Government agencies generally attempt to report the data they collect by ownership (regulatory status), electrical control and political subdivision. Table 2-1 and the accompanying maps show the structure and number of the electrical control and political hierarchies. Interconnections, ISOs, NERC Regions, and States generally encompass a mix of entities with differing ownership, regulatory requirements, and boundaries, both geographic and electrical. That organizational complexity alone makes it difficult to estimate regional totals or to make sharp interregional comparisons. But organizational complexity is not the only challenge.

As markets for energy develop, the grid’s economics and operations are becoming more integrated. Prices, supplies and reliability are not as closely associated with individual firms as in the past. Neither power flows nor markets begin and end at ownership and jurisdictional borders. Even if they did, individual companies and system operators rarely have complete information on topics of policy interest. Federal and State policy makers are forced to look beyond individual company reports and political boundaries to inform their oversight of the grid.

Table 2-1. Electrical and Political/jurisdictional data collection and reporting hierarchies

Electrical (number)		Political/Jurisdictional (number)	
Interconnections	3	Countries	3
ISOs	6	Census Divisions	10
NERC Regions	10	States (Contiguous)	48
Control Areas	About 140	Utility service areas	About 3100

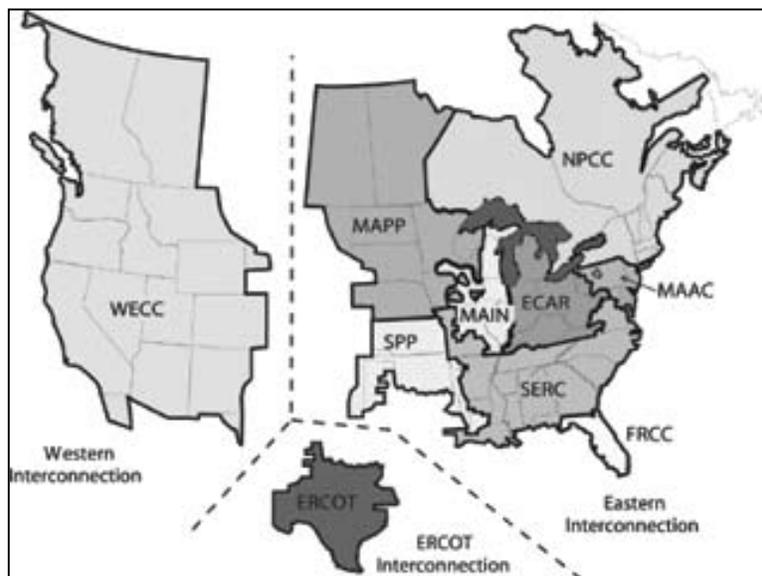


Figure 2-1. NERC Interconnections and Regions



Figure 2-2. ISOs
Source: EIA, MISO

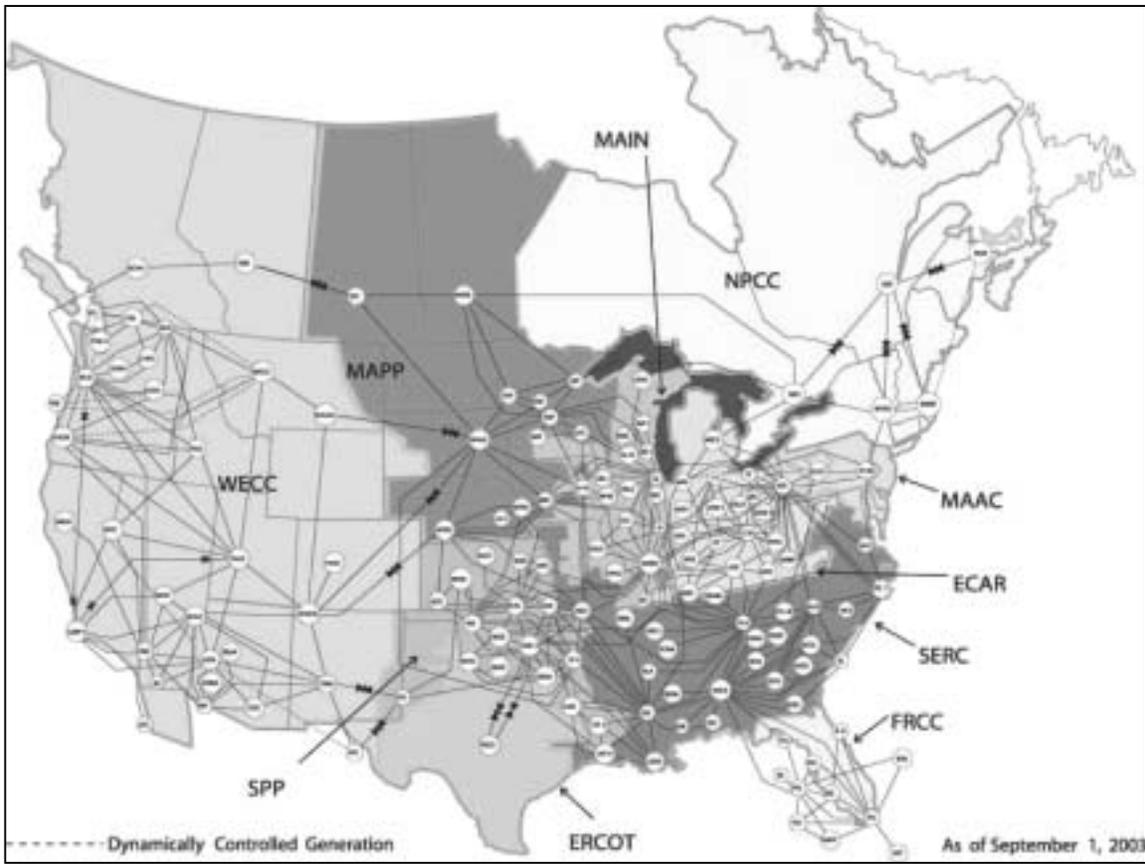


Figure 2-3. NERC Regions and Control Areas

When there is a fundamental change in the way an industry does business, as is now happening in electricity, the basic data needed to describe the industry must also change. Federal Agencies charged with collecting industrial data must modify how they collect data and on occasion need to acquire new kinds of data. The Agencies must also develop new ways of aggregating and disaggregating basic reports to accommodate new organizational and market boundaries. Given the physical and institutional complexity of the industry, and the variety of government interests in particular parts of the industry, it is not surprising that the data for answering relatively new questions about transmission are uneven, and even non-existent.

3. Official Transmission Data Being Collected

The official data elements describing the existing system relate to:

- Physical assets;
- Configuration of these assets as a power delivery system;
- Performance of that system under normal and emergency conditions; and
- Economic Data-Cost, investment and price.

