THE NEW GLOBAL COMPETENCE IN HOT ROLLING
INTRODUCTION
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Primetals Technologies represents a new global plant building competence with extended portfolio, technology and services for the metals industry. This competence becomes visible especially in the area of conventional hot rolling mills. Two entities with different history but with comprehensive know-how and advanced technologies come together:

Primetals Technologies Japan (PTJ) in Hiroshima has the business leadership for hot rolling mills. In addition to its engineering and R&D capabilities a state-of-the art workshop for equipment manufacturing is located in Hiroshima. In this workshop heavy and large rolling mill equipment can be manufactured, assembled and tested. Together with the workshop in Worcester (Morgan, USA) and the workshop in Montbrison (France) Primetals Technologies has a global and comprehensive set-up for manufacturing of rolling mill equipment.

Primetals Technologies Austria (PTAT) in Linz has developed its own hot rolling technology with focus on improvement of rolling processes and modernizations. The know-how and technology of PTAT is the perfect complement to PTJ’s portfolio. In addition PTAT is the competence center for Arvedi ESP (Endless Strip Production) lines.

The demands related to the capabilities of a conventional hot rolling mills have changed in the last years. In addition to the high level of output and productivity the demand for quality improvement is still ongoing. Safety and energy saving become a very important aspect. Today there is a clear trend in developing new steel grades like AHSS grades (Advanced High Strength Steel), dual-phase and multi-phase grades. This trend challenges the conventional hot strip mill technology because it requires new technologies which provide more flexibility in metallurgical treatment during the rolling process. In parallel, the high level of productivity and quality must be maintained.

In order to follow these trends Primetals Technologies is continuously investing in R&D. High skilled researchers cooperate with universities and other R&D institutes. Beside the application of an impressive number of patents Primetals Technologies offers advanced equipment and technologies for rolling mills. Examples are: slab sizing press, PairCross and SmartCrown® technology for profile and flatness control, looper shape meter (LSM) for strip tension measuring within mill stands or power coiler for coiling of thick and hard material. In the area of strip cooling technology Primetals Technologies is in the role of a trend setter with its Power Cooling technology which opens the door for many metallurgical treatments in a conventional rolling mill such as transfer bar cooling, strong early cooling or strong late cooling.

The number of references (new mills and modernization projects) proves the capability of project management of Primetals Technologies. The installation of new mills requires different project management skills in comparison to modernization projects where the precise shut down planning becomes one of the most critical topic. Primetals Technologies employs a well experienced team of project managers and commissioning managers with specific know-how in rolling mills in order to provide the best services to the customer.

The hot rolling technology of Primetals Technologies comprises a wide range of advanced equipment and technologies. Beside the rolling mill equipment Primetals Technologies offers services and consultancy in the area of rolling processes and metallurgical know-how.
Primetals Technologies supplied sixteen (16) new conventional hot strip mills in the last 10 years. This number of mills corresponds to a yearly production of hot rolled coils of approximately 50 million tonnes.

The table on the next page gives an overview of the installations. The mills are located all over the world, from Brazil over Turkey, Europe, India, Korea, Taiwan, Vietnam to Japan which proves the high and worldwide acceptance of Primetals hot rolling technology and the trust of our customers into Primetals capabilities in engineering and project management.

Looking to the individual mills the wide range of dimensions and steel grades becomes evident. Whereas the hot strip mills for JSL (India) and Fujian-Fuxin Special Steel (China) are dedicated for the production of stainless steel the hot strip mill for Allegheny Ludlum (USA) is capable of rolling Titanium and Zirconium ingots and slabs in addition to carbon steels. The thickness range varies from 1.2 mm to 25.4 mm and the width range is from 700 mm to 2100 mm.

The process layout of some of the mills allows production of more than 5 million tonnes per year, an example is the mill for Formosa Ha Tinh Steel (Vietnam) or the hot strip mill for Tata Kalinganagar (India). Many layouts have already the provision for future extension of production and product mix.

The different requirements of production and product mix require individual planning of the process layout and the selection of the related rolling mill equipment. The portfolio of Primetals Hot Strip Mill Technology covers all these demands.

