

SMS insights

Stories of transformation

2023—2

150 years of shaping the future

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SMS  group

Integrated Lifecycle Partnership



To be the leading partner for our customers in this transformation, SMS group bundles all competencies from electrics/automation, digitalization, and technical service. Our goal is to maintain and expand the performance of our customers' plants throughout their entire lifecycle. Together with our customers, we develop integrated solutions specifically geared to the customer's use case. In doing so, we focus on crucial KPIs such as plant availability, product quality, productivity, or delivery reliability but also on increasingly relevant topics such as sustainability and safety.





Dear reader,

This year, as SMS group proudly celebrates a 150-year legacy of partnership with the metals industry, I am honored to step into the role of CEO for the company that I have called home since 2008. I am thrilled to now take on the challenges that lie ahead – guided by the legacy of those who came before me and inspired by the potential of our industry and our company.

If you're curious about our vision for the coming years, I invite you to read the in-depth interview starting on page 6. As Executive Vice President of Global Service, I have always focused on optimizing our customers' performance. I firmly believe that further evolving strategic operations like Integrated Services and Lifecycle Partnerships, as well as continuing our commitment to the sustainability transformation of our industry, will strengthen our position in the market and create value where our clients need it most.

Adding to my excitement this year is another, quite literal move we're about to make when we relocate our corporate headquarters to our SMS Campus in Mönchengladbach – a modern working environment that symbolizes a new and exciting chapter for SMS. I cordially invite you to visit us in our new home soon!

This summer, many of our partners and customers had a chance to get an in-depth view of some of our most current projects, new initiatives, and future plans at Metec 2023, the world's leading trade fair for the metallurgical industry. If you missed us in Düsseldorf, you can now learn more about what we presented there in several featured articles. I wish you an enjoyable read!

A stylized, handwritten signature in blue ink, consisting of several loops and a long horizontal stroke.

Jochen Burg
CEO and Chairman of the Managing Board
SMS group

FOCUS

150 years of shaping the future

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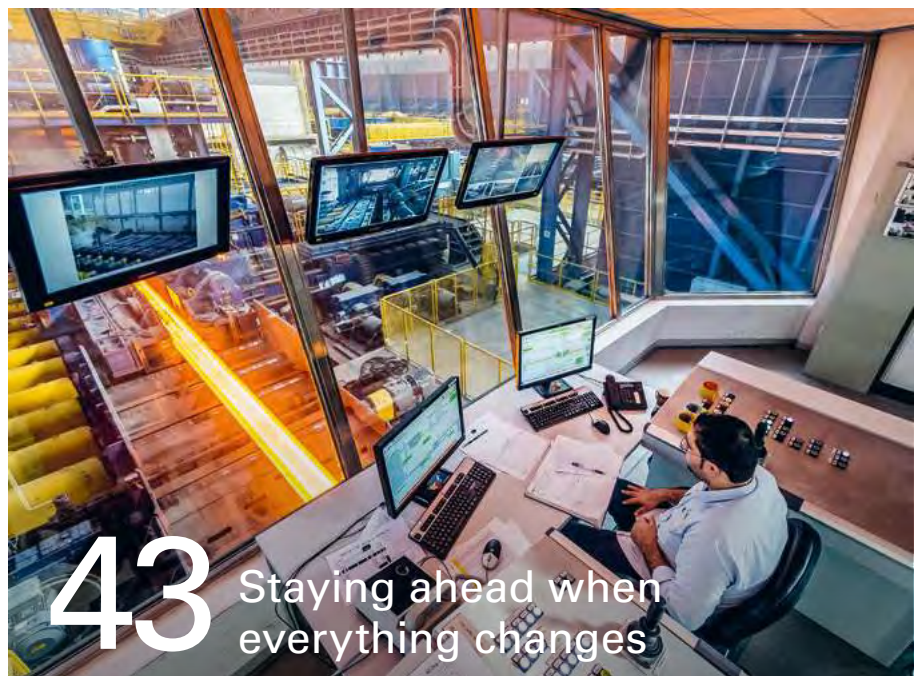
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“We want to become our customers' performance partner”

Interview with Jochen Burg,
CEO of SMS group

Change on the board of SMS group:
On October 1, Jochen Burg took over as CEO, replacing Burkhard Dahmen, who has been the head of SMS since 2012. We talk with Mr. Burg about values, goals, and his first few weeks in the role.



Mr. Burg, our customers want to get to know not only Jochen Burg the CEO but also you as a person. Can you tell us a little about yourself?

Jochen Burg—I started my career at SMS back in 2008 and have since worked with several of our locations and business units. In particular, my last position as Head of the Global Service Business was formative for me, because for our customers the biggest challenges are not in the construction of plants, but rather in their operation. We intend to sharpen our focus on this going forward.

As regards my personal life, I live with my wife and two children near Mönchengladbach. One of my interests is to participate in triathlons. What I particularly like about this is the challenges of training and that I am completely accountable for my own performance. Although it is an individual sport, there is also a great sense of community with your teammates and other participants. We triathletes are a big family. We suffer and we win together.

What is your internal mission as new CEO of SMS?

The past few years have been challenging for us with the pandemic and the international upheavals and disruptions in the supply chain. We have given everything

for our customers, but our own profitability has suffered. Together with my management colleagues, we will make SMS even more competitive and keep an eye on the quality of our results.

Your appointment coincides with the 150th anniversary of SMS. What does this mean for you and the company?

The anniversary has made us all aware of what a strong company SMS is and that qualities such as innovative strength, courage, creativity, teamwork, and customer orientation have made us great.

The staff celebrations at all of our locations worldwide have also shown that we share a common culture within the SMS family. We have identified Act, Share, Care, Innovate, and Succeed as our corporate values, which have always been an integral part of the success and growth of our family business. They represent a promise to our customers and to our employees, and they are what make us stand out as a company.

We apply these values not only in our daily work at SMS, but also externally in our dealings with our customers and partners. From an internal perspective, the value of “Succeed” is the result of delivering successful technologies and services, sharing knowledge and perspectives, taking care of customers and colleagues, and working on innovations. From the customer’s point of view, “Succeed” is, above all, the promise

that the focus for us is on the joint success of a project.

What are your goals behind your new responsibilities as CEO?

The management team led by Burkhard Dahmen has set the course for a successful future and, in recent years, strengthened our customer orientation by implementing a regional structure. Our core business and strength as a leading plant builder for the metals industry will not change.

At the same time, we want to become our customers’ performance partner – not just in terms of the plant performance, but also in terms of a sustainable overall performance. We strive to increase our customers’ profitability and thus grow as a company. In order to be a strong partner for our customers, we also have to focus on our own profitability, which allows us to invest in new technologies and services. The business model we follow enables us to share in the profits of successful projects with our customers. At the same time, we share the risks. It is like being part of a triathlon team: we suffer and we win together.

Why should our customers enter into such a performance partnership with us?

Our customers are facing an increasingly complex environment arising from global overcapacities, increased →

“Those who apply new technologies like AI have a considerable advantage.”

— Jochen Burg

demands on quality and lead times, rising energy prices, changes in the world of work, and the all-encompassing topic of decarbonization. At the same time, technologies are developing at a rapid pace: only a few years ago at Big River Steel, we set the benchmark for digitalization in the metals industry. Today, we are talking about the widespread use of artificial intelligence. Those who apply these new technologies have a considerable competitive advantage.

We can help our customers to overcome these challenges, minimize their risks, and take advantage of opportunities. Based on our intelligent, integrated services, we offer performance partnerships that help them focus on their core business. What this actually entails is for the customers to define, and for SMS to subsequently support.

Why is SMS particularly suited for this?

We are full liners, in a multiple sense. As a plant supplier, we cover the entire process chain from the raw material to the finished product. That means we understand both the plant and equipment and the metallurgical processes. This horizontal integration enables us to exploit hidden potential, which often lies in the transition between different process steps.

At the same time, we are also experts in automation, digitalization, and services. The challenge lies not in developing a particularly smart individual solution, but in mastering the interfaces between machines, software, processes, and, most importantly, people. Our ambition is to provide holistic solutions. Thanks to our expertise, we take responsibility and minimize the risks for our customers by providing performance-based services. Consequently, our success goes hand in hand with our customers' success. Of course, the focus on services is a way to push our own performance and drive our growth.

One proof of concept here is Big River Steel. We supplied them with the plant technology, complete with digital solutions, and we are assuming responsibility for a wide range of services too. Big River Steel has defined metallurgical

"The new SMS Campus will boost our creativity."

—Jochen Burg

process expertise as its core business, and outsourced remaining elements to partners like us. This approach has made them one of the most profitable steel producers in the world.

You mentioned the subject of decarbonization. What role do green metals play for SMS?

The fight against climate change is a global task for all humankind and therefore already a central topic for SMS and our customers. We are the pioneers here with our two major reference projects at H2 Green Steel and thyssenkrupp Steel in Europe. Not only that, we are also currently pursuing green metals projects in India as well as in North and South America.

We have made #turningmetalsgreen our vision and, as a technology company, are taking on a pivotal role in enabling this. Metals are, in two respects, central to the transformation of the economy on the path towards sustainability. On the one hand, because of the large carbon footprint of these industries, we need to decarbonize the production chains quickly and efficiently. To this end, we are continuously developing the necessary technologies and enabling the appropriate solutions. On the other hand, steel, aluminum, and copper play a central role, for example in sustainable energy production or electromobility. Looking ahead, it will also be a matter of

bringing these metals back into the loop at the end of the product lifecycle with the highest degree of purity. That is why the circular economy is the second pillar of our green metals strategy.

SMS currently has a high order backlog, partly due to the projects for H2 Green Steel and thyssenkrupp Steel. How do we ensure that we handle all orders on time? Does SMS still have the capacity for further major projects?

Here, too, we have done our homework by strengthening the "Implementation" business unit and reorganizing the way we handle projects worldwide. So far, we have already made considerable progress in the engineering of both projects, and we plan to utilize this experience in our future projects. Thanks to these two large-scale projects, we have a competitive edge in terms of both time and know-how. All of our customers benefit from this.

You mentioned earlier that innovation has made SMS great. How do you intend to strengthen our ability to innovate?

Innovation is one of the fundamental cornerstones of SMS, and we will continue to foster our innovation culture and take it to the next level. Our innovation strategy is based on several pillars: on the one hand, we are driving our own developments in

order to revolutionize the metallurgical industry again with new products and solutions, with a strong focus on promoting our growth plan for services and green metals. On the other hand, we have to be open to developments from the outside. Technical progress is so rapid that you cannot develop everything yourself. Here, it is often a matter of speed: recognizing industry innovations, then evaluating and integrating them.

We know that diverse teams are exceptionally strong at producing and recognizing innovations. That is why we will continue to build inclusive leadership and workforce teams, who prioritize collaboration between contributors representing different cultures, genders, and educational backgrounds.

Mr. Burg, as we wrap up, talk us through your first steps as CEO. What is on your agenda in concrete terms?

For me, one of the important tasks of a CEO is to ask the right questions. It is an advantage that I am already familiar with all of our locations and structures. Nevertheless, I will be constantly taking a critical look at my own performance and the overall performance of SMS. I plan to travel a lot to introduce myself to customers, listen to them, and exchange ideas with them. Burkhard Dahmen will accompany me in the first few months in order to ensure a seamless transition in our ongoing projects.

In the next weeks, we will open the SMS Campus in Mönchengladbach. The Campus will make it easier to collaborate on projects, breaking down barriers between areas and boosting our creativity. That will be good for us and, I am sure, will benefit our customers too. ●

Fabíola Fernandez

The Managing Board will be welcoming a new member: On January 1, 2024, Fabíola Fernandez will take over the CFO role from Torsten Heising.

Fabíola Fernandez was born in São Paulo, Brazil. She studied law at the Pontifical Catholic University of São Paulo and later gained her master's degree in European and German law at Berlin's Humboldt-Universität. Before joining SMS group, Fabíola Fernandez worked as CFO and co-CEO of Gegenbauer Holding SE & Co. KG, one of Germany's leading facility management companies, with around 18,000 employees in Germany, Poland, and Luxembourg. Before joining Gegenbauer, she held various senior management positions at the German mining group K+S AG (a DAX/MDAX company), where she worked internationally in Germany, Canada, USA, Chile, Brazil, and Peru. She has served as Director of International Taxation, Managing Director of K+S Finance Belgium, CFO Latin America, and VP Controlling & Finance Potash Business. Fabíola Fernandez has five children and lives with her family in Mönchengladbach.



FOCUS 150 years of shaping the future



The steel industry in 2050

The challenge is clear: To combat climate change, steel must become “green”. As a technology supplier, we have turned this challenge into our mission. However, the pathway towards green steel depends on many variables from steel demand to energy supply and raw material availability. We take a look into the future and different scenarios.

The world will need more steel and different steel grades

Let’s start with the most important question: How much steel will the world need in 2050? Today, 8 billion people on Earth “consume” around 1.8 billion tons of steel annually. This translates into roughly 222 kg of steel per person each year. However, there are huge differences. The apparent steel use per capita ranges from 310 kg in Europe to around 30 kg in Africa.

The United Nations forecasts a global population of almost 10 billion in 2050. At today’s apparent steel use per capita, that will require an annual steel production of around 2.2 billion tons. However, many forecasts also anticipate a surge in steel demand per capita in populous regions such as India or Africa. This could drive steel production up to around 2.75 billion tons per year.

At the same time, the transformation of the energy grids to renewable energies will change the demand for steel. Presently, a mere 1% to 3% of steel is used for energy infrastructure. However, this figure is expected to rise significantly, exceeding 10%, especially for the construction of

wind turbines or photovoltaic systems. The burgeoning electrification trend will also increase the demand for silicon steels.

So, how can we produce more steel and yet reduce CO₂ emissions? One part of the equation is the existing plant infrastructure. Given their long investment cycles, plants and equipment will only be renewed step by step.

In 2022, 71% (1,347 million tons) of steel was produced using the traditional blast furnace and BOF (Basic Oxygen Furnace) route. This method produces an average of 1.9 tons direct CO₂ emissions per ton of steel. Another 23% (or 412 million tons) of the total volume was produced via the scrap route with electric arc furnaces (and a CO₂ intensity of 140 kg per ton of steel on average). The share of steel production via the direct reduced iron route was around 6% and emitted around 650 kg CO₂ per ton of steel.

Scrap-based steelmaking: poised for significant growth

The electric steel route is the fastest way to produce near-zero emissions →

AVERAGE GREENHOUSE GAS EMISSIONS PER TON OF STEEL (SCOPE 1 + 2)

1,900

BF-BOF ROUTE

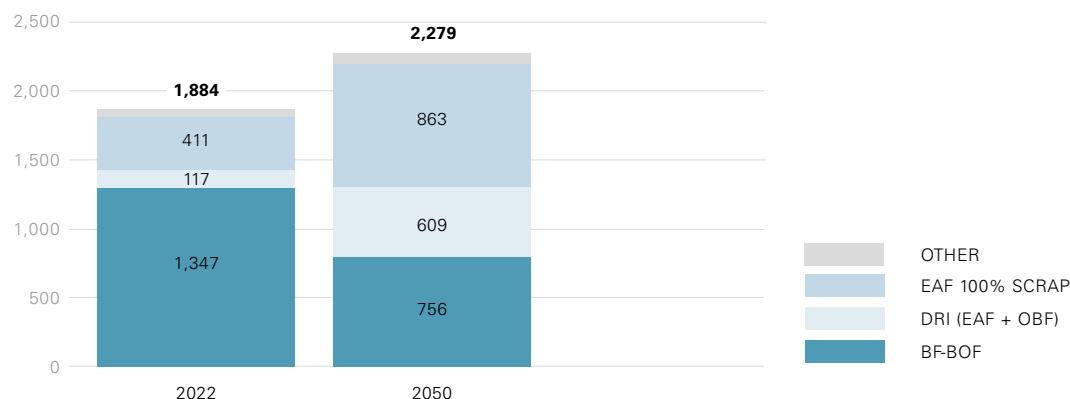
650

DRI ROUTE

140

EHF

OUTLOOK: STEEL PRODUCTION IN 2050 (IN MILLION T/YEAR AT CONSTANT STEEL CONSUMPTION PER CAPITA)



steel, as long as green electricity is used. But how much scrap will be available in the future? The World Steel Association expects end-of-life scrap to more than double from today's 445 to around 900 million tons in 2050. Adding scrap from steel processing (prompt scrap) and internal scrap from steelmaking (home scrap), we can expect a total of up to 1.4 billion tons of scrap to be available each year.

However, not all of this will be available for the electric steel route. Much like today, a good third of this scrap will be used in primary steelmaking, i.e., the DRI-EAF route, and as cooling scrap in remaining BOF converters. Taking into account the typical yield losses of the EAF, we can project steel production quantities of between 850 and 900 million tons via direct scrap recycling. That would represent an increase from today's 23% to more than 35% of total steel production. However, scrap availability on local markets will be impacted by trade restrictions. The rising concentration of tramp elements like copper, lead, and tin necessitates scrap processing of further dilution.

The availability of high-quality iron ore will be a limiting factor

While the EAF route may account for a third of the steel output by 2050, the remaining two-thirds will be based on virgin material. Even if scrap was abundantly available, for certain high-quality grades, there is no alternative to virgin

material. That's because the accumulation of tramp elements in scrap makes it impossible to produce all grades on the secondary route.

Most green steel projects today rely on direct reduction plants. H2 Green Steel is a pioneering example for many greenfield projects, relying entirely on green hydrogen and green electricity generated from hydropower and other renewable energies.

In a two-step process, direct reduction can also replace the traditional blast furnace in existing steelworks, as our flagship project at thyssenkrupp Steel Europe shows. Here, natural gas will be gradually replaced by hydrogen for reduction. The electric smelter (OBF, Open Bath Furnace) developed by us enables the production of hot metal, seamlessly integrating into the existing works infrastructure.

Several critical hurdles impede the exclusive adoption of direct reduction as the ultimate solution. The most important factor is that shaft-based direct reduction requires the use of high-quality (>67% Fe and <2% acidic gangue) iron ore pellets. Today, less than 40 million tons of this material is shipped to the global market.

To bolster the supply of these high-grade pellets, large sums have to be invested in the development of new, high-quality iron ore deposits, for example, in West or Central Africa. The beneficiation and enrichment of low-grade ores will also be increased despite the high cost and the resulting high quantities of tailings. In the upcoming decades, we'll most probably

also develop technologies tailored for the direct reduction of these lesser-grade ores. Yet, despite these developments, the availability of high-quality iron will remain a critical factor.

The battle for green hydrogen

The growth trajectory of the direct reduction route is not without its challenges. All scenarios anticipate that natural gas will be replaced by green hydrogen as a reducing agent for direct reduction, at least in the medium term. Steelmaking is the field in which the use of hydrogen is the most efficient because every ton of hydrogen saves around 28 tons of CO₂. Nevertheless, the steel industry will face intense competition for the scarce resource hydrogen. Other sectors, including the chemical industry, also have their eyes set on hydrogen for decarbonization. Plus, its potential applications in transportation and heat generation may add to the demand.

Industrial-scale green hydrogen production through electrolysis calls for a significant ramp-up of wind and solar energy infrastructure. A complete conversion of the blast furnace capacity to green hydrogen-based direct reduction would require the additional production of around 4,600 terawatt hours of electrical energy – about 20% of today's global electricity consumption. This figure alone illustrates the extent of the challenge ahead. In addition, geographical constraints make

28

TONS OF CO₂
are saved when using
1 ton of green hydrogen
for ironmaking

1.4

BILLION TONS OF SCRAP
will be available
per year in 2050

ubiquitous green hydrogen availability implausible, making ammonia a more feasible hydrogen carrier.

Given these complexities, forecasts expect direct reduction capacity to grow from today's 117 million tons to almost 500 million tons by 2050. For that to happen, another bottleneck must be resolved: plant engineering. In recent years, an average of two new full-scale direct reduction plants have been built globally each year. To achieve an annual capacity boost of approximately 15 million tons, the construction of six to eight DRI plants per year would be required. Recognizing this, we are investing heavily in our engineering and order execution capabilities.

A plea for openness

To sum it up: Depending on the development of per capita steel use, experts assume a global annual crude steel pro-

duction of between 2.32 and 2.75 billion tons. Under the lower scenario, around 20% (approx. 500 million tons) will come from direct reduction, while the electric steelmaking route will account for 35% to 40% (approx. 900 million tons). In addition, we'll see the emergence of new processes, such as iron ore electrolysis, which are currently under development. Even under optimistic assumptions, no capacity of more than 50 to 100 million tons can be expected over these new routes by 2050.

