In 1988, a Static Var Compensator (SVC) with a rating of -2.5/+15 Mvar supplied by ABB was commissioned in the 115/34.5 kV network of SaskPower in Canada.

The purpose of the compensator is to give dynamic voltage support during start-up and operation of heavy mining loads at the Rabbit Lake ore mine, mostly AC motors of induction type. A low fault level at the feeding point of the mine in conjunction with low inertia in the system makes it difficult to keep up a stable voltage during varying operating conditions without the var support offered by the SVC.

The mine is fed at a voltage of 34.5 kV and the load during peak conditions is about 20 MW.

The SVC is rated at 2.5 Mvar inductive to 15 Mvar capacitive continuously variable (-2.5/+15 Mvar) and comprises a TCR (thyristor controlled reactor) rated at 17.5 Mvar in conjunction with harmonic filters yielding totally 15 Mvar. The compensator works off a tertiary winding of a 115/34.5 kV substation transformer.

The reactive absorption capability built into the SVC (2.5 Mvar) is useful in order to enable a certain amount of overvoltage limitation of the system voltage during low load conditions.

The overvoltage condition can arise as a consequence of excessive reactive power generation from a 400 km long 115 kV feeder supplying part of the power to the mining area.

The thyristor valve of the TCR is air-cooled and has its three phases mounted on top of each other to form a 3-phase stack. The harmonic filters are tuned to the 5th and 7th harmonics, respectively.
Advanced compensator control
The mine loads can be supplied either from remotely located hydro power stations or from local diesel generators or from a combination of both. Because of this, the short circuit capacity at the load area can vary substantially. This strongly varying and in some cases very low short circuit level of the network calls for an advanced SVC control scheme in order to enable efficient dynamic voltage control under all existing operating conditions.

Gain supervisor
To ensure stable voltage control with optimum loop gain for all system conditions, automatic gain supervision has been incorporated in the control scheme. This gain supervisor continuously monitors the stability of the closed voltage loop in the compensator, and whenever necessary adjusts the loop gain so as to keep a stable response.

Overvoltage control
The sometimes very low fault level of the network makes the system extremely voltage sensitive. In order to prevent dangerous overvoltages from occurring as a consequence of load tripping, a special TCR control mode has been incorporated in the SVC with the effect that if the line breaker at the load end (34.5 kV) is tripped for any reason, a command is immediately given to the SVC control which results in continuous firing of the TCR, thereby keeping the system voltage within safe limits.

Similarly, in case of extreme undervoltages (≤0.7 p.u.) caused by system faults, the SVC is commanded to go fully inductive, this since any attempt of the compensator to support the voltage in this situation would result in system overvoltage upon clearing of the system fault.

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Technical data

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled voltage</td>
<td>115 kV</td>
</tr>
<tr>
<td>SVC Rating</td>
<td>2.5 Mvar inductive to 15 Mvar capacitive</td>
</tr>
<tr>
<td>Control system</td>
<td>Three-phase voltage control by means of a voltage regulator. Regulator functions include strategy selection and gain supervision</td>
</tr>
<tr>
<td>Thyristor valve</td>
<td>Air-cooled, three-phase valve with magnetic firing and redundant fans</td>
</tr>
</tbody>
</table>

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Layout

1 Reactor
2 Capacitor bank
3 Current transformer
4 Thyristor valve
5 Disconnecter
6 Control cubicles

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