The hot strip mill for ArcelorMittal in Krakow (Poland) and the hot strip mill for SAIL RSP in Rourkela (India) are two examples of full turn-key projects. In these projects the scope includes civil works, bays, steel structures and cranes, water treatment plant, roll shop, slab and coil yards etc. The mill for ArcelorMittal Poland was installed within 24 months from contract signature to first coil. The hot strip mill for SAIL RSP is expected to be commissioned in 2018.
The new, fully integrated hot-rolling and processing facility supplied by Primetals Technologies on a turnkey basis was started up at the Brackenridge facility of Allegheny Technologies Incorporated (ATI) in Pennsylvania, U.S.A. The mill is capable of rolling up to 3.5 million t/a of a broad range of highly diversified stainless and carbon steels, specialty metals and electrical steel grades that find use in the aerospace, automotive, defense, petroleum, chemical, construction, mining and power industries, as well as in various medical, food-equipment, machine and cutting-tool applications. The rolling forces are the highest ever to be applied in a hot-rolling mill. The project scope included engineering, manufacture of special components, and the supply, installation and commissioning of mechanical equipment as well as electrical and automation systems. Leading-edge technologies are built into the mill to ensure top-class performance and to control key parameters such as thickness, cooling and coiling temperatures through the use of built-in process models and the associated automation-controlled actuators. This project represents an outstanding example of a successful cooperation between a market-leading supplier of specialty metals and a metallurgical plant builder. The installed power, size and advanced technology of the mill, combined with decades of operational expertise, allow ATI to utilize this unparalleled capability to fully meet the most demanding customer requirements in a highly efficient and productive manner.

**UNIQUE ON THE PLANET**  
**THE WORLD’S MOST POWERFUL HOT-ROLLING MILL**

![View of ATI’s hot-rolling processing facility, Brackenridge, Pennsylvania, U.S.A.](image)

**PRIMETALS TECHNOLOGIES SCOPE OF SUPPLY**
- Transfer and handling equipment for slabs and ingots
- Heating/reheating furnaces
- Primary and secondary descalers
- Slab and rotary crop shears
- 4-high reversing roughing stand with integrated heavy edger
- Heat-retention Encopanels
- 7-stand, 4-high finishing train
- Laminar strip-cooling section
- Two Power Coilers
- Modular coil shuttle cars for coil handling
- Integrated sampling, inspection, marking and strapping machines
- Hydraulic, lubrication and cooling systems for the process equipment
- Water-treatment plant
- Main and auxiliary motors and drives
- Instrumentation
- Basic and process automation
- Siloc yard-management system
- Manufacturing execution system (MES)

**HOT-ROLLING AND PROCESSING FACILITY EQUIPMENT**

**ROUGHING MILL**
Following reheating and descaling, the slabs or ingots are initially rolled in the roughing mill which is equipped with an edger and state-of-the-art twin drives each with a motor power of 9.5 MW. The roughing mill stand is capable of exerting a maximum load of 60 MN. This immense power gives the hot-rolling and processing facility the capability and versatility to process and roll the broadest ranges of specialty metals in the industry. Slabs can be processed up to thicknesses of 250 mm, at widths up to 2,083 mm and at lengths up to 12,497 mm allowing a maximum coil weight of up to 40 metric tons to be produced. Ingots can be processed with thicknesses up to 660 mm, at widths up to 1,778 mm and at lengths up to 5,080 mm.

**FINISHING MILL**

The finishing mill is designed with seven 4-high stands, each of which is powered by 10 MW drives and is capable of exerting a mill-stand load of up to 55 MN. Patented technological controls allow the application of long-stroke hydraulic automatic gauge control cylinders for improved operation and maintenance. All stands feature dynamic work-roll cooling that allows defined cooling patterns across the work-roll barrel length to be carried out. Additional systems include interstand cooling, work-roll lubrication, a fume-suppression system, strip cross sprays, entry-guide cooling as well as looper cooling as the basis for optimum process parameters and equipment conditions.

This includes SmartCrown rolls installed in the finishing stands, which operate in conjunction with L-type bending blocks and the work-roll shifting system. This technology is a decisive factor for assuring excellent strip profile and flatness control.

