The controllable series capacitor at Kanawha River

In 1991 a segmented series capacitor was installed by ABB in the south-eastern part of the American Electric Power Service Corporation (AEP) system. This grid includes lines at 765 kV, 345 kV and 138 kV. There series capacitor was installed in the Kanawha River – Funk 345 kV line, which is 174 km long.

An installation that provides flexibility

Before the installation of the series capacitor, the loadability of this line was limited to about 950 MW. Series compensation to a maximum degree of 60% was required, as contingency loading resulting from the outage of a critical 765 kV circuit could exceed this limit.

Fixed series compensation of 60% would have increased system losses unnecessarily under normal operational conditions. However, segmented capacitors, in 10% increments over the range 0% to 60%, could be justified since this provides flexibility to use only the minimum amount of compensation required to meet current system conditions.

Brief description

The installation consists of a 788 Mvar, 2500 A, 42 ohm series capacitor bank located at the Kanawha River Station. Each phase consists of two platforms, one with a 10% (7ohm) and a 20% (14 ohm) segment and the other with the remaining 30% (21 ohm) segment. This combination allows compensation from 0% to 60% in steps of 10%. Each capacitor segment is switched by a bypass switch.

Metal Oxide Varistors, MOV, are connected across each capacitor segment. The energy rating of these MOVs has been selected based on the maximum energy that may appear during external faults. In the event of an internal fault, i.e. a fault located on the compensated line, the energy rating of the MOV could be exceeded. Therefore, a triggered spark gap is installed across each segment to bypass the capacitor and MOV under these conditions.

Technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>System voltage</td>
<td>345 kV</td>
</tr>
<tr>
<td>Rated reactive power</td>
<td>788 Mvar</td>
</tr>
<tr>
<td>Degree of compensation</td>
<td>60% in 10% steps</td>
</tr>
<tr>
<td>MOV rating</td>
<td>39 MJ</td>
</tr>
<tr>
<td>Protective level</td>
<td>2.25 pu</td>
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</tbody>
</table>
AEP System

- 765 kV
- 345 kV

Single-line diagram, Series capacitor

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