Some of the data refers to generation and demand because transmission is meaningless without them. The official data describing the planned system include:

- Projected facility additions/retirements;
- Projected performance of the planned system in meeting future needs.

Most Federal transmission data are collected on survey forms. The Paperwork Reduction Act (PRA) requires each Federal agency to seek and obtain Office of Management and Budget (OMB) approval before undertaking a collection of information directed to ten or more persons, or continuing a collection for which the OMB approval will expire. Under the PRA, OMB approval for an agency to use each information collection instrument can last a maximum of three years. For questionnaires and forms, agencies are required to provide the public with 60-day notice in the Federal Register requesting comments from the public and affected agencies before submitting the information collection package for OMB review.

The Federal Government currently fields 11 major data collection instruments directly relevant to transmission. Table 2-2 exhibits these forms and their target respondents.

Table 2-2. Federal Data Collections

<u>Agency</u>	<u>Respondents</u>	<u>Form number</u>	<u>NAME</u>
FERC			
	IOUs	FERC 1	Annual Report of Electric Utilities, Licenses, and Others
	Control Areas	FERC 714	Annual Electric Control and Planning Area Report
	IOUs or NERC	FERC 715	Annual Transmission Planning and Evaluation Report
EIA			
	NERC	EIA 411	Coordinated Bulk Power Supply Program Report
	Public & Federal	EIA 412	Annual Electric Industry Financial Report
	G&T Cooperatives		
	Electric utilities	EIA 417R	Electric Power System Emergency Report
	generators>IMW	EIA 860	Annual Electric Generator Report
	Industry participants	EIA 861	Annual Electric Power Industry Report
DOE		FE-781R	Annual Report of International Electric Import/Export Data
RUS	Cooperatives	RUS 7	Report for Electrical Distribution Borrowers
			...Borrowers with Generating Facilities
		RUS 12	

Independent System Operators and the North American Electric Reliability Council (NERC) typically produce electronic reports, often databases, on system operations as a part of their system monitoring and oversight responsibilities. These reports are specific to the needs of the particular collecting organization and can change quickly. They also write market oversight reports and planning documents, usually annually. NERC data mostly pertain to their members; ISO data mainly involves physical and economic transactions within their boundaries. Data collected and disseminated by the ISOs are generally available on their websites in spreadsheet

or database format. Some ISOs provide summary reports on much of the data collected, while others simply provide the raw data. The data elements individual ISOs collect and make available to government and the public varies greatly.