![Roughing mill with attached edger](image)
AUTOMATION AND LOGISTICS

The entire facility is controlled from control pulpitis positioned at the roughing mill, finishing mill and downcoiler. A complete suite of Level 1 automation systems and sophisticated Level 2 process-optimization systems with integrated tailored process models ensure that nothing is left to chance. Level 2 rolling systems include models for the precise control of rolling parameters; models for monitoring and governing strip temperature, heat transfer and phase transformations; and other models for profile and flatness control, roll bending, roll thermal crown and roll wear, material flow, roll flattening and roll shifting. The cooling section includes models for temperature monitoring and control, heat-transfer and phase transformations. The automation systems allow manpower requirements for the operation of the facility to be reduced compared to conventional hot-rolling mills.

The application of a manufacturing execution system (MES) and a logistics system (Siloc) serve as the basis for record-breaking melting-to-shipping throughput times. This allows ATI to operate this exceptional facility at maximum output on a one-shift production basis without the need for a slab yard and coil yard specifically dedicated to the facility. This considerably enhances ATI’s capability to reduce its managed working capital.

LAMINAR COOLING SECTION

The laminar cooling section comprises 54 top headers and 162 bottom headers that allow a maximum water-flow rate of 20,000 m³/h. The cooling headers are flow-controlled on the basis of calculations from a microstructure target-cooling model. Laminar cooling is split into a fast cooling zone and a normal cooling zone. Each top header with the associated group of bottom headers is separately regulated by a flow-control valve. This increases the overall flexibility of the cooling system and allows a variety of cooling rates to be applied for exact control of phase transformation, depending on the desired steel grade to be produced.

DOWNCOILER SECTION

Two Power Coilers are installed in the coiling section, which are dimensioned so that they are capable of coiling API X100 pipe-grade material at a thickness of 21.2 mm. and a width of 1,956 mm. or API X80 pipe-grade material with a thickness of 25.4. and a width of 2,083 mm. The power coilers are equipped with servohydraulically controlled side guides, pinch-roll units and four wrapper arms. They are also outfitted with pinch-roll polishers, quick-exchange pinch-roll units. The coils are subsequently strapped, weighed, marked and, if required, inspected before they are transferred to the coil yard for subsequent processing or dispatch.
The 2,050 mm Semi-Continuous hot strip mill supplied by Primetals Technologies in Taiwan started up in 2010. Dragon Steel Corporation, a member of CSC Group, is a manufacturer of long product in Taiwan. It promotes modernization and expansion project in the factory. Dragon Steel Corporation, decided to construct a hot strip mill producing flat steel products as a core project. Primetals Technologies provided the hot strip mill for production of strip up to 1,880 mm wide utilizing state of the art technologies.

LINE SPECIFICATION

PRODUCTION DATA

Production capacity 3.8 million tons/year
Steel grade Low-carbon steel
High-strength steel
Slab thickness 250 mm, 200 (stainless steel)
Slab width 780 mm to 1,880 mm
(900 -1,550: SS)
Slab length max. 10 m
Strip thickness 1.2 mm to 25.4 mm
(2.0 -6.5: SS)
Strip width 700 mm to 1,880 mm
(900 -1,524: SS)
Coil weight max. 35,500 kg

UNIQUE FEATURES

START-UP PHASE

• Slab sizing press
• Vertical edger (E1) with automatic width control (AWC)
• 2-high roughing mill (R1)
• Vertical edger (E2) with automatic width control (AWC)
• 4-high roughing mill (R2) with quick roll changing device
• Heat Retention Cover
• Drum-type crop shear
• Descaling facilities
• Seven 4Hi finishing stands with:
  - Pair cross (F1-F4)
  - Mill stabilizer (F1-F4)
  - Work roll shift (F5-F7)
  - Work roll bending (F1-F7)
  - Hydraulic automatic gauge control (AGC)
• Hydraulic looper
• Quick roll changing
• Hot rolling oil
• Interstand cooling
• Two down coilers with hydraulic quick opening control (QOC)
• Non-step expanding mandrel
• Coil conveyor

FUTURE PHASE

• One additional down coiler (No. 3 DC)

The No. 2 Hot Strip Mill at USIMINAS Cubatao started operation in 2012. To cover the wide range in production sizes and steel grades, many modern technologies were applied. Primetals Technologies was involved in this project as a mechanical equipment supplier for the following equipment:

• Furnace entry and delivery tables
• Roughing mill
• Finishing mill
• Down coiler
• Coil conveyor

In addition to the above main line equipment, Primetals Technologies also supplied foundation design, auxiliary equipment such as roll shop equipment, water treatment system, compressed air plant, cranes, ventilation air condition system, fire detection and extinguishing system, etc.