Different regions and nations will pursue different paths towards decarbonization. Direct reduction technology will see the most significant growth in countries with access to high-quality iron ores and low-cost energy sources such as solar and hydroelectric power. The electric arc furnace route, on the other hand, is poised for substantial expansion in countries with rising scrap availability. In China, an influx of scrap resources is anticipated by the 2040s, as infrastructure established in the late 20th and early 21st century gets renewed.

However, all forecasts also show that the blast furnace route will continue to play a major role for the next three decades. Come 2050, almost 40% (approx. 850 million tons) of world crude steel will be produced using the conventional route. That it why the conversion of blast furnaces into low CO₂ emission operation is the key challenge to decarbonize the steel industry.

Decarbonizing the blast furnace

Two solutions that build on each other are available for this purpose: the Blue Blast Furnace and the EASyMelt. The Blue Blast Furnace would always be the ideal first step. Its advantage is its low investment costs and, therefore, its potential to swiftly slash CO₂ emissions by around 15%. The defining feature of the Blue Blast Furnace is the generation of syngas and its injection through a new bustle pipe at the lower shaft area of the blast furnace. Comprised mainly of carbon monoxide and hydrogen, syngas acts as a reducing gas, substituting coke to facilitate the

reduction of the iron burden in the shaft. This gas can be produced via a variety of technologies. One is a new reforming process, the so-called dry reforming of coke oven and blast furnace gases in reformer stoves. During this process, methane, carbon dioxide, and water steam are reformed at a high temperature. Since the process mostly uses exhaust gases from the steel plant and can replace coal, it is called a circular carbon approach.

Based on, but going beyond, the emission reduction potential of the Blue Blast Furnace, SMS group is developing the EASyMelt. This electrically assisted syngas smelter is an alternative to the direct reduction route and a complementary building block for filling the gap between iron ore availability and green steel demand. Building on the Blue Blast Furnace technology, EASyMelt can be realized in a step-wise approach of implementing several technological elements that work together towards near-zero emission ironmaking. You can learn more about the EASyMelt concept in our article on page 28.

The process is flexible in its inputs, boosts resilience against supply shortages and market volatility, and can be adapted to various scenarios. Most importantly, however, traditional sinter feed may still be used in EASyMelt, avoiding fierce competition for the limited supply of (high-grade) pellets. This versatility, in conjunction with its energy flexibility, translates into highly competitive operational costs. ●



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Disruptive service solutions



The digital, autonomous plant becomes reality. This brings about disruptive service relationships beyond classic boundaries and enables our customers to increase profitability by focusing on their core business.

for autonomous plants

The metals industry is on the verge of a massive disruption. This time, we are not talking about decarbonization and the circular economy but digital, autonomous plant operations. Today, digitalization helps counteract problems early on by using artificial intelligence (AI) algorithms predictively. Thanks to recent technological advancements in measuring and control technology as well as AI and optimization, we have process optimization applications and operational use cases that were previously unimaginable. To SMS group's Chief Digital Officer Katja Windt, the way towards fully autonomous operation does not end here: "To SMS group, autonomy does not only refer to self-optimizing processes. Peripheral operations such as maintenance, spare part management, and the like must be autonomized as well. This calls for integrated solutions and a new, closer way of collaboration between metals producers and equipment service providers."

That's why we want to build autonomous service relationships that go beyond established boundaries. It's all about enabling our customers to maximize focus on their core business through long-term service partnerships. While traditional customer-supplier relationships are limited to individual services, modern digital solutions focus on the performance and cost targets of our customers' production holistically and over the long term. In joint teams, we analyze the challenges of our customers' operational practices relating to the core target parameters of availability, production efficiency, product quality, and CO₂ emissions. We then optimize the set in a diversified approach involving combined competencies.

A multi-challenge environment

Today, various forces are pressuring and are shaping the future of metals production. Above all, our industry's sustainable transformation will require the entire industry to adapt how it conducts business. Greening

iron and steel production will require investments of \$1.4 trillion along the entire value chain up to 2050.

Additionally, macroeconomic challenges like over capacities and external factors such as political crises and supply chain issues hamper global trade. Ultimately, raw material and energy prices are affected.

The metals industry is also confronted with higher product quality and delivery performance requirements. Specifically, this comprises end-to-end quality and energy certifications, shorter lead times, and smaller lots.

Finally, long-experienced staff from the baby-boomer generations are about to retire. Younger generations bring a new skill set, yet they tend to stay with one employer for less time. Consequently, know-how needs to be preserved and shared more efficiently, and new hires must be trained faster.

How digitalization is changing the metals industry

Digitalization is reshaping the collaboration between the metals industry and equipment manufacturers. Even before a plant is up and running, insights from previous projects can be integrated into equipment design, enhancing maintenance-friendliness, longevity, and process stability. Entire plants can be simulated with Augmented Reality (AR) and Virtual Reality (VR), and staff can easily be trained in flight-simulation-like environments. The equipment itself is evolving into an integrated cyber-physical system. Standardized data and interfaces for swift integration of digital solutions are becoming the norm, and integrated digital platforms expedite application-based solutions and AI model development.

Autonomous operation enabled by digitalization empowers self-optimizing production processes. The line between equipment automation and digitalization blurs as digital solutions intervene in operational process control while following a global optimization strategy. Human intervention diminishes as automation and self-optimization enable staff to be centralized in operations centers, focusing on higher-level duties. →

“We strive for integrated solutions, and a new, closer way of collaboration between metals producers and equipment service providers.”

—Katja Windt, Chief Digital Officer

In integrated steelworks, complex performance indicators are overwhelming for humans. Cutting-edge sensors and hardware generate real-time data on the equipment as well as the condition of production processes. These data come together in a harmonized data management that turns data into usable information. This streamlined information feeds both process automation and digital tools from a single source. SMS groups vast X-Pact basic and process automation solutions together with fully integrated energy supply, drive systems, and sensory comprise the operation technology systems landscape controlling the process. Digital solutions enable predictive, data-driven decision making. They interact with the plant automation and align all elements of the production process, maintenance activities and logistics. By integrating data from all automation and digital systems, integrated optimization provides comprehensive insights into equipment conditions, quality management, production planning, and energy usage. This aligns conflicting indicators, emphasizing the value chain as a whole.

Smart sensors gather real-time data on equipment and process conditions, while digital tools provide insights into present and future states, including effects on key performance indicators. Through remote access, these insights can be shared with the equipment manufacturer, who can assist with acute questions and issues based on their domain expertise. At the same time, updates to software and automation technology can be performed remotely.

Starting from digital twins, equipment manufacturers can develop specific simulations for customers, which can be used to plan new products or grades. This reduces the need for extensive production tests. The same applies to simulating expansions or modernizations of the plant. Material flows or production processes can be simulated, and new plants can be seamlessly integrated into existing processes, significantly reducing integration risks.

Using equipment and process data, predictive insights from digital tools enable proactive maintenance planning. This allows peripheral tasks like maintenance, servicing, and spare parts management to be outsourced to equipment manufacturers, who possess the equipment knowledge and a dedicated service network that ensure economies of scale. As a result, metals producers can focus on core tasks and delegate peripheral activities to specialized suppliers. With algorithms for predictive pattern recognition, this specialized expertise combined with infrastructure leads to improved equipment availability and process stability. In conjunction with performance-based models, this approach allows metals producers to delegate operational risks. Resources can be allocated effectively to enhance core production processes, ultimately boosting productivity and product quality.

Why focusing on core business pays off

Equipment availability, product quality, and yield – or in other words, the Overall Equipment Effectiveness (OEE) – significantly contribute to overall productivity and thus to profitability. Improving OEE by reducing downtimes, enhancing operational efficiency, and minimizing defects can lead to lower costs, increased production capacity, and, ultimately, improved business profitability.

Looking at the beginning of the plant lifecycle, metals producers must consider integration risks. The total costs of poorly integrated solutions can surpass the initial investments by far. On the one hand, additional integration costs can blow up the initial CAPEX investment. On the other hand, the process will never be able to reach its full potential, thus causing negative effects on yield and product quality. In addition, a lower level of integration will tie up human capital, as typically a lower level of

automation and thus requires more manual labor. Metals producers must find holistic solutions that seamlessly integrate into one another and existing infrastructure.

In daily operations, metals producers should increase their focus on the core business by outsourcing peripheral functions like maintenance or spare part management to specialized suppliers. Specialized suppliers bring a dedicated infrastructure and know-how that enable scale effects. Ultimately, in combination with predictive pattern recognition algorithms, this leads to increased equipment availability and higher process stability, thus increasing overall equipment effectiveness. Jan Heimann, EVP of Technical Service, adds: “Metals producers can outsource certain operational risks by combining the mentioned aspects with dedicated performance-based business models. For them, that releases resources, which can be utilized to optimize core production processes, which again increases productivity and product quality.”

Autonomous operation is more than just self-optimizing processes

When working with SMS group, customers profit from comprehensive solutions that prioritize three key aspects: interoperability, minimized integration efforts, and operational cost savings. All SMS plants come digital-ready, with all machine and automation data described in contextual meta-information in a standardized format via supported interface technologies. Comprehensive X-Pact electrics and automation packages containing drives, sensors and actuators, the power supply as well the complete process automation could be in scope of supply. Additionally, dedicated base packages, which include various digital solutions accelerate the ramp-up, ensure smooth integration into existing assets, and boost overall productivity. We fully integrate predictive solutions for process and condition optimization, product quality management, production planning, and energy management. That way, we not only reduce integration risks and increase interoperability, but we also enable our customers to integrate and manage the multiple and contradicting KPIs with a unified approach that boosts overall productivity.

In a digital twin, we bring together all data from equipment design and automation systems with insights from our digital ecosystem. This enables our customers to operate each process from a single pulpit, even locally detached in centralized operation centers. Thiago Turchetti Maia, EVP of SMS digital: “These principles underlie all our solutions, reduce reliance on uninformed decision-making, and surpass traditional automation methods. Instead, automation,



Prof. Dr.-Ing.
Katja Windt
Member of the
Board (CDO)



Jan Heimann
Executive Vice
President, Technical
Service



Thiago Turchetti
Maia Executive
Vice President,
SMS digital



Gerald Mayr
Executive Vice
President, Electrics/
Automation

digitalization, and AI make high-level decisions that consider implications and optimize across entire value chains.”

Automating repetitive tasks and streamlining processes autonomously increases operational efficiency, saves time, and reduces labor costs for our customers. Gerald Mayr, EVP of Electrics/Automation: “Already now, we supply centralized control rooms that oversee all of customer’s global plants. Operators in these control rooms are able to remotely monitor and control equipment in the plants.” This remote operation will further increase efficiency by reducing the number of personnel needed on-site at each plants. Additionally, it will allow for improved exchange of information between operator teams across multiple plants.

As part of our performance packages, we also offer to take over dedicated operations for our clients, such as roll or segment workshop operations. Since we would operate these workshops using the findings and recommendations from our own software solutions, a holistic ecosystem emerges. This ecosystem puts our customers in full control of their plant operations while we handle the specialized workshop operations. ●

FOCUS 150 years of shaping the future

The new SMS

TEST CENTER ELECTRICS AND AUTOMATION

3

2

MANUFACTURING CENTER

1

THE SMS CAMPUS

The SMS Campus is our new home in Mönchengladbach. Employees who previously worked in five different locations now come together under one roof to develop solutions for the green and digital future of the metals industry.

Campus

The membrane roof is the “eye-catcher” of the SMS Campus spanning the plaza in the center with a diameter of 82 meters – held in place by ropes made of high-strength steel.



Building: Hartmann Architekten BDA

A well-known location with a new address:
Am SMS Campus 1



Building: Hartmann Architekten BDA

Breaking new grounds

Building: Hartmann Architekten BDA



2020

Ground breaking

Start of the foundation works with site clearing and ground preparation.

2021

Shell construction

After nine months, the five modules and the structure of the building are clearly visible.



Building: Hartmann Architekten BDA

Building: Hartmann Architekten BDA



2022

Interior work

Workplaces, meeting rooms, and the lobby take shape.



Building: Hartmann Architekten BDA

2023

Membrane roof

The foil of the membrane roof is attached with extreme sensitivity.

Building: Hartmann Architekten BDA





Top: The plaza is a place for collaboration and exchange.

Left: The SMS Campus offers 1,500 modern workplaces in an open office concept.



See the
SMS Campus
grow



“I wanted to spend my life with these people”

The history of SMS is directly tied to the owner family Weiss. On the occasion of our 150th anniversary, Heinrich Weiss, who has been a central figure of the company for more than 50 years, looks back at the history of SMS, the success factors, and the course for the future.

Mr. Weiss, SMS today is a company with more than 14,000 employees at locations in more than 30 countries and has generated sales of more than four billion euros in the past year. If you remember your childhood, what was SMS like at the time?

Heinrich Weiss—I grew up directly next to the company in Hilchenbach. Siemag, the company's name at that time, was my adventure playground, so to speak, and in the afternoon after school I got a glimpse into many departments and simply helped out where I could. Of course, the orders and projects were always a topic at our dining table, so that I naturally grew into the task. Siemag was a family company in the best sense of the word, with employees who have been working with us for many years and in some cases over several generations. I decided early on that I wanted to spend my life with these people.

In 1971, at the age of only 28, you took over the management of the company. How did you turn a medium-sized company in the Siegerland region into a global player in metallurgical plant engineering?

At that time, even in Germany, we were only the number three among the rolling mill suppliers, and my father already knew that Siemag alone was too small to be able to compete internationally in the long term. For this reason, negotiations were held at that time for a merger with Schloemann, which was then completed at the end of 1973. SMS was then strong enough to realize major projects like those in China in the 1970s and 1980s.

From the very beginning, my goal was to make SMS a full-liner in order to be able to offer our customers solutions over the entire process chain. That is why we have expanded our portfolio whenever we have seen a strong opportunity. Along the way,



Heinrich Weiss

Dr.-Ing. E. H. Heinrich Weiss was born in 1942. After completing his studies in electrical engineering, he became Managing Director of Siemag in 1971. In 1974, he took over the management of the newly formed SMS, making the company a leading partner of the steel, aluminum, and copper industries. In addition, he has held numerous positions on supervisory boards and in politics for many decades.

we were able to expand our technological leadership in many areas, too. The last step in this direction was the takeover of Paul Wurth. Today we see how important this was, because this is how we can be a leader in climate-neutral metals production.

At the same time, we have developed from a purely mechanical engineering company to a system supplier. The first important step was the setting up of our own electrical and automation systems at the beginning of the 1990s. At the turn of the millennium, we started to expand our service business. Inspired by a trip to Silicon Valley, I finally initiated the development of our digitalization competence. This integrated approach enables us to support customers today throughout the entire lifecycle of their plants.

Through the years, SMS has always combined a leading technological role in many areas with the culture of a family business. For me, this means quick decisions, little bureaucracy, and keeping people motivated through a positive working environment.

You have already mentioned the major projects in China in the 1970s and 80s. What was the significance of these orders at that time?

Already in 1904, SMS delivered the first rolling mill to China. After the Second World War, when the country carefully opened up to the Western world after years of isolation, we were able to establish a basis of trust with the new leaders. We convinced them that we would be the best partner with respect to technol-

ogy and order execution. Of course, the implementation was a huge challenge in many respects – without the modern means of transport and communication, as we know them today.

I am proud that SMS has contributed significantly to China's rise to be the world's largest steel nation. At the same time, we have also benefited enormously from this. For this reason, too, I am convinced that a disentanglement of the world economy and a de-coupling from China would cause enormous damage to both sides.

At the end of the 1980s, CSP technology propelled our growth – proof of why technological leadership is so important. However, we must not forget the courage that Nucor showed at the time. We were only able to test the CSP technology on our pilot plant and, together with Nucor, demonstrated the potential it offers. Our corporate cultures in this partnership matched very well – like us, Nucor had the philosophy of a medium-sized company.

Looking back, what made SMS successful?

The success factors have remained the same over the last 50 years: entrepreneurial responsibility, trust in our employees, constant technical innovation, focus on the wishes of our customers, and, last but not least, maintaining a global perspective – this philosophy has shaped us from the very beginning and will continue to do so. A major advantage compared to many of our competitors was that we have always taken a long-term perspective. In view of the size of the projects, trust between

the owners of our customer companies and the plant supplier is crucial – a private company has the advantage here.

Your great-grandfather Carl Eberhard Weiss founded the company in 1871 and since then SMS has been family-owned. Will this continue in the future?

Many years ago, I gradually retired from operations in the business and the next generation of the family will not play an active role in management. SMS has developed very well in recent years with non-family management. With the transition from Burkhard Dahmen to Jochen Burg as CEO, we have now made a generational change and begun a new phase of growth and profitability.

Even without a family member in the management, SMS will keep its character as a family business in the future. As early as 2016, all shareholders contributed their company shares to a family foundation and thus ensured continuity. We may be open to investments of strategic partners in the future, but these too will have to fit our values and philosophy. The course has been set for us to keep our character as a family business in the next generation. ●

Green metals

Our vision is to create a carbon-neutral and sustainable metals industry. We supply the technology to produce and recycle all major metals. This gives us a key role in the transformation towards a green metals industry.



Lead the way in copper recycling

Back in 2021, Aurubis AG and SMS group signed a landmark contract to join forces in a groundbreaking circular economy endeavor: to build the first multi-metal recycling plant in the US. At Metec 2023, we caught up with Aurubis COO Heiko Arnold and SMS group COO Michael Rzepczyk to see where the project and partnership stand.

Dr. Heiko Arnold

Chief Operations Officer Custom Smelting
& Products, Aurubis AG (right)

Michael Rzepczyk

COO of SMS group (left)



Refresh our memories, what is the project's significance for the recycling industry, and why did Aurubis decide to embark on this ambitious undertaking?

Heiko Arnold — Most people know us as a producer of primary copper and other metals. But this project is about our strategic goal to become the leading multi-metal recycling player committed to sustainable metals production in the US. Aurubis is already processing around 1 million tons of recycling material annually. The Richmond plant will add another 180,000 tons per year.

Michael Rzepczyk — This project aligns perfectly with our commitment to going beyond green steel towards our all-encompassing “turning metals green” strategy. The beauty of metals is that they can be recycled almost indefinitely without sacrificing quality. We’ve been working with metals for more than 150 years now – that experience and the products and process expertise we’ve been developing throughout that history are highly relevant to the business of recycling metals and sit at the core of the project with Aurubis.

Heiko Arnold — Exactly. That’s why we partnered with SMS group. By combining your extensive plant know-how with our unique expertise in processing and

in raw materials treatment, we are creating an environment for the highly efficient recovery of metals. With the new Richmond site, Aurubis is blazing the trail in the US: The Georgia-based plant will be the first secondary smelter for multi-metal recycling. The project's high strategic importance requires a well-balanced risk exposure. We're confident that with SMS group, we have a strong partner who can deliver. SMS has the local presence and experience in the US, and a successful track record working with Aurubis.

Undertaking such a vast project must mean you expect to make an equally significant impact with it.

Heiko Arnold — Yes, indeed. With our facility in Augusta, we aim to make a key contribution to building a true sustainable economy in the US. Today, most of the discarded circuit boards, cables, and other e-waste in the country are exported, landfilled, or not collected. Valuable raw materials are wasted. But like the rest of the world, the US needs more and more mineral materials. Therefore, we must switch from the linear model of produce-consume-dispose to a circular model. An economy where products are kept in circulation for as long as possible. The concept of "urban mining" accounts for more than 50% of the current geological reserves and is a significant "resource on demand". Moreover, recovering copper from recycling requires 80% to 85% less energy than primary production. On top of that, recycling helps to achieve resource independence in regions that lack primary raw materials. In a nutshell: Recycling is the basis for a renewable and independent economy.

Let's talk about the plant. Augusta is known as a famous golf tournament site. What made you decide it's a good place for a metals recycling plant?

Heiko Arnold — Apart from other factors, the Richmond site has a strategically advantageous location. It is centrally located in the southeastern US, near the Port of Savannah, and close to key economic regions. A location that offers good logistics connections plus regional availability of recycling materials and an attractive energy supply. One of the most important selection criteria when choosing the Richmond County location was the skilled local workforce. The state of Georgia and Augusta-Richmond County strongly encourage job creation and gave us the necessary political support. In general, we are very pleased with the favorable local conditions and with the overall pro-business environment in the US.

