Success in Electric Steelmaking
ARCCCESS® EAF TECHNOLOGY
You want to achieve even better results manufacturing flat and long products. We have been supplying solutions for electric steel production for more than 100 years.

Technologically advanced design and quality construction are standard for our plants. This is reflected in our impressive list of worldwide references that clearly prove the business success they ensure with stable, reliable operating routines.

We manufacture metallurgical plants and rolling mills at the highest level. First-class products, extensive services, and custom solutions cement our excellent reputation. Equally convincing are our solutions and systems because they unite cutting-edge technology and efficiency with quality and reliability.

A global leader in industrial plant construction, SMS Siemag supplies the full range of products for the steel, aluminum, copper, ferrous alloy and non-ferrous metal industry.

Here you can choose from a wide range of plants for hot metal including all areas of steel production, continuous casting, and rolling technology right up to finishing and tempering mills for hot and cold strip.

One focus of our Steelmaking Plants and Continuous Casting Technology Division is electric arc furnace technology. That is evident in the 1,400 plants we have supplied so far. Included here is the full range of products for electric arc furnaces, auxiliary equipment and gas cleaning plants.

Whatever your requirements, you have a wide choice of turnkey plants, from stand-alone furnaces to all-inclusive plants complete with control and optimization systems, as well as engineering and on-site support.
OUR PLEDGE TO YOU
Expect the best systems designed and manufactured to ensure rapid run-up and reliable, continuous operation.

You can also count on eco-friendly, resource-saving production. We team up with you to achieve your project goals. Plus, after your plants go on-stream, we stay in close contact to support you in the future.
ARCCCESS® EAF TECHNOLOGY boosts your business

ARCCCESS® Technology
ARCCCESS® stands for success with electric arc furnace technology from SMS Siemag. All ARCCCESS® components are dedicated to minimizing the cost of electric steel production. That’s how your investment pays off even faster.

To help you gain a great deal, we draw on decades of experience in electric arc furnace technology, metallurgy, and optimized processes, to offer you the most cost-effective solutions for your business.

ARCCCESS® – building your success
Here’s how you benefit from our experience:
- Lower production costs
- Higher productivity
- Better-quality steel grades
- Steeper run-up curves
- Longer running times with less maintenance

ARCCCESS® strategies
Teaming up with you, we draw up ARCCCESS® strategies geared for your production requirements.
- Reduced production costs from our burner and injection technology
- Increased productivity with short tap-to-tap times and ideal shell geometry
- Excellent energy result with FEOS, our innovative metallurgical Furnace Energy Optimization System for process control and optimization

Plant Technology
innovative, sound, sophisticated

Process know-how
long-term, established, reproducible

Reference plants
1,300 +, worldwide, wide-ranging

Research & Development
continuous, customer-oriented, successful
ARCCCESS®
Technological modules
In former times, electric arc furnaces for steelmaking used scrap as the main charge material. Meanwhile, to allow for equalizing price fluctuations on the raw materials markets, modern electric arc furnaces are designed to efficiently process a variable mix of scrap, direct-reduced iron and liquid pig iron. Our EAFs come with large shells and extra plant technology to give you maximum versatility.

**Cold DRI**
Direct reduced iron, or DRI, is the preferred choice for high-quality steel grades. It produces steel with low sulfur and phosphor contents, combined with reduced nitrogen. This level of purity is necessary for most flat steel products as well as special grades for long products.

**Hot DRI**
The production process for direct reduced iron allows drawing the material from the shaft furnace at high temperature, then feeding it continuously into electric arc smelting at around 600°C.

The hot direct reduced iron, or HDRI, utilizes the thermal energy from DRI production and is fed directly into the EAF via a special conveyor system.

That offers you two advantages:
- Lower energy consumption compared to cold DRI
- Higher productivity

A cooperation agreement between SMS Siemag and Midrex awards the two companies exclusive rights to market steelworks equipped with CSP® plants and upstream MIDREX® Direct reduction plants. It’s a perfect combination. Why? Because MIDREX® Direct reduction and steelworks technology from SMS Siemag with downstream CSP® give you an ideally coordinated minimill solution for energy-efficient, cost-effective production of high-grade hot strip.
**Hot metal**

Using hot metal as the charge material in your electric arc furnace, you can achieve lower charge costs and high degrees of purity. So here is an attractive alternative to conventional methods. Our plants use up to 80 percent hot metal. That gives you high-quality steel grades at low charge costs.

