CONTINUOUS ROLLING MILL FOR RAILS AND MEDIUM SECTIONS AT CORUS – UNITED KINGDOM [1]

Luigi Giacomini [2]
Jim Hogg [3]
Nigel Dransfield [3]

Abstract
Corus recently contracted to Siemens VAI the project for revamping its Scunthorpe facilities. The installation produces finished rails up to 120m length in a continuous finishing mill - a world first for the steel industry. The project has been awarded on a turnkey basis, comprising design, manufacturing, installation and commissioning. Its scope includes descaling facilities, universal rolling stands, marking, hot-sawing, rail pre-cambering, cooling equipment, dispatching facilities.The rated production capacity of rails is 200,000 mtpy.
Key words: Long rolling; Section; Rail

LAMINADOR CONTÍNUO PARA PERFIS MÉDIOS E TRILHOS EM CORUS – REINO UNIDO

Resumo
Recentemente, a Corus contratou a Siemens VAI para o projeto de reforma de suas instalações em Scunthorpe. Esta unidade produz trilhos acabados com comprimento de até 120 metros em um laminador acabador contínuo – um pioneirismo para a indústria siderúrgica. O projeto foi contratado no regime *turn key*, compreendendo o projeto, fabricação, instalação e comissionamento. O escopo inclui as instalações de descarepação, as cadeiras de laminação universal, marcação, corte a quente, pré-curvamento dos trilhos, equipamento de resfriamento e instalações de despacho.
Palavras-chave: Laminação de aços longos; Perfis; Trilhos.

[1] *Technical Contribution to the 45th Rolling Seminar – Processes, Rolled and Coated Products, October 21st to 24th 2008, Ipojuca - Porto de Gainhas - PE*
[2] *Engineers at Siemens VAI Metals Technologies in Italy and UK*
[3] *Engineer at CORUS Group PLC in UK*

1 INTRODUCTION

Corus recently contracted to Siemens VAI the project for revamping its Scunthorpe installation to produce finished rails up to 120m length in a continuous finishing mill - a world first for the steel industry. The project has been awarded on a turnkey basis, comprising design, manufacturing, installation and commissioning. Its scope includes descaling facilities, continuous universal rolling train, marking, hot-sawing, rail pre-cambering, cooling equipment, dispatching facilities.
The rated production capacity of rails is 200,000 mtpy.
The Long Product unit of Siemens VAI Metals Technologies (former VAI POMINI) has delivered all the equipment and technology for this mill on a turn key basis.
This paper outlines the revamping project of existing Corus' Medium Section Mill in Scunthorpe UK. After a quick introduction to the project partners, it describes the project objectives and its most salient technical features. All measurement units are SI metric.

2 PROJECT PARTNERS

In May 2005 Corus awarded Siemens VAI Metals Technologies - Italy (former VAI Pomini) the contract for the revamping project of Corus' Medium Section Mill.
The LIBRA project was part of Corus' £130 million investment plan for long products.
The mill is located in Scunthorpe, Lincolnshire (UK)
Corus Group Plc is one of the world's largest metal producers with a turnover of over £9 billion and major operating facilities in the U.K., the Netherlands, Germany, France, Norway, Belgium and Canada. It has over 48,000 employees and has recently come under the ownership of TATA.
Headquartered in London, Corus Group comprises four divisions

- Strip Products
- Long Products
- Aluminum
- Distribution & Building Systems

Corus' portfolio covers the full long products range from wire rod to heavy sections, in all qualities including engineering steels and other quality steel applications.
The capacity of Corus Scunthorpe Medium Section Mill is 570,000 tpy (metric) of sections, and 200,000 tpy of rails. Scunthorpe's product mix includes :

- equal and unequal angles
- universal columns and universal beams
- parallel flange channels
- IPE sections, HE sections
- Joists, etc.

Previously to Libra project, rails were rolled in the Workington mill located in Cumbria UK, with a 40meter maximum length limitation.
Siemens VAI Metals Technologies belongs to the Siemens Industry sector, and is one of the world's leading engineering and plant-building companies for the iron and steel industry. Siemens Industry in fiscal year 2007 (ended Sep 30):

- approximately 209,000 people employed worldwide
- around EUR 40 billion in total sales (pro forma, unconsolidated)

Siemens VAI's Centers of Competence for Long Products rolling are located in :

- USA (Morgan Construction Company)

- Italy (Siemens VAI Metals Technologies S.r.l., which consolidated well known brands such as Pomini, Ashlow, GFM)

Siemens VAI Long Products is dedicated to Hot Rolling of carbon, special and high alloy steel grades for :

- bars
- wire rods
- bars-in-coil
- sections (light, medium, heavy)

Core competences cover the entire life-cycle of plant:

- process & engineering
- manufacturing
- installation & service

Examples of technologies: RedRing stands (including reversing and sliding), high-speed monoblocks, sizing systems, flat blocks, rolling guides (Ashlow and Morgan)