So, how are things going on the construction site? I understand that a second stage was added to the project to bring the initially planned capacity of 90,000 tons of copper up to 180,000 tons.

Michael Rzepczyk — Absolutely, this is evolving into a massive project, and thanks to our culture of totally transparent collaboration, things have been working exceptionally well. Aurubis is very clear about their expectations, and we are entirely open about

our progress. A lot of equipment is already on-site, and so far, we're perfectly on track to commission stage one of the plant by middle of 2024. It's state-of-the-art equipment for processing complex recycling materials to recover raw materials like copper, nickel, tin, precious metals, and platinum group metals in additional downstream stages. These metals are crucial raw materials for the technologies of the future, like the energy transition, sustainable mobility, or digitalization. We anticipate the second stage to start production in 2025.

Heiko Arnold — We have jointly developed a unique modular design for the project. This means additional components can be added step by step, expanding the plant to meet future growth requirements and flexibly respond to market needs. The Aurubis Modular Recycling System enables us to build new capacities according to market demand and to integrate them seamlessly into our expanded smelter network. Combining additional capacity with maximum flexibility – for us, that's the best strategy to approach a greenfield investment and the dynamically growing US market. And we are confident that Richmond will not be the first and last modular plant we build – but that the project will serve as a blueprint for future projects.

We at Aurubis are very excited about our progress at the Richmond site, our prospects on the North American market, and about our partnership with SMS group in taking recycling in the US to the next level. ●



KEY FACTS

- > Total investment: €640 million
- > Highlight: First secondary smelter for multi-metal recycling in the US
- > Recycling capacity: 180,000 t/year
- > New jobs added in the region: >200
- > Ground-breaking: mid-2022
- > Start-up stage 1: 2024
- > Start-up stage 2: 2025

Turning metals green

The innovative EASyMelt is an alternative to direct reduction and fills the gap between iron ore availability and green steel demand. We have signed a MoU with Tata Steel India to conduct a joint industrial demonstration for this groundbreaking technology.

T.V. Narendran (left) CEO of Tata Steel and Burkhard Dahmen CEO of SMS group celebrate the signature of the Memorandum of Understanding.



In the last 15 months, SMS was awarded two green steel lighthouse projects based on direct reduction. By the middle of this decade, both H2 Green Steel in Sweden and Germany-based thyssenkrupp Steel will prove that a massive decrease in CO₂ emissions by up to 95% is possible.

There is no question that conventional blast furnace ironmaking must be tackled, as greenhouse gas emissions are primarily attributed to this process. However, is direct reduction the only technology on the pathway towards carbon-neutral iron production?

One constraint is the availability of high-grade iron ore. Today, iron ore in the form of pellets or lump ore, as required for direct reduction, represents less than 25% of the global market share. Moreover, current forecasts see a 50% gap between supply and demand of high-grade iron ore by 2050.

Second, the economic feasibility of widespread green hydrogen adoption remains challenging, given the scale required to meet global steel demand. The availability of decarbonized electricity makes ubiquitous green hydrogen production implausible. Thus ammonia has become a rising star for the future green hydrogen supply chain as a cheap hydrogen carrier.

Furthermore, electricity consumption emerges as a significant factor, given the imperative to more than double renewable energy generation by 2050 to attain net-zero targets. A staggering

with EASyMelt

two-thirds of existing renewable generation capacity worldwide (approximately 2,000 GW) would be earmarked for the steel industry.

Last, but not least, transition speed is also important. Limitations on plant builder capacities and funding opportunities present significant challenges.

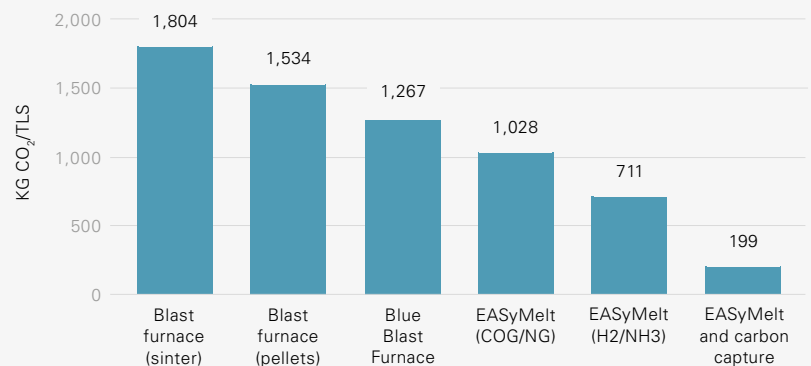
Given all these constraints, the World Steel Association projects that steel production based on the direct reduction shaft furnace will see more than a fourfold increase by 2050. In return, this means that conventional BF-BOF production routes will continue to play a pivotal role.

The transformative solution for greening conventional ironmaking is the Paul Wurth EASyMelt, short for electrically assisted syngas smelter. The EASyMelt is a resource-flexible, crisis-resistant, and cost-efficient alternative to direct reduction shaft furnaces. It offers much lower investment and operational costs compared to conventional direct reduction plants. Plus, it can be integrated into existing integrated steel plants, demonstrating a significant pathway for the decarbonization of existing blast furnaces worldwide.

The EASyMelt process employs a systematic five-step approach.

- > Production of reducing gas
- > Injection of reducing gas via shaft
- > Injection of reducing gas via tuyeres
- > Plasma-based tuyere-level superheating
- > Carbon capture integration

STEPWISE CONVERSION OF BLAST FURNACE TO EASYMELT



CO₂ emissions (scope 1 + 2; 80 kg CO₂/MWh) per kg per ton of liquid steel for different operation modes during the stepwise conversion from blast furnace to EASyMelt.

Collaboration with Tata Steel India

In June 2023, SMS group signed an agreement with Tata Steel India to advance and demonstrate this groundbreaking technology on an industrial scale. "Tata Steel is actively looking for solutions to facilitate the transition to green steel production, and thus contribute to a sustainable future. Further, as the second-largest steel producer in the world, India also places huge responsibility on large manufacturers like Tata Steel to lead the country's decarbonization journey," says Tata Steel India's CEO and Managing Director, T. V. Narendran. "We are delighted to reaffirm our partnership with SMS group and intend to take this association ahead with deeper collaboration to access better technologies and processes that meaningfully and

consistently reduce our carbon footprint." By implementing EASyMelt, Tata Steel aims to cut CO₂ emissions by over 50% compared to baseline operations, showcasing the industry's drive toward sustainable steel production. This agreement marks the potential start of a revolutionary shift.

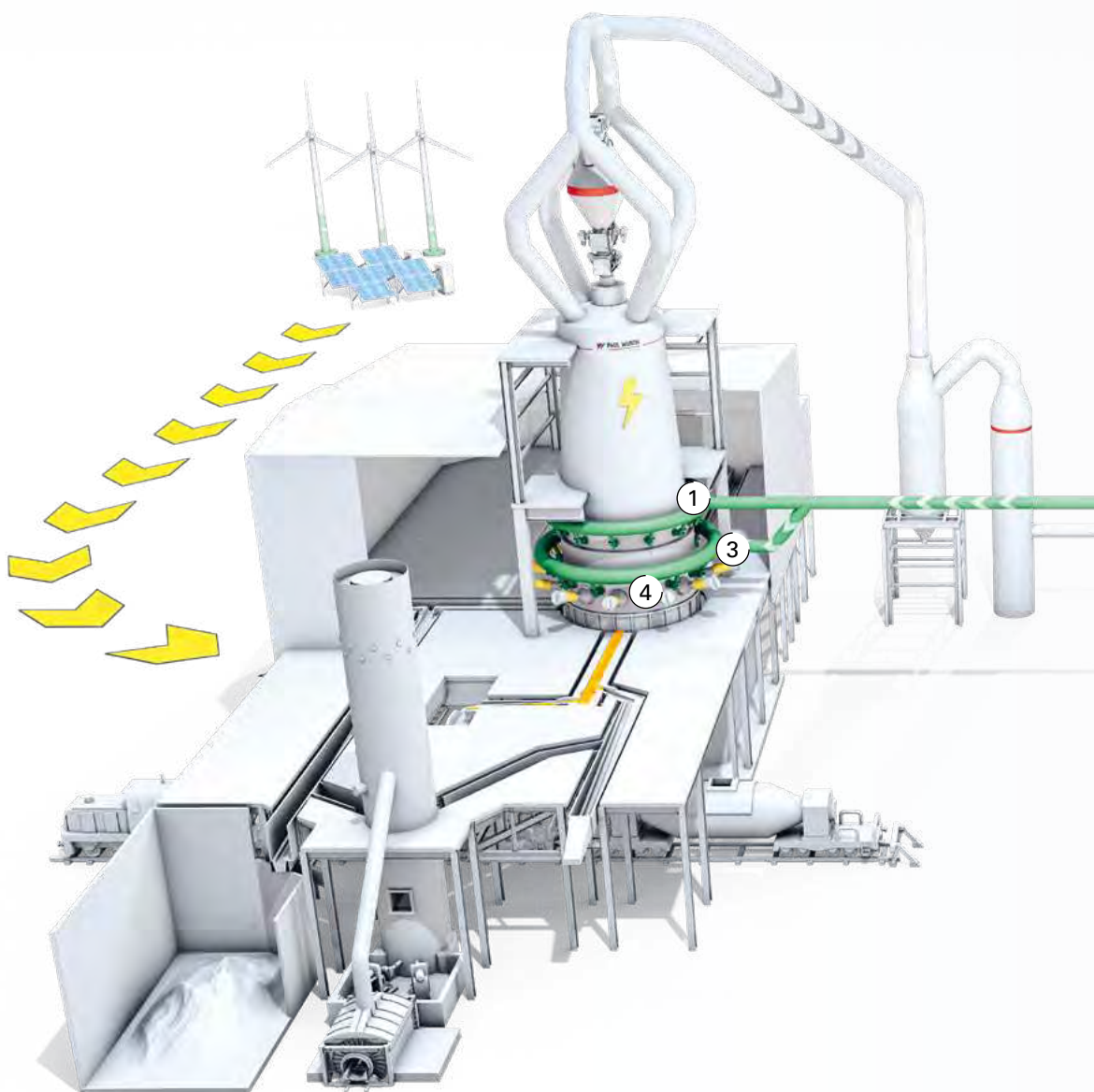
Thomas Hansmann, CTO of SMS group, is proud of the joint commitment: "As the first example of its kind, introducing EASyMelt on an industrial scale will pave the way for future projects, showing how the green transformation can be implemented using existing plants."

The EASyMelt principle

Step 1

INJECTION OF REDUCING GAS VIA SHAFT

The initial phase involves the injection of syngas (reducing gas) at 950°C into the existing blast furnace at shaft level, creating the conditions for iron ore direct reduction. This syngas can be generated through optimized methods such as SMS group's novel dry reforming hot stoves.



Step 3

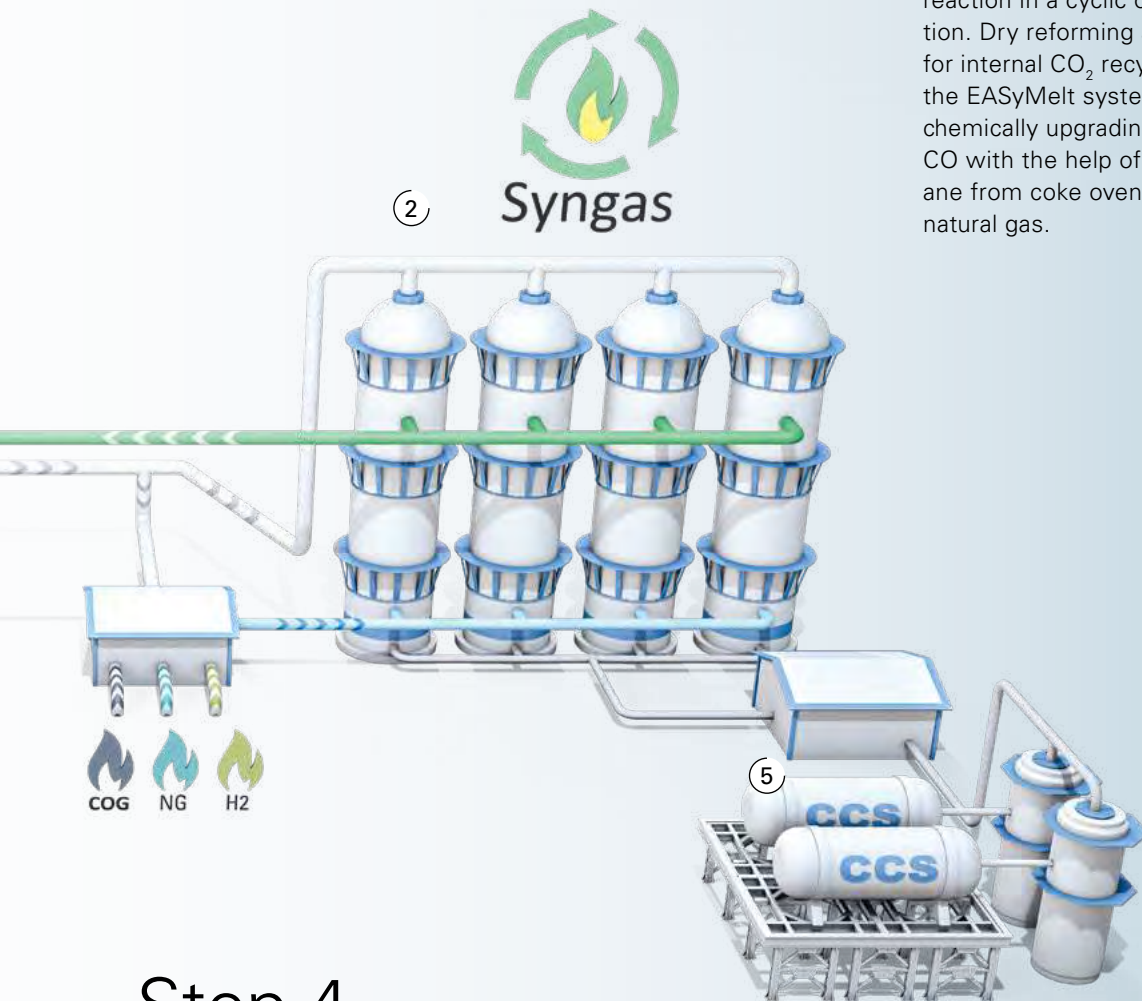
INJECTION OF REDUCING GAS VIA TUYERES

Syngas is introduced at the tuyere level. This innovative approach diverges from traditional methods, offering technical ingenuity and flexibility to incorporate hydrogen into the reducing gas composition. Hydrogen utilization is highly efficient in this context, as the very high temperatures unattainable from conventional heating methods allow for a large percentage of the hydrogen to reduce iron ore very quickly.

Step 2

PRODUCTION OF REDUCING GAS

The syngas stoves produce syngas ($H_2 + CO$) from methane and CO_2 , using a non-catalytic dry reforming reaction in a cyclic operation. Dry reforming allows for internal CO_2 recycling in the EASyMelt system, by chemically upgrading CO_2 to CO with the help of methane from coke oven gas or natural gas.



Step 4

PLASMA-BASED TUYERE-LEVEL SUPERHEATING

A plasma-based superheating system is implemented at the tuyere level, effectively elevating the syngas to temperatures between $1,700^{\circ}C$ to $2,200^{\circ}C$. This electrifies the ironmaking process and has undergone successful previous trials.

Step 5

CARBON CAPTURE INTEGRATION

The final phase revolves around carbon capture. Any remaining emissions are systematically captured for storage or utilization, ensuring complete climate neutrality. A notable synergy arises from the enriched CO_2 stream produced by the syngas dry reformers, aligning seamlessly with carbon capture objectives. Additionally, processes like sorption-enhanced water gas shift (SEWGS) are viable options for decarbonizing the residual top gas.

Green electric steelmaking



DC electric arc furnace

The decades to come will see electric arc furnaces take over as the predominant method of producing steel. SMS group technology ensures maximum efficiency and minimal emissions with this route.

Electric steelmaking can save up to 90% of CO₂ emissions compared to producing steel from virgin material in the blast furnace and BOF route. Given the dependence on the availability of scrap as a resource, predictions say that the share of scrap-based electric steelmaking will grow from around 20% today to more than 35% by 2050. Since the electric arc furnace (EAF) can also process direct reduced iron (DRI) and hot briquetted iron (HBI) from direct reduction plants, they will make up for over 50% of steelmaking capacity by 2050.

However, EAFs also vary widely in terms of their efficiency and power consumption. Here, it is important to consider not only the metallurgical vessel, but also the overall system including the power supply, particularly when using renewable energies.

Why the DC EAF is more energy efficient

The expected growth in electric steelmaking over the next few decades will naturally entail substantial investments in new EAFs. Therefore, every steelmaker should have an answer to this simple question: What is the best technology for my steel plant? AC (alternating current) or DC (direct current) technology?

There are many direct and indirect factors that influence a response to this, as well as, fortunately, some evidence, too. In the last few years, many steelmakers have opted for DC furnaces, thanks to the many advantages they offer.

First, the SMS DC EAF is more energy-efficient than the AC EAF due to the natural stirring effect, which provides temperature and chemical homogenization for a reduced “power on” time. With a longer arc compared to the AC design, it increases the heat transfer and reduces electrode consumption too. In addition, flicker is reduced, which means lower capital expenditure for power compensation and less maintenance. The bottom electrode pin designed by SMS offers an extended lifetime (up to 2,000 heats) with limited handling costs.

Looking at all factors together, the operating costs of a DC furnace, as well as CO₂ emissions, are lower. Finally yet importantly, the operator environment is enhanced, and noise levels during operation are under 40% compared to the AC design.

X-Pact AURA for DC furnace feeding

The goal of sustainable and energy-efficient production and reduced OPEX is also driving our customers to replace conventional EAF power supply systems based on a thyristor-controlled rectifier with feeding solutions based on advanced IGBT (insulated gate

bipolar transistor) power electronics. The grids in existing production sites that use the integrated route are often not powerful enough to cope with a conventional EAF.

The new family of IGBT-based electronics modules, called X-Pact AURA, boasts a completely modular concept, and the state-of-the-art power electronics technology guarantees maximum efficiency and power density. The new design achieves world-class performance in terms of current stability, dynamic response, efficiency, reliability, redundancy, and minimal impact on electric network quality.

The X-Pact AURA platform provides a common, modular approach for DC furnace feeding. The chosen topology includes a multi-pulse diode bridge rectifier, a common DC bus, and an IGBT-based chopper stage. The rated power ranges from five to 350 MVA, depending on the power and number of modules. The use of innovative modulation techniques and proprietary control algorithms ensure a maximum power transfer with minimal impact on grid power quality.

Compared to the conventional thyristor-based DC design, the X-Pact AURA offers customers an unprecedented improvement in the key power quality parameters: a power factor above 0.95 and 30% flicker reduction. The IGBT-based X-Pact AURA system “cleans” the load of the furnace and enables the installation of a high-power melting unit within a weak grid environment. ●



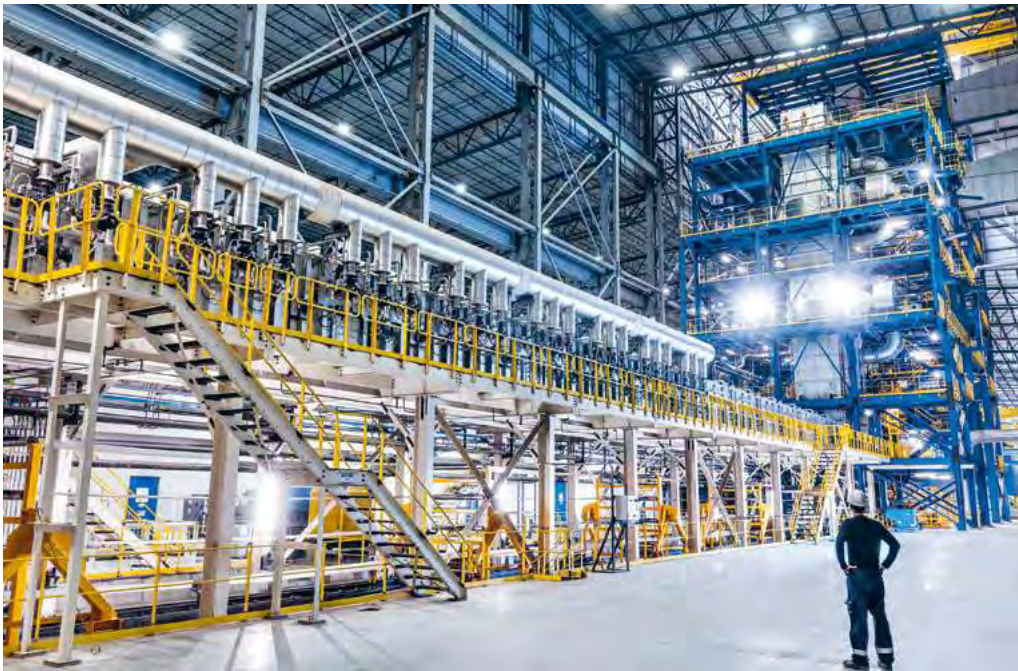
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Green coil

CSP Nexus and advanced annealing technology make high-quality hot strip production carbon neutral.



