ABB received an order for four Relocatable Static Var Compensators (RSVC) in the National Grid 400/275 kV power transmission network. The compensators, all having a dynamic rating of 0–60 Mvar, are located at Penn, Hams Hall, Coventry and Oldbury in the Midland area. The SVCs have been designed to be connected to the 13 kV tertiary windings of existing substation auto-transformers.

The operating range of the compensators is achieved by means of Thyristor-Switched Capacitors (TSC) exclusively.

The purpose of the installations is to maintain the stability and power transmission capability of the national grid during various network conditions.

**RSVC: A useful tool in deregulated power industry**

Deregulation has been introduced in power industry to meet the market’s growing demands for flexibility. For this to work in reality, technical solutions must also be flexible. Operational safety and stability must be maintained under changing power system conditions.

ABB’s Relocatable Static Var Compensators were conceived precisely for this. By making an SVC relocatable, dynamic voltage support can be obtained where it is needed in the power grid in order to meet current demands for network stability. Then, when the picture changes to follow the demands of a changing power market, the Static Var Compensators can be relocated to enable the system to adapt to the situation.
Modular build-up

The truly relocatable design of ABB RSVC enables full relocation of each installation from one place in the grid to another within just a few weeks, depending on local conditions. The RSVC is modular, thus enabling the equipment to be moved on existing roads using standard transportation facilities. The design is compact, and the technical solutions utilized guarantee low noise as well as low magnetic interference, thereby limiting the environmental impact.

Each RSVC consists of seven preassembled and transportable modules:

- One Switchgear module, built up on an open steel frame. This module contains the 13 kV circuit breaker and disconnector, as well as measuring transformers and surge arresters.
- Three TSC modules, each built up on open steel frames. These modules contain the capacitor banks and damping reactors.
- One Thyristor valve module, housed in a prefabricated building. This module contains the thyristor valve, valve base electronics as well as the valve cooling.
- One Control module, housed in a prefabricated building. This module contains the control, protection and DC distribution equipment.
- One Auxiliary power module, housed in a prefabricated building. This module comprises an auxiliary power transformer and AC distribution.

Easy erection and commissioning

The modular build-up of the RSVCs greatly facilitates erection and commissioning work on site. The various modules are furthermore interconnected by prefabricated buswork and cables, for quick and easy connection.

The modular build-up also means that a large part of the equipment and system testing can be done in the workshop, thereby minimizing the need for testing on site. This saves time as well as money.

Civil work is limited to concrete sleepers, or if desired, foundation slabs on which the equipment is placed. With the exception of the Switchgear module, anchor bolts are not needed.

Truly relocatable with TSC

The three TSC branches are rated at 10 Mvar, 20 Mvar and 40 Mvar respectively in a binary scheme which yields a total dynamic range of the RSVCs of 0–60 Mvar in 10 Mvar steps, with a short-time overload capability of another 10 Mvar.

Although the TSC generates no harmonics itself, detuning reactors are installed to prevent amplification of pre-existing harmonics wherever the TSCs are installed on the system.
Low environmental impact

The absence of TCR (Thyristor-Controlled Reactors) in the RSVC scheme has the benefit of low stray magnetic flux close to the installation.

Similarly, with only damping reactors in the scheme, and with no harmonic currents generated by the RSVC, the noise contribution from the RSVC is low.

Compact equipment design

The thyristor valve is of a highly compact design, with all three TSC branches built together side by side into one valve assembly. The RSVC valve utilizes high rating thyristors with indirect light firing. The valve is water cooled, with a single closed loop system and water to air dry type cooling tower.

The control system is of the ABB VarMACH type, offering a compact, modular design utilizing microprocessors and digital signal processors connected by high performance industry standard buses and fibre optic communication links. Due to extensive selfsupervision, the need for periodic maintenance of the control system has been reduced to a minimum.

In VarMACH, most of the application functions are produced by using fully graphic programming. The simplicity in programming gives great flexibility if changes are needed after the installation has been done, again adding to the feature of relocatability.

Control functions

The primary function of the RSVCs is to give dynamic support to the system voltage, particularly during circuit outages immediately following a fault. This is performed by means of a closed loop voltage control function. To ensure the best possible dynamic response under network conditions which include varying network impedances in different locations, the control system includes a gain supervisor.

The RSVCs have been designed to permit continuous and controllable operation at tertiary voltages between 0.8 and 1.2 p.u. The slope of the VI characteristic is adjustable over the range 2% to 10%.

Additionally the RSVCs give capacitive support in undervoltage situations continuously down to 0.8 p.u. and down to 0.4 p.u. for 1.5 second.

To prevent substation transformer saturation, the RSVCs are furthermore equipped with a tertiary voltage limitation function.

Local and remote control

By means of the Station Control and Monitoring (SCM) which is part of the VarMACH concept, the RSVCs can be controlled from the local substation control room as well as from the area control centre.
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