Oncor Leads with SVCs

Jul 1, 2011 12:00 PM
By Rafic ElFakir and Todd Rosenberger, Oncor

Static VAR compensators provide grid reliability as local generation is retired and future renewable energy comes online.

In 2009, Oncor began using leading-edge power delivery technology in the form of static VAR compensators (SVCs) to maintain the reliability of the grid while enabling the improvement of the environment in the Dallas/Fort Worth (DFW) area. As a regulated electric transmission and distribution business, Oncor provides electricity delivery service to more than 7 million customers throughout the state of Texas. With so many customers depending on the delivery of reliable electric service, Oncor is continuously searching for ways to improve its electric delivery system.

Identifying the Need for SVC

To understand the need for the innovative SVC technology, it is important to know the type of electrical load and issues with which Oncor is dealing. Oncor works with the Electric Reliability Council of Texas (ERCOT), which serves about 85% of the electrical load in Texas. Within ERCOT, Oncor is the largest regulated transmission and distribution entity, serving about 40% of the ERCOT load. The DFW area alone constitutes 30% of the total ERCOT load.

The DFW area is constantly increasing, with an average load growth of 2% over the past few years. Large load centers like DFW require reactive power for voltage support. The historical source of dynamic reactive power was local generation, and from the late 1990s to the present, market changes and environmental restrictions have changed how local generation is dispatched while system loading has increased. This reduction in local generation in the DFW metroplex has resulted in a severe drop in available dynamic reactive power in the area.

Reactive power cannot be reliably transferred long distances. Without reactive power available in this dense load area, voltage-stability issues become a real problem. All of these issues led Oncor to seek out the technological advances of SVCs to help in three key areas:

- Grid reliability
- Advanced technology
- Environmental improvement.
Delivering Grid Reliability and More

Studies indicate the need for voltage support solutions beyond the benefit provided by fixed capacitors. Capacitors are effective for steady-state conditions but have limitations in responding to rapidly changing grid conditions. Motor load systems, such as air conditioners, impact grid-voltage recovery during system faults. Of various solutions studied, Oncor determined a SVC was the best solution to help reduce the risk of serious voltage depressions and voltage collapse. Oncor also expects its SVCs will benefit service quality by decreasing the severity of voltage fluctuations resulting from transmission-level faults.

Part of the family of flexible AC transmission system (FACTS) devices, SVCs use advanced electronics to provide high-speed grid-voltage support during electrical disturbances. SVC technology, while advanced, is not new. Continued advancements have enabled a reliable and robust modern-day application.

Oncor's SVC technology is an innovative no-wires solution that enables the improvement of the environment by allowing the older-generation in the DFW area to be retired, while maintaining an uninterrupted and reliable flow of electricity. SVCs are advanced technology designed to provide high-speed grid-voltage support to continue the reliable operation of the electric delivery system. Oncor expects this new technology also will help the utility maintain grid reliability throughout its service area. The robust design and flexibility of the SVCs will allow Oncor to continue to reliably operate the transmission grid in North Texas with less dependence on local generation.

Installing SVCs minimized ERCOT's need to run generation plants in close proximity to system loads and dense urban areas, therefore limiting air pollutants. The SVCs also will accommodate the future use of wind power and other forms of remote generation.

Choosing the Correct Technology

Making sure the right technology was chosen for this project was critical. Many factors were taken into consideration. Oncor had a cross-functional team of experts consisting of planning, engineering and operation personnel to develop the key needs for the technology. The team focused on defining the requirements in the specification to meet Oncor-specific needs. The key items to Oncor were reliability, availability, cost, operational characteristics (SVC vs. STATCOM) and what system changes could be expected over the life of the technology. After carefully reviewing detailed studies, the team came to a unanimous decision in choosing the SVC. The technology of the SVC would meet all of Oncor's requirements and provide some exceptional advantages.

Oncor requires a SVC to provide additional dynamic reactive support in both peak and off-peak conditions. The most common installations of SVCs consist of one SVC with three single-phase transformers and one spare single-phase transformer. Obviously any equipment is subject to failure; therefore, availability of close to 100% is not achievable without introducing an excessive amount of redundancy and further increasing complexity.