NERC disseminates unique data collections such as the Transmission Loading Relief reports filed by Reliability Coordinators.⁴ They also provide Reliability Assessments, based on the data they and others collect, and make the assessments available at their website. These reports are at a regional level, and provide an overview of system reliability, rather than the detailed data and analyses they used to reach their judgments about reliability. In addition to the data unique to NERC, the Council provides compilations of data from the Form EIA-411 (and additional, non-transmission related forms) in their Electricity Supply & Demand Database (ES&D). The reports are available on the NERC website. The ES&D is sold on NERC's website, however, Government entities can receive a copy of the database upon request.

The appendix to this chapter summarizes the principal Federal transmission data collections. Table 2-3 is a summary of the transmission data currently collected by the Federal Government and associated organizations, and lists the available data elements. An empty box indicates no existing collection of that data element and type on the associated form. Although a particular data element such as "voltage" is being collected on five forms this does not mean that the government is asking individual data respondents the same question five times. Instead, Investor Owned Utilities report on the FERC Form 1 and Public Power Facilities, Municipals, Coops and others not reporting to FERC report on the EIA 411. These forms essentially identify what individual companies and other entities own. The EIA 412 associates power line rated voltage and other information with NERC regions. The FERC 714 presents voltage data by control region. The FERC 715 identifies nominal operating voltage and a host of electrical parameters by individual line number and buses in an electrical network. Planned transmission elements are indicated on the EIA-411 and the FERC 715. The variety of forms directly reflects the complexity of the industry and the electrical system.

Several of EIA's collections can be understood as complimenting FERC collections. The FERC Form 1 is the major Federal source of financial and facilities data about investor owned utilities. The EIA 412 collects similar data from entities not reporting to FERC. The FERC Forms 714 and 715 are important sources of official data used for Federal oversight of reliability plans, which, in the case of the 715 includes electrical modeling of the grid. EIA's Form 411 includes information on the "adequacy" of existing and planned generation for meeting projected demand and on new transmission facilities that is not captured on the FERC 714.⁵ The EIA form also includes electrical data on new lines that are not already included on the FERC form 715. Finally the EIA Form 417 collects information on power outages and the DOE's Form FE-781R reports international power flows, neither are collected by FERC.

⁴ A reliability coordinator is an individual or organization responsible for the safe and reliable operation of the interconnected transmission system for their defined area, in accordance with NERC reliability standards, regional criteria, and subregional criteria and practices.

⁵ Chapter 3 discusses "adequacy" in the context of reliability.

Similarly the RUS collects detailed information on its clients, cooperatives. Cooperatives are not under FERC jurisdiction.

NERC and the ISO's are the other major source of transmission data. NERC typically works with its members to assemble, verify and submit the data appearing on the EIA411, 412 and the FERC 715. NERC also collects a great deal of information about power flows, system disturbances, and curtailments.⁶ Most of the data is not public and little of that data is immediately and routinely available to the Federal government. There is no publicly available document describing precisely what data NERC does collect and archive.

ISOs collect and release a variety of performance data as part of their normal operations. ISO high frequency (hourly) data generally refer to markets-prices, generation, imports and exports. While each ISO generates vast amounts of virtually real-time operating, scheduling, planning, and bidding data, the ways in which the data are defined, collected, formatted, and made available to the public are not congruent from organization to organization. The data do not necessarily cover matching time frames, nor are the data of the same scope in most cases. ISOs also produce a variety of reports on market oversight, their planning processes and planned investments.

Similar information exists outside of the ISOs but is rarely made public. The data available to describe transmission and related markets in most of the United States is limited to that collected by the Federal government.

Many of the suggestions for improving the data available for public policy analysis of transmission issues involves standardizing data that is now collected within the ISOs, extending that standardized collection to areas outside of ISOs and coordinating Federal and NERC data efforts.

⁶ See, for example, "fast links" on NERC's website, www.nerc.com.

