

# High Power Rectifiers for DC Arc Furnaces

The smart solution for smooth and  
flexible production



## Increasing power quality for faster return on investment

The primary goal of any electric arc furnace operator is to minimize overall capital costs, optimize production line quality, maximize efficiency and revenue.

A further requirement is smooth and stable arc operation in order to boost production line quality and lower the impact on the power grid. When it comes to power quality, utilities are very demanding, especially in the case of weak grids in remote locations.

ABB offers an integrated system of DC power supplies for arc furnaces that provides an unrivalled low life cycle cost to give technical performance that boosts productivity and allows for a fast ROI (Return On Investment) on your plant.

### **DC arc furnace – the best solution for ferrous and non-ferrous metal production**

The use of electric arc furnaces for the production of ferrous metals has grown substantially in recent decades. The majority of steel producers charge scrap as the main raw material. Owing to the nature of arc furnaces and the inconsistent quality of scrap, arc furnaces represent a very complex load within a power system.

Nevertheless, a DC arc furnace equipped with controllable high power rectifier systems from ABB ensures a stable arc under all conditions, at the maximum possible power ratings.

In the non-ferrous metallurgical industry, DC arc furnaces come with further decisive process-related benefits, and they allow production lines to operate at maximum efficiency and sustainability. A controlled DC arc means a fast reaction to changing raw material parameters, plus high flexibility when selecting the raw material grade. As a result, the DC arc furnace has now also emerged as the most efficient technology for extracting ferrochrome, titanium oxide, cobalt, platinum and ferronickel, as well as for processing stainless steel dust.



# ABB – the No. 1 rectifier supplier for the DC arc furnace industry

With ABB high power rectifiers, you get total melt-shop integration of the furnace power system. ABB systems are based on wide-ranging experience with more than 70 arc furnace installations worldwide, and they ensure robust DC power supply for continuous availability.

## Reasons for choosing DC arc furnaces

- Low electrode consumption thanks to extensive work in optimizing system regulation
- Maximum arc stability
- Excellent power quality even under weak grid conditions
- Independent voltage and current control
- Maximum flexibility with respect to raw material types
- Robust and reliable design

## Reasons for choosing ABB

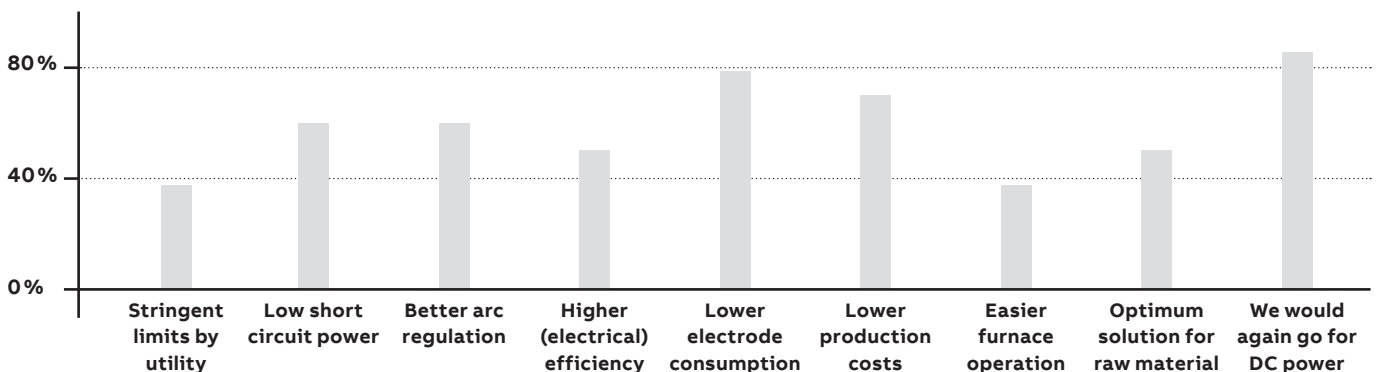
- Customized rectifier, transformer and DC reactor system
- Intelligent control add-on packages for even higher electrode regulation performance
- Support throughout the full life cycle and access to our worldwide 24x7 support line
- Vast experience in various DC arc furnace applications
- Total power system simulation capability
- Integration of rectifier and power quality control equipment (e.g. SVC) to enhance flicker performance

“The DC arc process allows the use of fine ores (< 6mm) without the need for expensive agglomeration techniques. Furthermore, non-coking coal can be used as a reduction agent. This furnace technology is therefore regarded as one of the low-cost options for the production of ferrochromium.”

Donald Grant, Engineering Manager, Samancor Chrome, Middelburg, South Africa



Customer's reasons for choosing a DC arc furnace



Source: survey of arc furnace users conducted for the AIST conference in 2007

# Smart DC power maximizes furnace throughput

To achieve maximum furnace throughput, furnace power control must be optimized to ensure maximum power input at all stages of the melting process and during variations in the charge material. At the same time, minimum network disturbance must always be guaranteed.

## Power quality – at ease with your utility

When talking to electrical power authorities about arc furnace plants, power quality is their main concern. ABB makes compliance with flicker, power factor and harmonic limits as part of its design commitment.

