SVC Light® enabling strong flicker reduction from a steel plant in the UAE

An SVC Light® rated at 33 kV, 0-164 Mvar capacitive has been installed by ABB at Emirates Steel in the United Arab Emirates for reduction of flicker emanating from the operation of an electric arc furnace (EAF), rated at 130 MVA, and a ladle furnace (LF) rated at 24 MVA. Flicker mitigation is called for due to the considerable size of the EAF in relation to the limited fault level of the feeding grid. The SVC Light came on line in 2010.

The steel plant takes its power from a 220 kV grid. The fault level varies between 4,800 MVA and 10,000 MVA, depending on grid conditions and winter/summer variations. Considering the substantial rating of the EAF, unless proper measures were taken, strong flicker could have been expected as a result of the operation of the EAF, particularly at minimum fault level of the grid. With the SVC Light operated on the 33 kV EAF bus, efficient flicker mitigation is attained, and the Grid Code of the feeding grid is fulfilled for all operating conditions. A flicker reduction factor of 7 is achieved with the SVC Light in operation.

As a matter of fact, the flicker level at the 220 kV point of common connection (P.C.C.) is influenced by two additional steel plants situated in the same region and operated from the same grid. Consequently, the flicker measured is an aggregated value arising from the operation of all three plants. The main purposes of the SVC Light installation are to mitigate the flicker emission produced by the EAF, reduce the harmonic pollution, compensate the reactive power and stabilize the furnaces’ bus voltage.

EAF grid impact
The EAF generates several kinds of disturbances, which, unless remedied, result in more or less severe deterioration of power quality. The melting process inside an EAF is erratic in its nature, from time to time resulting in an “electrical short” within the furnace’s electric circuit. As a consequence, the consumption of reactive power strongly fluctuates in a stochastic manner. The fluctuation of reactive power flowing through circuit reactances results in voltage fluctuations.

Furthermore, the EAF acts as an asymmetrical load on the three-phase feeding grid, giving rise to current and voltage imbalance in the grid. Normally, only very limited levels of grid asymmetry can be allowed without causing deterioration of the power quality for other consumers connected to the same grid. And last but not least, the EAF generates harmonics, odd and even, as well as inter-harmonics.
Benefits of the SVC Light installation

With the SVC Light in operation, the following benefits are attained at the 220 kV P.C.C.:

- A flicker reduction factor of 7
- Acceptably low levels of harmonic distortion
- A high and constant power factor, with no back-feed of reactive power into the grid
- Voltage variations as well as voltage imbalance kept at acceptable levels
- Grid reinforcements kept to a minimum

Main circuit design

The compensated load is a joint operation of the EAF and LF. The type of charge of the EAF is 100% DRI (Direct Reduced Iron), continuously charged. For optimal flicker damping, the dynamic range of the SVC Light needs to be higher than the maximum reactive load power. For this application and taking into account the needed flicker reduction, a dynamic rating of 164 Mvar has been chosen.

Main performance features of the SVC Light

Flicker reduction factor at the 220 kV P.C.C.  7
Compensated power factor at the 220 kV P.C.C.  0.996

Voltage fluctuations, voltage imbalance and harmonic content at the P.C.C. are all within the values required by the grid owner.

Main technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Supply grid voltage</td>
<td>220 kV</td>
</tr>
<tr>
<td>Furnace bus voltage</td>
<td>33 kV</td>
</tr>
<tr>
<td>Rated EAF power</td>
<td>130 MVA + 20%</td>
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<tr>
<td>Rated LF power</td>
<td>24 MVA + 20%</td>
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<tr>
<td>SVC Light rating</td>
<td>33 kV, 0-164 Mvar capacitive</td>
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