The charging process developed by SMS Siemag features a specially designed launder. First, a charging crane or transport car with lifting function transfers the liquid pig iron from a ladle into the launder. Then the launder charges the liquid pig iron through the slag door into the electric arc furnace.

A glance at the operating results clearly shows you the benefits of using liquid pig iron as a charge material.

- Extremely low electricity consumption
- High liquid steel purity
- High productivity
Single-bucket charging
Our preferred solution for electric arc furnaces is single-bucket charging. It comes with key advantages:

- 30% higher productivity than standard furnaces
- High yield efficiency with long electric arcs
- Reduced specific losses using furnace heat to heat the scrap
- Efficient use of burner systems to support the smelting process using a higher scrap pillar
- High productivity at low energy costs

Split bottom shell
Also available in our supply scope is a two-part bottom shell. That makes it easier to replace the wear zone of the bottom shell.

Furthermore, it gives you the option to increase the life-time of the refractory wearing zone by the integration of cooling systems.

Exchange shell technology
Developed by SMS Siemag, this technology ensures much shorter downtimes and high plant effectiveness.

You can replace top and bottom shells either separately or together. As a result, regular maintenance is possible outside the production line.
Coal injection system
Injecting carbon material into the liquid bath is necessary to produce an effective foaming slag. Only then you can operate with long electric arcs through the foaming slag to achieve a high yield. In addition, the long electric arcs reduce specific electrode consumption. That’s because they require a smaller electric power to produce the same yield.

The coal injection lances are integrated in the copper blocks near the slag zone.

You benefit from:
- Easy installation and exchange
- Injection close to the bath surface

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Oxygen Injection System [SIS]
Today, oxygen in electric arc furnaces is the key to cost-effective production. That’s why we developed our Oxygen Injection System (SIS). Here is what it means for you:

- Effective, long oxygen jet from optimized Laval injector nozzles
- Low operating costs using hot gas burners
- Small oxygen apertures to prevent injector slagging
- Optional oxygen injection without burner function

SIS burner function
Also available is an SIS module with burner function. It is controlled in such way that the scrap is molten down homogeneously.
ELECTRICS

High-performance transformers
SMS Siemag ARCESS® electric arc furnaces are high-performance systems equipped with a transformer rating of up to 250 MVA. That is equivalent to a specific rating of more than 1.5 MVA per t of tap weight.

As a result, ARCESS® electric arc furnaces are the world’s most powerful melting systems.

Electrode control and foaming slag control
Modern, high-performance electric arc furnaces demand special dynamics for electrode control. That’s why we supply fully digital electrode control solutions. Now, within a few milliseconds, these systems correct voltage fluctuations, to allow a stable electric arc operation.

SMS Siemag electrode control measures up with:
- Digital electrode control with a processor dedicated to the control loop
- Parameters controlled on-screen
- User-friendly screen masks and real-time display of process signals and trends
- Optional impedance / reactance control

- Dynamic voltage control adjustment
- Sequence-switch control of the transformer
- Sequence-switch control of the reactor (optional)
- Foaming slag control by evaluation of the harmonic current fluctuation
FEOS FURNACE ENERGY OPTIMIZATION SYSTEM

FEOS – Energy optimization system for electric arc furnaces
It used to be down to experienced process engineers to draw up melting strategies and specify process parameters for different charge materials and consistencies.

SMS Siemag has developed a system that determines all the key processes in your electric arc furnace, then controls them to optimize energy utilization. This is our Furnace Energy Optimization System, or FEOS.

FEOS is designed to enable your engineers to adjust all parameters quickly and flexibly so they can adapt the melting strategy in line with their experience to optimize the process in the electric arc furnace.

Characteristics of FEOS
It is simple and user-friendly. You benefit from these key communication features:
- Design of the specific electric arc furnace and structured input of control parameters and limit values
- Documentation and visualization of all material and energy flows
- Combination of control diagrams (Level 1 controls) and conventional control strategies
- Offline test of algorithms and parameters with replay mode in a simulation environment

FEOS control basis
The special advantage of FEOS is it controls the regulation signals of the output variables that determine the process. How? By measuring, in real time, the process input variables and the pre-set functions of power control, reactor control, burner control and foaming slag control.
The results
FEOS has proven its worth in practical operation. The results show that an electric arc furnace running with FEOS gives you a whole range of benefits:

Performance control
- High melting yields
- No interruptions through switch-offs in borderline temperature area
- Rapid reaction with simultaneous reduction of switching frequency
- Reproducible and efficient electrical energy input
- Short tap-to-tap times

Injector control
- Process-dependent use of materials, independently of time
- Minimized, effective usage

FEOS – foaming slag control
FEOS foaming slag control is one of the most important modules for maximizing the energy efficiency of your electric arc furnace. It’s a method we developed to control the foaming slag level according to the furnace noise level.

