The Benefits Siemens PTI Brings to a Global Supplier of Power Transmission & Distribution Products, Systems and Services

Since joining Siemens in 2005, Siemens PTI has enjoyed a close working relationship with many sister divisions, but in particular with the Power Transmission Solutions business, which provides Flexible Alternating Current Transmission Systems (FACTS) and High Voltage Direct Current (HVDC) systems. The thread binding this business synergy is customers looking for optimum solutions to their transmission and distribution problems; customers who are not familiar with the technology or know how to go about modeling these more advanced solutions in PSS®E for power system planning and operation studies. Let's consider the areas where FACTS and HVDC can be credible solutions, using the US energy sector as an example. The business synergies will be obvious!

The North American Electric Reliability Council (NERC) is responsible for setting reliability criteria. The NERC criteria are implemented through regional standards across North America which differ due to regional considerations. System planners regularly study expansion or reinforcement alternatives to ensure that their power systems meet the respective regional reliability standards. These studies often make assumptions on load growth and generation additions/subtractions and are designed to demonstrate that credible system disturbances do not cause problems, such as unacceptable voltage or frequency deviations or overloads of transmission equipment.

In certain large metropolitan areas, very slow fault recovery situations are becoming a major concern, and FACTS systems are being viewed as “non-transmission line alternatives,” thereby meeting the fundamental reliability requirements without the need for transmission line additions.

Figure 1 - A 500kV, -110/+605MVAr Static VAr Compensator, California
The transmission systems in the US were developed years ago by vertically integrated utilities. Today, however, the same systems have to support vibrant and competitive energy markets, and indeed support entry of merchant entrepreneurs. Transmission systems are being driven harder, as power is wheeled from one region to another. FACTS can overcome the overloading of transmission circuits by affecting the natural power flow and transferring power to other transmission system assets, thereby relieving transmission congestions.

Some people think of power plants, regardless of their primary fuel source, as providing real power (i.e. MWs) only. However, the same power plants are also sources of reactive power (i.e. MVARs), both in steady-state and dynamically. Therefore, a planned power plant closure, particularly of one deemed Reliability-Must-Run (RMR), can cause a scarcity of dynamic reactive power. It is the dynamic VArS that we are mainly concerned about, as the recovery time needed by the system to prevent a total collapse is so demanding that conventional methods of supporting voltage (e.g., transformer tap-changers or mechanically switched shunt capacitors) may not react in time. In addition, there are a number of synchronous condensers (also sources of reactive power, although not as fast acting as FACTS) that are still in-service across the US. Some of these installations date back 30 years or more, and generally require extensive operations and maintenance activities to keep them operational today. In contrast, modern FACTS installations require minimal operations and maintenance activities and hence provide an excellent alternative solution.

Traditionally, utilities have solved their steady-state reactive compensation problems by incrementally installing mechanically switched capacitor (MSC) banks that are switched in and out by operators to match the system needs. However, simultaneous switching of multiple units can present control problems. Power system planners with a more strategic approach are now installing shunt FACTS devices that control these MSC banks. With the correct communications and SCADA systems, an
effective wide-area voltage control strategy can be adopted, thereby providing steady-state and transient functionality and ensuring effective reactive compensation management.

The renewable energy sector is the fastest growing segment in the electric power industry today. Much of the debate to date has centered on who pays for the necessary infrastructure to harness the wind power to the transmission system, and to what criteria the wind project developers must be held by the utilities, generally referred to as Grid Code Compliance. To this end, the Federal Energy Regulatory Commission (FERC) has stepped in to recommend standards for adoption by the industry. There are two key areas in the FERC recommendations that provide opportunities for FACTS applications: the requirement for the wind farm to: 1) ride through a low voltage event in the adjacent transmission system; and (2) maintain a power factor within the range of 0.95 leading and 0.95 lagging, measured at the high side voltage of the substation transformer. Just to quantify the 0.95 leading/lagging power factor requirement - if we assume a 100 MW wind farm, this equates to approximately ±33 MVAr of reactive power requirement. Depending on the wind turbine type, this could be provided by a reasonably sized FACTS installation, which can also assist in low voltage ride-through duty, as part of the interconnection requirement. Given the large amount (i.e. GW) of wind farms being considered in remote locations throughout the US, HVDC and FACTS will play an important role in harnessing the remote wind energy and delivering it to load centers.

There are four main Alternating Current (AC) interconnected power systems in North America: the West Coast system, the Central/Eastern Seaboard system, Quebec in the North and Texas in the South. These AC systems are interconnected by HVDC transmission. Consequently, if any party wishes to increase interconnection capacity across these electrical boundaries, HVDC transmission is the obvious solution. In addition, those involved in AC transmission grid expansion today are well aware of the time required for project implementation as well as the environmental perspective of new overhead line constructions. Therefore, developing a solution with substation-based FACTS installations (which require minimum siting permissions on land already owned by the transmission utilities) and quick project implementation (in as little as 15-18 months) is a perfect response to the planning needs of a vibrant market.

Figure 3 - A 660MW HVDC Converter Station, New Jersey
The US market has seen a number of non-regulated transmission projects making the news. Some have been successful and others have not. One critical aspect for success is the ability to ensure that a transmission project can be built in a timely fashion to capture the market economics. Project developers often favor HVDC transmission because it is point-to-point transmission with known energy losses. Furthermore, the use of underground and submarine cables in an HVDC project do not generate the same environmental oppositions as do overhead lines, which can speed the in-service date enormously.

For those familiar with Siemens PTI’s capabilities in power systems analysis software, network consulting and education, the above should clearly demonstrate the business synergies Siemens PTI enjoys with its sister, the Power Transmission Solutions business. Siemens PTI personnel regularly coordinate training and customer visits with Power Transmission Solutions to provide Siemens customers with the knowledge and understanding of the benefits and study procedures for FACTS and HVDC system solutions. Siemens PTI has also assisted by performing specific steady-state and dynamic studies for confirming the location, rating and performance of FACTS and HVDC solutions to meet customer’s needs, as well as more specialized harmonics studies and interconnection studies. Key to the synergy between these Siemens organizations is that, as new FACTS and HVDC technologies are emerging, Siemens PTI is developing new PSS®E models to ensure that our customers can perform the necessary analyses using advanced software tools.

As long as transmission and distribution system owners and operators continue to strive to meet the challenges of serving the ever-growing demand while accommodating new generation options - whether wind, solar, tidal, coal, gas, hydro or nuclear - Siemens PTI and its sister divisions will continue to enjoy a close synergy that benefits our customers.