

Partnership for progress:



THYSSENKRUPP STEEL EUROPE MAJOR REVAMP AND NEW-BUILD CONTRACTS FOR CORE UNITS AT DUISBURG AND BOCHUM SITES



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THYSSENKRUPP STEEL EUROPE

2 SLAB CASTERS, HOT STRIP MILL, DOUBLE REVERSING MILL

AIMING FOR HIGHER-PERFORMANCE PRODUCTS, INCREASED FLEXIBILITY, AND GREATER CUSTOMER PROXIMITY

thyssenkrupp is forging ahead with projects under its Strategy 20-30. The greater part of the contracts—a revamp of the casting-rolling line, rebuild of an existing continuous caster, both in Duisburg, and construction of a new double reversing mill in Bochum—have been awarded to Primetals Technologies Ltd.

The approved investment projects are implemented immediately to achieve positive portfolio effects as quickly as possible. Primetals Technologies succeeded with a cohesive, holistic, and innovative proposal for the revamp and new-build work.

The centerpiece of the quality offensive at thyssenkrupp Steel is the separation of the casting-rolling line at the Bruckhausen plant. With integrated casting and rolling sections, the existing 20-year-old unit's quality capabilities are no longer sufficient to meet future customer requirements.

The casting-rolling line will be replaced by a new continuous caster, two walking-beam furnaces, and a hot strip mill. This plant layout allows energy savings like a casting-rolling line but with higher flexibility in production. Hot slabs can be charged directly into the furnace and temporarily stored or forwarded for reworking to improve quality before rolling. In addition, slabs from other suppliers can be sent for rolling in the hot strip mill

Bernhard Osburg, CEO thyssenkrupp Steel:

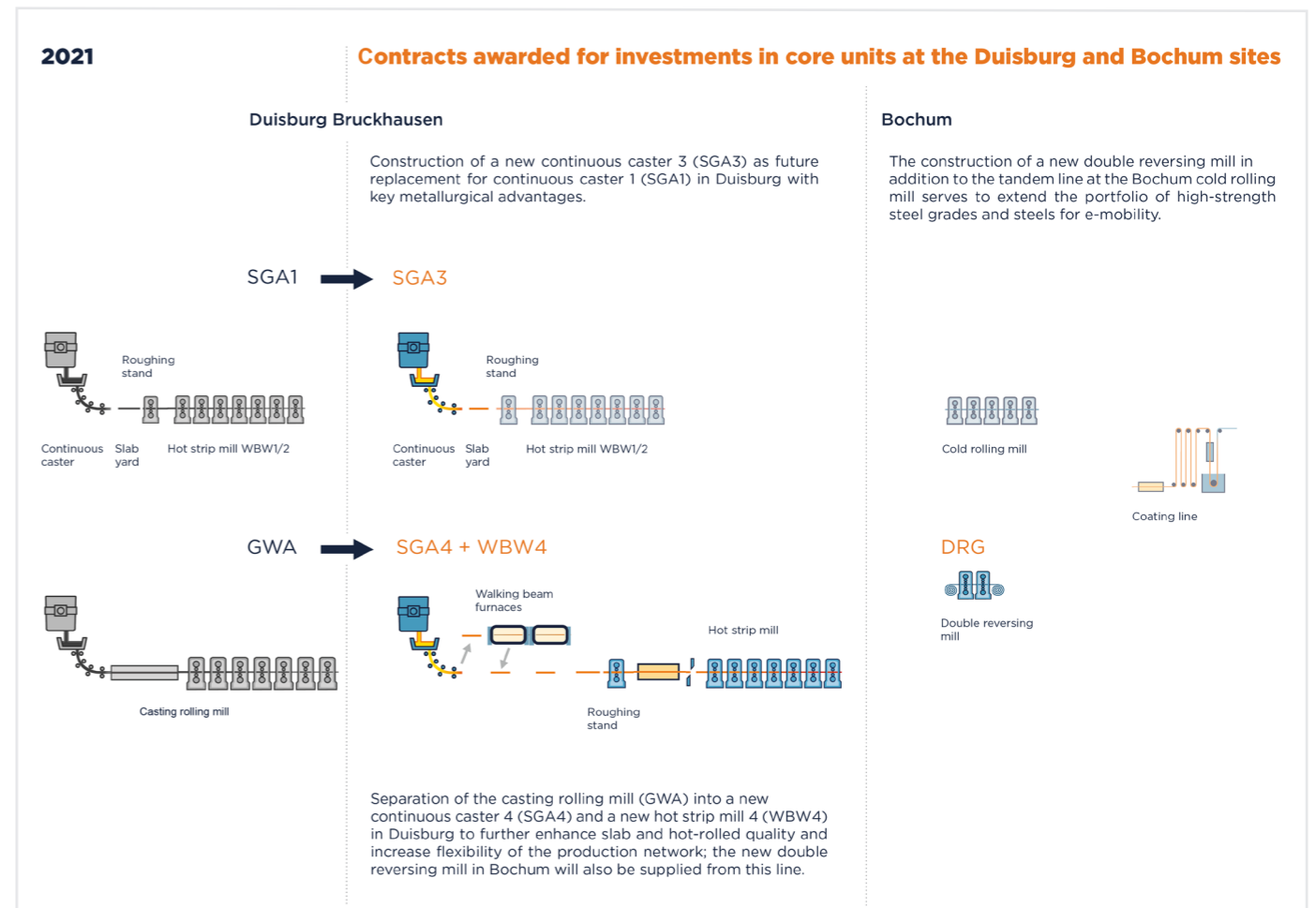
“With the biggest investment package under our Strategy 20-30, we are going on the offensive in order to maintain and strengthen our position as the leader in key growth and focus segments. Our customers will require different and better products in the future: lower tolerances, increased crash safety requirements, and steel for more powerful electric motors. The investments in our facilities will enable us to meet these requirements. Another important point: as part of our transformation to climate-neutral steel, we will also be able to offer the new high-quality grades in ‘green’ in the future.”