Electricity will replace natural gas for annealing.

Looking at today's strip production process chain, the largest amount of CO₂ is released when intensive heating processes are involved. That refers to CSP plants, especially the tunnel furnace, and in strip processing, the annealing furnace. However, with CSP Nexus and advanced annealing technology, strip production too is ready for near-zero emission steel.

Emission-free casting and rolling with CSP Nexus

Talking about CSP means talking about casting and direct rolling technology. Since the invention of this technology in 1989, and the first installation at Nucor Crawfordsville in the US, the technology stands for highly efficient flat steel production.

CSP Nexus has a vertical liquid bow-type casting machine, facilitating a higher throughput and a thicker

slab. This results in much-increased productivity and improved quality – for a one-strand plant in a range usually associated with conventional hot strip mills. Because the CSP Nexus plant employs a decoupled roughing and finishing rolling process, the roughing mill speed can be freely and flexibly adjusted. As in a conventional hot strip mill, the roughing mill's rolling speed is very high in order to reduce temperature losses during the rolling process.

The casting machine's high throughput also enables a very efficient endless mode. Endless means that we are rolling and processing the hot strip directly toward the downcoiler in a coupled casting and rolling process in which the cut to coil weight is performed in front of the downcoiler. All of this gives us a stable rolling of ultra-thin gauges and an increased yield.

Our first CSP Nexus plant is successfully operating in the US at SDI. The CSP Nexus plant we are

designing for H2 Green Steel is going to be our second one and will produce a maximum strip width of 1,950 mm with an output of 2.5 million tons per year.

What's more, the CSP Nexus plant of H2 Green Steel will be without CO₂ emissions. This is realized by replacing the tunnel furnace with a combination of electrically heated roller tables and highly efficient induction heating systems. The heating function of the tunnel furnace will be replaced by an inductive heating solution. The SMS Elotherm induction heating system heats up the slab on a very short length and the heated roller tables ensure the homogeneous slab temperature as well as the homogeneous transfer bar temperature. It is a hybrid solution, because it combines inductive heating with the heated roller tables.

In addition to purely electrical solutions, we offer the option to process green hydrogen, also in combination with an inductive heating unit, so that we can utilize the advantages of both solutions in one plant.

Annealing is the key to establishing carbon-neutral downstream processes

In pickling and cold rolling, we can achieve carbon-neutral production by using green electricity from hydropower, solar energy, or wind turbines. In strip processing, annealing furnaces are the primary source of CO₂ within cold strip production because they are typically operated with natural gas. This means that about 50 kg of CO₂ is emitted per ton of strip. Approximately 250 kilowatt hours per ton are needed for processing the strip in the annealing furnace.

By using electricity, we can reduce emissions to 4 or 5 kg per ton. Today, a typical annealing furnace consists of a direct-fired heating zone and soaking zones with radiant tubes. Our concept, which we will also implement at H2 Green Steel, is to use inductive heating in the heating zone and electrically heated radiant tubes in the soaking zone.

Digitalization also plays a crucial role in reducing the carbon footprint. As all lines are digital ready, the necessary data are available to monitor the status of the plants and products. With our quality execution system, we can better manage quality by instantly removing deviating coils from the line. That process also conserves energy because the coil does not undergo processing until the end of the line.

Another digital solution is the intelligent furnace, which adapts the heating temperature or the annealing temperature of the strip. Considering the upstream processes, we are developing offset mini models to reduce the amount of scrap occurring during the entire production process.

Last but not least, the manufacturing execution of the CSP Nexus system also facilitates optimal planning of the entire production process, ensuring the optimized transition of coils to achieve additional energy savings. ●



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See our video
on CSP Nexus:



processes

Every drop counts

Climate change has turned the spotlight on water management. By providing new solutions, SMS is helping to reduce both water consumption and the disposal of sludge.



Water treatment is an essential element of every metallurgical plant.

Cogne Acciai Speciali is an Italian special steel producer based in the Aosta valley, a mountain valley surrounded by the highest Alpine peaks. One of the reasons why the steelmaking industry took hold here in 1916 was the abundant availability of water. However, even close to the ice-capped Mont Blanc, water has become a scarce resource.

Frediani Salvatore is Engineering Department Manager at Cogne Acciai Speciali: "Water was never regarded as a critical resource. Now, rainfalls have reduced, glaciers have shrunk and mountain lakes

sometimes run dry. So saving and reusing water has become a must and that's why we have teamed up with SMS group."

The collaboration started in 2019 with the installation of a new SMS solution called Zero Solid Discharge to reduce the amount of sludge produced. In 2022, Cogne awarded us the contract to supply a new water treatment plant. During these projects, the collaborative partnership between the two companies grew stronger and stronger, and they decided to launch a research project aimed at reducing water consumption.

Removing contamination with electrocoagulation

Recirculating cooling water systems are widely used for cooling equipment and pipelines in the field of steel manufacturing. Due to the evaporation effect, recirculating cooling water usually contains a high concentration of salt and is highly conductive.

As soon as the circulating water reaches threshold concentration values, it must be discharged as blowdown water and replaced with fresh water (also known as makeup water).

At Cogne, electrocoagulation tests were carried out to remove suspended, emulsified, or dissolved contaminants from water by using an electrical current instead of expensive chemical reagents. It was shown that electrocoagulation reduces the need to top up makeup water and thus lowers total water con-



Salvatore Frediani from Cogne Acciai Speciali (second from left) with SMS water treatment experts Jovana Gradinac and Stefan Schmidt at Metec 2023

sumption. The electrocoagulation equipment can be installed with only minor modifications to the setup of the water treatment plant.

Combination of cooling towers and air cooling

The evaporation-based water losses in cooling systems can also be reduced with our combo water treatment plants. This system combines cooling towers with air coolers, where fresh air is used to dissipate the heat and is especially suitable for revamping existing water treatment plants.

Combo water treatment plants are designed for local, specific ambient conditions. They are extremely flexible, so the ideal cooling system can be chosen for each application and offer water consumption savings of up to 500,000 m³ per year. What's more, by using an air cooler there is no evaporation inside the system, thus increasing the service life of the overall system.

Zero Solid Discharge

The first project realized at Cogne Acciai Speciali was called Zero Solid Discharge, aimed at reducing the amount of sludge from water treatment. Zero Solid Discharge is based on bioaugmentation, which means that bacterial cultures are

added to speed up the degradation rate of organic contaminants.

The main advantage of this technology is the increased biological processes in the water. This reduces sludge production significantly compared to conventional water treatment systems. And the best thing about it is that it requires zero CAPEX, as there is no need to modify or modernize existing systems.

Jovana Gradinac, our expert for water treatment systems, monitored the tests at Cogne. "When we started, the chemical oxygen demand, which can be seen as representing the amount of organic sludge produced later in the process, was 215 mg per liter. After one week, this value could be reduced by 75% and then was brought down to a plateau of around 9 mg per liter. This led to an enormous reduction in sludge," Jovana Gradinac explains.

Yet Zero Solid Discharge can also be used as an early warning system. During the ongoing analysis of the water quality, parameters based on nitrogen compounds showed the presence of oil and grease in the water. Jovana Gradinac: "We were able to warn Cogne about oil leakages from the machines, which in return saved money and helped to keep the water clean."

WATER TREATMENT PLANTS

SMS group has decades of experience in the construction of water management systems for metallurgical plants and rolling mills. We specialize in equipment from raw water treatment through cooling and process water circuits, right up to wastewater treatment and water recycling. We take care of all necessary steps in every phase of the project: from the planning, delivery, and erection, right up to the commissioning and performance tests. Our special focus is on developing customized plant and equipment that we design and build jointly with our customers.



See the Leading Partner Talk with Cogne at Metec 2023:



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Lifecycle partnership



Our integrated lifecycle services increase competitiveness in a challenging market environment. Technologies, services, and business models support a plant throughout its entire lifecycle, from the very start to ongoing optimization and lifecycle management.

Integrated performance services

In our interview, David Jeffrey provides enlightening insights into SMS group's integrated performance services and partnership approach for supporting customers through technology and organizational changes in the face of new global market and technology drivers.

Mr. Jeffrey, we're here to talk about SMS group's integrated performance services. Can you start by breaking that down for us – what does that really mean?

David Jeffrey — Let's take it from the top and start with performance. When we talk about performance in this context, what we mean are the business performance outcomes our customers experience as a result of the services we provide. And when we say "integrated", that refers to both the manner in which we deliver the services and how we get paid for them. That's the crux of the matter in the types of contracts we're talking about here; our economic success depends directly on our customers' level of success. If what we do doesn't work for them, we don't make money. The integrated performance services model is 100% customer-focused.

In a service world that often overpromises and underdelivers, that almost sounds like a radical shift. What does it take to make that work?



David Jeffrey

is Senior Vice President Technical Service at SMS group. David brings vast experience in technical services and operations, along with a specialization in growth analysis and predictive technologies to his role. He joined SMS group 17 years ago and served ten years as CEO for Technical Service Russia/CIS before assuming his current position.

It requires a serious commitment to integration – both internally and externally. Otherwise, we could not keep the promises we are making to our customers. The commitments we make to them are hard and fast and, as a consequence, have to be measurable. When we say to them that by doing certain things, we can raise their productivity for a certain grade of steel by a certain percentage, we need to be absolutely sure that we can do that. And that requires two things – knowing precisely what’s going on at the customer’s plant, down to the very last detail, at any given moment. It also means that we must be able to access and deploy every last bit of expertise and know-how that exists within our group. Here’s a simple example: When we’re maintaining a caster, getting paid on its output, and the hot strip mill stops producing for some reason, the money stops for everybody – us and the customer. Obviously, we can’t have that. So that’s the level of integration we’re talking about.

And just as there is no single solution, as you said, the processes you describe are continuous, correct?

Absolutely. This is a customer lifecycle partnership approach. Generally speaking, there are four parts to it. It starts with the project phase, which takes us from a plant concept to the start of production, the ramp-up. Then the steady state where we ensure stable plant operation, after which we introduce change and optimization processes that might lead to a new project, and so the cycle becomes continuous – a true lifecycle partnership.

Now, you didn’t just come up with the concept of integrated performance services out of the blue. Presumably, you are reacting to changes in the market. So, what are the global drivers that generate demand for these kind of services on the customer side?

Certainly, our customers face fundamental market changes that pose significant challenges for which we must figure out solutions. Foremost among the external changes is definitely decarbonization. But there are others – digital transformation, the need to manage and control overall energy consumption, and the need for overall lifecycle financial efficiencies. These are all high-level forces that affect pretty much every one of our customers. But there are essential differences in how individual customers have to respond to the drivers, for instance, depending on whether they have a start-up, a greenfield, or a brownfield project. Let’s take a greenfield operation, for example. The most critical factor for them is to get a return on their

“Our success is born off the back of total integration with our customers and their ultimate downstream success.”

—David Jeffrey, Senior VP Technical Service, SMS group

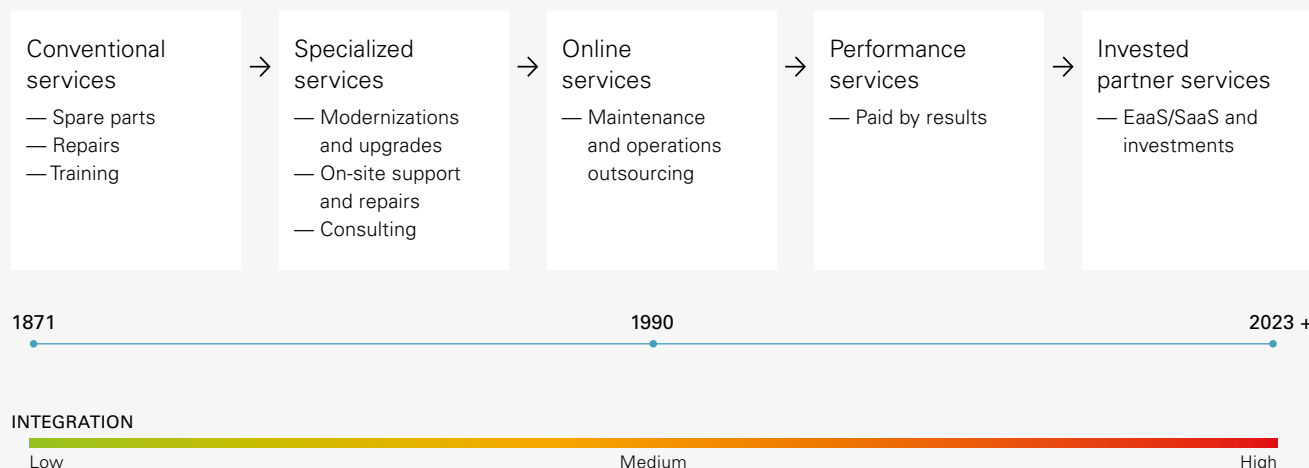
investment as quickly as possible. The plant needs to make money. You’re looking to minimize CAPEX and stabilize OPEX. These are drivers that we must address in our solutions if we want to deliver value. In addition, you have your conventional drivers that really have stayed the same – that’s your throughput, consistent quality, yield, and cost-efficiency.

All of the above is significantly affected by unplanned downtimes. Predictive maintenance is a key measure to avoid these. We offer integrated solutions to our customers that are based on all our competencies with respect to automation, digitalization, and technical services. Based on our plant automation, predictive tools can derive maintenance tasks before negative effects on the plants productivity occur. The maintenance can be done by SMS group staff even in our dedicated workshops on the premises of our customers.

So when you’re changing how you service your customers, you also have to make internal changes.

Yes, as a company, we are in a unique position because we currently manage the maintenance/operation of customer assets in excess of 100 million tons of liquid crude steel. And roughly 85% of that is through contracts with performance-based and investment performance-related services. →

CUSTOMER SUCCESS IS INTEGRATED AND CRITICAL TO OUR SUCCESS



That's a complete paradigm shift from the days of the conventional services we would provide in the past when our work was largely about repairs, managing spare parts, and training. The performance-based services we deliver today represent a totally different risk structure for us and require a much deeper level of integration with our customers. Today, we are truly breathing the same air as our customers – we only get paid when that's working as advertised. We feel their pain in real time. When things go wrong for our customers, they go very bad for us – that's why we do everything in our power every day not to let that happen. It drives everything we do.

Change of that magnitude is never just technological, is it? There must be more to it from an organizational perspective, right?

That is correct. To successfully implement the necessary changes on a technical and technological level, we really had to also adapt our culture. That meant looking at how we are integrated globally. The important thing was to really make sure we got rid of any silos we had in the group. This is because the solutions we provide for our customers are never out of the box – so we can't be doing our thinking inside of silos. We also had to become a lot more local than ever before – we have now empowered the regions to manage the business much closer to the local customers, which has made a world of difference. When you want local accountability, you've got to give your teams on the ground more responsibility. We've taken that even further now

to empowering individual projects and contracts. The decisions are made where the business impact comes from.

So, with all these new global drivers and massive resulting changes internally and externally, how would you boil down the role SMS group plays for your customers? What is it that they really need you for?

There, you've said it already. We're shouldering a massive burden for them. All those technology changes and all that change management required to be successful today in this business, we're now operating for them. They simply don't have to worry about it and can focus on growing their core businesses profitability. ●



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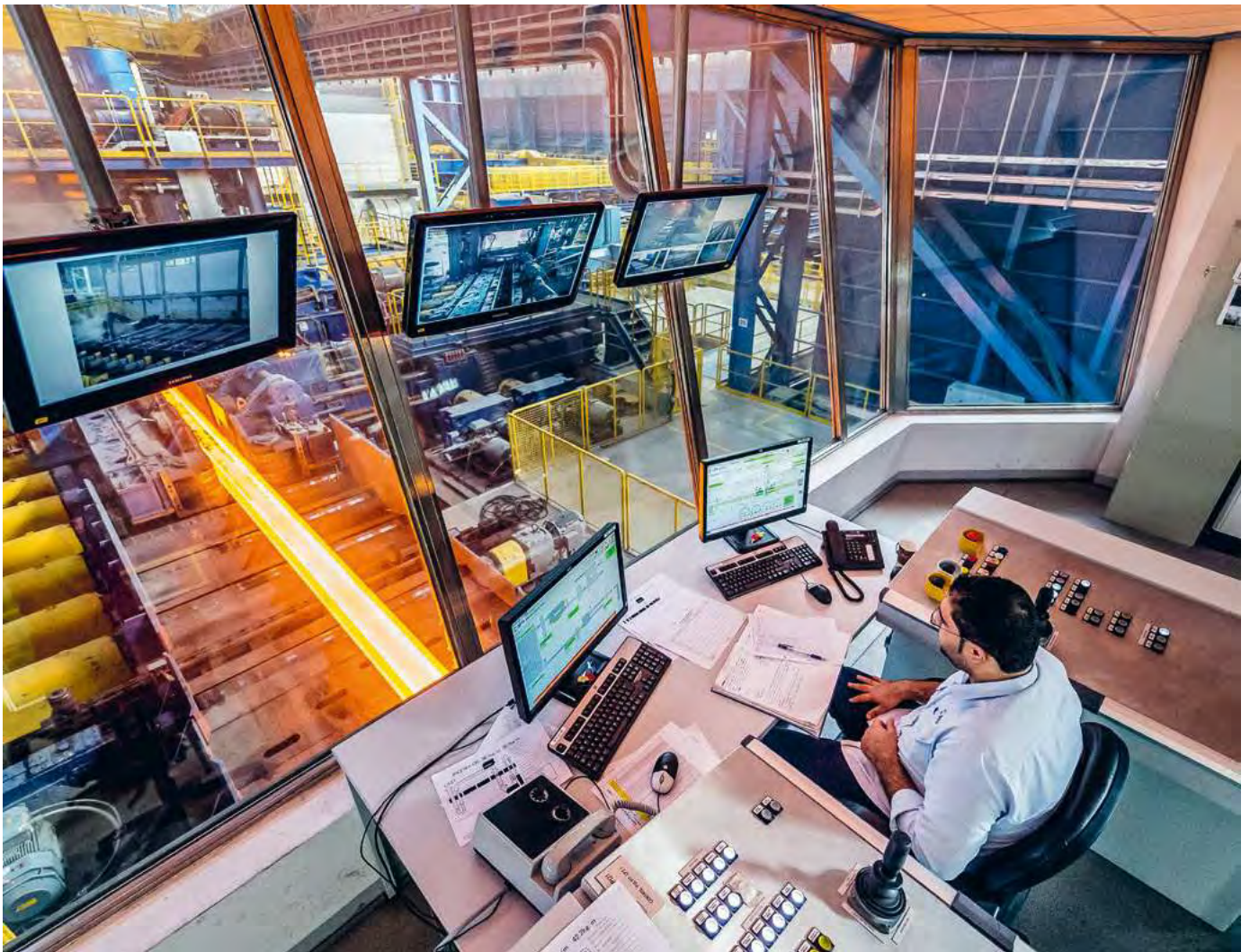
See the Leading Partner Talk with
David Jeffrey at Metec 2023:



Staying ahead when everything changes

The GCC countries are undergoing a massive transformation away from oil-based economies and are on a mission to decarbonize. We're helping our customer SULB thrive in this challenging environment by championing a genuine lifecycle partnership approach.

Heavy section mill at SULB



“Having a good technology partner is like living with your wife. That’s how we work with SMS. We’re solid partners.”