The production capacity of the mill is 2.3 million tons per year in the initial phase, with a maximum of 4.8 million tons per year in future expansion. The product mix includes low, middle and high carbon steel, API pipe steel (up to X80), DP, TRIP, HSLA, IF steel and electrical steel. The hot run tests and performance tests were successfully completed within 6 months after hot run start. During these tests, low carbon steel of 1.5mm thickness, API X70 of 6 mm to 19 mm thickness, HSLA of 2.0 mm thickness with a tensile strength of 590 MPa, DP, IF, as well as electrical steel were all produced successfully.
Today’s market demands for superior strip quality and high-strength steels rolled to thinner gauges require higher rolling forces. Strip moves faster through the mill and greater rolling forces are exerted. This results in larger impact forces during threading, and leads to vibrations of enormous amplitude. The larger impact force or mill vibration not only shortens the life of mechanical parts, but also reduces operational stability and rolling efficiency.

By equipping conventional roll chocks with the hydraulic Mill Stabilizing Device (MSD) from Primetals Technologies, impact forces during strip threading into the finishing stands of a hot-strip mill are reduced by approximately one half and the amplitude of mill vibrations is substantially lowered.

Since 2000, nearly 160 MSDs have been installed in the work and backup rolls of Pair Cross mill stands and other types of mill stands. When backup rolls are also equipped with MSDs, clearance between the backup roll chocks and housing is eliminated, which maintains better alignment between the backup and work rolls.

Thus, the thrust force in the axial roll direction is reduced, which decreases the differential rolling force between the drive side and work side. As a result, an improvement of strip steering stability can also be achieved. The MSD can easily be installed as a retrofit as well as in new mills.
SLAB SIZING PRESS
Primetals Technologies is the pioneer developer of the slab sizing press, and the first slab sizing press in the world was supplied to JFE Steel Kurashiki in 1988. The slab sizing press has shown excellent performance, and Primetals Technologies has been continuously improving the technology. Because the slab sizing press can reduce the slab cast for the HSM, the productivity of the caster can be increased. It can achieve the large economical advantage for total production of the steel plant. Because of the large width reduction achieved by the slab sizing press, the ratio of hot charge rolling can be increased. It can contribute the large energy saving.

HEAVY EDGER
Fully hydraulic vertical edgers feature long-stroke cylinders with integrated system control, a position transducer for absolute width measurement as well as advanced automatic width-control functions. Heavy edging with high width reduction capability introduces the benefit of adjusting to various rolled strip widths from standard slab sizes.

AUTOMATIC WIDTH CONTROL (AWC)
The automatic width control comprises roll gap adjustment during rolling to compensate width and temperature deviations. Furthermore, the short stroke functionality enables compensation of narrow head and fish tail effect. This concept is especially beneficial for upgrades because of the minimum additional investment cost and low extra maintenance required.

ROUGHING MILL
Primetals Technologies has supplied many roughing mills with the following functions:
- Electrical screw down for high speed gap adjustment
- Hydraulic gap adjusting cylinder
- Twin drive for top and bottom work rolls.

The hydraulic gap adjusting cylinder can enable the following functions:
- Fine leveling and zeroing calibration with higher zeroing and leveling force
- Excellent thickness accuracy including top end and tail end of the roughed bar

The hydraulic gap adjusting cylinders are located under the bottom backup roll chocks or on top of the backup roll chocks.

In the case where the hydraulic gap adjusting cylinders are installed at the bottom side, the cylinder can also enable the following function:
- Proper pass-line adjustment

By means of the pass-line adjustment, the bottom hydraulic cylinder also can be used to reduce the turn-up and turn-down the ends of the roughed bar especially for hard material such as stainless steel along with with independent speed control between top and bottom work rolls.