Dr. Arnd Köfler, COO thyssenkrupp Steel:

“The interface between our upstream operations and hot strip production is a core element of our integrated production network. We are now making this area fit for the next generation. By separating and rebuilding the casting and rolling sections, we can further enhance our capabilities for high-strength steels and premium finishes. By splitting off the rolling section into a separate hot strip mill, we will also make our slab production more flexible.”



thyssenkrupp Steel Europe, Duisburg

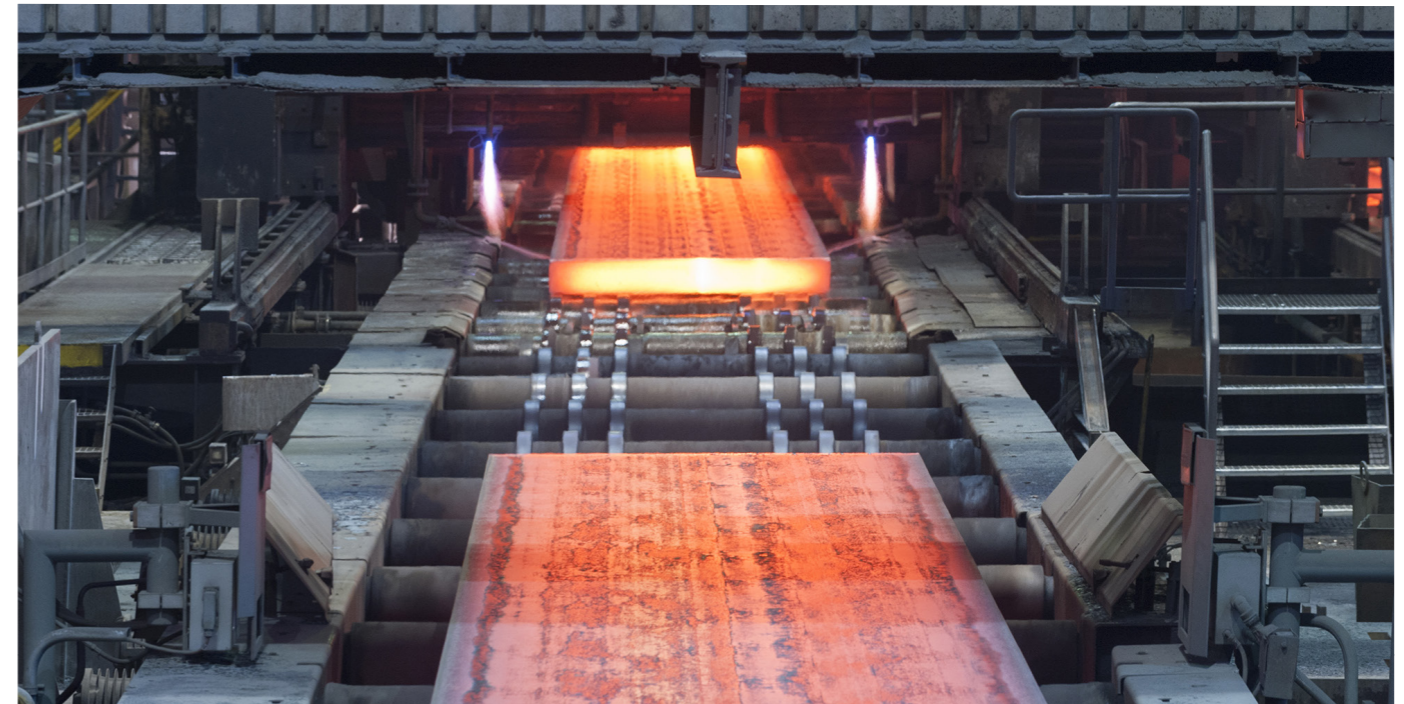


2-STRAND SLAB CASTERS SGA3, SGA4

CONVERSION OF THE CASTING-ROLLING UNIT INTO TWO SEPARATE UNITS AND CASTER REPLACEMENT

MAIN BENEFITS

- Advanced features with Connect & Cast to maximize product quality and production from the beginning
- Maximum system and plant availability at low maintenance costs
- Operator-friendly control concept
- Fast rebranding using a dummy bar top feeding system
- EcoStar Spiral Rollers allow for the casting of high-quality steel grades



The casting-rolling line at the Bruckhausen plant will be separated into a new continuous caster (SGA4) and a hot strip mill with new key components.

The plan is for the new and revamped units to be installed with minimum disruption to production. Many major components will be manufactured in advance and then installed. At the same time, some existing plant parts can be integrated into the new units, such as the ladle