ABB Advanced Power Electronics

STATCOM to compensate long power line with heavy load

Substation with STATCOM container

PCS 6000 STATCOM: +/- 12 MVAr unit with 280% overload capability
Introduction and Main Technical Features

As part of the forthcoming capacity expansion of an oil pipeline in British Columbia, Canada, three additional pumping stations were installed. With each pumping station consisting of motors rated at 5000HP, this causes a significant load change to the already weak and long radial 138kV power line. It is therefore necessary that the effects of heavy load changes can be compensated by using a very fast reactive power source. Three ABB PCS 6000 STATCOMs, each with a rating of +/-12MVar and 280% overload capability were installed along the power line to maintain the grid voltage.

Challenge

A long radial 138kV power line in Canada supplies large pump-station motors of an oil pipeline. Dynamic voltage support is required during heavy and changing load conditions as well as for improving power quality and reducing the requirements of load shedding to prevent possible voltage collapse when severe grid faults are cleared.

Solution

To fulfill all these requirements, three STATCOMs, were installed along the long radial 138kV power line. Each STATCOM has a positive and negative sequence controller for the fundamental voltage and a 5th and 7th harmonic controller to actively filter existing grid harmonics and thereby improving power quality. In addition, the controller also controls capacitor banks in the substation.

Benefits

- Reactive current at reduced voltage (no Q–U^2 characteristics as Capacitors)
- Negative sequence control & active filter functionality
- Very fast industrial control system AC800 PEC
- High reliability and low losses due to MV IGCT
- Low operation costs (no mechanical breakers)

PCS 6000 STATCOM

The STATCOM (Static Synchronous Compensator) provides outstanding performance for both steady state and dynamic operation. Having no switched passive elements means no oscillation problems and no Q–U^2 characteristics limiting fault ride through support. The fast dynamic voltage control and the behavior during balanced or unbalanced grid faults are significant advantages in comparison to other reactive power compensation topologies.

Case study

In steady operation the STATCOM regulates the grid voltage together with the capacitor banks and reduces the voltage harmonic content of the 5th and 7th harmonics with an active filtering function. During grid faults and disturbances the STATCOM provides up to 280% nominal current to support the grid. Tests have proven the value of the STATCOM solution. The following table illustrates the harmonic filtering benefit of the STATCOM during normal operation.

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<thead>
<tr>
<th>Harmonic</th>
<th>Active filtering turned OFF</th>
<th>Active filtering turned ON</th>
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Figure 2: Visualization of active filtering benefit

High reliability and low maintenance

Oil pipeline pumping stations must have a very reliable electrical feeder. The robust PCS 6000 STATCOM solution based on MV IGCTs provides this. In the rare event that a STATCOM should require maintenance, it can be serviced while the oil pipeline motors are in operation without affecting the plant process because the other two remaining STATCOMs can supply the needed reactive power.

The MV STATCOM design is part of ABB’s family of PCS 6000 products which are used for a wide range of applications. It uses the same power technology as the ACS 6000 range of MV Drives. The standardization of these power electronic modules delivers substantial advantages in terms of cost and quality. With many PCS 6000 units sold worldwide this converter has a proven track record of high reliability.

ABB

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Case study project data

Plant: British Columbia, Canada
Type: PCS 6000 STATCOM double
Installation: outdoor
Nominal; overload reactive power: +/- 12; +/- 33.6 MVar
Nominal voltage: 138 kV
Nominal frequency: 60Hz
STATCOM Controller: ABB AC600PEC