Table 2-3. Transmission Data Elements and Related Collection Systems

Transmission Data Elements	Data Collection Systems												
	About Physical Assets					About System & Performance							
	FERC Form 1	Form EIA-412	RUS Form 7	RUS Form 12	Form EIA-411	Form EIA-417	Form EIA-861	FERC Form 714	FERC Form 715	Form FE-781R	ISOs ^a	NERC ^b	OATT ^c
Line data													
Voltage (AC or HVDC)	•	•			•			•	•				
Line design information	•	•			•								
Capability									•				
Location (terminals)	•	•			•				•				
Length (miles)	•	•	•	•									
Ownership	•	•			•				•				
Stations/terminals data													
Name & location	•				•				•				
Voltages	•				•				•				
Function	•												
Load (MVA)	•	•	•		•				•				
Other trans. facilities	•	•			•				•				
Electrical Configuration													
Electrical configuration					•				•		•	•	
Miles of line by voltage	•	•	•	•									
Control area interconnection								•					
Performance													
System operating data													
System loading								•			•	•	
Transfer capabilities											•	•	
Congestion (duration)											•		
TLRs												•	
System disturbances											•	•	•
Losses	•	•	•	•							•	•	•

Table 2-3. Transmission Data Elements and Related Collection Systems

Transmission Data Elements	Data Collection Systems											NERC ^b	OATT ^c		
	About Physical Assets					About System & Performance									
	FERC Form 1	RUS Form 7	RUS Form 12	Form EIA-411	Form EIA-417	Form EIA-861	FERC Form 714	FERC Form 715	Form FE-781R	ISOs ^a					
Cost, price, rate, revenue, and fee data															
Capital costs line/struct.	•	•	•												
System O &M costs	•	•	•										•		
Balance sheet info	•	•	•												
Connection costs															
Trans. service rates													•		•
Ancillary service rates													•		•
Trans. service revenue	•												•		
Ancillary service revenue	•												•		
Nodal prices													•		
R&D expense	•														
Transaction data^d															
Interregional transactions	•	•	•	•	•	•	•	•	•	•	•	•	•		
Intraregional transactions	•	•	•											•	
International imports/exports														•	•

^aData available from one Independent System Operator (ISO) is not necessarily available from another ISO; nor are the data always comparable.

^bThe North American Electric Reliability Council (NERC) may provide access to some of the data elements in this chart that are not noted, however they are not the primary source of the data they disseminate.

^cOpen Access Transmission Tariffs.

^dThis is not an indicator of capability but a validation that the transmission systems facilitate economic transactions.

Table 2-4. Data for Facility and Reliability Planning

Planned Transmission System Data Elements	Data Collection Systems		
	Form EIA-411	FERC Form 715	ISOs
Planned System			
Electrical configuration	•	•	
Miles of line by voltage	•		
System Operating Data			
System loading			•
Congestion			•
Individual line information			
Voltage (AC or HVDC)	•	•	
Capability	•	•	
Location (terminal)	•	•	
Length (miles)			
Cost			
Ownership	•	•	
Projected in-service date	•		
Stations/Terminals			
Location	•	•	
Voltages	•	•	
Function		•	
Load (MW/MVAR)	•	•	
Capacitors (VAR)		•	
Ownership	•	•	
Projected in-service date	•		

Appendix: Federal Data Collections

FERC Form 1, “Annual Report of Major Electric Utilities, Licensees and Others,” is filed with the FERC and can provide DOE/EIA with a comprehensive listing of transmission data for investor-owned utilities. Data from this form include line location, voltage rating, structure type, conductor information, number of circuits, and land and construction costs. This form also delineates whether the data are related to either old or new transmission lines. The FERC Form 1 is one of the most useful data sources for investor-owned utilities with critical information related to transmission line identification, ownership, physical/electrical characteristics, and cost.

FERC Form 714, “Annual Electric Control and Planning Area Report,” is filed annually by electric utility or group of electric utilities that operate a control area with annual peak demand greater than 200 megawatts. Information related to transmission reported on this form includes

adjacent control area names, control area interconnection line/bus names, control area scheduled and actual interchanges, and corresponding line/bus voltage.

FERC Form 715, “Annual Transmission Planning and Evaluation Report,” is filed annually by any transmitting utility that operates network (not radial) transmission facilities at or above 100 kV. In the case of joint ownership, only the operator of the facilities must complete the FERC Form 715. FERC requires each transmitting utility to submit in electronic form its base case power flow data if it does not participate in the development and use of regional power flow data. A respondent that participates in the development and use of regional power flow studies must either submit the regional base case power flow data or designate the regional organization to submit such data. Also included in the submittal are transmission system maps and one-line diagrams, a detailed description of the transmission planning reliability criteria used to evaluate system performance, and a detailed evaluation of the respondent’s anticipated system performance as measured against its stated reliability criteria using its stated assessment practices.