turret, which will be used to supply liquid steel from the melt shop to the new continuous caster. The switch from the existing casting section of the casting-rolling line to the new continuous caster will begin in September 2023, with the start-up scheduled for February 2024.

After the revamp of the casting-rolling line in 2024, the existing continuous caster SGA1 at the Bruckhausen plant will be replaced by the new 2-strand slab caster SGA3 to provide improved surface quality. The start-up is scheduled for January 2025.

SOLUTION

- Butterfly ladle turret with independent liftable arms and ladle weighing (SGA3)
- Gantry-type tundish car and trough-type tundish (SGA3)
- Straight Smart Mold cassette-type mold with DynaWidth-designed for the use of EMS/EMBR Type G3 (SGA3)
- Curved Smart Mold cassette-type mold with DynaWidth and EMS/EMBR Mold Stirrer Type G3 (SGA4)
- DynaFlex hydraulic oscillator for an improved strand-surface quality
- Strand guide with bender, Smart Segments with online and remote roll-gap adjustments for slab-thickness changes as well as to enable dynamic soft reduction (SGA3)
- Strand guide with segment 0, Smart Segments with online and remote roll-gap adjustments for slab-thickness changes as well as to enable dynamic soft reduction (SGA4)
- EcoStar Spiral rollers for ideal strand support
- DynaJet air-mist nozzles with optimized spray pattern for optimum strand cooling
- Chain type dummy bar with a top-feeding system for fast rebranding

