

## Static Var Compensation of DC Arc Furnaces



A Static Var Compensator (SVC) rated at 5 Mvar inductive to 195 Mvar capacitive supplied by ABB has been in operation since 1992 in the DC arc furnace shop of NUCOR Steel, Blytheville, Arkansas. The purpose of the compensator is to provide dynamic voltage control and reduce fast voltage variations created by the operation of two DC arc furnaces, each rated at 130 MVA. Two ladle furnaces, each rated at 21.5 MVA, are being compensated as well.

Dynamic power factor correction is also provided by the SVC, achieving an overall power factor for the plant of close to unity for all operational conditions.

DC arc furnaces in general constitute troublesome loads on industrial networks, consuming large and quickly varying amounts of reactive power as they operate through the various phases in their process, thereby giving rise to voltage depressions as well as fluctuations in the surrounding network and on the furnace bus itself. They are also large sources of harmonics.

The SVC offers an efficient means to rectify these shortcomings as it will keep up a high and stable voltage on the furnace bus, thereby contributing to productivity and economy of the process. The overall power factor correction for the plant provided by the SVC will also contribute in a favourable way to process economy.

At the same time, the SVC ensures that specified limitations regarding voltage fluctuations and harmonic distortion at the point of common coupling are fulfilled for the plant.

The SVC of NUCOR Steel, Blytheville operates directly on the 34.5 kV furnace bus and consists of one Thyristor-Controlled Reactor (TCR) rated at 200 Mvar and five Harmonic Filter branches with a total rating of 195 Mvar. The Filter branches are tuned to the 2nd, 3rd, 4th, 5th and 11th harmonics, respectively.

As the major sources of harmonics consist of the thyristor converters for the two DC arc furnaces, each working in 12-pulse connection, the Harmonic Filter tuned to the 11th harmonic constitutes the largest of the branches (80 Mvar). Its size and the fact that it is damped gives it a characteristic that will allow it also to filter out the 13th as well as higher harmonic components from the thyristor converters to a sufficient degree.

The control system of the SVC offers several operational modes, with a feed forward mode for fast reactive power compensation available, plus additionally three selectable closed loop modes for voltage control, reactive power control and power factor control. This gives flexibility and secures optimum performance of the SVC for all operational conditions.

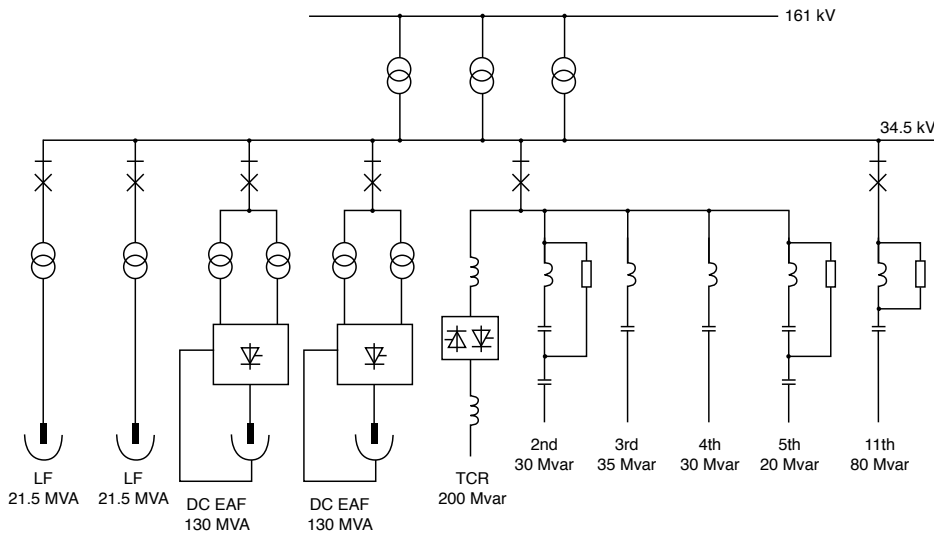
The overall power factor for the plant can be chosen between 0.95 and 1.0.

There is one more SVC at the NUCOR plant at Blytheville supplied by ABB, operating in a neighbouring rolling mill. This SVC is rated at 0-65 Mvar (capacitive) at 34.5 kV and has the purpose of providing dynamic stability of the voltage feeding the rolling mill during various operating conditions. It was commissioned in 1992.

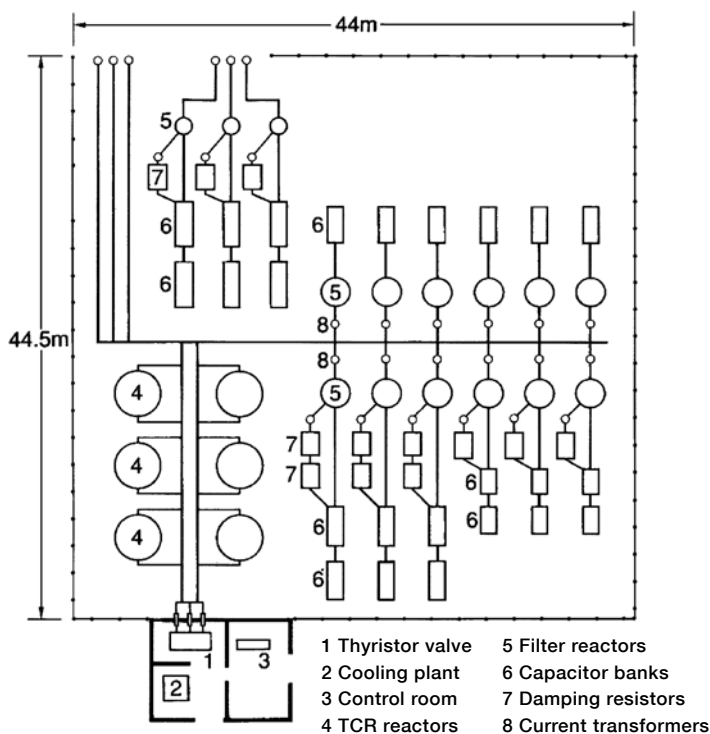
**Technical data** (Arc Furnace SVC)

Controlled voltage	34.5 kV
Dynamic range	5 Mvar inductive to 195 Mvar capacitive
Harmonic filtering	30 Mvar/2nd harmonic 35 Mvar/3rd harmonic 30 Mvar/4th harmonic 20 Mvar/5th harmonic 80 Mvar/11th harmonic
Control system	Feed forward reactive power control plus selectable closed loop modes for voltage control, reactive power control and power factor control
Thyristor valve	3-phase water-cooled valve with indirect light firing of thyristors

**Single-line diagram (Arc Furnace SVC)**



**Station layout**



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