FEOS – continuous off-gas monitoring
In the future, FEOS will be extended by the continuous off-gas monitoring module to detect and evaluate further metallurgical process parameters.
Deservedly, with almost 1,400 electric arc furnaces in both new construction as well as revamp projects, SMS Siemag ranks among the world’s leading suppliers of electric arc furnace technology.

Here is what makes our electric arc furnace design stand out:
- Modular design
- Standardized component groups
- Low maintenance

SUCCESS BASED ON EXPERIENCE
More than 100 years of development, construction and commissioning of electric arc furnaces give us a valuable store of experience. It’s an expertise strengthened by know-how from former companies Krupp Industrietechnik, Mannesmann Demag and GHH. That translates into a capacity to apply the very best methods and designs to our electric arc furnaces.
Today, our X-Melt® electric arc furnaces come with a whole range of innovative design features:

- Modular design
- Standardized component groups
- Low maintenance

### Furnace roof with off-gas elbow
- Self-supporting stand for the furnace roof
- Roof elements with tube-gap-tube design and extra slag holders for optimal slag build-up
- Off-gas elbow as a gas-tight welded tube-to-tube construction
- High angle of incline of the off-gas elbow reduces slag caking on the lid

### Furnace gantry system
- Bearing system with wide slewing angle for shell change
- Roof lifting system mounted at three points for balanced lifting
- Couplings with lifting hooks for free access to the furnace roof for maintenance and repairs
- Fast and easy changing of the central refractory hearth

### Electrode mast guiding system
- Rectangular shape of the electrode mast for optimal guidance with four guide rolls
- Good accessibility and exact adjustability for reduced maintenance and repair costs

### EBT – Eccentric Bottom Tapping
- Eccentric bottom tapping was developed and patented by SMS Siemag. Today it is standard for electric arc furnaces worldwide.
- Automatic cleaning of the bottom edge of the EBT channel

- High safety with pneumatically air-cooled cylinder
- Additional accumulator for increased availability of the tapping system

### Upper furnace shell
- Tube-gap-tube design for optimal slag adherence with corresponding thermal insulation
- Each panel is separated into two circuits for optimized cooling
- The slag door drive is mounted for protection against slag splashing

### Lower furnace shell
- Eight resting points for the furnace shell and the eccentric bottom area for evenly balanced support
- Modular, optional installation of copper cooling blocks
- Minimization of energy losses by selecting the shortest distance between the eccentric bottom tapping and the shell center
- Cooling vents for thermal circulation of surrounding air to prevent local overheating

### Tilting platform with rockers
- Torsion-stiff performance with Finite Element Model (FEM)
- Only one tilting cylinder required
- Self-righting to 0 position
- Exact guiding by geared guides for exact tilting operation
- Integration of additional, water-cooled heat shields on areas under thermal strain
1. Furnace roof with off-gas elbow
2. Furnace gantry system
3. Electrode mast guiding system
4. Upper furnace shell
5. Lower furnace shell
6. Tilting platform with rockers
FROM PIONEER PERFORMANCE TO PEAK PERFORMANCE
AC EAF – SUPERIOR EXPERIENCE

Right from the start of electric steel production, our alternating current electric arc furnaces have demonstrated their capability again and again. Over the years, we have steadily improved our designs.

These state-of-the-art alternating current electric arc furnaces offer you an extremely high production capacity and a transformer rating of more than 1.5 MVA/t.

Superior performance

Today, our alternating current high-impedance furnaces are state of the art. They feature low reactance on the secondary side as well as an impedance coil on the primary side of the furnace transformer.

Your advantages:
- Stable electric arc operation
- Low energy consumption
- Low electrode consumption
- Fewer electrode breakages
- Low force applied to the electrodes and electrode bearing arms
- Less network interference

High performance

Connecting transformers with a rating of up to 250 MVA makes high demands on the design of the mechanical equipment. Just as challenging, the water-cooled panels of the wall and roof elements have to withstand extremely high thermal strains.

That’s why the electrical high-current section from the transformer to the electrodes is specially designed to cope with extremely high currents and voltages. Our specialists know all there is to know about building symmetrical high-current systems. This ensures even power input into the electric arc furnace and prevents local overheating.
High current/voltage
Power Conducting Arms (PCA) developed by SMS Siemag perform efficient and reliable transfer of electrical power to the graphite electrodes. That requires control of ultra-high power up to 100 kA, plus insulation from the conducting components.

