

Static Var Compensation of AC and DC Furnaces in joint operation



A Static Var Compensator (SVC) rated at 2 Mvar inductive to 56 Mvar capacitive at a voltage of 22 kV supplied by ABB is in operation since 1993 in the NatSteel steelplant in Singapore. The purpose of the compensator is to provide dynamic control of reactive power, power factor correction and reduction of fast voltage variations created by the simultaneous operation of electric arc furnaces of DC and AC type in several possible combinations:

- 1 DC furnace rated at 53 MVA
- 1 AC furnace rated at 30/36 MVA
- 2 AC furnaces each rated at 30/36 MVA
- 2 DC furnaces each rated at 53 MVA

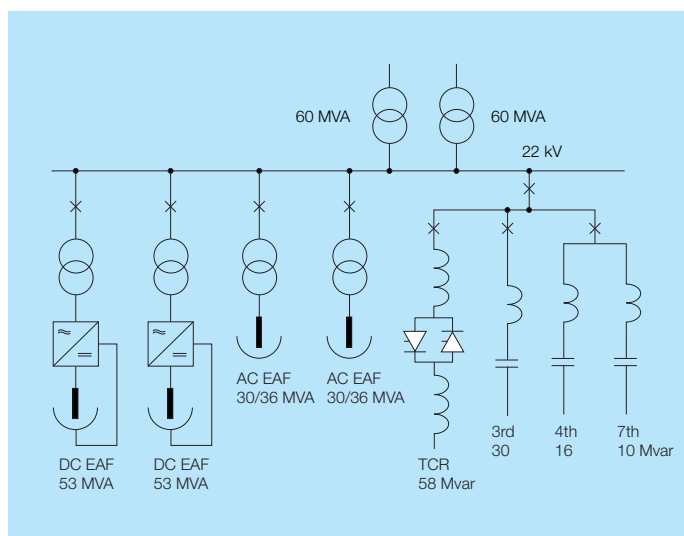
In addition, reduction of harmonics created from the operation of the furnaces is provided. The residual harmonic distortion at the Point of Common Coupling (66 kV) is thus kept below the following specified limits:

Total harmonic distortion	<3%
Even harmonics	<1 %
Odd harmonics	> 2%

Electrical arc furnaces, AC and DC alike, constitute large and troublesome loads on their feeding networks, with large and rapidly fluctuating consumption of reactive power, which in its turn gives rise to voltage depression and fluctuations in the surrounding network as well as on the furnace bus itself, thereby in many cases preventing the furnaces from being utilized to their fully rated capability. They are also large sources of harmonics.

The SVC deals efficiently with these shortcomings and offers a useful means for mitigation as it will keep a high and stable voltage on the furnace bus and thereby contribute to productivity and economy of the process. The overall power factor improvement for the plant achieved by the SVC also contributes in a favourable way to process economy.

The SVC at NatSteel operates directly on the 22 kV furnace bus and consists of one Thyristor-Controlled Reactor (TCR) rated at 58 Mvar and three Harmonic Filter branches with an overall rating of 56 Mvar. The Filter branches are tuned to the 3rd, 4th and 7th harmonics, respectively.



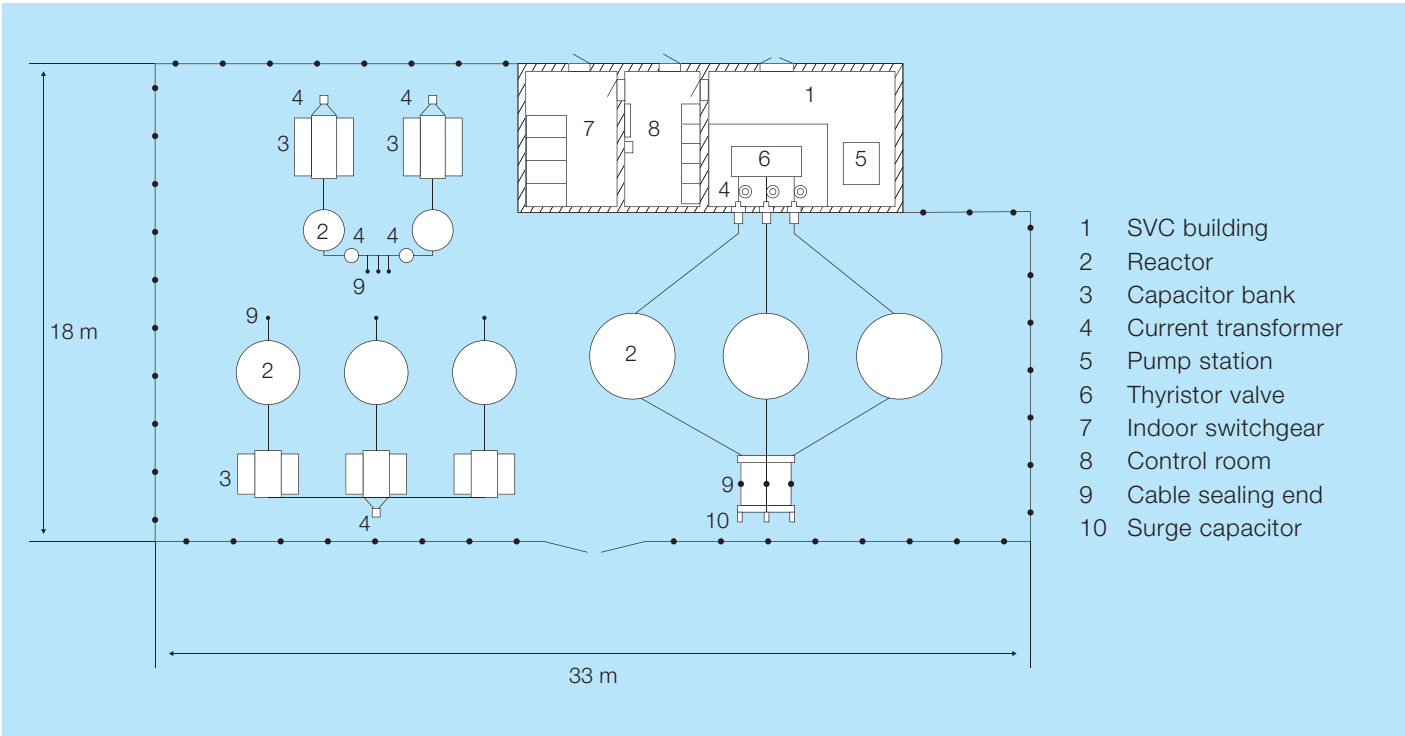
Single-line diagram

The control system of the SVC consists primarily of an open-loop reactive power controller which operates phase-wise plus additionally a three-phase, closed-loop power factor control. The var control functions have been built up in a programmable microcomputer system which uses standardized program modules for the different control functions in the SVC.

The SVC ensures that specific requirements on the overall power factor for the plant (>0.85) are met.

Technical data

Controlled voltage	22 kV
Dynamic range	2 Mvar inductive to 56 Mvar capacitive
Harmonic filtering	30 Mvar/3rd harmonic 16 Mvar/4th harmonic 10 Mvar/7th harmonic
Power factor correction	From 0.7 (uncompensated) To > 0.85 (compensated)
Control system	Phase-wise control of reactive power means of fast-acting open-loop control, plus three-phase closed-loop power factor control
Thyristor valve	3-phase water-cooled valve with indirect light triggering



layout

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