— Ravi Singh, CEO of SULB

Based in the Kingdom of Bahrain, SULB is a successful integrated steel producer of long products with plants in Bahrain and Saudi Arabia. The plants are widely recognized as some of the best-performing plants in the GCC (Gulf Cooperation Council), a political and economic union comprising Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. Maintaining a production rate of 144% of capacity in the melt shop and 120% in the heavy section mill, SULB is full steam ahead, doing its part in boosting the infrastructure in the GCC. Getting to that point was a challenging ride, and SULB credits its ability to perform at these levels and meet the market’s quality demands to its close cooperation with SMS group’s services team and local support, with whom they discuss technical changes and challenges on a weekly basis. In addition to the technological advancements, both companies stress that they are driving the plant’s success by aligning their diverse international workforce around a common mindset with clear value priorities: innovation, doing more with less, and limitless thinking.

Skyrocketing demand

There are good reasons why SULB is pushing forward so hard and expanding capacity. With several giga-projects underway in Saudi Arabia alone, the region is transforming its economy to rely less on oil-based profits. With sizable investments from GCC governments, SULB is right in the middle of this massive transformation and the steel-intensive infrastructure it requires. SULB realizes that such rapid change can only work with a supplier partnership that goes far beyond fixing single issues as they arise. Their partnership with SMS group is a pure-bred team approach in which SULB’s steelmaking know-how is continuously supported by SMS group’s engineering expertise. The partners are going about this by methodically identifying possible areas for improvement, clustering them into priorities, and executing them to maximize the value for both partners.

Decarbonization – beyond meeting requirements

As just about everywhere else, decarbonization is a major goal in the GCC countries. Specific targets are being set at the level of individual companies, with compliance and review mechanisms to ensure everyone performs. For SULB, this means that, by 2035, they have to reduce their 2015 baseline emissions by 35%. With a combined DRI-EAF route, the company already has a head start on many others. Thanks to energy audits with SMS group, SULB has been continually reducing its fossil energy consumption and,



Billet caster

therefore, its CO₂ emissions. On its current trajectory, the company will comfortably surpass the mandated 2035 goals. To continue showing improvements down that path, SULB and SMS group are also actively exploring additional avenues, such as new reheating furnace technologies and possibly converting the combustion system to hydrogen in the future.

Innovating to lead

Another significant economic driver in SULB's market are the much-talked-about Saudi Arabia giga-projects as part of the country's National Transformation Program to become less oil revenue dependent. But the transformation takes place on all levels, including new industries like electric car plants, solar energy installations, and even an expanding public transportation sector. For SULB, all of this is good news on the demand side, but it will also pose a challenge to the company. The giga-projects and other new markets will motivate SULB to expand and optimize its portfolio. SULB is already working closely with SMS on several projects to upgrade the

existing mill in Bahrain to cater to some of the new size, quality, and materials requirements. In addition to the energy audits and the productivity-boosting revamp of the 130 ton electric arc furnace, SMS group is also installing the first TBK laser measurement system for contactless dimension measurement and surface defect detection on the Arabian Peninsula into the heavy section mill in Bahrain. Ravi Singh, SULB CEO, is optimistic about the company's prospects to serve a sizable chunk of the market created by the giga-projects. Because of the SMS group partnership and the upgrade projects underway, he believes they will be the mill first in line to meet all the new giga-project requirements. Singh sees the SMS group partnership as something akin to a marriage: "Having a good technology partner is like living with your wife. That's how we work with SMS. We're solid partners." ●

SULB

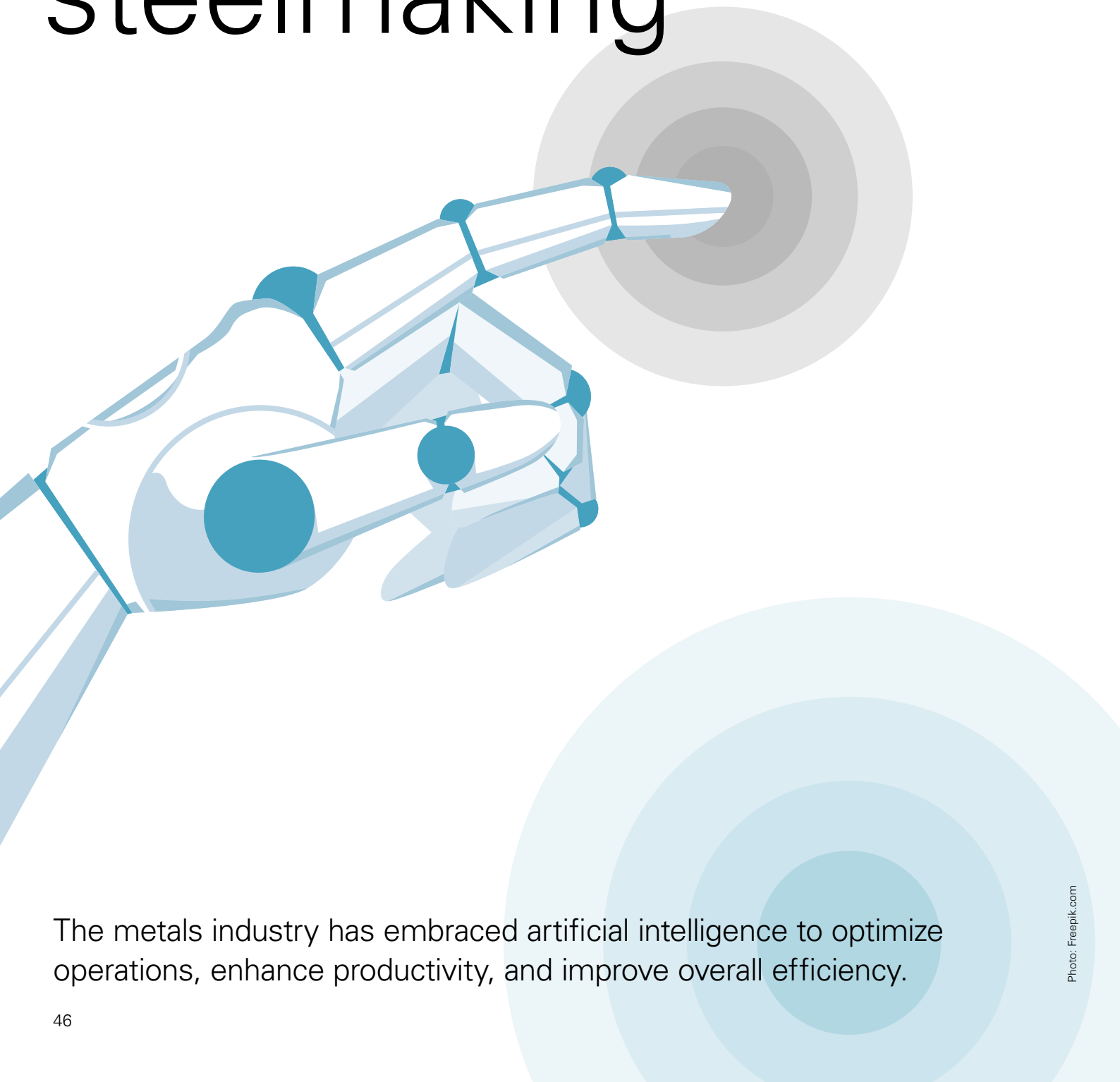
is a specialized and fully integrated producer of structural steel products with operations in Bahrain and Saudi Arabia.



See the Leading Partner Talk with SULB at Metec 2023:



Real-life AI use cases in electric steelmaking



The metals industry has embraced artificial intelligence to optimize operations, enhance productivity, and improve overall efficiency.

Back in 2017, leading artificial intelligence (AI) thinker and Google Brain project founder Andrew Ng said, “AI is the new electricity” and explained in an interview for Stanford Business School, “Just as electricity transformed almost everything 100 years ago, today I have a hard time thinking of an industry that I don’t think AI will transform in the next several years.” Now, a short six years later, AI has already brought transformative change to the steel industry, allowing manufacturers to seize a competitive edge in an ever-demanding marketplace. Here, AI isn’t a future promise; it’s today’s game-changer. Imagine a factory where machines self-diagnose and auto-schedule their own maintenance – preventing costly breakdowns, minimizing downtime, and optimizing maintenance schedules. That’s predictive maintenance, one of the AI marvels revolutionizing operations and productivity. At SMS group, we have identified strong use cases and successfully implemented the technology in several projects that underline the potential of such applications.

Tap hole blockage prevention

The objective of this development was to address the issue of premature failure of the tap hole, a refractory component through which steel drains in an electric arc furnace (EAF). Conventional efforts, like process optimization, had failed, so it was time to utilize a new approach: In the given customer use case, the tap hole only lasted 20 to 50 heats instead of the industry standard of 100 to 150. The occurrence of blockages, requiring frequent lancing with an oxygen pipe, was a contributing factor to the premature failure.

Our aim was to improve tap hole life and minimize the need for lancing. We developed a predictive analytics system that could assess the risk of tap hole blockages during a heat and enable root cause analysis to identify influential factors.

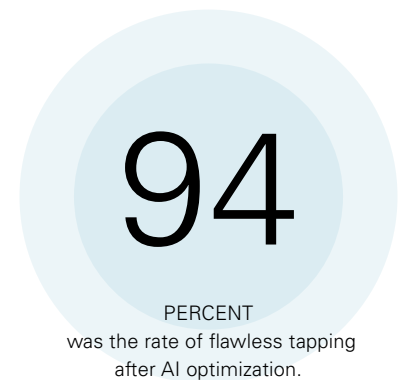
The dataset consisted of approximately 1,000 signal readings from the EAF across 8,000 heats, with a resolution of every 200 milliseconds. The heats were labeled as “blocked” or “free open” based on the presence or absence of blockages at the end of each heat. We deployed ma-

chine learning models to cluster tap hole blockage events into distinct segments. These segments revealed key behaviors deviating from the norm, potentially contributing to blockages. We developed a predictive model to quantify the risk of a tap hole blockage by integrating the risks associated with each segment. Afterward, we utilized visualization tools to highlight the behavior of signals associated with the highest-risk segment. This facilitated an in-depth understanding of the contributing factors and supported decision-making for process improvements. SMS groups’ process experts were involved throughout the model development and validation process, to leverage the outputs and drive improvements. For our customer, we were able to increase the rate of flawless tapping from around 80% to over 94%.

Optimizing EAF efficiency with predictive analytics of cooling panel temperature

The rate of rise (RoR) of the cooling panel temperature of an EAF is a critical factor that impacts a furnace’s performance and lifespan. It refers to how quickly the furnace panel’s temperature increases during operation. If the temperature rises too rapidly, it can lead to premature failure of the refractory lining and damage to the furnace panel, resulting in unplanned downtime and increased maintenance costs. Conventionally, a specific Programmable Logic Controller (PLC) logic is used to prevent overheating on the panels. When a corresponding alarm is triggered, the PLC reduces the electrical energy input into the furnace. Even though this measure prevents increased RoR of the panels, it also results in increased tap-to-tap times (duration between the start of melting the scrap and the tapping of the molten steel) since the power-on time (time of electric energy input) must be prolonged. For our given use case, each heat averaged about one RoR, leading to significant energy costs.

Our objective was to decrease the power-on time of the furnace, thereby increasing throughput and overall operation profitability. Our joint team of digital, automation, and process experts utilized



the alarms generated by the PLC to detect sidewall temperature raises and combined that with various sensor inputs.

Based on these data, we developed a machine learning classifier that can predict RoR events before they occur. To achieve this, we developed an advanced predictive analytics system assessing the rate of rise of the EAF panel temperature and detecting potential failure risks. Furthermore, it aimed to facilitate root cause analysis by identifying factors that influence abnormal rate-of-rise patterns. It generates actionable recommendations to prevent such occurrences, aiming to reduce the number of excessively long power-on time heats.

Additionally, we created visual charts that focus on specific areas that are likely to cause an increase in RoR probability. This gives us a clear understanding of what factors contribute to these risks and helps us make better decisions for EAF operations.

The predictive model is able to accurately predict the RoR events with a high degree of accuracy and thus prevents these events. Overall, the case showed that the predictive analytics system can successfully reduce the number of RoR events and improve the productivity of the furnace. In the next project phase, we will decouple the trained model from the PLC logic in order to detach the model from changes in the PLC logic and thus preserve the given prediction quality. ●



Technology



Technology and innovation are fundamental cornerstones of SMS. Our new solutions ensure sustainable, competitive advantages and therefore, future revenue and growth.

Advanced pass schedule design in radial forging

The new ComForge Property Predictor is capable of simulating the temperature and strain distribution in radial forging within seconds for any given pass schedule.



Hydraulic radial forging machine in operation

Up to now, the process of designing radial forging pass schedules has only considered the characteristics of the forging machine in terms of the required forces and kinematics. To realize a pass schedule design that takes into account the workpiece properties, we developed ComForge Property Predictor. This innovative software predicts the strain and temperature within seconds using new stand-alone models. This not only allows pass schedules to be optimized with regard to quality and workpiece properties, but also provides economic benefits by enabling shorter process chains, fewer personnel, and thus improved safety margins within the process.

Pass schedule design

Our SMX hydraulic radial forging machine has been a success story for more than 30 years, where the defining feature of the SMX is given by the hydraulic drive of the four forging dies. Compared to the conventional mechanically driven system, our hydraulic drive offers significant advantages with regard to the forging process

and workpiece quality, as the full forging force is available over the entire stroke of each forging cylinder. This provides for effective core penetration and enables flexible forging strategies with controlled die movements.

Nowadays, radial forging processes are mainly designed based on the experience and knowledge of the operator or geometry-based pass schedule calculations. Although this allows for a reliable analysis of the process sequence, forces, and kinematics, it only offers an insight into the geometrical evolution of the workpiece and does not provide any further information, e.g., on the distribution of equivalent strain or temperature.

On the other hand, a numerical simulation of the open-die forging process using FEA (finite element analysis) is complex, requires a great deal of computational effort and personnel with relevant technological knowledge, and is very time-consuming, as there are usually many hundreds of forming steps in the forging process. Consequently, designing radial forging processes often takes a lot of time, is expensive, and results in pass

schedules where excessively large safety margins, e.g., as regards the temperature, are chosen, thus leading to lower profitability.

To overcome this challenge and improve the radial forging process, SMS group developed its new ComForge Property Predictor software, which can calculate the temperature and deformation for any given pass schedule within seconds.

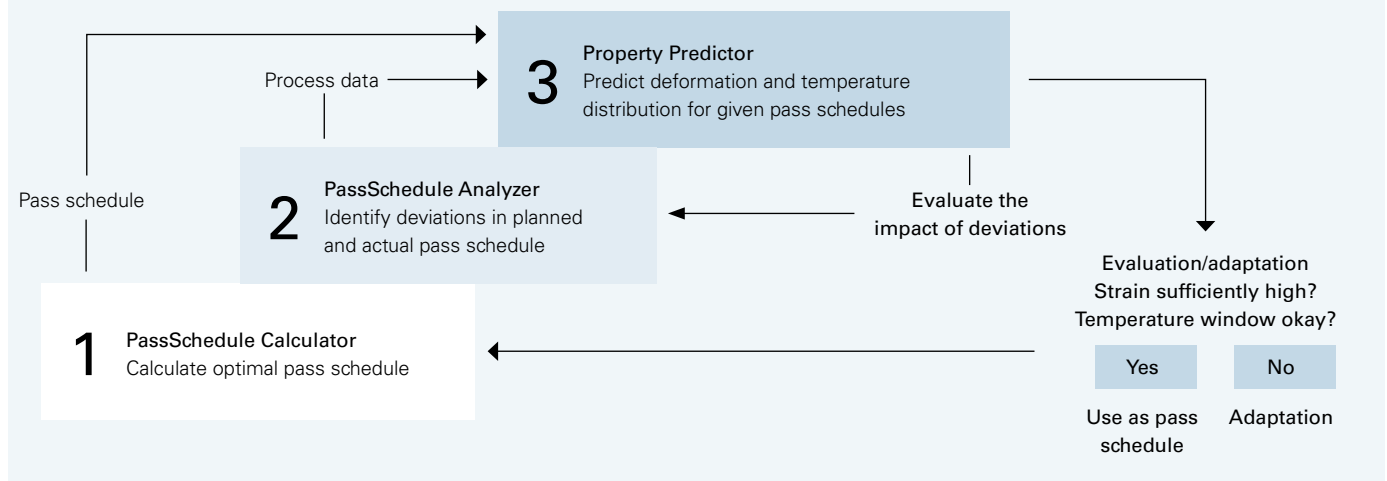
ComForge Forging Technology Suite

The Property Predictor is part of the ComForge technology suite combining three modules from pass schedule calculation to material properties optimization:

- ComForge PassSchedule Calculator
- ComForge PassSchedule Analyzer
- ComForge Property Predictor

ComForge PassSchedule Calculator: Since its introduction with the first SMX radial forging machine, ComForge has proven to be an efficient and powerful tool for creating pass schedules.

From process analyzing to material properties optimization: The ComForge Forging Technology Suite



ComForge ensures a consistently high level of production quality by addressing the main challenges in process design:

- Increased productivity for maximum performance
- Minimal tolerances
- High reproducibility with detailed documentation.

With data on over 200 materials, the ComForge Forging Technology Suite has everything required for calculating the relevant forging schedules for all customers. This provides plant owners with a comprehensive database for trouble-free and technologically proven forging processes. Once calculated, the pass schedule is transferred directly to the PLC of the SMX and finally executed in a fully automated way. The PassSchedule Calculator offers various forging strategies for the production of round, square, and rectangular bars using different tool sets. To ensure a precise prediction of the forging time and the resulting productivity, the characteristics of the machine's hydraulics are implemented directly in the PassSchedule Calculator.

ComForge PassSchedule Analyzer: During forging, there may be discrepancies between the planned pass schedule and the forging operation, for example because of alloy composition deviations, which result

in higher forces or require manual intervention by the plant operator. The PassSchedule Analyzer is used to analyze the recorded process data from the SMX (e.g., speed, position, forces) to identify these deviations. The next step is to compare these deviations with the intended pass schedule to check for any critical impact on the material properties.

ComForge Property Predictor: The ComForge Property Predictor is our advanced technology module, which allows a detailed calculation and analysis of radial forging processes with regard to the material properties:

- Calculation and visualization of the strain distribution along the cross-section of the workpiece. The strain model is available for all of the most relevant material classes, and additional material groups or alloys can be included upon request.
- Calculation of the temperature distribution in the cross-section, taking radiation, convection, tool contact, and heating through dissipation into account. The principle of temperature modelling is based on the finite-difference method (FDM).

The Property Predictor can be utilized as a stand-alone technological solution as well as in combination with the PassSchedule Calculator, so that the temperature and

strain distribution can be evaluated directly for any pass schedule in no time. The process can be further optimized using the calculated pass schedule as input data for the Property Predictor. The forging technologist can adapt the pass schedule parameters and evaluate the effects of the forging parameters on the resulting strain and temperature distribution.

The software is also easy to use for employee training as it enables a direct evaluation of the impact of different forging parameters on the workpiece quality. Additional benefits of the ComForge Property Predictor include:

- No special FE simulation software is required, saving high license fees.
- Due to the total integration within the ComForge Forging Technology Suite, a simple data transfer directly within ComForge is possible and can be handled by the process engineer, so that no simulation specialist is required.
- Due to the fast modelling of the strain and temperature, very short simulation times (less than one minute) are possible. ●



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Jumbo section mills today and in the future

In recent years, the demand for rolled steel sections has shifted to heavier products with greater thicknesses, higher yield strength, and increased toughness in combination with improved fabrication properties such as weldability.



CCS 1500 universal stands at Nucor Yamato Steel after the revamp of rolling mill no. 1 in Blytheville, USA

In view of these demands, we have developed technologies and equipment that enable the reliable and cost-efficient production of steel sections.

Rolling so-called jumbo beams that are up to 140 mm thick and weigh up to 1,377 kg per meter requires the use of extremely large beam blanks as feedstock. The past practice of rolling from slabs is less reliable and requires many passes in the breakdown stand, resulting in temperature losses, limited productivity, and unfavorable yields. In recent decades, however, the possibility of continuously casting ultra-large and heavy beam blanks has become a reality.

The use of beam blanks for rolling large and heavy beams has brought about a change in the rolling technology used in the breakdown stand, meaning fewer passes, stable product quality,

and increased yield. At the same time, it was also possible to reduce the size of the breakdown mill and the drive power (compared with the use of slabs).