An effective electrode control algorithm, reduced transformer switching, correct sizing of the DC reactor and harmonic filters enable furnace plants to meet utility company requirements. In addition to that, optional active flicker reduction and continuous power factor correction through a Static Var Compensator (SVC) featuring ABB's ArcComp link guarantee compliance with the most stringent utility demands and/or permit operation in remote areas with weak grid conditions.

The above solution belongs to ABB's comprehensive Power Quality Solution portfolio for process industries.

Flicker is mainly caused by reactive power fluctuations. The ArcComp is a fast-forward link that sends information from the rectifier control to the SVC control, allowing the calculation of the actual reactive power consumption of the furnace. This information is used to improve the flicker mitigation performance. The result of using ABB's SVC system is:

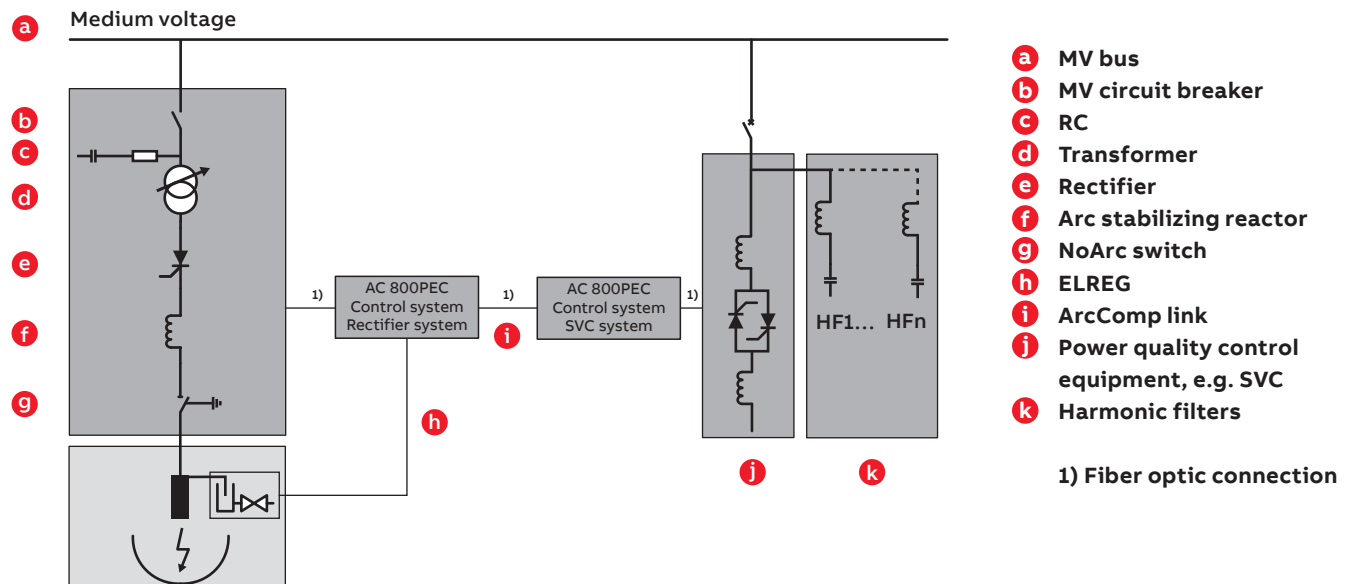
- Higher average power input compared to conventional VAr compensation
- Continuous power factor correction close to unity
- Control of furnace bus voltage
- No unbalanced load in the network
- Low flicker and harmonic levels even in weak grids

## Arc stabilizer for higher productivity

A stable process is essential for productive operation. ABB uses an optimized DC reactor design (low losses) to smoothen the electrode current. A stable arc is thus maintained at all times. The result is:

- Lower stress on the electrode hydraulic system
- Less vibration
- Lower electrode consumption
- Higher productivity
- Even greater flicker reduction
- Lower radiation losses

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Total meltshop integration: customized furnace power system