These are the special design features of our PCAs:
- Copper-plated arms with excellent power conducting properties
- The option of a small partial circuit which reduces the thermal strain on the water-cooled wall elements
- Electrode breakage monitoring system, a safety system patented by SMS Siemag
DIRECT-CURRENT electric arc furnaces

ALL ADVANTAGES IN ALL NETWORKS
The technology
What sets our direct-current furnaces apart is their low energy and electrode consumption. They also ensure excellent thermal and metallurgical homogenization of the liquid steel. Plus, there is the increased stirring effect of the direct-current arc that supports this process.

Compared to alternating-current electric arc furnaces, direct-current furnaces cause fewer network disturbances, so you can connect them even to weak electric grids.

Key to the efficiency of a direct-current electric arc furnace is optimal central arc positioning. Our computer simulation system for avoiding electric arc deflection offers you perfect high-current bus bar system arrangement.

The bottom electrode
Another element in the success of our direct-current electric arc furnaces is our patented and continually improved pin-type bottom electrode.

Depending on the current density required, the current is distributed over more than 300 individual steel pins. That ensures a symmetrical load on the bottom electrode, which can also be thermally monitored at fixed points. Safety is a top priority in our plants, so the bottom electrode is air-cooled.

The advantages of pin-type bottom electrodes:
- Extremely low operating costs
- Air-cooled bottom electrode
- Long service life, so maintenance work can be carried out together with maintenance of the bottom shell brick lining
- No interim repairs necessary

Revamps
It is always worth examining whether your existing bottom electrode system should be replaced by SMS Siemag pin-type bottom electrodes.

Our pin-type bottom electrodes offer you:
- Long service life of more than 2,000 heats
- Safe operation with possible bottom electrode wear monitoring
- Rapid change-over times using tried-and-tested methods and tools
- High safety provided by air cooling
- Top plant effectiveness and productivity
DOUBLE VERSATILITY

Our CONARC® furnaces combine the technological advantages of electric arc furnaces with those of the conventional converter blowing process. They consist of a single production unit with two identical shells.

We chose the name CONARC® to reflect this combination (CONverter ARCing). It gives you the advantages of free choice of charge materials and a wide range of steel grades. Depending on the steel grade as well as the availability and price of charge materials, you can vary the percentages of scrap, hot metal and sponge iron.

Equally flexible is your choice of energy sources with the CONARC® method. You can achieve a converter and arcing phase balance using a suitable mix of electrical and chemical energy. That ensures perfect symmetry between the delayed-action tapping sequence times of the two shells.

Two process steps

CONARC® is optionally equipped with one swiveling or two stationary top lances for oxygen blowing. Plus, there are devices for bottom stirring that can be integrated in the shell floor.

The process is divided into two stages:

- The converter phase, which involves blowing oxygen onto the melt through the top lance to decarburize it.
- The electric arc furnace phase, during which electric power is applied to melt the solid material and overheat the bath to tapping temperature.

The world is changing dynamically: you respond with flexibility.
CONARC® – METALLURGY WITH FUTURE-ORIENTED FLEXIBILITY

Electric arc furnace – Standard operating range

BOF converter – Standard operating range

CONARC® route – Flexible charge mix

Scrap  HBI/DRI  Hot metal

HBI/DRI  Hot metal

Scrap

Scrap  HBI/DRI  Hot metal
RESPONSIBILITY
The moment we start to plan your steelmaking plant, we work with you to promote safety and protection of the environment. To support you in this respect, we supply tailor-made plant solutions for steelworks dedusting, as well as cleaning of primary and secondary gases.

Stages of gas cleaning
Our X-Melt® gas cleaning plants are carefully coordinated:
- Primary gas extraction from the water-cooled off-gas elbow and channeling into the post-combustion chamber
- Primary gas cooling with quenching systems or gas coolers
- Secondary gas extraction using gas collecting hoods
- Secondary gas cooling and spark separation in horizontal or vertical gas mixers
- Dust extraction using bag filters
- Gas emission through the stack as cleaned process gas, clean and environmentally harmless

Improving the future
Here at SMS Siemag, we are continually developing and expanding the environment-friendliness of the steelmaking process as well as the treatment of by-products. Our focus is on improving the energy impact and eco-friendly processing of filter dusts.