AUTOMATION FEATURES

Process optimization functions

- CC Optimizer (Level 2 automation)
- Mold Expert for breakout pre-detection and mold monitoring,
- Quality Expert (advanced edition) for quality tracking and rating prediction
- Dynacs 3D secondary-cooling model
- DynaGap SoftReduction 3D fully automatic roll-gap control system
- Yield Expert for cut length optimization
- Intermix Expert for calculation of mixed steel in the strand
- Equipment Expert for optimized maintenance tracking

Process control functions

- CC Controller (Level 1 automation)
- LevCon - automatic mold-level-control system
- DynaWidth - automatic mold width adjustment
- DynaFlex for flexible online adjustment of the mold-oscillation parameters
- EMBR/EMS Mold Stirrer
- Flow Master Roll strand stirrer (SGA4)
- LubriCon, CoolCon, DriveCon, HydraulCon
- WamBoy, OsciBoy

Condition monitoring

- Asset Life Expert (ALEX)

SCOPE OF SUPPLY

Primetals Technologies will supply the entire equipment for the casters. The scope also includes all technological packages, the basic and process automation system, and the advisory service for installation and start-up.

PLANT DATA

	SGA 3 Vertical bending CC	SGA 4 Curved CC
Heat size	365 t	365 t
Caster capacity	2.7 Mtpy	2.3 Mtpy
Machine radius	9 m	12 m
Metallurgical length	32.1 m	35.5 m
Slab thicknesses	257 mm	257 mm
Slab width range	900 – 1,800 mm.	900 – 1,800 mm
Strand center distance	7 m	7 m
Slab lengths	5.7 – 12.0 m	5.7 – 10.0 m
Casting speed max.	1.3 m/min	1.4 m/min

HOT STRIP MILL WBW4

CONVERSION OF THE CASTING-ROLLING UNIT INTO TWO SEPARATE UNITS

MAIN BENEFITS

- Improved quality, e.g., purity segregation
- Improved yield, e.g., less scrap loss, fewer edge cracks
- Higher flexibility: hot charging, use of different slab dimensions and grades, caster and hot mill are not coupled
- Extending product portfolio, e.g., high strength-, e-mobility-, C-, DP-, Trip- and Multiphase Steel
- Higher cooling rates due to additional cooling headers with a higher flow rate and better efficiency
- Better cooling accuracy due to new valves and cooling model



A single stand 4-hi reversing roughing mill will be installed right after the new continuous caster and the two new walking beam reheat furnaces. In addition, the first two stands of the existing finishing train and the strip cooling system will be modified.

The switch from the existing casting section of the casting-rolling line to the new continuous caster will begin in September 2023. Regular operation will continue while the new hot strip mill—the most extensive construction measure under the investment package—is prepared and connected to the production network by late summer 2023.

The hot strip mill will include proven, innovative, and energy-efficient solutions in the new roughing train, an upgraded finishing train with a highly innovative downstream strip cooling section, and new automation and process models.

Dr. Arnd Köfler, COO thyssenkrupp Steel:

“The reconfiguration of this area will enable us to achieve higher quality and better utilize the capacity of our upstream melt shop by increasing our casting and rolling capacities. This will further improve the overall performance of our production network at a central point with lasting positive effects, including the security of supply for our customers.”

