A Static Var Compensator (SVC) rated 0-120 Mvar and supplied by ABB Power Systems has been in operation since 1997 at Marcial Ucin’s steel making plant Aciérie de l’Atlantique at Bayonne in France (ADA). 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 compared to the size of the EAF, the flicker situation is severe, with an estimated flicker severity uncompensated reaching $P_{st}$ = 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.

In fact, as power quality issues are getting 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 will 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, Electricité de France (EDF). ABB Power Systems was chosen as SVC supplier on a turnkey base.

With the SVC in operation, the flicker level at the point of common coupling (225 kV) has been reduced by a factor better than 2 (SVC alone). The compensated power factor at the point of common coupling 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.

**Flicker diagram**

According to IEC/IEC:

- **SVC in**:
  - $P_{st}$ (10 min.)
  - Time (h), 2 weeks period

- **SVC out**:
  - $P_{st}$ (10 min.)

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**ABB Power Systems**
Also, the stabilising of the EAF bus voltage on 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 120 M var and three parallel Harmonic Filters, also with an overall rating of 120 M var.

This gives a total dynamic range of 0-120 M var 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 only)

- **Controlled voltage**: 31.5 kV
- **Dynamic range**: 0-120 M var capacitive
- **Flicker reduction factor at P.C.C.**: >2
- **Power factor correction at P.C.C.**: P.F. > 0.93
- **Total harmonic distortion at P.C.C.**: ≤ 4.5%
- **Control system**: Phase-wise reactive power control by means 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.

### Single-line diagram

![Single-line diagram of the SVC system](image)

### Layout

1. TCR
2. 2nd harmonic filter
3. 3rd harmonic filter
4. 4th harmonic filter
5. Thyristor valve
6. Pump station
7. Control room