Advanced Transmission Planning with Modern Network Analysis Tools

(PSS™E, PSS™MUST, PSS™E OPF)

Training Course

Industry Need
Winston Churchill said, "A plan is nothing. Planning is everything." What one may see as a plan for developing transmission systems may have little or no value if the conditions and assumptions for the plan do not hold true. This applies even more so today in the era of open access, re-regulation, power markets, merchant power plants and available transfer capability. However, the act of planning in and of itself provides a means for a new plan to be developed quickly out of the ashes of the previous one. As Churchill implied, knowing the process is essential.

That process, known as transmission planning, has expanded in breadth and scope in recent times. Although reliability, cost, and optimization remain key aspects, transmission must now also address cost recovery, service pricing, new stakeholders and changing regulatory oversight. It must address a larger set of future conditions as competition in the generation market shrinks the pool of available information, and as merchants develop their own plans within plans. Today the transmission planner needs to know how to evaluate these multiple futures and integrate them into an effective transmission plan.

The options available to transmission planners have also evolved. Building transmission lines on new right-of-way is now a less attractive option considering the lead-time and licensing requirements. Creative use of existing circuits or paths is finding broader acceptance. Hence, options such as reconductoring, tower structure modification, use of alternate types of conductors, flexible AC transmission systems, and high voltage DC are finding their own niches in transmission plans.

Unquestionably, the situation calls for a dramatic change in the nature and application of analytical tools. Modern network analysis techniques can perform more complex processing with efficiency, accuracy and speed to provide critical information at minimum turnaround.

Objectives
This course provides transmission planners, designers and operators with concepts, tools and methodologies essential to address modern-day issues of competition, open access, wheeling and new technology in transmission planning. This objective is achieved by combining lectures from experienced transmission planners with discussions of participants' related experience, and hands-on exercises of practical transmission problems.

Prerequisites
The structure of the course presumes that participants are power system planners, designers and operators who have had at least a year of involvement in the application of load flows and a working understanding of time simulation applied to network dynamics.

Course Structure
The course duration is four and one-half days, presented in three-hour morning and afternoon sessions. The last day concludes at noon.

The concepts and methodologies are introduced through classroom lectures which feature discussions wherein participants are encouraged to relate their own experiences or introduce their own ideas. These are paralleled by hands-on sessions, which constitute about 50% of the class time, where representative practical transmission problems are examined using modern network analysis.

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Documentation
Each participant will receive a bound set of course notes that complement the lecture. In-class access to Siemens PTI programs, PSS™E, PSS™MUST, PSS™TPLAN and PSS™E OPF, are included as part of this course. The lectures closely follow the notes to minimize the need for note taking in the class.

Instructors
The course will be taught by Siemens PTI engineers with extensive experience in transmission planning concepts, tools, and methodologies.

Location
The course is conducted on a regular basis at Siemens PTI offices in Schenectady, NY and at other major cities throughout the United States. It is also available for presentation at a client's location by special arrangement.

Continuing Education Units
2.7 Continuing Education Units (CEU's) will be awarded for successful completion of this short course. The CEU is the nationally recognized unit for recording participation in noncredit educational programs. One CEU is equal to ten classroom hours.

Course Outline

- Overview of the Transmission Planning Process
  - Review of "traditional" process"
  - Changes due to open access, competition, technologies, modern analytical tools
  - New framework for transmission planning under uncertainty

- Outline for a Modern Transmission Planning Study
  - Identification and modeling uncertainties
  - New and old transmission options
  - Formulating and minimizing future scenarios
  - Synthesis of transmission plans
  - Formulating a minimum risk plan

- Planning Criteria
  - Review of international practice
  - Representing reliability measures and customer costs
  - Application examples

Hands-on: Introduction and Review of PSS™E load flow, dynamic simulation and IPLAN (a programming language that accesses the PSS™E database); PSS™TPLAN contingency analysis, interactive expansion planning, reliability indices, transfer limits, Optimal Power Flow (OPF).

De-coupled Thermal Capacity and Voltage Planning
  - DC analysis methods
  - Interactive thermal capacity analysis
  - Reactive compensation planning using optimal power flow
  - The steady-state view of voltage collapse
  - Optimal capacitor/reactor allocation
  - Using and defining area reactive margins

Hands-on: DC-based Analysis interactive thermal capacity expansion planning; application of the PSS™TPLAN DC functions to identify alternative plans; Reactive power planning: using OPF to optimally allocate capacitors, set transformer taps and voltage settings, and define reactive reserves; quantifying the reactive margin to voltage collapse.

- AC Contingency Analysis
  - Ranking and screening methods
  - Defining a study area
  - Handling divergence, islanding, relaying events
  - Calculating probabilistic reliability indices
  - Measuring customer impact

Hands-on: Contingency Analysis using PSS™MUST and PSS™TPLAN to define a study system, represent criteria and evaluate reliability, identifying transmission additions; applying reliability indices, determining customer impacts.

- Transfer Limit Analysis
  - Thermal and voltage limits
  - Defining transfer conditions
  - PV curves for normal and contingency conditions
  - Using transfer limit tables
  - Transient stability limits

Hands-on: Transfer Limit Analysis representing a bottleneck within a load flow model; calculating PV curves with IPLAN; calculating transfer limits using PSS™TPLAN AC-based functions; evaluating simultaneous transfers.

- Dynamic Simulation
  - Review of transient stability concepts
  - Applying stability criteria
  - Representing new technology
  - Selecting and testing practical countermeasures

Hands-on: Dynamic Simulation using PSS™E dynamics to model stability criteria; applying countermeasures; models for new technologies; stability transfer limit.

- Synthesis of Transmission Plans
  - Selecting a planning horizon and staging years
  - Putting together components of a plan
  - New technologies that make a difference
  - Evaluating a plan
  - Formulating alternatives
  - Iterations to improve a plan
- Developing a Feasible Transmission Plan
  - Defining uncertainty of future scenarios
  - Identifying plan objectives
  - Review of economic analysis
  - Handling of a short planning horizon
  - Identifying risks and possible hedges
  - Considerations for competitive environments
  - Optimizing multiple objectives

Hands-on: Developing a flexible plan using results from earlier exercises to put together a transmission plan; class presentation and discussion.

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