TRANSFER BAR COOLING
The Primetals Power Cooling technology is especially designed reach the highest cooling rates. This technology can be implemented as intense cooling between the roughing and the finishing mill area. This leads to improved strip temperature control for increasing productivity. Furthermore transfer bar cooling enables advanced “in-line” metallurgical treatment of the strips.

ENCOPANELS®
The Encopanel heat-retention system is installed after the roughing mill to conserve the heat of the transfer bars as well as to enable a more accurate control of the strip temperature, especially for thin-gauge strip. As a special feature, bottom scale-cleaning panels discharge scale from the system to ensure a scale-free Encopanel surface for the transfer bar.

COILBOX
The coilbox design is characterized by modern design features such as coil transfer without the use of a mandrel. Advantages of this equipment include reduced power rating and lower energy consumption in the mill train, as well as a shorter distance between the roughing mill and the finishing mill in a new plant. It is capable of handling a wide range of transfer bar dimensions (20 – 50 mm transfer bar thickness and up to 2,000 mm width as in reference plants) and can be used with carbon and stainless steel grades.
PRIMARY AND SECONDARY DESCALER

Primetals “Technologies” descalers feature low-maintenance design and optional height adjustment and are designed for minimum water and energy consumption.

CROP SHEARS

In order to meet the requirements of high-strength steels, Primetals Technologies has developed several shear types for different applications. For example, a special drum type shear for cutting bars up to 55 mm thickness in API grades. An innovative switchable gear design minimizes motor power demand. A set of standard drum-type crop shears for different widths and cutting strengths can also be ordered. As an alternative Primetals Technologies offers the casette type crop shear.

The full integration of the crop optimization system into the overall automation system ensures minimal crop-losses.

ADVANCED PAIR CROSS MILL

(PC MILL WITH MILL STABILIZING DEVICE)

The pair cross mill (PC mill) was developed in the 1980’s and has contributed to the achievement of high accuracy and quality of the strip crown and flatness through its superior strip crown and flatness control. Primetals Technologies has enhanced the PC mill and is now supplying a 3rd generation PC mill with a mill stabilizer, the so-called Advanced Pair Cross Mill.

The advanced PC mill is simpler to operate and easier to maintain.

The number of the roll cross devices is reduced to less than a quarter of those of the 1st generation PC mill. The advanced PC mill has the capability for higher reduction through the use of a mill stabilizer to reduce mill vibration. The mill stabilizer is installed on the entry side housing and eliminates the clearance between the chocks and housing during operation.

This feature will reduce the task of maintaining the entry-side housing liner to approximately one-third that of a conventional mill.

The main features of the advanced PC mill are as follows:

• Higher reduction rolling without mill vibration through the combination of PC mill and mill stabilizing device
• Powerful strip crown and flatness control with the simple principle of axial roll crossing
• Stable operation with the elimination of clearance between roll chocks and housing and symmetrical roll crown control to reduce camber and pinching problems

SMARTCROWN®

SmartCrown work rolls feature a modified, sine-shaped contour. By selecting the correct contour coefficients and shifting the work rolls by the same amount in opposite directions, the resultant unloaded roll gap is always cosine-shaped, regardless of the actual shifting position of the rolls.

THICKNESS CONTROL

Gap adjustment is actuated by hydraulic automatic gauge control (HAGC) systems consisting of a long-stroke cylinder with integrated system control and the adjacent hydraulics. Integrated load cells in the mill housing guarantee correct set-values. This system provides faster roll change times and increased flexibility in setting up the mill.

LOOPER SHAPE METER (LSM)

The measurement of strip shape between mill stands on a Hot Strip Mill has previously been rather difficult and unreliable. Primetals Technologies has developed a looper shape meter (LSM) to continuously and accurately measure interstand shape as well as strip off-centering.

LSM measures the tension distribution across the strip width through individually detected loads on segmented rolls, and then converts the distribution of tension into the strip shape.

LSM also detects off-centering through the distribution of the loads on segment rolls.

