Electric Transmission System Planning

Transmission system planning involves determining and scheduling the additions and changes that will need to be made to a high-voltage power transmission grid as future conditions, including demand for power, change. Transmission planning and transmission studies for electric utilities and regional operators represents about fifteen percent of Quanta Technology's on-going business and is the single biggest element of our business. Our transmission group consists of four teams led by some of the most widely recognized and respected transmission planners in the power industry, Don Morrow, Tom Gentile, Len Januzik, and Gerald Sheble to name a few. They are supported by a team of over 30 experienced and innovative utility system planners. Contact information and links to information about their background and teams is provided in the final portion of this page.

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Reasons For and Goals Of Transmission Planning

The majority of transmission system planning required is due to a continuing growth of electric demand. Even allowing for significant improvements in the efficiency of electric appliances and usage, a growing population and economy leads to increased demand for electric power. Typically electric demand grows by one half to one percent a year in most areas of the developed world, and at faster rates in developing nations. Increasing demand requires more transmission system capability, even if more transmission lines and substations are not built. A large part of transmission planning in many cases involves determining how to increase the capacity of existing systems without adding new lines and rights of way. This is accomplished by upgrading transmission lines and transmission systems throughout a utilities area. Other reasons that transmission planning is required include replacement of aging electric power infrastructures, planning for relocation of transmission lines that must be moved due to societal demands or changes in
the makeup of metropolitan areas, or to lower the cost of power by reducing what is called power transmission congestion in a regional grid.

The goals of transmission system planning include those common to all utility system planners: assuring reasonable reliability and quality of service to energy consumers, minimizing costs, assuring the system is safe and built and operable within all laws, codes, and regulations. In addition, transmission system planning for regional and wholesale grids normally has to take into account system interconnected security, transmission congestion constraints, transmission market costs including in some cases locational marginal based pricing, the availability and esthetic impacts of required rights-of-way and transmission switching substation sites that will be required, and community and social acceptance in determining what plans best meet current and future needs.

Quanta Technology’s Transmission Planning Methods and Processes

Transmission system planning involves a host of complicated technical considerations related to power flow through an electric network and the dynamic behavior of demand, equipment, systems, and control equipment.

As to the planning method used in a particular study, Quanta Technology follows the instructions of its clients, but generally recommends that all planning studies adhere to best-practice guidelines. This means that there is zero-base planning in all cases, that each study begins with an explicit examination and analysis of consequences and costs of the “do nothing” option, leading to a quantitative enumeration of the system needs and deficiencies that need to be corrected. This is followed by evaluation of a series of options to address the system’s needs and correct deficiencies. Quanta Technology uses an exhaustive list of potential planning alternatives covering all possible categories. Many times one or more categories are not feasible, but in such cases, that is documented early in the study and a traceable trail showing such options were not viable is established for later defense of the recommended plan.

Feasible alternatives are each tailored to the situation and developed to further detail, and then all are evaluated on a balanced basis for feasibility, fit-to-system needs, flexibility, capital cost, O&M cost, lifetime or other time-value-of-money economics, and other factors as appropriate for the particular study. Reliability, system security, congestion and LMP pricing considerations, as well as aesthetic transmission line impacts and community preferences may also be considerations. Either traditional (least overall cost) or multi-attribute Pareto-type prioritization can be used to rank and determine the best alternatives for recommendations. Our staff has access to and is skilled in the application of a wide variety of analytical tools to assess power system performance.

Analytical Tools Used By Quanta Technology

Transmission system analysis involves complicated computations of power flow, fault currents, transient phenomena and a host of other engineering factors related to system performance and equipment suitability. Quanta Technology has in-house capabilities and skilled personnel who can operate the analytical software listed in the table below. A set of proprietary methods has also been developed to aid in the analysis of features or phenomena not covered by standard commercial tools.

