Just the FACTS

A family of proven power technologies already making the grid stronger is poised to do even more. With the growing use of distributed generation, the future of electric power systems is changing. Greater consumer reliance on roof-top solar and other local sources will have an impact; however, few expect consumers to completely sever their grid connection and the back-up power it provides. The electric grid is not going away.

Nevertheless, the daily peaks and valleys of distributed energy use will challenge the stable balance of power required to keep the lights on and power flowing. The question becomes, given the instability introduced by changing generation, how do we ensure the grid is healthy, strong and reliable?

One simple answer is Flexible AC Transmission Systems (FACTS).

What are FACTS?

FACTS are a family of power electronics devices that have been in use on power systems around the world for decades. They work to achieve a number of objectives, such as:

- Stabilizing voltage levels
- Mitigating grid fluctuations
- Increasing the effective throughput of transmission lines
- Addressing power quality issues (e.g., flicker) on the grid
- Ensuring power quality for sensitive industrial loads

In addition to providing grid stability during power fluctuations, in many cases FACTS devices offer an alternative to building new transmission lines or upgrading existing ones, both of which come with significant cost and siting implications.

By contrast, most FACTS installations occupy a relatively small footprint and can be commissioned within 18 months of project startup. In terms of results, FACTS can increase the capacity of existing transmission lines by up to 40 percent, but they are being used for a variety of purposes.

Examples of FACTS uses

An increasingly common application for FACTS devices is in urban areas with the replacement of aging synchronous condensers (i.e., generators used only to provide voltage support rather than usable power). These units tend to be less efficient than modern generation located outside of city centers, and replacement projects often represent a confluence of operational, economic and environmental objectives that make a strong case for the wider adoption of FACTS.

The West Coast experience

The experience of one major West Coast utility is typical. The area around a major urban center where the company operates is generation-poor and contains a significant dynamic load. Synchronous condensers were used historically to provide the reactive power needed for voltage recovery following faults, but the generator units were more than fifty years old in some cases and unreliable. Not surprisingly, maintenance costs were high and getting higher. Faced with growing load and a corresponding need for stronger voltage support, the company decided to replace the generators with a FACTS device known as a static VAr compensator or SVC.

The machines on site could have been upgraded, but the cost would have been comparable to that of a FACTS installation. Even with an upgrade, at least two of the six units would have had only 10 years of remaining life. However, there were even larger cost considerations in operations and maintenance.

The synchronous condensers incurred losses five to ten times that of the SVC, and they used a lot of water for evaporative cooling. That, combined with the chemicals used to clean the cooling system, made the units an environmental liability. The SVC, by comparison, uses a closed-loop cooling system that requires less than 10 gallons of water per year.

Maintenance on the synchronous condensers would also have continued even after the upgrade. The ongoing costs were estimated at more than ten times that of the SVC on an annual basis, and this did not include collateral equipment such as breakers, oil pumps and controls that were similarly outdated and difficult to maintain. From a cost perspective, the SVC was the clear choice.

The Texas experience

In 2005, a municipal utility in Texas faced a decision on what to do with an old generation plant that was now being used solely for dynamic voltage support. Such urban generators are typically less efficient and more expensive to run than their modern equivalents but are kept going under reliability-must-run arrangements.

Because of their location, the units are often considered a source of sight and noise pollution. To make matters worse, they must often run on the hottest days, exacerbating poor air quality on the worst days of the year.

Space was very limited at the project site, and its proximity to an adjacent park made ambient noise a significant concern. Also, magnetic fields created by conventional SVCs could potentially contribute to destructive forces in the rebar and oil tank beneath the site. For these reasons, the utility opted for a STATCOM, another FACTS device, along with three capacitor banks.

In this case, the STATCOM option offered key advantages, primarily because the main components are housed inside a two-story building. Ambient noise is reduced by the enclosure's acoustic noise screening and the encapsulation of the nearby transformers with still more sound insulation.

Golden Valley Electric Association (GVEA)

GVEA is operating in Fairbanks, central Alaska, an SVC supplied by ABB in 2005. Despite its distant location, the installation was erected and commissioned in less than 12 months.

The SVC was necessary for the operation of a pump station in the Trans-Alaska Pipeline System. The grid in this remote region is relatively weak, so the SVC provides dynamic control of the system voltage to assure an uninterrupted flow of oil via the pipeline. Also included in the project were two mechanically switched capacitors used during annual maintenance, when the SVC is offline, or in the event of an unexpected trip of the SVC. With the geographical conditions of the installation, the equipment was designed to operate over a temperature range of -52 to +35 degrees C.

San Diego Gas & Electric

San Diego Gas and Electric Co. (SDG&E) is operating two series capacitors in their 500 kV South-West Power Link at Imperial Valley in Southern California. The FACTS devices were installed to increase the power transmission capability of the South-West power Link which brings power from the Palo Verde power plant to take advantage of inexpensive remote generation.

In 2012, a third series capacitor went on line at the Suncrest substation as part of the Sunrise Powerlink transmission project. The Sunrise line is 120 miles long, and provides access to electricity from solar, geothermal and wind resources located in the Imperial Valley and eastern San Diego County. The line will also help reduce transmission congestion by strengthening the transmission grid and improving access to cheaper energy generated outside the region.

Electric reliability: what's next

As operators and regulators strive to meet the demand for electric reliability in the face of shifting generation and heightened demands for transmission capacity, FACTS devices will play an increasingly important role. Their numerous applications and increasingly attractive economics promise the technology's even wider adoption as part of our nation's energy future.

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Document ID