LSM has superior advantages as follows:

• The load on the segment roll is measured by a torque meter without any influences of hysteresis of the mechanism, unlike a load cell. Measuring by torque meter enables higher accuracy and increased measuring reliability without any influences caused by changing mechanical condition.
• The strip shape and off-centering can be measured at the same time.
• Easily interchangeable with existing loopers and LSM because the moment of inertia is small
• Easy replacement of segment roll for maintenance
WORK-ROLL LUBRICATION
The work-roll lubrication system is designed with patented mixing nozzle units that apply the water oil emulsion directly on the entry side of the work roll. A lower coefficient of friction between the work rolls and the strip is achieved, which leads to a significant reduction in rolling force and improvement of the work roll surface quality, and thus to better strip quality. Due to the position of the nozzles the normal work roll cooling can be kept in operation during strip lubrication. Special wiper material is installed to keep the strip surface dry and ensure optimal lubrication.

ONLINE ROLL PROFILER (ORP)
The online roll profiler is installed in the mill stands and used to grind work rolls during rolling to maintain the work roll surface quality. The disc-type grinding wheel is composed of a cubic boron nitride material mounted on higher damping mechanism. The design has improved service life highly damped greater grinding capacity and more reliable operation. The driving components to rotate the grinding wheel, to press the grinding heads onto the roll and for oscillation along the roll axis are mounted in a compact box that keeps the components clean for higher reliability and lower maintenance.

INTERSTAND COOLING AND DYNAMIC WORK ROLL COOLING
Strip temperature during the rolling process strongly influence steel properties. Thus, to increase productivity and still meet target temperatures and properties, it is necessary to employ interstand cooling. In combination with model predictive control, interstand cooling ensures increased throughput with constantly high steel qualities. Dynamic work roll cooling provides control of thermal crown through the combination of three different spray patterns. The system is integrated into the Level 1 and 2 automation system. The work roll cooling spray headers are separately actuated by motor valves.

COILING TECHNOLOGY
Perfect coiling is an important requirement for strip producers. The Primetals Technologies coiler standard design has three wrapper rolls and is applied for soft grades as well as high-strength steel from 12 up to 20 mm thick. A special down coiler design is applied for endless strip mills (Arvedi ESP) to coil the thin strips from 0.8 up to 6 mm. For high-strength steel strip up to 25.4 mm thickness, the heavy duty coiler design can be used.

COIL TRANSPORT
The most important requirements of coil transport system are safe and gentle coil handling, high reliability, maximum coil collection frequency and minimum maintenance costs. For this purpose Primetals offers numerous different coil transport systems. The latest solution is the modular coil shuttle car system. The shuttle cars are driving autonomously on the rail system from the down coiler to the coil storage area. They are fed by current collectors via conductor rails and controlled by an Industrial Wireless Lan System. Implementing the modular components such as shifting, turning or lifting, the coil transport route can be designed highly flexible. The transport capacity can be easily adapted by varying the number of shuttle cars in operation.

COIL INSPECTION AND SAMPLING
By trend the ratio of sampled coils is increasing especially for high strength steel grades. Primetals Technologies offers in line sampling and inspection directly implemented in the coil transport line as well as offline stations. Surface inspection typically for strips up to 6 mm thick can also be done without cutting the sheet of the coil and recoiling it after inspection for minimized scrap. High strength steels with thickness of up to 25.4 mm strip thickness (e.g. X80) can be handled by Primetals heavy gauge plasma cutting unit.
Hot strip mills often reach their limits in terms of power and flexibility for production of advanced high strength steel grades (AHSS) like API X80/X100, dual-phase, martensitic and complex-phase grades.

For cooling and advanced “in-line” metallurgical treatment of new materials, Primetals Technologies developed “Power Cooling” technologies. This combines the advantages of normal laminar cooling or “low pressure cooling” and “high power cooling” with the highest cooling rates for flexible operation.

**EQUIPMENT – POWER COOLING TECHNOLOGY**

In addition to applying Power Cooling Technology to the early stages of cooling it can also be applied between the roughing mill and the finishing mill, between the finishing mill stands and in the late part of the cooling area. This is necessary to make different production strategies possible as they are shown in the diagram below.

The Power Cooling unit can be retrofitted into existing plants using the existing water treatment plant, tank and piping infrastructure. The Power Cooling units are supplied with water via a booster pump generating the required operation pressure. Alternatively the pump can be by-passed to supply the Power Cooling headers directly from the overhead tank for operation in laminar cooling mode. Thus, the full operation spectrum which requires laminar cooling on the total cooling length can be kept after installation of Power Cooling.