Analytical Tools Used In Quanta Technology Planning Studies
A Defensible Plan Is the Key to Practical Success

Quanta Technology’s experience dictates that the practical success of transmission planning depends chiefly on preparing an understandable and defensible case to justify the resulting transmission plan. This defense must show that the zero-base option is not viable, that there are definable and measurable needs not met, that all reasonable options were considered, that feasible options were evaluated and compared on an even and balanced basis, and that the recommended plan is superior to any other option, and why. Quanta Technology approaches every transmission planning study from the standpoint of building a defensible transmission planning case: a transparent, traceable fact-based path based on credible and proven methodology, performed by acknowledged experts qualified in each step, leading to a well-explained, understandable case from data to conclusion, and back by fully defensible evidence for the superiority of the recommendations over all other alternatives (including “do nothing”). This practical approach focused on achieving approval, along with Quanta Technology’s experience and skill at preparing for and supporting utility plans with expert testimony in stakeholder and regulatory forums and hearings, assures the plan will have maximum value.

Strategic Transmission Planning involves the determination of the best long-term approach to handling the wholesale power transmission needs in a region. These usually lead to a long range (20-year) overview plan that identifies the preferred voltage ranges (e.g., 765 and 500 kV) and general characteristics of the future grid.

Regional Grid Planning involves most of the factors of strategic transmission planning in addition to the factors considered in most transmission planning studies, such as policy issues involving complicated regional issues and equity of distribution costs and capability which may have to be accommodated.

Sub-Transmission Planning involves planning of the transmission-voltage portions of local power delivery systems, lines most often of delta configuration and operating at nominal voltages of anywhere from 34.5kV to 345kV. While of high-voltage, the predominate reason these lines are needed and operated is to route power to local distribution substations. As such, they are legally and practically part of the local delivery system rather than the regional wholesale power grid, and are best planned as part of that local delivery system. Quanta Technology is the industry leader in local delivery system planning, having two of the industry’s most honored and respected distribution planners among its founding partners: H. Lee Willis and Richard E Brown. See the Distribution Planning page in this website for more details.
**Substation-Planning** involves the determination of the sites, sizes and configurations, and timing of future additions of distribution and transmission switching stations, as well as additions and upgrades to existing substations. The planning of transmission switching stations (e.g., 500 kV to 230 kV stations) is a key element of good transmission planning and accomplished as part of that function.

Planning of distribution substations is more complicated, and because these distribution substations are both tied to the transmission system and the anchor points of the local distribution system, they are regarded by Quanta Technology as the most important strategic element in the planning of a retail electric utility’s system. Planning for the location, size, and design of power distribution substations is done as part of the sub-transmission planning process at about 60% of utilities worldwide, and as a part of distribution planning, or as a planning function separated from both, in the others.

Regardless, the impact of substation location and capacity and design decisions on feeder system cost and reliability can often exceed the cost of the substation itself, so distribution considerations need to be carefully weighed regardless of where and how this step is done. However, transmission considerations cannot be ignored as they often impose severe locational and capacity constraints on the possible alternatives. Quanta Technology has developed innovative comprehensive methods of substation planning that consider all aspects completely in a balanced, bottom line manner.

**Regulatory Compliance of Transmission and Plans**

Modern transmission systems must meet FERC and NERC requirements in a host of technical and operational areas. Quanta Technology is an industry leader in expertise in meeting regulatory rules for power transmission. David Hilt, former VP of Compliance for NERC, and Jerry Adamski, formerly VP of Standards at NERC, lead a team that specializes in helping utilities meet all regulatory requirements and in assuring the transmission plans for the future both meet those needs, too, and are documented so they will adequately demonstrate that to regulators. See the NERC and Regulatory Compliance page on our website for more detail.

**Quanta Technology Experts in Transmission Planning**

- Don Morrow
- Tom Gentile
- Len Januzik
- Gerald Sheble
- David Elizondo
- Ed Pfieffer
- Srijib Mukherjee

**References and Resources**

**Articles**


Books by Quanta Technology Authors


On reactive planning in transmission systems http://www.amazon.com/Reactive-Power-Problems-Solutions-Eh0262-6-Pwr/dp/9997279646/ref=sr_1_10?s=books&ie=UTF8&qid=1325260151&sr=1-10

Interesting Sites for Transmission Planners

Example of modern planning public policy http://www.atc10yearplan.com/A5.shtml

Edison Electric Institute’s take on some of the issues: http://www.ornl.gov/sci/ees/etsd/pes/pubs/TransPlanningEEI.pdf