Oncor's location for the SVC is in an urban setting that has multiple transmission paths, as opposed to a SVC that is connected to a single transmission line. If the SVC is unavailable because of scheduled maintenance or equipment failure, generation not normally on-line may be required to run (out of merit dispatch) to provide the necessary dynamic VAR support.
A SVC with a designed availability of 98.5% (one SVC installation with four single-phase transformers) could experience up to 131 hours of forced outages per year. The highest availability any vendor could provide for a single SVC was 99.5%. Based on engineering analysis, Oncor required the installation to be separated into two fully independent SVCs at the same site. By applying this concept, Oncor will always have at least half of the installed dynamic reactive power available, even if one of the SVCs is not in service. It was concluded that, at the time of the specification of a +600 MVAR/-530 MVAR SVC, splitting the SVC into two was economical. The specification defined a non-typical connection to the two 300 MVAR SVCs.

In addition, to split SVC availability, thyristor-based SVCs are a proven technology with an expected availability of 99%. The expected frequency of forced outages is typically one outage per year. By implementing redundancy in critical components such as control and protection systems and auxiliary power, and installing redundant thyristor levels in the thyristor valves, the expected unavailability caused by these components is insignificant. Storing spare parts at the site limits downtime in the event of component failure.

**Design and Status**

The design is two parallel-connected SVCs with a rated capacitive load between 300 MVAR capacitive and 265 MVAR inductive. This forms a total dynamic reactive power device with an operation range between 600 MVAR capacitive to 530 MVAR inductive. The building blocks of the two individual SVCs are one thyristor switched capacitor, two thyristor controlled reactors and harmonic filters.

Special attention was made to investigate the harmonic performance. Considering a series of different operational conditions for system intact, N-1 and N-2 conditions for the 1st through the 50th harmonic resulted in more than 2.3 million impedances being calculated. This thorough analysis method allowed for an optimized configuration of the harmonic filters. The thyristor valves are optimized for SVC applications and are water cooled; the cooling system is a closed-loop system automatically controlled by the MACH 2 control system. This is the type of cooling system that has successfully been implemented in a majority of the installed utility SVCs.

Choosing the correct vendor also was very important. Through a competitive bid process, Oncor selected ABB to build the SVCs. The first phase of the turnkey project was completed in less than 15 months, and the second phase was completed in 2010. ABB worked hard to develop an electrical power solution that will keep pace with the North Texas area's ever-increasing power demands.

At this point, Oncor has two sites, Parkdale and Renner SVC, in service. The SVC reacted to system events 97 times at Parkdale and 42 times at Renner, which shows the control system is operating correctly.

**Future SVC Use in ERCOT**

Oncor is one of several transmission utilities involved in a competitive renewable energy zone (CREZ) project in the ERCOT system. The Public Utility Commission of Texas' website states, "CREZ projects are primarily designed to move electricity generated by renewable energy sources (primarily wind) from the remote parts of Texas (West Texas and the Texas Panhandle) to the more heavily populated areas of Texas (Austin, DFW and San Antonio)."
CREZ transmission lines are often more than 100 miles (160 km) in length. Anytime long transmission lines are used to deliver power to load centers, there will be reactive power and voltage issues. A reactive study was performed as part of the CREZ initiative, and from that study came recommendations for how to address these issues. Several SVCs were recommended in different parts of the CREZ area. The expected service life of an SVC is more than 30 years. Although it is difficult to predict the transmission system that far in the future, it is expected SVCs will remain in use for years to come.

Rafic ElFakir (rafic.elfakir@oncor.com) has a BSEE degree from McGill University in Montreal, Canada, and a MBA degree from the University of Texas at Arlington in Arlington, Texas. He started with Oncor in 2007 as a substation project engineer and is currently a resource engineer for switching stations and the project lead for FACTS devices.

Todd Rosenberger (todd.rosenberger@oncor.com) is the manager of conceptual design at Oncor. He received his bachelor's degree from Rensselaer Polytechnic Institute in 1993 and ME degree from Rensselaer Polytechnic Institute in 1994. Prior to joining Oncor in 2001, he worked seven years for National Grid as a substation engineer. He is a professional engineer in the states of Texas and Massachusetts.

Companies mentioned:

ABB www.abb.com
ERCOT www.ercot.com
Oncor www.oncor.com
Public Utility Commission of Texas www.puc.state.tx.us

Find this article at:
http://www.tdworld.com/substations/power_oncor_leads_svcs/index.html

Check the box to include the list of links referenced in the article.

� 2008 Penton Media, Inc. All rights reserved.