

Transmission system planning

Bringing a world of knowledge to your power system

At a glance

Siemens Power Technologies International (Siemens PTI) is a world leader in power system planning, having performed extensive studies in key disciplines of transmission networks in many different countries all over the world. Siemens PTI's solutions offer:

- definition of suitable planning criteria,
- development of optimal network concepts meeting customer requirements,
- simplification of asset management and maintenance using standardized equipment
- ensuring high security of supply and good performance of network operation
- Verification of developed network behavior in steady-state and dynamic operation,
- development of an optimized investment master plan

The challenge

The introduction of competition and incentive regulation in the utility sector has created challenges and opportunities for utilities. After years of low investment in electrical infrastructure,

many network owners face a number of challenges to maintain a secure and economical operation of their networks in the future, including:

- increasing consumption and relocation of load centers
- integration of renewable generation
- changes in generation structure and technologies
- aging equipment and expensive maintenance
- historically grown network structures leading to operational difficulties
- demand for highly reliable networks

Fault detection and clearance, as well as protection coordination within networks with a historically aged infrastructure are very complicated. Large-area outages are often the results, causing low reliability and high interruption costs for public consumers.

Our solution

Siemens PTI draws on many years of experience from a wide range of projects conducted all over the world, and our international staff consists of renowned experts in power system planning. Siemens PTI offers customers the

development of optimal solutions to all kinds of individual questions regarding electrical networks. The main objective of network planning is to achieve a coordinated, long-term development of the transmission network to achieve a secure, reliable, efficient and economical performance.

The main services offered by Siemens PTI for transmission network planning projects are:

- on-site data collection and assessment of existing assets
- definition of planning criteria, KPIs for network performance and key technologies
- analysis of the status of the as-is network, and forecasts for load and generation development
- development of optimal network concepts, e.g. using a Greenfield or forward-planning approach along an optimal path
- analysis, evaluation and comparison of network concepts using steady-state calculations (e.g. load-flow, short-circuit, etc.), reliability and dynamic studies
- design of suitable protection and automation concepts
- development of suitable asset management strategies
- evaluation of options and concepts for power plants connection to the grid, as well as transmission of bulk power
- grid code compliance investigation for defined power generation plants according to local grid requirements and standards.

Typical planning procedure

A typical task of transmission network planning is to determine a master plan for the future network development. The goal is to achieve an optimized and consistent target network concept meeting the defined target KPIs and considering agreed planning criteria.

A planning project starts with data collection on site to assess the actual state of the network and all components, and to define the basic conditions for the whole planning process. An initial analysis and evaluation of the system structure reveals any weaknesses and bottlenecks.

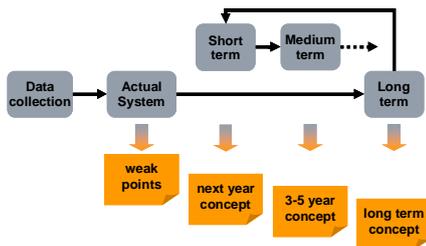


Figure 1: Typical planning procedure

The geographical map of the grid forms the foundation for the network planning project. It contains the connection between loads, generators and installed equipment. In this map the network area can be divided into sections according to their usages and expected future load development, like industrial, residential and commercial areas, as illustrated in Figure 2. Thus, the development of the load and generation for the next decade is analyzed for each section.

An optimal, long-term target network is developed in close cooperation with the customer, based on the planning

criteria and defined targets. This task also identifies the optimal location of new substations according to the load centers. An example is shown in Figure 2. Such a long-term plan can be developed using the Greenfield planning approach. Suitable network concepts are developed considering the use of standardized network components, the selection of optimal voltage levels and defining the optimal location of all substations.

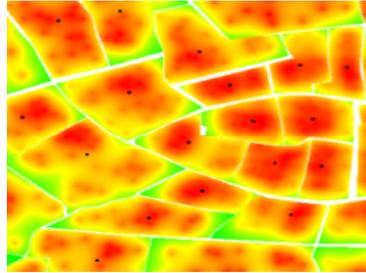


Figure 2: Example – Load density, load centers and optimal MV-substation location

To optimize the geographical structure of the network, as well as the topological (electrical) structure, network calculation programs, such as PSS[®]SINCAL and PSS[®]E, are required to perform the necessary calculations and handle geographical information. With these sophisticated and proven planning tools, the network planner can easily switch between the schematic and geographic layout of the network. The proposed concepts are then compared, and by means of calculations a good network performance of the final concept is verified. The final concept should account for reducing operation costs and ensure high quality for customers.

As a next task based on the long-term plan, intermediate development phases are derived to describe the roadmap for the development of the existing network into the optimal target network.

Investment and operation costs (CAPEX and OPEX) are determined and the advantages and benefits of the target network compared to the actual network are described.

Benefits for the customer

After finalizing a network structure development study for an electrical network, the customer benefits from:

- identification of weak points in the existing network
- development of optimal network concept
- verification of an appropriate network performance by analyzing defined KPIs
- detailed, transition master plan towards an optimized network concept, ensuring optimal investment utilization
- reduction of network costs using standardized equipment and suitable asset management strategies

The investment in a strategic network planning study is very low compared to the capital and operation costs that can be saved by an optimal development of the network. Costs are repaid early with compound interest.

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