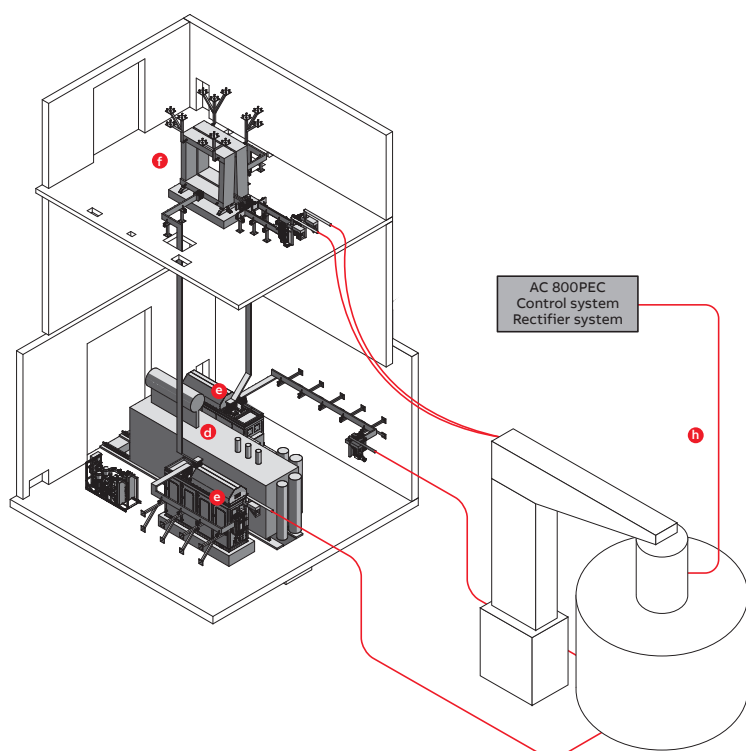


## Optimized process control for economical, utility-friendly operation

ABB's high-speed AC 800PEC controller provides high processing power with very short cycle times. The AC 800PEC has been specially designed for power electronic applications in harsh industrial environments such as arc furnace plants. System communication is via fiber optic links only and is therefore immune to electromagnetic interference even with high magnetic fields.



Typical layout of key components feeding the DC arc furnace plant



### Intelligent control add-ons for even better performance

#### ELREG for optimized electrode control

ABB's electrode control software controls and fine-tunes the position of the electrode. Adaptive arc control logic ensures the electrode and current controller operate at the best parameters for every melt stage – regardless of operator skill and raw material variations to minimize power on time.

### NoArc for a reduction in maintenance costs and furnace downtime

During charging, tapping and other furnace operations, the rectifier transformer remains energized while the furnace is disconnected and grounded. The thyristor rectifier ensures that the current can be brought down to zero smoothly. With NoArc, the furnace breaker becomes obsolete and transformer energizing can be reduced by up to 95 percent. System availability is increased, along with the service life of the transformer and switchgear. Flicker performance is improved thanks to a decrease in transformer switching.

### ArcComp link for increased flicker performance

The ABB high-speed AC 800PEC controllers used in the power quality control equipment and rectifier enable fast real-time communication between the two systems. The flicker mitigation algorithm thus works at maximum efficiency to guarantee the lowest possible flicker.



## ABB engineering – ensuring total electrical meltshop integration

ABB's extensive experience in the electrification of DC arc furnace plants is not limited to the rectifier system, but it extends to all the electrical equipment and engineering between the HV substation and the furnace. ABB's offering includes:

- Customized rectifier and transformer design
- DC reactor design
- System and components protection design
- Regulation of the furnace-electrode
- Power quality system for both the furnace as well as the rolling mills
- Integration of communication between rectifier and power quality systems
- Switchgear
- Bay and yard layouts
- Busbar engineering
- Magnetic field study
- System stability study
- Installation, supervision, and commissioning of equipment
- Service and maintenance during the system's lifetime

ABB saves you the stress of designing the power supply to achieve the required performance and take care of both power quality and furnace power performance.

SysCal, ABB's own software tool, has been specially developed for the design of DC power supplies. SysCal forms the basis for dimensioning the DC reactor and calculating the power factor, flicker and harmonic levels.

ABB understands the requirement of process industries. As the owner of the design, ABB also guarantees continuous technical development in parallel with metallurgic process innovations. Our regular participation in the relevant committees and technical forums ensures state-of-the-art concepts plus maximum flexibility in adapting to future technology and industry needs.

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“I wanted to pass a word of thanks to ABB's team of application field engineers both in Canada and Switzerland. Their thoroughness and attention to detail of the EAF Rectifier and SVC Systems coupled with on-time startup at our facility have gone above and beyond my expectations. Our electrical utility supplier has commented many times on the superiority of both flicker and power factor control from this facility. This of course has made my job much easier. As well, the EAF Rectifier has performed flawlessly on this world class furnace from day one. Great job by all.”

Barry Steele, Power Distribution Supervisor, SDI,  
North America

## Life cycle service – for customer satisfaction

A key objective is to maximize your process uptime by providing low-cost guarantees of an extended service life for all ABB products.

- Throughout the entire lifetime of a product, ABB will provide training and technical support and arrange service contracts – all backed by a world-class global sales and service network.
- ABB's preventive maintenance programs increase active life, minimize replacement costs and lower investment. At the same time, the right service plan will extend the service life of ABB equipment by several years.
- Thanks to a long life, low maintenance costs and very low spare parts consumption, ABB equipment will soon pay for itself. An extended service life is also achieved through control add-ons and power components that operate well below their design limits.

A properly maintained ABB rectifier system can last more than 25 years.

### A local presence – worldwide

With offices in around 100 countries, ABB is well placed to offer the best technical advice and local support around the clock.

ABB's global presence is built on strong local companies. We offer local sourcing while drawing on our worldwide experience. By combining the experience and know-how gained in both local and global markets, we ensure that our customers will get the most out of our product solutions.

- We guarantee fast and flexible support with our remote access platform via the 24/7 support line on a global level.
- We offer condition monitoring service across the whole system starting from HV switchgear downstream to the DC output or process.

For further details about all our services, please contact your nearest ABB office or visit us at [www.abb.com/rectifiers](http://www.abb.com/rectifiers).





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Picture courtesy of  
AM/NS India