**APPLICATION**

The working area of Power Cooling is not only dedicated to thick strips (> 18mm) with high cooling rates. Due to the extended control of water flow and therefore control of heat flux it is also used for strips with a critical combination of thickness-speed ratio and required cooling rates and for standard steel grades, e.g. using the Power Cooling in laminar mode.

The combination of Power Cooling with laminar cooling is a perfect solution for cooling lines which offers a wide range of applications as well as for optimizing the current product mix and future metallurgical requirements.

**IMPLEMENTATION INTO NEW OR EXISTING PLANTS**

**APPLICATION**

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**TYPICAL PHYSICAL CHARACTERISTICS OF POWER COOLING**

- Significantly increased cooling rates compared to laminar / turbo laminar cooling
- High heat flux rates up to 5 MW/m²
- Wide flow-rate control range for maximum metallurgical flexibility

**ALLOYING**

Power Cooling opens the door for reduction of alloying costs by substitution of hardening elements with hardening effects of higher cooling rates.

**REFERENCE INSTALLATIONS**

- 16 Power Cooling headers at TKSE Beeckerwerth, Germany (2010)
- 16 Power Cooling headers at TKSE Bruckhausen, Germany (2011)
- 36 Power Cooling headers at WISCO, China (2013)
- Further upgrade to 32 Power Cooling headers at TKSE Beeckerwerth, Germany (2014)
A new hot strip mill has a lifetime of several decades. During this time, the mill must be able to meet market demands for a wide range of steel grades especially for high-strength steel and advanced steel grades with superior strip quality. Additional important factors in hot strip rolling are high yield, mill availability and production throughput. Continuous modernization of the existing equipment is the most effective way to continuously meet market requirements and to achieve the competitive level of conversion cost during the lifecycle of the mill.

Also, when taking a hot strip mill out of operation after a number of decades, the mill still has the potential of being employed as a second hand mill and may be refurbished and relocated for a new “lifecycle”, as examples have shown.

Primetals Technologies has vast experience in upgrading and modernizing hot strip mills. Using a systematic approach, we work closely with our customers to develop a tailored modernization concept according to the particular requirements and constraints of the project. Each solution may be purely mechanical, purely electrical, purely automation, or a combination of these. Based on the selected concept, the modernization can be carried out in several steps or during a single mill shutdown.

Prior to modernization Primetals Technologies may offer specific investigations (studies) in order to e.g. check technical feasibilities, to identify bottlenecks or justify investment estimations.

Primetals building experience, feedback from installed references and application of dimensioning and simulation tools guarantees that the results of such studies are of the highest standard of technical elaborations.

Beside high-tech equipment and skilled employees a comprehensive process know-how and metallurgical know-how is necessary for the successful operation of a hot rolling mill. Primetals Technologies support customers with metallurgical simulations for further development of steel grades or introduction of new grades.

TYPICAL MILL STUDY PROCEDURE

Continuous modernization and complex upgrades are often based on a long term partnership with our customers. For their medium wide hot strip mill TKSE Hösch Hohenlimburg (Germany) decided to undertake a large investment for upgrading the existing hot strip production (designated MIBA 2015). Primetals Technologies provided the technical base by executing a comprehensive study with process simulations, design studies and selection of technologies. Finally, the modernization project has been successful executed by Primetals Technologies. Hohenlimburg’s Hot Rolling Mill Manager Frank Pozun said after the modernization: “Operation of the modernized mill has exceeded our high expectations by far. We are now producing record quantities.”
Primetals Technologies Japan, Ltd.
A joint venture of Siemens, Mitsubishi Heavy Industries and Partners

Tokyo office:
Shintamachi Bldg.,
34-6, Shiba 5-Chome, Minato-ku
Tokyo 108-0014, Japan

Hiroshima Works:
6-22, Kanonshin-Machi, 4-Chome, Nishi-ku,
Hiroshima 733-8553, Japan

Primetals Technologies Austria GmbH
A joint venture of Siemens, Mitsubishi Heavy Industries and Partners

Turmstrasse 44
4031 Linz
Austria

primetals.com

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