

# SVC for mitigation of flicker from electric arc furnaces



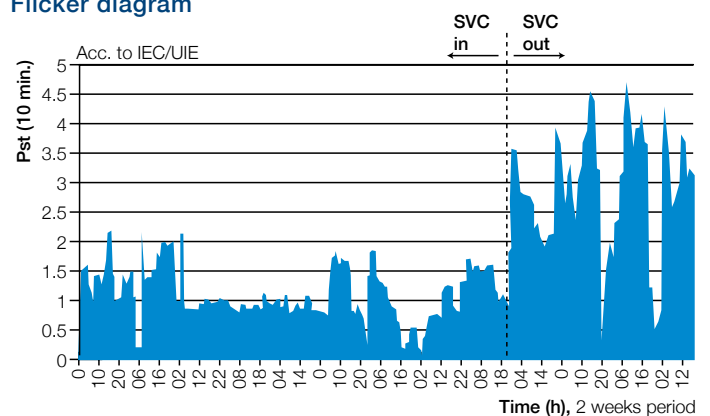
A Static Var Compensator (SVC) rated at 0-120 Mvar (capacitive) and supplied by ABB has been in operation since 1997 at Marcial Ucin's steel making plant Aciérie de l'Atlantique (ADA) at Bayonne in France.

The purpose of the compensator is mitigation of flicker caused by the operating of a 123 MVA electric arc furnace (EAF) as well as a 25 MVA ladle furnace (LF), as well as dynamic power factor correction of the plant.

Due to a relatively low fault level of the supplying grid at the point of common coupling (P.C.C.) compared to the size of the EAF, the flicker situation is severe, with an estimated uncompensated flicker severity reaching  $P_{st}(95) = 4$ . This has called for a solution with an SVC operating in conjunction with a saturable reactor in series with the EAF. The SVC, with its continuously variable compensation, also safeguards the plant against overcompensation during furnace outages.

Flicker, the random variations in light intensity from incandescent lamps caused by the operating of nearby fluctuating loads on the common electric power supply grid, is highly irritating for those afflicted. The random voltage variations giving rise to it can also be disturbing to other process equipment fed from the same grid. The proper mitigation of flicker is therefore a matter of power quality improvement as well as an improvement to human environment.

Flicker diagram



In fact, as power quality issues are coming more and more into focus in many parts of the world, requirements on the mitigation of flicker and other kinds of current and voltage distortion are being imposed by regulatory bodies at an increasing scale. To meet this, grid owners and operators of process industry are meeting each other in order to work out solutions to common problems which satisfy the needs and interests of all concerned.

Thus, the SVC at ADA was conceived as a project in cooperation between Marcial Ucin and the local grid owner. ABB was chosen as SVC supplier on a turnkey base.

With the SVC in operation, the flicker level at the P.C.C. (225 kV) has been reduced by a factor better than 2 (SVC alone). The compensated power factor at the P.C.C. is better than 0,93. The SVC also achieves filtering of harmonics caused by the operating of the furnaces in the steel plant as well as acts as a balancer of the highly unsymmetrical load on the AC supply grid represented by the EAF. The total harmonic distortion must not exceed 4,5% at the point of common coupling.

Also, the stabilising of the EAF bus voltage at a higher level than without compensation leads to an increase of furnace productivity as well as to a decrease of electrode consumption, both important contributors to process economy. Likewise, money is saved by means of lower specific energy consumption of the process, lower electric system losses in the plant and a more favourable power supply tariff due to a higher overall power factor.

The SVC at ADA is operated directly on the 31,5 kV arc furnace bus. It comprises a Thyristor-Controlled Reactor (TCR) rated at 120 Mvar and three parallel Harmonic Filters, also with an overall rating of 120 Mvar.

This gives a total dynamic range of 0-120 Mvar capacitive to the compensator. The filter branches are tuned to the 2nd, 3rd and 4th harmonics, to achieve the best possible harmonic reduction from the two furnaces.

The control system of the SVC consists of a phase-wise open-loop reactive power controller plus a three-phase closed-loop power factor control. The control principles are based on high speed space vector control with instantaneous current measurements. The control functions have been built up in a programmable microcomputer-based system using standardized program modules for the different control functions of the SVC.