The rolling mill equipment needs to be more rigid to accommodate much higher loads. Reversing tandem mill stands require larger roll diameters, higher horizontal and vertical roll separating forces, as well as more drive power. Since jumbo beam mills typically also produce the standard range of beams and other products such as sheet piles, the CCS-type mill stand (Compact Cartridge Stand) is designed to accommodate different roll sets with varying diameters and barrel lengths. This feature allows the use of existing and new rolls for modernization projects like that at Nucor Yamato Steel, or the use of a range of roll diameters that suit the different products within the product mix.

Digital commissioning of the automation system at the X-Pact Plug & Work test center in Mönchengladbach, Germany



Despite the use of heavy beam blanks, the rolled stock can only be reduced to a limited extent in the rolling mill. In addition, since the yield strength decreases as the thickness increases, the beams must be thermally treated. To achieve the required mechanical properties, such as high yield strength, improved toughness (at low temperatures), and good weldability, in-line thermal treatment is essential, since normalizing rolling routes are unable to achieve these mechanical properties for the finished products.

Thermo-mechanical beam rolling, selective flange cooling, as well as quenching and self-tempering (QST) processes for beams were developed and introduced back in the 1990s. Thermo-mechanical rolling is used for thinner beams, and QST for thick-flange beams, while selective flange cooling is used for both applications. Hence, the economical production of beams with increased tensile properties, excellent toughness, improved weldability, and low operating costs, and the reduced cost for alloying elements in steelmaking, is now possible.

SMS group's design of such in-line treatment facilities is distinguished by its flexibility for use with the entire product range recipes for different beams and grades, generated using a so-called BeamCool process model, however without the need to change equipment for varying beam sizes.

Due to the thickness of the flanges and web, it is not possible to cut the jumbo beams to length in cold conditions or straighten them by roller straightening. Indeed, despite the fact that SMS group built the world's largest CRS straightening machine for the heavy section mill at Masteel in China, the jumbos still need to be gag pressed.

Hot sawing is required for cut-to-length operations. The hot saws are distinguished by large saw blade diameters and high drive power.

In the last five years, SMS group has built a heavy section mill for jumbo beams in China, and another is under construction in North Africa. In addition, two heavy section mills were revamped in the USA and Korea. This underlines the increasing demand for these products.

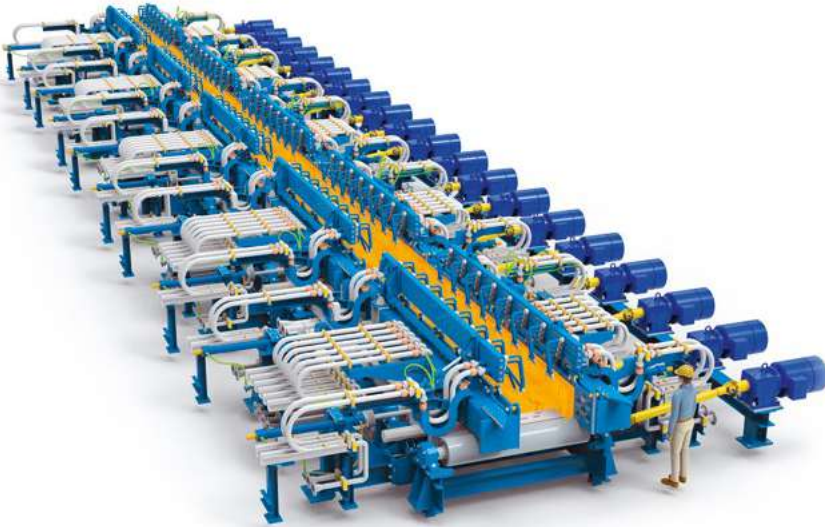
Combining integrated services is the key to plant efficiency

By pooling our expertise, we can offer customized plant optimization systems and holistic system solutions that enable plant operators to make accurate predictions about production processes, product quality, and plant condition based on machine learning. We combine all competencies from the areas of electrics/automation, digitalization, and technical service in order to maintain and expand the performance of customers' →

140

MILLIMETERS
is the maximum thickness of
jumbo beams that can be
produced on our rolling mills.

Typical quenching module that can be applied to the entire beam program.



plants over their entire lifecycle. Working with customers, we develop integrated solutions that are specifically tailored to their requirements, focusing on key performance indicators such as plant availability, product quality, productivity, delivery reliability, and sustainability.

By combining integrated services with performance-oriented business models, SMS group is a long-term partner for its customers and helps them to concentrate on their core competencies.

Electrical and automation systems

Our modular X-Pact electrical and automation packages are especially designed to meet the process requirements of jumbo section mills and ensure that all plant components complement each other perfectly.

As part of the X-Pact product family, the next-generation technological control system enables process control in real time and optimized product dimensions. Alongside the proven, well-known functions such as Hydraulic Gap Control (HGC) and Automatic Gauge Control (AGC), the X-Pact Minimum Tension Control

(MTC) ensures minimal tension on the material between the stands, and the X-Pact Screw Down Optimizer shortens the adjusting time of the AGC cylinders between runs.

The automation systems are developed and tested in the test centers in Mönchengladbach. The combination of the optimized control systems and process technologies enables efficiently controlled production.

SMS group implements its vast technological experience in X-Pact products, solutions, and functions for long products and so provides an excellent basis for digital applications.

Digital solutions enable a high degree of plant autonomy

SMS group develops innovative solutions for the digital transformation age and Industry 4.0. Benefiting from state-of-the-art development methods, our software solutions for asset optimization, product quality, production, planning, energy, and sustainability management as well as infrastructure solutions actively contribute to saving money, increasing profitability, and conserving resources.

Technical service guarantees a successful plant lifecycle

As a lifecycle partner, SMS group supports its customers for the entire lifespan of their plants. If spare parts, modernizations, customized maintenance measures, or individual training programs are required, experts are available at more than 50 locations worldwide to offer service packages that are tailored to individual needs and cover the whole metallurgical process chain. SMS group benefits from its combined expertise to provide exactly the services needed on time, on budget, and in the right quality. With tailor-made services, SMS group ensures that downtimes are reduced, productivity is increased, and the plant is optimally equipped to cope with changing industrial conditions in the future. ●

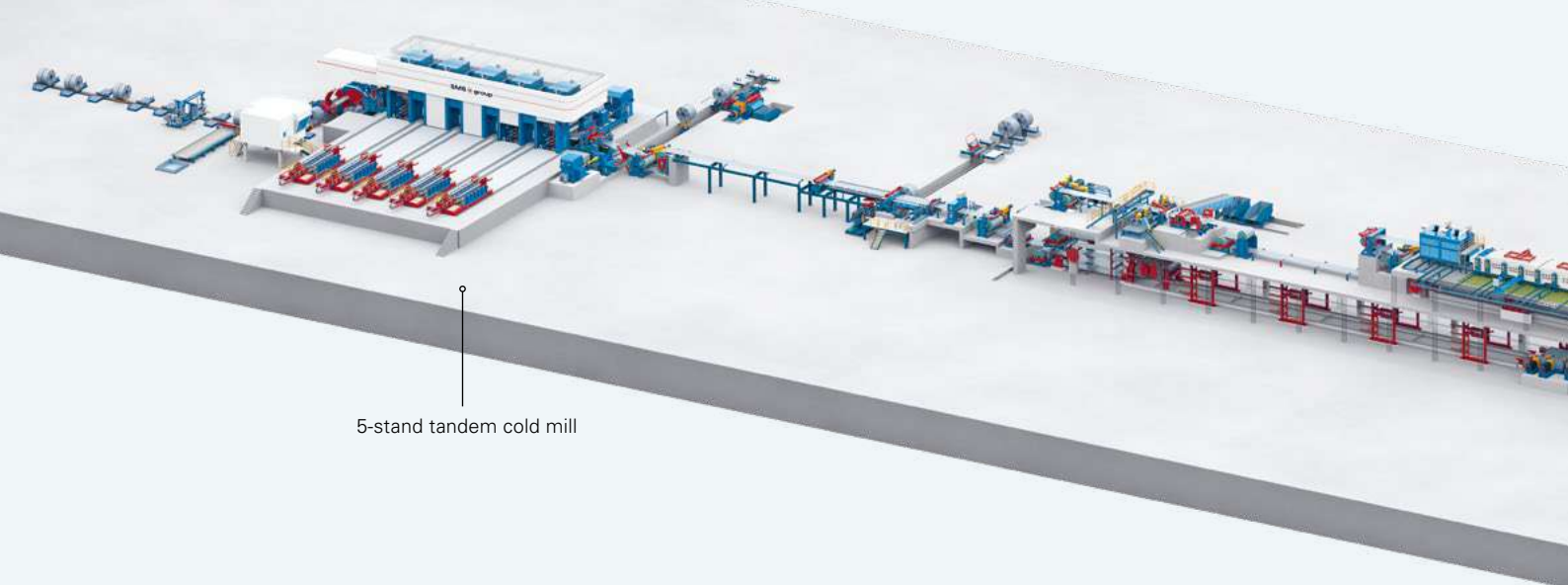


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Growing thinner is a challenge



When the market calls for thin flat rolled strips for a variety of applications, we deliver! SMS group offers plant and process technology packages to produce high-quality thin hot rolled strips in conventional hot strip mills as well as high-productivity cold rolling solutions for ultra-thin strips with excellent product quality.



5-stand tandem cold mill

CONTINUOUS COUPLED PICKLING TANDEM ROLLING MILL (PL-TCM)

The thin-gauge toolbox is hot

Rolling thin-gauge hot strip presents both opportunities and challenges. Higher prices are paid for thin strip dimensions due to the increased challenges and risks associated with their processing. Disruptive cobbles, unscheduled roll changes, and downtimes are a significant concern.

To address these challenges, SMS group offers mechanical and automation packages as part of a “toolbox” for improving process stability in hot strip mills. The toolbox includes fast mechanical actuators and control elements, mechatronic packages and sophisticated process models, well-designed strip-guiding systems, and advanced strip steering control modules to ensure straight transfer bars and stable thin-strip rolling.

Rolling low-carbon thin-gauge strips at high speeds within the austenitic temperature range brings with it metallurgical and process challenges. The use of a coilbox helps to maintain a nearly constant strip temperature during rolling, whereas without a coilbox, temperature losses at the strip end require process acceleration to reach the final rolling temperature. The SMS coilbox provides a heat balance above the transformation temperature, ensuring consistent mechanical properties of thinner gauges. To mitigate temperature losses, HIBOX heat insulation hoods can be used. By implementing hold-down blowers and narrow-pitch roller tables, the demand for high process speeds is taken into consideration. Sophisticated and holistic process models for temperature, profile, contour, and flatness, as well as advanced control systems for thickness and mass-flow, help stabilize the rolling behavior and enable the production of thinner strips or higher-strength steel grades.

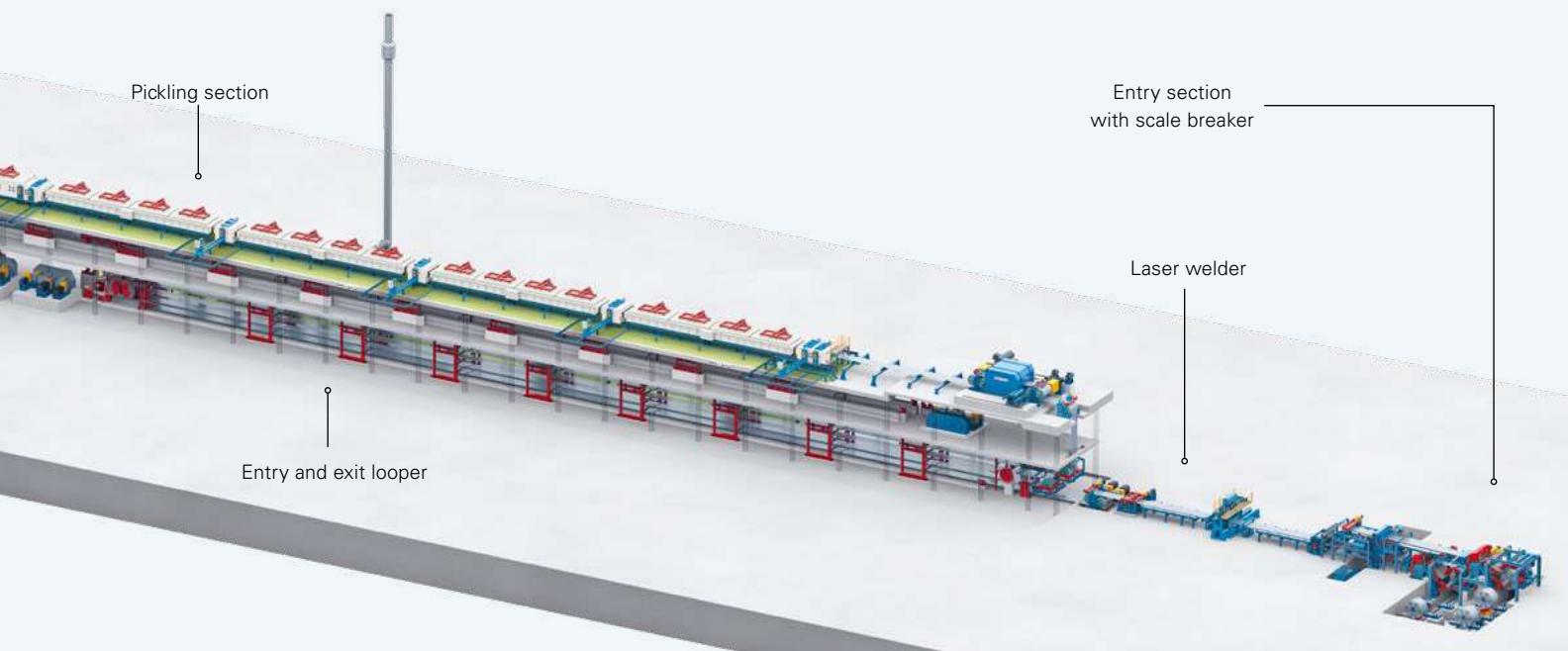
Steering malfunctions can cause ripped tail ends, which occur when the strip moves off center, turns, and is rolled double thick or with breaks. SMS group’s X-Roll Guide System ensures a straight and wedge-free transfer bar and improves control in the finishing mill area. The system includes roll alignment control strategies,

side guiding mechanical equipment, and camera-based measuring systems for real-time feedback on the strip position. X-Pact Centerline Control offers integrated strip guidance and is crucial for the stability of the rolling process, especially for high-value thin-gauge and high-strength materials. It reduces the number of unplanned roll changes and supports the operator by suitable visualization.

For strip center measurement, the system uses X-Pact Sense hotCAM designed against harsh environmental conditions like high strip temperature, fog, steam, dust, and vibrations. X-Pact Centerline Control uses a closed-loop algorithm to calculate the strip center line deviation and provides a levelling correction signal for the mill stands. A smooth transition between the control actions in the different phases is ensured. These advancements help to make the rolling process fully automatic and improve rolling stability throughout the hot strip mill. All X-Roll Guide systems can be understood as performance modules combining reliable mechanical actuators, sensors, and automation systems with appropriate control loops and tracking functions. These mechatronic systems are controlled and adapted with corresponding measuring devices. They can be integrated in an existing rolling plant as a whole unit or in packages. Each module comes with specific advantages and helps to increase the rolling stability and yield of a hot strip mill.

Handling with care – thin-gauge rolling in a tandem cold mill

Producing strip with a final thickness of below 0.25 mm is a demanding task for a fully continuous pickling line and tandem cold mill (PL-TCM). The



challenges of the continuous process include avoiding frequent strip breaks as well as taking into account the higher demands with regard to production planning and process control and the increased maintenance involved.

SMS group recently implemented two PL -TCMs in Asia. The five-stand arrangement with hydraulic screwdowndown system provides the necessary reduction capacity in order to achieve a final thickness of 0.16 and 0.18 mm as well as the desired production volume. The 6-high stands ensure perfect flatness control independent of incoming hot strip profiles. The equipment includes CVC plus systems on intermediate rolls, work rolls, and positive/negative bending systems for the intermediate rolls. The last stand features a multi-zone cooling system. Both mills (maximum strip width 1,350 mm and 1,560 mm) are capable of rolling at 1,800 meter per minute.

Challenges and solutions

The main challenges in rolling thin gauges are avoiding strip breakage, ensuring fast rolling speeds, and maintaining the reproducibility of rolling conditions. Essentially, these are guaranteed by reliable mechanical equipment, automation systems for smooth operation with almost no operator intervention, perfect mass flow and flatness control, precise adjustment of the draft distribution and emulsion parameters, special handling provisions for thin strip in automation mode, as well as high-level maintenance and process knowledge.

The skills and competencies required to operate a PL -TCM for such applications include ongoing operator training, a particular focus on equipment maintenance, and ensuring stable work roll quality with roll grinding procedures. Design aspects such as achievable flatness results, cooling systems, and emulsion system stability to keep the work roll and strip temperature within set limits are important too. The careful selection of measurement devices is also relevant in this context.

Regarding process automation, SMS group's widely proven X-Pact automation solutions with powerful level 2 process models are imperative when rolling thin-gauge strip. It must at least include X-Pact Pass Schedule Calculation for the generation of optimal set points and X-Pact Profile, Contour and Flatness Control for the CVC plus system and the bending system. Final strip flatness control is assured through the interaction of the reliable and precise X-Shape Flatness Measurement roll and control equipment in the mill. With CVC plus, bending and multi-zone cooling is dynamically controlled based on the measured shape. When rolling thin gauges, the interstand flatness plays a more important role in the rolling process. Excessively high edge tension, in particular, can cause strip breaks. The technological models calculate the setup values for the actuators together with the parameters for acting on dynamic disturbances, such as roll force variations, and ensure the requested flatness in the mill. All this emphasizes the role of automation in dealing with sensors and actuators, providing for perfect thickness and mass flow control, and the specialized strategy for handling thin strips during transfer to the tension reel.

The technological tasks involved in rolling thin strips at high speed focus on the adaptation of the emulsion conditions, roll roughness, and tensions. The characteristics of the emulsion used and the influence of various parameters have to be considered. Establishing a stable working point and addressing chatter issues is also essential. If all these measures are implemented, strips with a thickness of under 0.25 mm can be handled with special care and the highest yield levels can be maintained. ●

Hot isothermal forging

Our new hot isothermal forging line represents decades of experience in the design and construction of hydraulically driven closed-die presses, used for both conventional and hot-die forging, and vacuum and furnace technology, coupled with our comprehensive tool expertise from which the industry is set to benefit considerably. It is an intelligent solution for producing turbine parts for the aircraft and aerospace industry and for manufacturing high-temperature components for power plant turbines under vacuum.

In the world of advanced manufacturing, the emergence of isothermal forging plants marks a significant milestone. This leading-edge technology is designed to manufacture workpieces with near-net-shape precision, all within a controlled, constant high-temperature environment. The advantage of this process lies in its execution under vacuum conditions, with both the tools and workpieces maintained at constant forging temperature.

The aerospace and energy sectors, among others, require components capable of withstanding high mechanical and thermal stresses. To meet these requirements, innovative materials must be used to produce the large components involved. This emphasizes the importance of cost-effective solutions that bring substantial savings and make isothermal forging plants a smart investment decision.

Up to now, isothermal forging lines were developed by the aerospace industry suppliers themselves. They used their own knowledge to meet the certification requirements of aircraft turbines and aerospace industry material

qualities. These suppliers procured the individual units, such as the isothermal forging press, vacuum chamber, and heating unit, as well as the isothermal tools themselves, to develop all the interfaces.

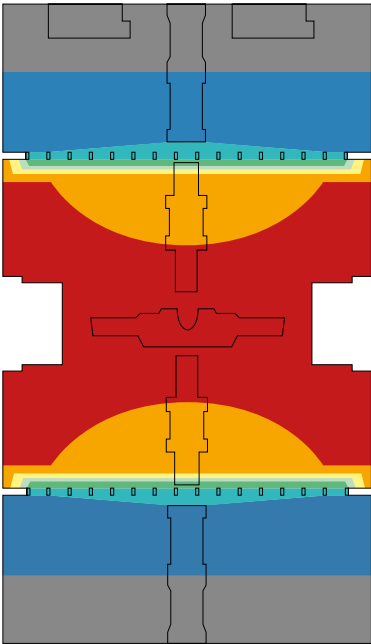
Elevating industry standards through integration

We combined our experience in forging press equipment with our proven vacuum technology used in secondary and tertiary metallurgy, a standard feature of these isothermal forging plants. The integration of the tool tower (die stack) and state-of-the-art heating technology along with our process expertise has produced an optimal system capable of processing a diverse range of future materials.

