The Growth of Siemens PTI US in Medium Voltage Distribution Network Solutions in the Past Year has been Remarkable, Thanks to PSS®SINCAL

Siemens PTI US, and our PSS®E product suite, are widely recognized as a world leader in steady-state and dynamic studies for power transmission systems. We are also well equipped with the consulting expertise and software tools required to perform FACTS and HVDC studies.

The success of Siemens PTI US after our acquisition by Siemens in 2005 can’t be discussed completely without mentioning our work in medium voltage distribution studies. Thanks to PSS®SINCAL, we have grown enormously in this area, domestically as well as internationally. For distribution and industrial clients, the addition of PSS®SINCAL modeling and simulation capabilities has enabled us to expand our services offered from the Houston, Texas regional office.

The purpose of this article is to bring to light some accomplishments of Siemens PTI US in the field of medium voltage distribution network planning studies in the past year. In addition to transmission related projects, consultants at the Houston, Texas, regional office have been actively involved in these distribution planning studies. Following is a summary of projects which we successfully completed this past year using PSS®SINCAL.

Analysis of Kabul Distribution System using PSS®SINCAL

This study of the Kabul, Afghanistan, distribution system (a balanced three-phase network) was conducted for both short term (one year out) and medium term (three or more years), and also included our estimation of the investments necessary to provide adequate quality of service to the final customers under both timeframes. Results were obtained based on a detailed model of the medium voltage system produced in PSS®SINCAL starting from field information on asset parameters and network topology. This model also incorporated load measurements and our own estimations on the likely load that will materialize in the system once the existing generation restrictions are lifted, by the implementation of the North East Power System of Afghanistan and by the addition of new local generation. Figure 1 shows the Kabul model in PSS®SINCAL. Siemens PTI also performed analysis of the 110 kV network with the
incorporation of 100 MW of diesel-fired generation located to the north and east of the East Kabul substation.

Several new substations were recommended, and the optimal location for each was determined by: (a) defining a typical area of influence of the new and existing substations as a function of feeder length and load density, and (b) finding the load centers of the resulting service areas selected, taking into consideration the location of existing substations. The end result was a system served from substations located close to all load centers.

![Kabul Model in PSS®SINCAL](image)

**Figure 1: Kabul Model in PSS®SINCAL**

**Review and Planning of Belize Electricity Limited (BEL) Network using PSS®SINCAL**

This project delivered the results of the review and planning conducted for the BEL distribution network (unbalanced network). The initial network data obtained from BEL was in PSS®ADEPT and had to be converted to PSS®SINCAL. The conversion, while straightforward, required numerous changes to get the load flow running in PSS®SINCAL. We appreciate the help received from SimTec GmbH on this conversion process.

In this project, we made use of all the powerful tools for network planning which are available in PSS®SINCAL. Short descriptions of some tools and functions we used are as follows:

*Feeder Function:*

The Feeder function allows the user to analyze the electrical network structure. (A feeder is a network supply area that leaves from a substation.) The user can determine all feeders of the network starting from specially designated nodes/busbars. Feeders are determined by the tripping status of the network elements. This means the current network operational status is being observed.
**Load Development:**
The Load Development tool calculates load flow in distribution networks, taking into consideration the load increase, power ratings, and start-up and shutdown dates. This tool determines the load in these networks at future times. These calculations are based on a detailed network analysis.

**ISO Areas:**
The ISO Area tool can be used to determine the point of load center based on load density. The point of load center is an important piece of information for planning an installation of a new substation.

Figure 2 shows the BEL model in PSS®SINCAL.

In the review and planning of the BEL network, Siemens PTI:

- Developed a load forecast at the distribution level.
- Produced an immediate to short term (2008 – 2012) distribution plan that:
  1. Identified a prioritized list of system upgrades necessary for delivering power to final customers to maintain adequate quality of service.
  2. Identified those investments that are necessary to reduce technical economic values.
- Recommended required reactive compensation and capacitors.
- Analyzed the upgrade of all the distribution networks to 22 kV and defined the implementation strategy.

![Figure 2: BEL Model in PSS®SINCAL](image-url)
Distribution Transformer and Low Voltage Network Optimization Study for BEL using PSS®SINCAL

This work involved an efficient planning methodology to select an optimal combination of transformer size and the LV network conductor that would minimize the Life of Asset (LOA) costs, while taking into account the voltage drop and the transformer loading constraints for a period of 30 years including load growth. Using different combinations of typical transformer size, triplex service drop conductor and choice of network configuration, 200 study cases were simulated in PSS®SINCAL. For each case, the cost per kVA was calculated by dividing the LOA costs by the initial loading capacity for each transformer. (The initial loading capacity was preferred over the nominal rating as it takes into consideration the possible loading limitations due to voltage drop.) Finally, all network configurations were generalized based on load density, and the coincident peak load per customer, and cost curves were obtained for several possible combinations of transformer size and triplex service drop conductor. The cost versus load density curves were parameterized using trend line analysis for other load densities which were not included in the list of study cases. The optimal combination of transformer size and LV network conductor was found by locating the combination that minimized the LOA costs for several given densities. Figure 3 is a representation of that study.

Figure 3: Representation of the Study for Selection of Optimal LV Network Configuration
**Ongoing Project:**

**Inventory, Review and Planning of the South San Joaquin Irrigation District Distribution Network using PSS®SINCAL**

Siemens PTI has assisted the South San Joaquin Irrigation District ("the District," in California) in the process of inventorying and evaluating certain electric distribution assets that they may wish to acquire. In 2004, after an inventory we conducted for the District, we projected system expansions and severance investments for 2008 and 2012. Since 2004, the distribution system may have had important changes and it may have been expanded and reinforced by Pacific Gas and Electric in a different way than what was envisioned. Therefore, the District has asked Siemens PTI to update this inventory and review the expansion plan as necessary to reflect the 2008 configuration of the system. PSS®SINCAL is used for review and expansion planning of this network. Figure 4 shows the South San Joaquin Irrigation District (SSJID) model in PSS®SINCAL. The concentric circles in the figure indicate the various radii of coverage of the substations.

![Figure 4: SSJID Model in PSS®SINCAL](image-url)