Form EIA-411, “Coordinated Bulk Power Supply Program Report,” is intended to provide DOE/EIA with an industry-wide source of information regarding regional supply and demand projections for a 5-year advance period. The utilities and other electricity suppliers submit their Form EIA-411 information to their respective NERC regional councils by April 1 of each year. NERC collects the data from the regional councils and then NERC provides the data to DOE/EIA. The data reported to DOE/EIA in this form consists of a comprehensive list of supply and demand figures for each NERC regional council. Also included in the Form EIA-411 are transmission line maps, proposed transmission line data (including location, line length, expected service date, kV rating, and ownership) and load flow studies. Finally, the Form EIA-411 provides information on capacity sales and purchases across regions.

Form EIA-412, “Annual Electric Industry Financial Report,” is filed annually by municipal and Federal utilities and includes information similar to the FERC Form 1. Data from the Form EIA-412 includes line location, voltage rating, structure type, conductor information, number of circuits, and land and construction costs. This form also delineates whether the data are related to either old or new transmission lines. This form contains very useful data from municipal utilities with critical information related to transmission line identification, ownership, and physical/electrical characteristics. Additionally, the form initiated collection of transmission data from the cooperatives that own generation starting with the 2001 annual data.

Form EIA-417, “Emergency Incident and Disturbance Report,” is filed at each occurrence of a loss of transmission ability by those electric utilities that operate a Control Area and/or Reliability Coordinators, or other electric utility, as appropriate. The type, cause, and extent of the emergency are reported, as well as the response and the eventual resolution of the emergency. Most of the types of emergencies reported on this form occur on local distribution systems rather than on transmission systems.

Form EIA-860, “Annual Electric Generator Report,” collects data on the status of existing electric generating plants and associated equipment in the United States, and those scheduled for

initial commercial operation within 5 years of the filing of this report. The Form EIA-860 is to be completed for all electric generating plants, which have or will have a nameplate rating of 1 megawatt (1000 kW) or more, and are operating or plan to be operating within 5 years of the year of this form. The operator (or planned operator) of jointly-owned plants should be the only respondent for those plants.” Data are collected at the generator level, and include fuel source. EIA also collects monthly information about electricity generation and fuel use. The respondents include both those in the electricity generation industry, as well as those that are in other industries (such as manufacturing) that also generate electricity (the latter are referred to as combined heat and power plants.)

Form EIA-861, “Annual Electric Power Industry Report,” reports on the status of electric power industry participants involved in the generation, transmission, and distribution of electric energy in the United States, its territories, and Puerto Rico. Electric power industry participants include: electric utilities, wholesale power marketers (registered with the Federal Energy Regulatory Commission), energy service providers (registered with the States), and electric power producers. . Form EIA-861 collects information on: owned or leased transmission lines, purchases (sales) of transmission services on other electrical systems, Wholesale power marketing, retail power marketing and Demand-side management (DSM) programs are designed to modify patterns of electricity usage, including the timing and level of electricity demand.

Form FE 781R collects electrical import/export data from entities authorized to export electric energy, and to construct, connect, operate or maintain facilities for the transmission of electric energy at an international boundary as required by 10 CFR 205.308 and 205.325. Actual imports and exports of electricity are reported in detail by month. Export authorization holders primarily report quarterly while Presidential Permit holders report annually. DOE uses these data to track electricity being imported into the United States.

RUS Form 7, “Financial and Statistical Report for Electrical Distribution Borrowers,” is filed annually by current RUS borrowers that do not own generation. Data from this form includes miles of transmission lines and transmission operating and maintenance expenses. The information included in the RUS Form 7 is somewhat limited in detail and scope and does not provide as much critical data as the preceding non-RUS forms.

RUS Form 12, “Financial and Statistical Report for Power Supply Borrowers and Electric Distribution Borrowers with Generating Facilities,” is filed annually by current RUS borrowers that own generation. Data from this form includes miles of transmission lines by voltage, limited substation information, and transmission operating and maintenance expenses. The information included in the RUS Form 12 is also somewhat limited in detail and scope and does not provide as much critical data as the preceding non-RUS forms.