Concept and features

The hot isothermal forging (HIF) line is seamlessly integrated without any interfaces. Our innovative approach is based on the round, multi-vacuum chamber design.

DIE STACK HEATING (IN °CELSIUS)
IN THE HIF LINE



1,120	580
1,100	470
900	360
800	250
690	

FEATURES

1. Hydraulic closed-die forging press
2. Loading and unloading chambers with integrated furnaces for heating the workpieces
3. Unique charging chamber with integrated manipulator
4. HIF chamber with combined heating furnaces for the upper and lower dies
5. Tool chambers for exchanging the upper and lower dies
6. Vacuum slide gates
7. Charging chamber with integrated handling cars for upper and lower dies



Hot isothermal forging line (HIF)

In the HIF line chamber, a stable synchronization of temperatures between the workpiece and the dies is maintained throughout the entire forging process. Achieving this balance is possible thanks to the use of vacuum heating furnace technology, which heats both the upper and lower dies and the workpiece.

One notable innovation is the utilization of ceramic blocks for thermal insulation of the tools. These ceramic blocks are highly effective, particularly under the tremendous forging forces. Moreover, the insulation plays a crucial role in protecting the press components from excessive heat.

The hydraulic system in the forging press is characterized by tightly controlled strain rates, which enable precise speed and force control. This system is designed with an energy-saving concept in mind and boasts a dynamic behavior system for the hydraulic unit, thereby optimizing the overall performance.

Heating furnaces are equipped with multi-zone heating elements, allowing for precise temperature control and uniform heating. To guarantee optimal quality of the final product, a monitoring system

is implemented for both the workpiece and the dies.

The vacuum unit with integrated mechanical vacuum pumps and filter units achieves the required vacuum level for the HIF process.

The power management system includes the power supply for the furnaces as well as ancillary supply and operating facilities, ensuring seamless operation throughout the forging process.

To oversee and manage the entire HIF line, a control and monitoring system, integrated into a broader digitalization framework, is used. Additionally, the system is supported by our “Management Information Diagnostic Indication System” digital platform, thus enhancing the overall efficiency and reliability of the forging process. ●

BENEFITS

- Precise forging
- Strict temperature control within a narrow range
- Prevention of redox reactions
- Elimination of potential negative material properties such as macrostructure and micro-crack formation
- Optimization of the metallurgical parameters
- Large turbine discs easier to produce
- High degree of automation
- Safe and rapid certification of processes, resulting in lower costs for the aerospace industry



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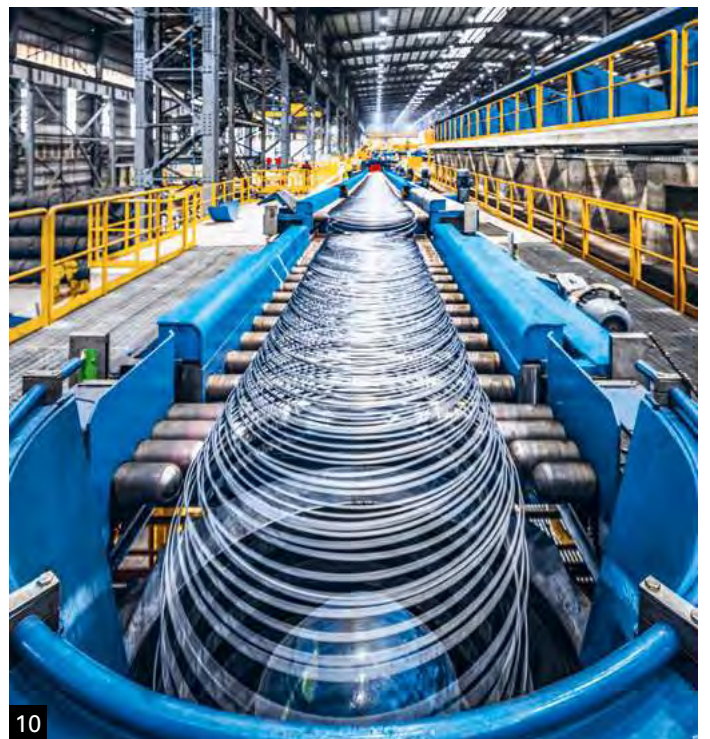
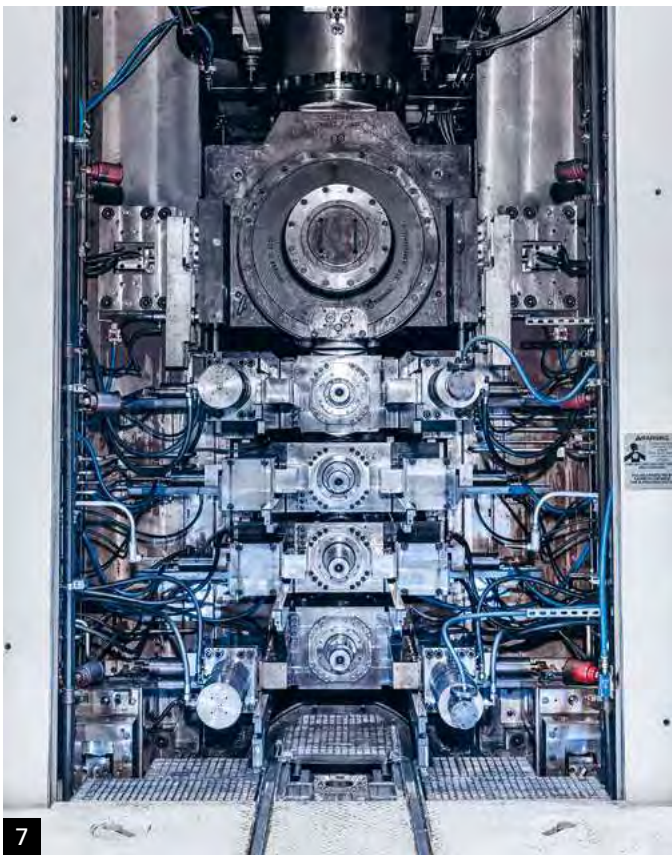


Success stories

Your projects are the heart of what we do. Each project is unique and gets our full attention. Here we showcase a selection of latest orders and start-ups. For a complete list, please visit www.sms-group.com/success-stories



1 SULB, 2 JIULI, 3 TATA STEEL, 4 TUFLESA, 5 PT GUNUNG RAJA PAKSI, 6 OUTOKUMPU, 7 INNER MONGOLIA CHUANGYUAN PLATE



8 SALZGITTER FLACHSTAHL, 9 AURUBIS, 10 FABRIMETAL

Orders and start-ups

First powder atomization plant put into operation



Inauguration of the powder atomization plant, attended by Hendrik Wüst (Minister of State of North Rhine-Westphalia), Marten Franz (Head of Powder Business, Outokumpu Oyj), Thomas Anstots (Head of Business Line Advanced Materials, Outokumpu Oyj), and Thomas Hansmann (Member of the Managing Board and CTO of SMS group)

In August 2023, Outokumpu Oyj officially inaugurated the powder atomization plant supplied by SMS at its Krefeld site in Germany. Outokumpu will use the plant to produce high-quality metal powder made of stainless steel for additive manufacturing. "The new plant is an important building block in the forward-looking positioning of this location and the first step toward our long-term goal: to support our customers by providing expertise, developing new sustainable materials, and by demonstrating our flexibility and adaptability for different powder metalurgy technologies," says Thomas Anstots, President of the Advanced Materials business line at Outokumpu.

For SMS, the commissioning is a milestone since the start of its additive manufacturing business in 2017. It was within this framework that, among other things, the pilot plant was built in Mönchengladbach for developing and expanding know-how in the field of powder production.

The facility in Krefeld is not only the first powder atomization plant delivered to a customer, but also the first one that we operate as Equipment-as-a-Service. According to this business model, SMS group remains the owner of the powder atomization plant, and Outokumpu, as the plant operator, remunerates us pro rata based on the quantity of stainless steel powder produced. This perfor-

mance-based form of contract clearly illustrates the new horizons that we are exploring with our customers.

The powder atomization plant, featuring an induction melting unit, atomizer, two cyclones, and filters, is designed such that the whole process takes place in an inert atmosphere. Steel scrap from Outokumpu's production process is used as feedstock.

"This pioneering plant represents a significant step forward in the development and processing of metals, particularly for 3D printing, and is setting new standards in the industry," explains Thomas Hansmann, CTO of SMS group. "The close collaboration between two visionary companies, which combined their extensive know-how and technological expertise, has resulted in this unique solution for producing high-quality metal powder here at Outokumpu."

CUSTOMER

Outokumpu, Germany

SUPPLY

Metal powder atomization plant

STATUS

Start-up in 2024

HIGHLIGHT

Performance partnership based on subscription model

Largest round blooms
in India



Saarloha orders a caster for sections and blooms.

Saarloha Advanced Materials Pvt. Ltd., a Kalyani Group company, has ordered a continuous casting plant to produce India's largest round blooms at its facility in Pune, India. The new caster is designed for section sizes of 160 x 160 to 340 x 400 mm and with a round diameter of 500 mm. It will be equipped with state-of-the-art technology for enhanced cast product quality including CONGAUGE, the patented mold level control system that also measures and controls the mold powder thickness along with the liquid steel level, CONDRIVE (mold oscillator drive) with servo drive for improved surface quality, as well as the mold and electromagnetic stirrers.

CUSTOMER

Saarloha Advanced Materials, India

SUPPLY

Bloom caster

STATUS

New order, start-up in 2024

HIGHLIGHT

Largest cast round in India with a diameter of 500 mm

Start-up of high-end aluminum
cold rolling mill



NCA operates a 6-high CVC plus aluminum CRM.

In February 2023, the new 6-high CVC plus aluminum cold rolling mill (CRM) at North China Aluminum New Material Technology Co., Ltd. (NCA) in China successfully rolled its first coil. NCA is a flagship of China's aluminum foil industry. With the new mill, NCA is able to produce up to 80,000 tons per year from soft to hard aluminum grades in widths between 1,000 to 1,800 mm and a minimum thickness of 0.1 mm. One highlight is the super-efficient inductive edge heating system developed by SMS group to prevent tight strip edges. Our scope of supply included latest-generation X-Pact electric and automation system as well as a Multi-Plate filter.

CUSTOMER

North China Aluminum New Material Technology, China

SUPPLY

Single-stand aluminum cold rolling mill

STATUS

In operation, start-up in 2023

HIGHLIGHT

First coil after 18 months only

Two high-speed open-die
forging presses for Saudi Arabia



Tuwaik Casting & Forging will be Saudi Arabia's biggest casting and forging plant.

SMS group supplies two open-die forging presses to Tuwaik Casting & Forging, a new joint venture between Doosan Enerbility, Saudi Arabian Industrial Investments Company, and Saudi Aramco Development Company. The two presses will be used to forge highly stressed parts for pumps and valves for petrochemical plants, and components for shipbuilding, wind farms, and power stations. For reproducible forging results, pass schedules can be pre-calculated using the ForgeBase technology software. Digital solutions will help to increase process transparency and plant availability while reducing maintenance costs to a minimum.

CUSTOMER

Doosan Enerbility, Korea

SUPPLY

Two open-die forging presses (40/45 MN and 20/22.5 MN)

STATUS

New order, start-up in 2024

HIGHLIGHT

Tuwaik Casting & Forging will be Saudi Arabia's biggest casting and forging plant

Next-gen X-Pact system replaces automation technology in hot strip mill



ArcelorMittal Tubarão and SMS group celebrate the start-up.

SMS group has successfully upgraded the automation system at ArcelorMittal Tubarão's hot strip mill that was delivered by another supplier 20 years ago. Due to intensive preparations and close cooperation with ArcelorMittal Tubarão, we were able to do the upgrade during the regular annual shutdown. The automation system was raised to a new technological level with X-Pact Embedded controllers and a high-speed EtherCAT I/O system. Our range of services included state-of-the-art X-Pact electrical and automation technology that guarantees digital readiness, which is essential for getting production units and automation systems ready for digitalization with a minimum of effort.

CUSTOMER

ArcelorMittal Tubarão, Brazil

SUPPLY

Modernization of automation system

STATUS

In operation, start-up 2023

HIGHLIGHT

Modernization of third-party automation system during regular annual shutdown

Second-largest cold pilger mill goes to Tubacex



Tubacex invests in OCTG business.

Tubacex S.A., a global manufacturer of seamless stainless steel tubes, has placed an order for a cold pilger mill, type KPW 290 L, at its new greenfield site close to Abu Dhabi. Our relationship with Tubacex stretches back almost five decades, and the two partners have already completed a large number of successful projects. The investment in a new cold pilger mill is part of Tubacex's strategy to increase its proximity to end users in the Gulf region and to serve the growing demand for gas extraction in sour environments, which requires the use of corrosion-resistant stainless steel tubes.

CUSTOMER

Tubacex, United Arab Emirates

SUPPLY

Cold pilger mill KPW 290 L

STATUS

New order, start-up in 2024

HIGHLIGHT

Second-largest cold pilger mill supplied by SMS group

Cooperation to accelerate digitalization



Dillinger and SMS group sign cooperation agreement.

Aktien-Gesellschaft der Dillinger Hüttenwerke and SMS group have announced a cooperation agreement to optimize blast furnace operation by modeling and digitalizing logistics processes. The Advanced Raw Material Tracking will include three digital models that track the bulk materials along the burdening-to-blast furnace process chain. This enables the blast furnace process to be controlled more precisely. Dr. Peter Maagh, Chief Operations and Technology Officer at Dillinger: "So far, the models have demonstrated the system's ability to adapt quickly to changes in feedstock qualities. Their implementation has led to more efficient logistical planning."

CUSTOMER

Aktien-Gesellschaft der Dillinger Hüttenwerke, Germany

SUPPLY

Digital models to optimize blast furnace operation

STATUS

Cooperation agreement

HIGHLIGHT

Advanced Raw Material Tracking for improved blast furnace charging and process control



Looking for more news? You find all new orders and start-ups on our website: www.sms-group.com/success-stories

Two aluminum cold rolling mills for China



Inner Mongolia Chuangyuan Plate signed the contract at Metec trade fair.

CUSTOMER

Inner Mongolia Chuangyuan Plate, China

SUPPLY

Two 6-high CVC plus aluminum cold rolling mills

STATUS

New order

HIGHLIGHT

Complete supply with latest-generation X-Pact electric and automation system

Inner Mongolia Chuangyuan Plate Co., Ltd. awarded a new contract on the supply of one complete set of a 1,850 mm 6-high CVC plus aluminum cold rolling mill and one complete set of a 2,300 mm 6-high CVC plus aluminum cold rolling mill.

Inner Mongolia Chuangyuan Plate is fully owned by Shandong Innovation Group. Founded in 2002, Shandong Innovation Group now possesses more than 20 subsidiaries and ranks No. 1 in aluminum downstream by capacity in the world. With the new cold rolling mills from SMS, Shandong Innovation will further strengthen its market positioning in the flat products area and produce in a wide range of alloys, from soft to hard

grades and to a minimum final thickness of 0.1 mm.

SMS group supplies the mills in the 6-high CVC plus (Continuous Variable Crown) design complete with entry and exit area equipment, including pay-off and tension reel as well as all the relevant equipment for coil and sleeve handling and the required fluid systems. The state-of-the-art X-Pact Level 2 setup system from SMS group provides optimal roll gap settings and the technological control systems ensure the tightest thickness and flatness tolerances. The multi-zone cooling system adds the finishing touch to excellent flatness results.

One highlight is the super-efficient inductive edge heating system to prevent

tight strip edges, a defect frequently seen during the aluminum cold rolling process. The system ensures highly accurate heating of the work rolls in the strip edge area. Compared to other hot edge-preventing systems on the market, inductive heating operates with far less energy.

SMS will equip the mills with the latest-generation X-Pact electric and automation system, comprising operating and sequence controls as well as controls for ancillary components. The advanced visualization concept behind the X-Pact Vision HMI, which boasts integrated faceplate technology, ensures harmonized operator guidance as well as safe and convenient operation of all the equipment.

The most modern galvanizing line in Europe

What is the strategic approach to becoming one of the leading companies for the production of steel and technology products in Europe? Focus on quality and high-growth markets – with SMS group technology and plant engineering expertise.

Our customer Salzgitter Flachstahl is a significant player in the steel industry. Committed to sustainability and innovation, they are a high-quality steel producer in Europe. But they're still aiming high, with ambitious goals in key strategic markets. To get there, they looked to SMS group and our technology to build a state-of-the-art hot dip galvanizing line in Salzgitter. This was no ordinary project for the company. They were looking for a leading-edge line that would keep pace with the ever-evolving demands on materials from products

and markets for the coming decades while meeting Salzgitter's high standards for environmental performance – the new line incorporates several sustainability features, such as a waste heat recovery system, which captures and reuses energy generated during the annealing and galvanizing process. Salzgitter's financial commitment to this project reflects its ambitious goals. The hot dip galvanizing line no. 3 project (FV3) is the single largest investment Salzgitter Group has made in the last ten years.

The opportunity

So where are these new and sophisticated grades of steel primarily needed? A major chunk of the opportunity for these materials comes from the automotive sector. The industry continues to grow and has an increased demand for galvanized steel because of a focus on lighter weight, improved fuel efficiency, and the increasing focus on battery-electric vehicles, as well as the need for greater safety and durability. Its latest body-in-



Salzgitter Flachstahl is Europe's most modern galvanizing line.



Matthias Kretschmer (SMS group), Michael Brühl (Salzgitter Flachstahl), and Holger Behrens (SMS group) after their talk at Metec 2023

white components require high-strength and ultra high-strength steel grades such as micro-alloyed steels, dual-phase steels, and multiphase steels with stringent requirements for reliable surface quality. In addition to the automotive industry, Salzgitter identified other growth opportunities in the household appliance and construction industries. Galvanized steel is the base material for the manufacturing of a wide range of products like refrigerators, washing machines, and ovens. The new line's ability to produce high-quality, durable galvanized steel will meet and exceed the needs of this industry and help grow Salzgitter's customer base in this sector.

Evolution built-in: the technology

The new galvanizing line is perfect for higher-strength steels. It supports enhanced formability and, therefore, more complex component geometries – all vital criteria for the materials that will be in demand as Salzgitter's customers continue to innovate. To achieve the required product properties, Salzgitter relies entirely on SMS group technology. In addition to the design and production of the mechanical equipment and the complete electrics and automation package, the furnace and process technology were a decisive part of the SMS group scope. Several key technologies stand out in that respect:

> Drever annealing technology: To manufacture advanced high-strength, multiphase, and complex phase steel grades with tensile strengths of up to and greater than 1,000 MPa exceptional cooling performance is required. The Drever ultra-fast cooling system for ultra high-strength steel grades delivers unmatched cooling rates of more than 200 K/s per 1 mm strip thickness. It does so by taking advantage of hydrogen's low density, high thermal conductivity properties. The unique feature of the patented ultra-fast cooling system is the addition of pure hydrogen (instead of a state-of-the-art nitrogen-hydrogen mixture) directly into the cooling chamber, pushing the hydrogen content up to 50% to achieve enhanced cooling performance without extra hydrogen demand in the other furnace areas.

> PrOBBOX technology: Depending on the alloying concept used, surface oxides can diminish the adhesion of the metal coating. Full wettability by molten zinc is challenging, especially for the steel compositions required for ultra high-strength steel grades. To ensure the highest possible surface quality, the annealing furnace is equipped with our PrOBBOX technology for pre-oxidation. The controlled infusion of air into the PrOBBOX chamber creates a closed iron-oxide layer on the surface. This barrier suppresses the silicon and manganese migration to the surface, which otherwise would lead to the production of their oxides at the surface preventing wettability by molten zinc. The thickness of the oxide layer produced is mainly influenced by temperature. The tight control of the PrOBBOX technology for pre-oxidation facilitates galvanizing high-alloyed high-strength steel grades eliminating zinc wettability issues.

> Air-knife: The Duma-Bandzink air-knife system achieves optimal setting of the coating uniformity and a high surface quality. To that end, the air-knife system is equipped with optimized components and new constituents that enhance product quality and productivity and reduce the consumption of zinc and energy.