Steam generation
Steam generation is an efficient way to recover a part of the excess thermal energy from your electric arc furnace. It utilizes the extremely high temperature in the primary off-gas cooling system. This method considerably improves the energy efficiency of an electric arc furnace. It makes the recovered energy available for other production units.
Filter dust injection
Filter dust injection also improves the ecological impact of electric arc furnaces. This involves repeatedly channeling the filter dust back into the electric arc furnace so that the zinc content in the dust builds up steadily.

Finally, the enriched filter dust turns from a by-product into a commercial product that can be recycled.

Filter dust processing
SMS Siemag has developed a special process for submerged-arc furnaces that recycles metallurgical by-products, including filter dusts.

This technology gives you the opportunity to effectively extract the metal content, so you gain valuable raw materials from your waste.
EVERYTHING UNDER CONTROL

X-Pact® enjoys a great worldwide reputation in the steelmaking and secondary metallurgy industry. You only have to look at the large number of plants in all kinds of steelworks we have automated using X-Pact®. Whether BOF, EAF or CONARC® melting processes, whether secondary metallurgy or stainless steel production – X-Pact® automation gives you perfect control of everything from turnkey plants to stand-alone or part plants.

All-inclusive packages from SMS Siemag

Here you benefit from our experience in system integration of the entire spectrum of drive technology – from energy supply to instruments, basic automation, and process optimization. Included are all the services you require for new plants as well as revamps.

Process models for calculating energy, charge materials and alloys

Energy and material management geared precisely to melting behavior is the basis for automating your steelworks with X-Pact®. It covers all units including measuring, control, and adjustment to ensure you apply your process models effectively. Complex calculations work out the ideal energy input, charge materials and amount of ferrous alloys.

You increase your productivity by keeping to close tolerances. This results from careful X-Pact® analysis that enables you to achieve exact final temperature, final steel weight and treatment time.

Increased productivity

X-Pact® minimizes treatment repetition, reduces ladle cycle times and increases the service life of refractory linings. That cuts costs and repair workload. There is even more you can expect from X-Pact® metallurgical process models: permanently lower production costs, higher productivity and consistent final product quality.
Conventional and integrated systems
You can choose from conventional or integrated automation systems from SMS Siemag. That means complete with separate or joint HMI for Level 1 and Level 2. Typical for X-Pact® are features such as process and technical data links from steelmaking to continuous casting and other metallurgical plants.

Metallurgical process models for the entire steel production process are integral parts of X-Pact® Electrics and Automation.

- EAF process
- CONARC® process

**ELECTRICS AND AUTOMATION WITH X-PACT®**

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More than 100 years of development, construction and commissioning of machines and plant for the global steel and nonferrous metal industry – it all adds up to a valuable store of experience. And that benefits you directly when you use our Technical Service.

Wherever you are in the world, X-Cellize® offers you support for your mechanical equipment, automation, maintenance and process technology.

That means our services give you the backup you expect from a global player in metallurgical plants and rolling mill technology.

X-Cellize® covers these services:
- Outsourcing your maintenance and repair work
- Integrated Maintenance Management System (IMMS®)
- Technical assistance
- Spare part management, inspection and repair service
- Teleservice / Hotline
- Training

How you benefit
Maximum plant effectiveness ensures you gain that extra competitive edge. Find out for yourself what concrete benefits our service experts can offer you. We will share all our know-how with you so that you achieve your production goals.

X-Cellize® – Technical service is in our genes.
TOP PLANT EFFECTIVENESS: HIGHER PRODUCTION YIELD – MINIMIZED COSTS

It’s a fact often overlooked. Yet plant effectiveness and reliability have a huge impact on quality and volume of production. Neglecting these aspects leads to production losses, higher production planning and maintenance costs as well as quality problems.

To tackle this issue effectively, SMS Siemag developed its Integrated Maintenance Management System (IMMS®) that maximizes Overall Equipment Effectiveness (OEE).

Specialists from our Technical Service (X-Cellize®) analyze and document your scope for applying Continuous Process Optimization.

We advise you on how to achieve higher plant reliability.

We carry out audits designed to improve your plant effectiveness and cut maintenance costs.

Choosing IMMS® means we design for you a preventive and therefore planned repair strategy comprising four main packages:

I. Technical assistance
II. Spare part management, inspection and repair service
III. Teleservice / Hotline
IV. Training
The information provided in this brochure contains a general description of the performance characteristics of the products concerned. The actual products may not always have these characteristics as described and, in particular, these may change as a result of further developments of the products. The provision of this information is not intended to have and will not have legal effect. An obligation to deliver products having particular characteristics shall only exist if expressly agreed in the terms of the contract.