

Recommendation that DOE Facilitate Development of a Standardized Bulk Power System Database

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Background

Bulk power transmission capability, or more importantly the lack thereof, defines and limits markets. The grid of the future need not be a product of past practices. Now is the time for leadership to address broad infrastructure planning needs regarding the bulk power system for the US. Incremental approaches which only consider regional needs, or look at potential interregional projects one at a time, are not an effective use of limited resources especially in an industry with aging infrastructure with tremendous economies of scope and scale, and huge potential to capitalize on better tools, approaches and technological advances to improve the efficiency and effectiveness of the future grid(s). So, what is (are) the future grid(s) in the continental US and portions of Canada and Mexico? Is it 3 or more independent AC networks or a national grid or a combination of both? The possibilities, let alone an optimal solution set or two, are indeterminate absent sound analytics based on solid data.

FERC Orders 890 and 1000 are necessary, but insufficient, steps to effective and efficient planning of the bulk power system. Standardization for bulk power system planning datasets is long overdue. The lack of common definitions, differing reporting practices, inconsistent study approaches, unique modeling conventions and performance metrics, and the lack of awareness/visibility regarding adjacent systems due to customized software applications and the lack of effective data exchanges are problematic and warrant industry action. While commercial interests must be acknowledged and addressed in an effective manner, Reliability Coordinators and Planning Authorities need to understand system configurations, commitments, projections regarding load as well as renewable generation patterns, expected transactions, proposed and approved maintenance outages, etc to accurately protect the security and economic interests of the bulk power networks which are becoming increasingly interconnected and complex.

As evidenced by event analyses subsequent to major blackouts, it is clear that maintaining system security and effectively operating and planning the bulk power system will require more collaboration, cooperation, awareness and transparency among grid operators and planners. System security will require procedures and protocols to limit access to certain data. For example, Remedial Action Schemes may need to be protected and only made available to individuals with a valid business reason and appropriate clearances.

Case for Action

Now is the time to study futures for the US bulk power grid which not only leverage existing and expected technologies, but also create a robust and flexible vision for the future to shape regional, interregional and interconnection-wide plans. Development of national models and simulations to inform national policy discussions are predicated on accurate interconnection-wide efforts first.

Efficient and effective planning for the bulk power system requires accurate simulation tools, which rely on models which are premised on accurate and complete data. Understanding and knowledge regarding the bulk power system must be addressed as we design the grid of the future. A first logical

step for the bulk power industry is to create better databases which accurately reflect existing and planned facilities to transmit and deliver energy to projected loads. These databases would also incorporate expected and potential resources, including traditional generation facilities as well as demand response, and scheduled, approved and potential transactions which can create loop flows and impacts on adjacent systems.

Standardizing powerflow data is priority one. Tremendous efforts have been made recently involving peer review and development of robust datasets for interconnection-wide studies sponsored by DOE. Additional standardization is warranted to capture the best practices of the 3 separate interconnections into data formats that work for every system, as well as existing tools and applications. Standardized naming conventions for network facilities must be the first step based on a reasonable approach developed and approved by a core group of industry experts. Existing processes and institutions must be leveraged to minimize any burden on data standardization efforts with a reasonable, yet aggressive, timeframe with sustained commitments to support and maintain data integrity and validity going forward. The Facility Owner/Operator must have the primary responsibility for any data changes and such updates need to be provided in a transparent and timely manner, with accountability to document changes to the extent it's needed and valued by stakeholders. Data fields beyond existing typical powerflow data will likely be needed too, including Surge Impedance Loading (SIL) capability and existing corridor capabilities for Extra High Voltage (EHV, typically 230 kV+) lines. Flexibility needs to be incorporated into the design of a standardized bulk power system database to allow for additional data fields. With time, aging assets can be expected to become a more critical issue in terms of facility replacements and upgrades, particularly if extended outages are required which could have tremendous economic impacts to markets and end users. Efforts like the NY STARS Study need to be leveraged to the extent its methodologies are beneficial to other regions or broader assessments by federal agencies, industry organizations, national labs and academia. It is expected that performance targets, remaining life, and underutilized capability of existing assets which are deemed critical to system security ought to be a priority. Documentation of the key design specifications, e.g., conductor size and clearances, design voltages, costs and efficiency of new projects will likely be needed beyond typical modeling parameters in a traditional powerflow simulation too.