Partnership: the critical success factor

On paper, SMS group and Salzgitter Flachstahl were already ideal partners. SMS group brought the ability to create and realize complex technological solutions to the table. Salzgitter adds the experience of successfully operating complex strip processing lines and succeeding in a competitive market environment with sophisticated products. But the project leadership from both companies recognized

CAPACITY

500,000 t/year

STRIP THICKNESS

0.7–2.5 mm

STRIP WIDTH

900–1,700 mm

PROCESS SPEED

150 m/min

MATERIALS

SS, HSLA, IF, HSIF, BH, DP, CP

that more than expertise, know-how, and talent was needed to drive a pioneering and ambitious project like this over the finish line. Michael Brühl, Director of Cold Rolled Flat Products at Salzgitter Flachstahl, and Holger Behrens, Executive Vice President of Flat Products at SMS group, talk openly about what counts. Mr. Brühl points out the importance of total transparency: "It's especially important when there are disagreements and things are not going perfectly. We made sure that everybody on the team knew it was not just okay to say when they didn't have a solution to a problem – it was expected. We would then take the problem to the next level of management of expertise, work on it, find a solution, and feed it back to the teams, all the while keeping them moving and productive." Holger Behrens adds: "For that to happen, you need an atmosphere of trust. We did that by creating open communication channels on all team levels, where everybody could bring up critical issues or challenges at any time. The goal was to be solution-driven as a team – you can only do that when everyone is aware of the obstacles and discusses them openly. Trust is a crucial success factor."



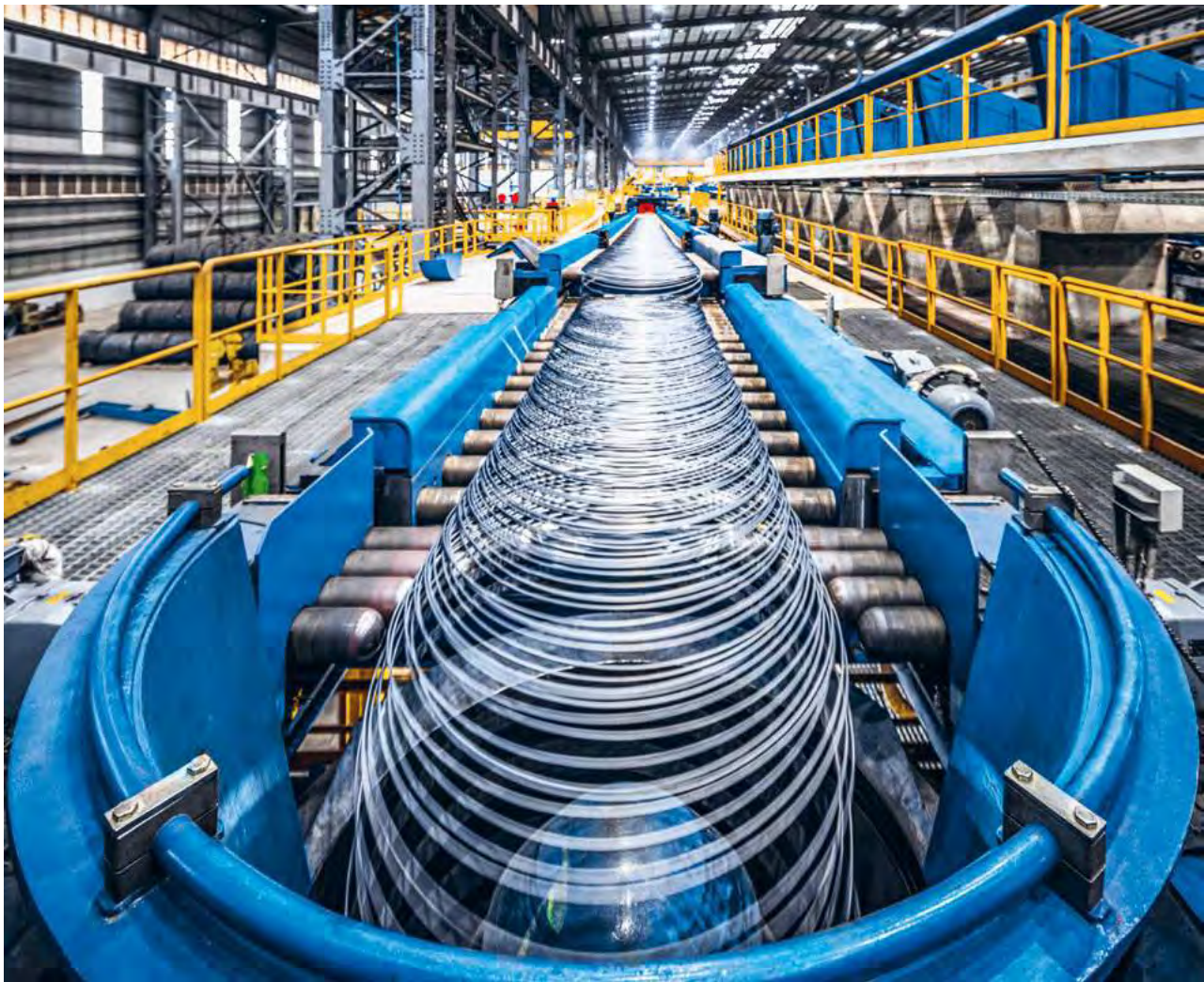
See the Leading Partner Talk with Salzgitter Flachstahl at Metec 2023:



Dreams of steel: Fabrimetal's pioneering Senegal project

What makes a success story? Of course, it takes modern technologies and determination. But it's also about cooperation and mutual understanding, as the project with Fabrimetal in Senegal shows.

Fabrimetal will produce 350,000 tons of rebar and wire rod per year.



Mounir Kavar is a busy man on a thriving continent. He is a partner and CEO of MMD & K4 Investments, a large, diversified enterprise with companies in various African industries. One of those companies is Fabrimetal, MMD's steel business brand with a presence in nine African countries and 4,000 employees. They produce high-quality steel bars for the burgeoning construction industry in Africa.

The site of Fabrimetal's newest investment and their partnership with SMS group is in Senegal, a country dear to Kavar's heart – he was born there, and his family has been there for three generations. So for him, investing in Senegal is a personal connection that is about giving back as much as it is about smart business. Indeed there are compelling business reasons for operating in Senegal. Located on the Atlantic Ocean in West Africa, it boasts abundant resources and serves as a strategic trade access point for its landlocked bordering countries and beyond.

A move towards quality, sustainability, and efficiency

The new bar and wire rod mill Fabrimetal commissioned SMS group to build in Senegal's capital Dakar is the first joint project for the two companies and part of Fabrimetal's evolution as a steel producer. Already actively producing rebar and wire rod in six other African countries, the company had long sought an opportunity to make a significant move towards better quality, more sustainability, and higher efficiency by building a state-of-the-art facility in a strategic market. When their research to find a suitable partner for making their dream a reality led them to SMS group, they felt at home right away. Mr. Kavar stresses the human connection between the companies as a crucial factor for embarking on a partnership in such a vital project for Fabrimetal: "Beyond their technical expertise and experience, the deep humanity we encountered at SMS group compelled us to move forward with them as our partner in Senegal."

Agreeing with that point and praising Fabrimetal's astute market knowledge and sheer determination, Marco Asquini, SMS group CEO for the Region APAC & MEA, compares undertaking such an ambitious project in a challenging environment like

"What caught our attention is the yield now possible from the mill – we are talking about 98.5% vs. 93.5% for the mills available in the region."

— Mounir Kavar,
Partner and CEO of MMD

Africa with a marriage. He points out the importance of listening closely to Fabrimetal's requirements and adapting SMS group's processes, know-how, and experience to work well with the local conditions and challenges.

Latest rolling mill technology

The Senegal plant will employ the latest SMS group rolling mill technology, and represents a significant step up compared to what is currently available from other suppliers in the region. Mr. Kavar stresses the importance of the yield gains the company can realize with SMS group's technology: "What really caught our attention is the yield now possible from the SMS group mill – we are talking about 98.5% vs. 93.5% for the mills available in the region."

Designed to output 350,000 tons of straight bars in bundles and wire rod coils per year, the new plant enables Fabrimetal



Mounir Kavar (MMD, left) and Marco Asquini (SMS group)

to expand its product portfolio and meet the increased demand for both rebar and wire rod coils locally and in neighboring countries. The plant's state-of-the-art HSD (High-Speed Delivery System) allows Fabrimetal to quickly reach full production capacity for the whole bar line size range while considerably increasing material yield and the mill utilization factor for a much faster return on investment. Moreover, SMS group's digital-ready approach enables immediate implementation of digital solutions based on harmonized data processing. SMS group's X-Pact technology will control the entire plant, integrating billet handling and combustion control for the reheating furnace, tension automatic loop control, and rolling mill monitoring with the maintenance and diagnostic supervisor.

But Fabrimetal's vision is about more than yield, quality, and efficiency and to remain a leader in a competitive environment. The company is committed to reducing its CO₂ emissions and contributing to the sustainable development of the African continent. To that end, the parent company MMD is a significant carbon creditor and plants over two million trees across Africa annually. Working together with other stakeholders like SMS group, MMD is committed to making a substantial contribution to the global efforts to combat climate change and promote sustainability.



See the Leading Partner Talk with Fabrimetal at Metec 2023:



MISSION STATEMENT

SMS group is renowned worldwide for its forward-thinking technologies and outstanding services in the metals industry. We apply our 150 years of experience and digital know-how to continuously innovate products and processes inside and outside our industry. As a partner for the most demanding projects, SMS accompanies its customers throughout the entire lifecycle of their plants, thus enabling profitable and resource-saving value chains. Our mission is to turn metals green and to advance climate-neutral and sustainable metals production.

At a glance

MILESTONES: SIX DATES THAT SHAPED SMS



1871

Many roots – one company
Carl Eberhard Weiss starts a forging business



1904

Global reach and local expertise
We supply our first rolling mill to China



1952

A partner for megaprojects
Building the first integrated steel plant in India

KEY FIGURES (2022)

Order intake

€ 4,612 million

Sales

€ 3,139 million

Order backlog

€ 5,517 million

Employees

> 14,400

MANAGING BOARD

Jochen Burg Chairman & CEO

Fabíola Fernandez CFO (as of January 1, 2024)

Dr.-Ing. Thomas Hansmann CTO

Torsten Heising CFO (until December 31, 2023)

Michael Rzepczyk COO

Prof. Dr.-Ing. Katja Windt CDO



1989

Pioneering solutions

We invent CSP technology – a revolution in sustainability



2016

Lifecycle partner

The Learning Steel Plant – our first fully digital steel production facility



2023

#turningmetalsgreen

Shaping the future of metals and driving the green revolution



OUR REGIONS

KEY FACTS (2022)

SMS group has always been a truly international company. Today, we have around 100 offices and workshops in 30 countries representing more than 80% of global steel production.

With our regional setup, we are close to our customers to create added value and develop opportunities and growth. Our regions team up with our worldwide CoEs (Centers of Excellence) for Products and for Services as well as with the CoEs for Implementation and Supply Chain, to make your project a success.

1. AMERICAS

Team members: 2,500
Headquarters: Pittsburgh, USA
Coverage: North, Central, and South America

2. EUROPE

Team members: 6,800 (incl. SMS group headquarters)
Headquarters: Luxembourg, Luxembourg
Coverage: Europe, Turkey, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

3. APAC & MEA

Team members: 1,600
Headquarters: Gurugram, Haryana, India
Coverage: India, Africa, Middle East, Asia Pacific, Japan, Australia

4. CHINA

Team members: 1,000
Headquarters: Beijing, China
Coverage: China

OUR PORTFOLIO

Plants

Anyone who produces steel, aluminum, or copper knows SMS group. We supply the technology to produce and recycle all major metals and cover the entire process chain from the liquid phase to the final high-quality product.

METALLURGY

Portfolio: Plants for ironmaking and steelmaking, secondary metallurgy, furnaces for non-ferrous metals and alloys, melting furnaces for aluminum, environmental technology

CASTING

Portfolio: Continuous casting technology for flat and long products, casting plants for aluminum and copper

FLAT PRODUCTS

Portfolio: Hot rolling mills, cold rolling mills, strip processing lines

LONG PRODUCTS

Portfolio: Hot rolling mills, tube and pipe plants, cold finishing mills, copper rod and tube lines

FORGING

Portfolio: Closed-die forging presses, open-die forging presses, radial forging machines, ring and wheel rolling machines, powder presses

EXTRUSION

Portfolio: Extrusion presses for light metal, extrusion presses for heavy metal, tube extrusion presses

Services

We support our customers with integrated services throughout the lifecycle of their plants, enabling profitable and resource-efficient value creation.

ELECTRICS AND AUTOMATION

Portfolio: Sensors and devices, power supply, drive systems, process automation, operation and visualization

DIGITALIZATION

Portfolio: Data infrastructure solutions, asset optimization, product quality, production planning, energy and sustainability management

TECHNICAL SERVICE

Portfolio: Spare parts and logistics, maintenance and repairs, upgrades and modernization

CONSULTING AND TRAINING

Portfolio: Consulting services, TECademy

Expertises

PROJECT EXECUTION

We are a project company. The full weight of our experience, global team network, and the comprehensive expertise of our specialists go into achieving the project execution excellence our customers count on.

MANUFACTURING

The in-house production of core components and preassembly in our own workshops in Germany and abroad is central to our approach.

Beyond

As a technology company, we keep pushing ourselves toward new challenges. We apply our expertise to new fields and venture into new business opportunities.

PORT LOGISTICS

Our joint venture BOXBAY revolutionizes port logistics by bringing automated high-bay storage technology from metals production to overseas harbors.

BATTERY RECYCLING

Closing the loop and decarbonizing battery supply chains with our metallurgical know-how is the mission of our joint venture Primobius.

ADDITIVE MANUFACTURING

We are experts in the entire value chain of additive manufacturing of metals – from producing high-quality metal powder to design and applications.

COATING

Innovative coatings are true multi-talents with enormous potential. Our Coating Competence Center develops and tests new coatings until they are ready for effective industrial use.

ENERGY FROM WASTE GASES

Producing valuable energy from climate-polluting lean gases: This is the innovative approach taken by our joint venture CATALYTIC Power Solutions.



Read more online at:
www.sms-group.com

Company



Celebrating our legacy

With a series of “Family Days” at all major locations worldwide, we are celebrating the 150th anniversary of SMS group. In August, the celebrations started in Hilchenbach, where the SMS journey began. The event was more than just a party; it was testament to the strong commitment to our employees and the local community. Heinrich Weiss, who is currently Chairman of the Shareholders’ Committee and has been a central figure in shaping the success and development of SMS for over 50 years, took the stage to share his gratitude and optimism. “Our roots are here. This location has always played a crucial role. We, the Weiss family, have always valued our relationship with our employees. Without our dedicated workforce, our success on the global stage would not be possible,” Weiss said, reflecting on the decades of growth and transformation.

Following on from this event, celebrations were held in all countries and locations, from Tokyo to Pittsburgh, from Luxembourg to Belo Horizonte. The finale will be the inauguration of the new SMS Campus in Mönchengladbach. Amidst the celebrations, a central theme emerged: SMS group’s legacy is not only one of innovation and success, but also a sign of the power of human connection, community, and a relentless commitment to making a positive impact. With our past firmly rooted and our gaze fixed on the transformation of our industry, we continue to shape the future.

Starting the celebrations on stage in Hilchenbach (from left to right): Edwin Eichler (Chairman of the Supervisory Board), Kyrillos Kaioglidis (Mayor of Hilchenbach), Heinrich Weiss (Chairman of the Shareholders’ Committee), Jochen Burg (SMS group CEO as of October 1), and Burkhard Dahmen (CEO until September 31).



news



SMS chronicle

To commemorate our 150th anniversary, we commissioned renowned German historian Professor Gregor Schöllgen to write a new chronicle on the history of SMS. To this end, he dove deep into our company archives and conducted extensive interviews with Heinrich Weiss. Over 600 pages long, the book “SMS. A German Plant Manufacturer in the World (1871–2021)” provides a detailed illustration of our story so far, from modest beginnings as a forge in the Siegerland region up to the present day. It is currently only available in German, an English version will be published in January 2024.



For more information on the chronicle and the history of SMS group, please visit our website.





Marco Asquini

New head for new region

In order to strengthen our sales and service network, we have adapted our regional setup: the Region India & Asia Pacific will in future also serve customers in the Middle East and Africa. The newly formed region APAC & MEA (India & Asia Pacific, plus Middle East and Africa) will foster greater cross-collaboration between groups of local customers and investors working under one SMS Region framework. On January 1, 2024, Marco Asquini will take over as CEO of the Region and Managing Director of SMS India Pvt. Ltd. Marco Asquini joined SMS group in 2005 as President and CEO of SMS group S.p.A. Italy.



Michel Siemon

Primobius appoints CEO

As Primobius commences its transition from R&D organization to commercial plant supplier, it has also started the strategic expansion of its leadership and senior management teams. Michel Siemon has been appointed CEO of Primobius, the lithium-ion battery recycling joint venture between SMS group and Neometals Ltd. Michel Siemon has been with Primobius since the very beginning. He was responsible for setting up the joint venture in 2020 and for helping to drive its strategic positioning so far. He is also currently Head of Corporate Development at SMS group.



Trade fairs 2024

In 2024, you will find us again at trade fairs and conferences all around the world. Among the highlights are Tube & wire (April 15–19) and Aluminium trade fair (October 8–10) which both take place in Düsseldorf, Germany. But also do not forget to add the major events such as AISTech (May 6–9, Columbus, Ohio, USA), EBM Recycling Expo 2024 (June 26–27, Frankfurt, Germany), Aluminium China (July 3–5, Shanghai, China) or Metec India (November 27–29, Mumbai, India) to your calendar. You find a complete list of events at www.sms-group.com/events.

Co-development of reverse water gas shift technology

We have signed a co-development agreement with Axens and IFP Energies nouvelles (IFPEN) for the optimization of the reverse water gas shift technology (RWGS) and its integration into e-fuel projects. RWGS technology is an essential part of the suite of technologies for converting CO₂ to renewable/low carbon fuels and chemical intermediates.

The partners are collaborating to define synergies to speed up the industrialization and maturity of the enhanced RWGS technology and to optimize its operating costs and output. This is key to bringing to the market a commercial e-fuel scheme to efficiently produce synthetic fuel to help meet the global demand for sustainable aviation fuels.



Metec 2023

For five days in June, Düsseldorf was the beating heart of our industry. More than 63,000 visitors from 114 countries visited Metec 2023 and three other metallurgical trade shows on the Düsseldorf trade fair grounds. SMS group's booth in hall 1 was one of the crowd pullers at Metec and the location of many interesting meetings and lively discussions.



At our booth, we put the spotlight on #turningmetalsgreen and our solutions for sustainable and CO₂-neutral metals production. The second focal topic was our integrated services, comprising automation, digitalization, operation, and maintenance services.

Our Leading Partner Talks were a major attraction during the five-day fair. They provided the platform for inspiring talks with customers including Aurubis, H2 Green Steel, Hybar, SULB, Cogne Acciai Speciali, ElvalHalcor, Fabrimetal, Salzgitter Flachstahl, and thyssenkrupp Rasselstein. Our own SMS group experts took the stage to present new technologies, service concepts, and digital solutions.



Did you miss our Leading Partner Talks? You can find all our talks at SMS group #Connect.

Register here:
www.sms-group.com/registration

The story behind

The signpost

A signpost next to a parking lot in front of a few site containers. This photo was taken at our customer Steel Dynamics Inc. in the US in 2020, yet the sign could have been put up in many other places – near the Arctic Circle in Sweden, on the outskirts of a Chinese metropolis, in India, Saudi Arabia, Brazil, Germany, or indeed in Sinton, Texas. This is because our job sites bring together all the parts that are designed, manufactured, or programmed at our locations around the world. Our on-site colleagues turn the many individual components into a whole, putting systems into operation and bringing long projects to a successful outcome.

In our philosophy, a project does not end with its commissioning or final acceptance. In many cases, a job site becomes the place where we open a service workshop or take over the warehousing of spare parts. With our lifecycle services, our customers can rely on us as a partner who supports them with the operation of their plant, continuously providing new ways to control and optimize processes and increase the plant's performance in a challenging market environment. ●

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