

## SVC for improved operation of EAF based steel plant from weak local power supply



Since 1994, Metaldom of Santo Domingo, Dominican Republic has been operating an SVC (Static Var Compensator) supplied by ABB for stabilization and improvement of an EAF process, fed from a network comprising a combination of four local medium speed diesel generator sets (DG) and a 69 kV, 60 Hz public supply.

The EAF is rated at 35 MVA at 34,5 kV. The diesel generator-sets are rated at 11,6 MW each, i.e. a total installed generating capacity in the same order of magnitude as the rating of the EAF.

### Background

In normal operation, three DG are connected to the furnace bus and one DG is connected to a bus feeding two rolling mills also present in the plant. When only three DG are available, two DG feed the EAF bus and one DG feeds the rolling mill bus.

The fault level at the point of common coupling to the 69 kV public grid is limited to 700 MVA. Furthermore, in certain situations, the plant needs to be operated in islanded mode, i.e. cut off from the public supply. In this situation, the operator faces a situation where a rapidly and strongly varying load, consisting of the EAF and rolling mills, must take its entire

power supply from local diesel generator sets of limited rating, which will then have to put up with the load variations as well as harmonics and phase unbalance induced by the operation of the EAF and the rolling mills. The load variations in their turn induce voltage and frequency variations in the plant power supply. Under islanded conditions, the fault level at the 34.5 kV furnace bus does not exceed 200 MVA.

### Objectives

These conditions of mutual influence of a detrimental nature between the metallurgical process and the power supply needed to be mitigated in a suitable way, to enable safe and proper operation of both. The answer was the SVC, rated at 10 Mvar inductive to 45 Mvar capacitive at 34,5 kV. The objectives of the SVC are:

- Improvement of the EAF and Rolling mill bus voltage regulation.
- Reduction of arc furnace flicker.
- Reduction of negative phase sequence currents and voltages generated by the EAF.
- Reduction of harmonic currents generated by the EAF and rolling mills.
- Improvement of the plant power factor under varying load conditions.
- Frequency stabilization (islanded mode only).

## Required performance

The SVC is required to safeguard the following plant performance:

- Voltage fluctuations at the 34.5 kV bus not to exceed 3%.
- Harmonic distortion at the 69 kV point of common coupling: Total voltage distortion factor  $DT < 3\%$ .
- Negative phase sequence voltage at 13.2 kV intermediate plant bus: Maximum voltage unbalance limited to 2%.
- Frequency stabilization (in islanded mode only): System frequency swings limited to  $-/+ 5\%$  of 60 Hz.
- Plant power factor 0,98 or better.

## SVC configuration

The SVC comprises a Thyristor-controlled reactor (TCR) rated at 55 Mvar at 34.5 kV, plus a Harmonic filter battery rated at 45 Mvar at 34.5 kV with three branches tuned to the 2nd, 3rd and 5th harmonics.

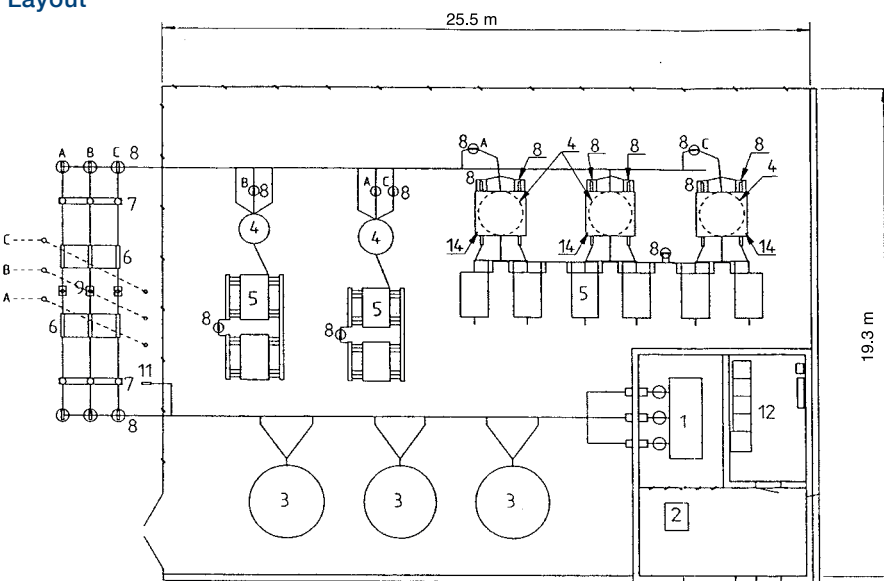
The Harmonic filters have been designed with particular concern to enabling them to perform with the system frequency variations taken into consideration.

## Control system

The control system comprises a phase-wise open-loop reactive power control, measuring the 34.5 kV voltage and the current into the EAF through a transducer. The reactive power demand is calculated continuously and the TCR is controlled in order to compensate the EAF reactive power consumption.

The control system also comprises a closed loop, three-phase symmetrical voltage control. The reference value for this function is derived from two parts. One part is a reference given from the actual system frequency, which will reduce the system voltage if the frequency is decreasing. The active power demand of the furnace will then also be reduced, and the system frequency is restored.

## Layout



- 1 Thyristor valve
- 2 Pump station
- 3 TCR reactor
- 4 Filter reactor
- 5 Capacitor bank
- 6 Disconnector
- 7 Circuit breaker
- 8 Current transformer
- 9 Voltage transformers
- 10 Surge arrester
- 11 Surge capacitor
- 12 Control room
- 13 Post insulator
- 14 Resistor

The other part of the voltage reference value is a direct reference setting for the 34.5 kV bus, adjustable in the span 95%–105% of the 34.5 kV voltage.

Finally, there is a secondary voltage limiting function, which has the task of ensuring that the 34.5 kV bus voltage never exceeds 1.05 p.u. (36.2 kV).

The control strategy is such that the secondary voltage limiter has the highest priority, thereafter the open loop control, and the voltage control as the lowest priority.

For more information please contact:

## ABB AB

### FACTS

SE-721 64 Västerås, Sweden

Phone: +46 21 32 50 00

Fax: +46 21 32 48 10

[www.abb.com/FACTS](http://www.abb.com/FACTS)

## Single-line diagram