#### Technical data, SVC

|   |                       |
|---|-----------------------|
| Controlled voltage                      | 31,5 kV               |
| Dynamic range                           | 0-120 Mvar capacitive |
| Flicker reduction factor at the P.C.C.  | > 2                   |
| Power factor correction at the P.C.C.   | P.F. ≥ 0,93           |
| Total harmonic distortion at the P.C.C. | ≤ 4,5%                |

Phase-wise reactive power control by means

Control system of fast-acting open-loop controller, plus three-phase closed-loop power factor control.

Thyristor valve Three-phase, water-cooled valve with indirect light firing.

For more information please contact:

#### ABB AB

#### FACTS

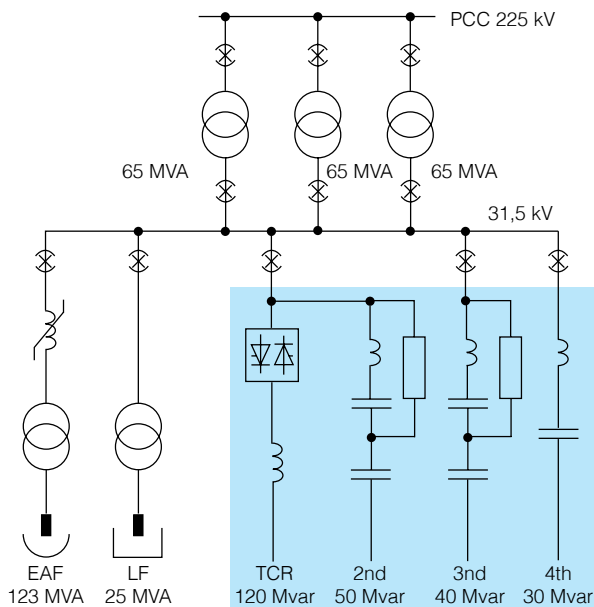
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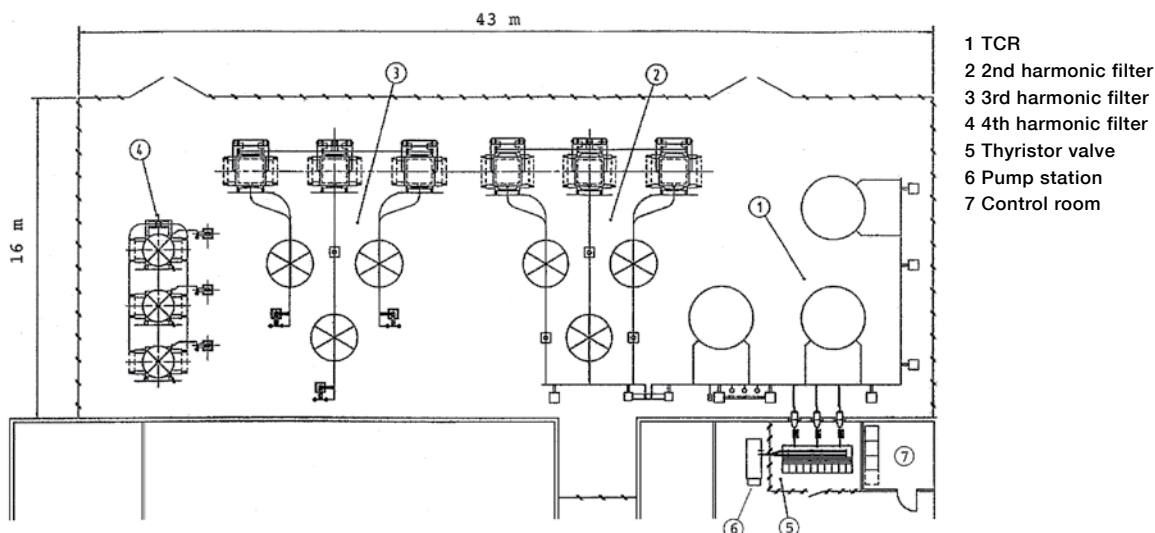
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#### Single-line diagram



#### Layout



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