SOLUTION

- New highly efficient primary descaling unit with a new frequency-controlled pump station
- New full hydraulic edger
- 4-hi reversing roughing mill with mechanical screw down and hydraulic gauge control cylinder, including motor and drive systems
- Delay table with transfer bar side shift
- Encopanel® for heat conservation
- Integration of existing crank type shear
- New crop optimization system
- New secondary descaling unit to replace the existing one in front of the finishing mill
- Increased roll force with new long stroke hydraulic gauge control cylinders in F1 and F2
- New bending and shifting system in F1 and F2
- Various expert systems to improve product quality and to stabilize strip steering
- Model-based width optimization from roughing mill to down-coiler
- Extended strip cooling line with new model—predictive cooling model including control of phase-transformation and low-temperature cooling

SCOPE OF SUPPLY

Primetals Technologies will supply the entire equipment for the hot rolling mill from the reheat furnace exit to finishing mill entry, modification of F1 & F2, and extension of the strip cooling system. This also includes all technological packages, the basic and process automation system, and the advisory service for installation and start-up.

The main components are:

- Reheat furnace discharge roller tables
- Primary descaling unit
- RM entry roller table
- RM entry side guides
- Vertical edger (attached to the roughing mill stand)
- 4-hi roughing mill including motor and drive systems
- RM exit roller table
- RM exit side guides
- Encopanel®
- Delay table
- Crop shear entry roller table incl. side guides
- Scrap disposal system
- Secondary descaling unit
- HAGC cylinders for F1 & F2
- Bending and shifting system for F1 & F2
- Work and backup rolls incl. chocks for F1 & F2
- Extension of existing strip cooling with new turbo laminar cooling headers
- Hydraulic, lubrication systems for RM area
- Descaling station for RM area

PLANT DATA

Annual capacity	3,100,000 t
Slab thickness	170 – 320 mm
Strip thickness	1.2 – 12.7 mm
Strip width	900 – 1,600 mm
Max. mill stand force RM	47,000 kN
Max. mill stand force FM	47,000 kN

DOUBLE REVERSING COLD MILL DRG

NEW 6-HIGH HYPER UC-MILL WITH MQL

MAIN BENEFITS

- The high-quality production of NGO electrical steels and advanced high-strength steels
- Minimized off-gauge and maximized yield
- Increased reduction capability, small product thicknesses, and excellent shape controllability
- Reduced edge-load, minimized strip break rate and operating costs
- Stable and energy-efficient production of high-grade electrical steels
- Maximum flexibility to produce a wide range of products



Primetals Technologies has also been awarded the contract to build a double reversing mill at the Bochum site. The trend is toward ever thinner and high-silicon materials, which place increased demands on cold rolling technology. The new double reversing stand will meet these demands and significantly enhance the site's capabilities for non-oriented electrical steel. With its back and forth (reversing) action, the mill can roll particularly thin materials. This is important for sheets used in electric motors and generators because it minimizes magnetic losses.

Dr. Arnd Köfler, COO thyssenkrupp Steel:

"The base material for our new double reversing mill will be supplied from our new Hot-Strip-Mill No. 4. In this way, we will excel with high-strength multiphase or optimized electrical steel grades by exploiting quality improvements throughout our entire production chain."

SOLUTION

The reversing mill features a twin-stand 6-high HYPER UC-MILL with driven work rolls and new MH-spindles for the highest torque transmission. The mill is equipped with Minimum Quantity Lubrication MQL® and an inductive strip heating system, dedicated to producing non-grain oriented (NGO) electrical steel and advanced high-strength steels (AHSS). A compact design and advanced instrumentation and automation systems to produce Silicon and AHSS steels permits shortening of the off-gauge length. The mill consists of a pay-off reel, two reversing mill stands, and two tension reels with belt wrapper and gripper slot for optimized threading and rolling process. Two flatness measurement devices (Contactless Shape Monitor) are integral to the advanced flatness control system. Primetals Technologies supplies the complete process equipment, electrics, and automation and is responsible for the installation and start-up of the plant.

