FACTS

Increased power transmission capacity over AC intertie by improved transient stability by means of SVC

A static var compensator (SVC) supplied by ABB was commissioned in 1994 in the Bang Saphan 230 kV substation of the Electricity Generating Authority of Thailand (EGAT). The SVC, rated at 50 Mvar inductive to 300 Mvar capacitive at 230 kV, was installed on a turnkey basis.

The power system in Thailand is undergoing strong expansion. Increased generating capacity in different parts of the system increases the power transfer demands on the transmission system and on transfer of power over long distances.

A weak part of the bulk system is a tie-line linking the load centre around Bangkok with a major generation area further to the south by means of a double-circuit 230 kV line and a double-circuit 115 kV line. The length of this interconnection is about 700 km, and the SVC at Bang Saphan is located approximately half-way in between.

Transient stability is a limiting factor for power transmission of this interconnection. The purpose of the SVC is consequently to increase the transient stability, thereby increasing the power transmission capability of the system by a considerable amount. At the same time the SVC provides continuous voltage control under various operating conditions of the system.

Mechanically-switched capacitors (MSC) were considered but ruled out due to the high demands on control dynamics, requiring a compensator response time well below 50 ms. Also, continuous var control efficiently eliminates all step-wise voltage changes, which since the system is weak could otherwise violate EGAT's requirement that voltage changes must not exceed 3% on 230 kV.

A Power Oscillation Damper (POD) is included in the SVC control software. This POD is activated if large power oscillations or a large power derivative (dP/dt) appear in the transmission system, thereby counteracting the power oscillations.

The SVC comprises one thyristor-controlled reactor (TCR) rated at 150 Mvar, two thyristor-switched capacitors (TSC) each rated at 100 Mvar, and harmonic filters rated together at 100 Mvar. The compensator can be continuously controlled over the complete reactive power range. In order to achieve the highest possible availability, the control system is redundant.

The SVC can be controlled from three different locations:

- The SVC control room mimic panel
- The main substation control building mimic panel
- EGAT's control centre.

The SVC is equipped with an undervoltage strategy, by which if the system voltage (230 kV) drops to extremely low values (typically 0.5 pu) the compensator is controlled to zero output and then goes back to normal control upon the return of the voltage.

To ensure optimum dynamic response of the SVC for various network conditions including varying short circuit levels, automatic gain supervision and optimisation is included in the regulator of the SVC.

The SVC at Bang Saphan has enabled a considerable increase of the active power transmission capability of the power corridor to Bangkok. Without the SVC, the power transmission capacity was limited to below 200 MW due to transient stability limitations of the tie-line. With the SVC in operation, the power transmission capacity has been raised to well over 300 MW, representing an improvement of power transmission capacity by more than 50% over existing lines.

Technical data	
Controlled voltage	230 kV
SVC rating	50 Mvar inductive to 300 Mvar capacitive.
Control system	Three-phase voltage control by means of a voltage regulator. Regulator functions include POD, strategy selection and gain supervision/optimisation.
Thyristor valves	Water-cooled three-phase valves with magnetic firing.

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Single-line diagram