Existing Databases

Numerous databases are maintained and used in the bulk power industry to support simulations and modeling for power systems analyses to ensure grid security and reliability. Standardized input file formats are used with power flow models like PSS/E, PSLF and PowerWorld which are the primary planning tools for power systems analysis. Data for power flow and stability analyses are standardized to a large extent, although modeling parameters do not capture physical capabilities or condition needed to facilitate effective long term planning and operations.

Economic studies using tools like PROMOD, GridView, Plexos, etc. are becoming increasingly important to support effective regional and interregional planning studies. While much of the data needed for economic assessments, e.g., generator start-up costs, heat rates, fuel costs, etc. are commercially

sensitive, consistently developed assumptions from public sources are available from vendors to support transparent planning studies and inform business decisions.

Data Priorities include:

- Definitive source and contact information for modeling and physical data for bulk power system facilities
- Unique substation IDs, based on an industry-adopted and standardized naming convention, with GIS coordinates for bulk power facilities to ensure consistency across various applications and tools
- Flow and capability (rating) data for consistently defined and monitored flowgates/ paths/interfaces/etc., within regions and across seams
- Price spreads across existing seams for nodes, especially those that are geographically close but electrically distant within systems as well as across seams
- Physical limits of critical 230 kV+ facilities which are rated below conductor emergency loading capabilities and transformer nameplate ratings
- Identification of system capability not shown in model data, e.g., facilities designed for higher capability (unused circuit positions or ROW, operating voltage less than design voltage)
- Remaining life (condition) of critical facilities

Additional requirements that should be considered include:

Periodic data updates

Updates to database will be made at least quarterly, and sooner if possible, with documentation regarding any material change from the original postings. A pedigree for data is a critical success factor.

Topology data for existing and planned projects

Supplemental data fields for transmission lines to include: length (miles), remaining life (years), target availability (%), conductor ratings (summer normal MVA, Summer emergency MVA) if different than reported element ratings, design voltage if greater than operating voltage (kV), part of an underutilized asset (If Yes, please comment, e.g., single circuit on double circuit tower), historical maximum loading experienced (MVA), dynamic line ratings in place, projected outage time and costs to rebuild). Impedance related data such as earth resistivity, conductor size, conductor geometric mean radius, conductor spacing, tower configuration, neutral spacing and height, etc. may be beneficial.

Supplemental data fields for transformers to include: highest nameplate rating (summer normal MVA, summer emergency MVA) if different than reported element rating, replacement plan (e.g., arrangement in place for spare to be replaced and energized in 2 month).

Supplemental data fields for HVDC devices to include: length (miles), remaining life (years), target availability (%)

Supplemental data fields for PARs, Phase Shifting Transformers, etc to include: available range for potential settings, current setting, basis for existing setting, remaining life (years), target availability (%)

Supplemental data fields for mapping requirements such as GPS coordinates and right-of-way should be managed. This data used in conjunction with publicly available data on land type and class will aid in estimating costs to replace or build new construction.

New projects should also include in-service year, and projected installed costs as data fields.

Load Data

Loads data needs to include designated portion of total load that is available for demand response or load management purposes, and what portion of load at the bus is seasonal (weather sensitive) versus non-conforming. It is important that infrastructure planning, particularly for long lead time assets with long lives like EHV transmission, be based on total, not firm load extrapolations reflecting relatively short term demand response programs that may not be sustainable.

Projected profiles of loads need to be provided in a standardized format.

Resource Data

Resource data fields need to include: remaining life (years), target availability (%), changes being implemented for CSAPR, MATS, once-through cooling with highlights about projected timing of capacity derates, impacts on FORs, maintenance outages, etc.

Dynamic data for generators needs to include if unit is operated on AGC or not, verification that governor and control systems are in good working order (not disabled or bypassed), if not then an explanation/mitigation plan is needed.

Robust datasets for variable renewable resources like wind and solar patterns need to be made available with necessary correlations to other related modeling parameters, e.g., loads

Special Protection Schemes and Operating Guides

To facilitate better coordination between adjacent and affected systems, owner/operators must provide a summary sheet as well as details of System Protection schemes, including relay settings, special protections schemes (including underfrequency and undervoltage load shedding schemes), or other remedial action schemes, as well as operating guides/directives to adjust system topology or resources. Access to details will only be provided to personal with an executed NDA subject to verification of valid business needs.