HYPER UC-MILL®

HYPER UC-MILL features a further development of the well-established UC-MILL technology with a small work roll size and a high-torque spindle. The smaller work roll diameter allows high reduction ratios and small exit gauges. A heavy work roll bending combined with an intermediate roll bending ensures excellent shape controllability. A unique feature of a UC-Mill is the edge-oriented intermediate roll shifting with reduced edge load and edge drop, which is a significant advantage to produce brittle materials, like high-grade electrical steel.

MINIMUM QUANTITY LUBRICATION (MQL)®

MQL is a unique flexible roll-gap lubrication system, which reduces rolling forces, energy consumption, and strip wear and improves strip surface cleanliness of the cold rolled product. In combination with a strip heating system, it prevents a cool-down of the strip temperature compared to conventional emulsion systems, which is advantageous for cold rolling of high-grade NGO products.

SCOPE OF SUPPLY

- First pass section with coil lifting car, pay-off reel, flattener, pinch roll, inductive strip heating system and threading table
- Mill stand section with two mill stands, powerful hydraulic roll load cylinders, positive and negative work roll bending and positive intermediate roll bending, UC-MILL intermediate roll shifting, multizone cooling, combined MQL / emulsion spray header, driven work rolls with twin-drive and automatic work roll change equipment
- Exit section with thickness and contactless flatness measurement devices and entry and exit reversing reels with sleeve manipulation
- Fluid equipment with the combined auxiliary and servo-hydraulic system, emulsion-, grease- and gear oil lubrication system
- Advanced expert systems to improve product quality
- Electrical and automation system
- Engineering, erection, supervision of erection and commissioning

PLANT DATA

Mill type	2-stand, 6-high HYPER UC-MILL
Annual capacity	475,000 t
Main drive power	2 x 3,000 kW per mill stand
Roll force	max. 21,600 kN
Rolling speed	max. 1,000 m/min

PRODUCTION DATA

Material	Hot rolled and pickled
Entry strip thickness	1.6 – 4.5 mm
Exit strip thickness	0.2 – 2.3 mm
Strip width	700 – 1,570 mm
Coil weight	max. 30 t

AUTOMATION AND DIGITALIZATION

ALIGNED SYSTEMS ACROSS ALL PLANT UNITS

MAIN BENEFITS

- Reliable and future-oriented equipment and automation solutions
- High-end expert systems and innovative models to improve product quality and performance
- Offline simulation for fast product development
- Digital twin for simulation and replay of production scenarios
- Easy upgradeability due to modular software architecture

Comprehensive Industry 4.0 solutions and high-end automation systems will enhance the viability of the overall project. This includes integrated process control (Level 1 automation) and optimization (Level 2).

Further developed and improved systems are used for the new continuous casters. The high degree of digitalization of the plants allows important parameters relating to the purity and homogeneity of the product to be controlled even more precisely, thus further enabling the ability to meet specific requirements .

A modern control platform for the hot and cold rolling mills utilizes the newest automation technology based on SIMATIC S7-1500/ TIA.

The emphasis on automation is prepared for future expansions or changes in the product spectrum and product mix. Flexible automation enables stable production even with changing process conditions and speed-up mode of operation.

SOLUTION

Highlights of the project include

- Digital twins, like offline layout tools, used already in the planning phase for optimal layout and engineering of the plants
- Intelligent solutions for equipment monitoring and maintenance, e.g., OPAL, Strand Checker, Equipment Expert
- Smart sensors and mechatronics solutions, e.g., Powder Expert, Flow Master, ShapeMon
- Highly advanced process models for continuous casting, e.g., Intermix Expert for exact calculation of the chemical analysis also for the areas of mixed steel
- Production of AHSS grades using patented process models for the cooling section
- High-end expert systems for rolling mills, e.g., strip steering, wedge and chamber, flatness roll and coil eccentricity
- Asset Life Expert (ALEX): intelligent digital assistant in the caster area to improve the plant availability by digitalizing know-how based on plant operation practice, offering clear status information, and recommending intelligent actions



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