3 GOALS OF LIBRA PROJECT

The main objectives which the Libra project has achieved are:

- transfer and upgrade current rail production from Workington to Scunthorpe
- achieve the rail production capacity of 200,000 m.tpy
- roll finishinged rails in a continuous finishinging mill up to 120m maximum length, one of the longest in the world
- benefit from lower operating costs, which the arrangement of continuous finishinging mill offers in comparison to a mill designed for rails only
- provide the consistent quality and high performance required to meet the exacting market demands for rails
- allow the flexibility to quickly change and setup rolling stands, in order to timely support the large product mix
- focus on operator safety concepts, in both design and manufacturing

4 SCOPE AND TECHNICAL CONCEPTS

The project has been awarded on turnkey basis including:

- design
- manufacturing
- installation
- commissioning

The main Scope of supply comprises:

- descaling systems
- universal rolling stands
- rail stamping equipment
- rail hot-sawing equipment
- rail pre-cambering and cooling facilities
- finished rail handling facilities
- accessory equipment (roller tables,buffer bank, pinch rolls, guiding equipment, utility units etc.)

5 LAYOUT

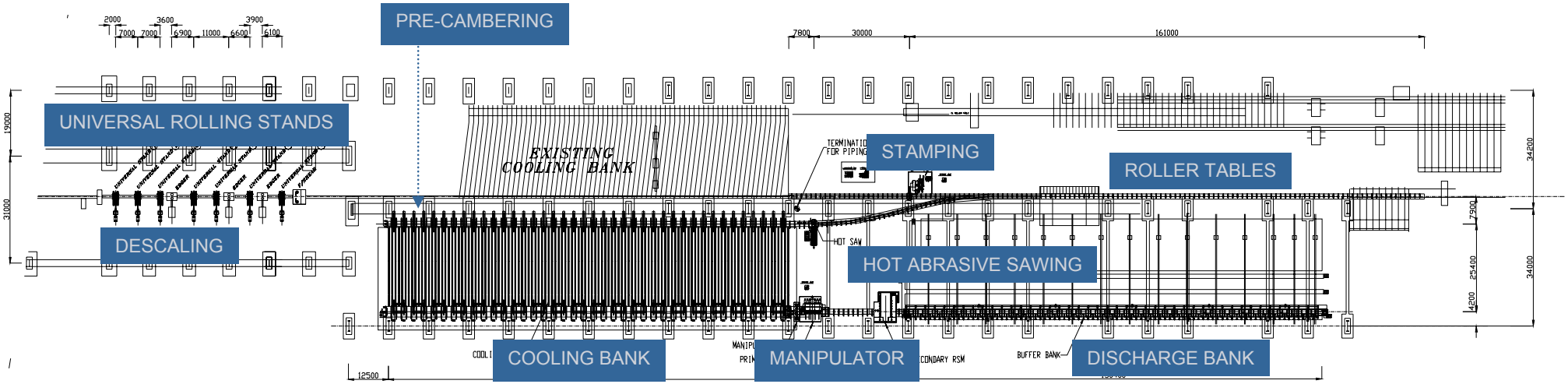

Figure 1 : Corus Scunthorpe Mill - Libra Project General Layout

6 PROJECT DATA

- Three possible bloom sizes feed the rolling mill:
  - 335 x 305 mm
  - 330 x 254 mm
  - 283 x 230 mm
- The linear weight of rail ranges from 30.6 ÷ 75.2 kg/m
- The length of finished rail ranges from 72 to 120m (seamless)
- The nominal rail production rate is 22 ÷ 33 pcs/h
- The applicable standard is BS EN 13674

7 UNIVERSAL STANDS

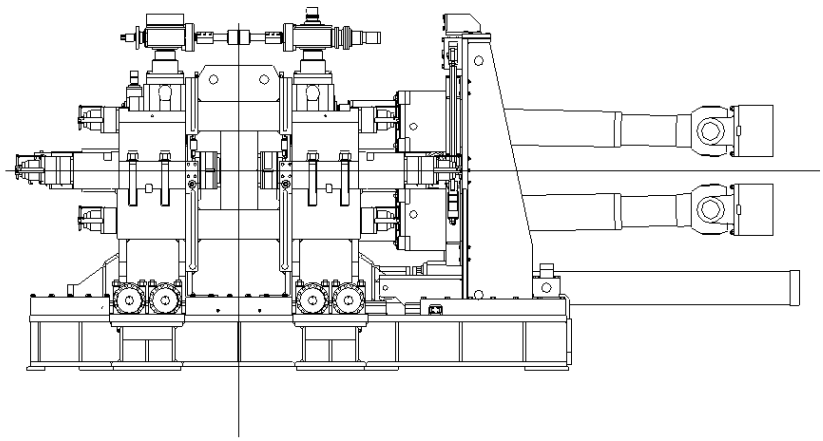

Figure 2 : RRU480 Universal Stand - Side View

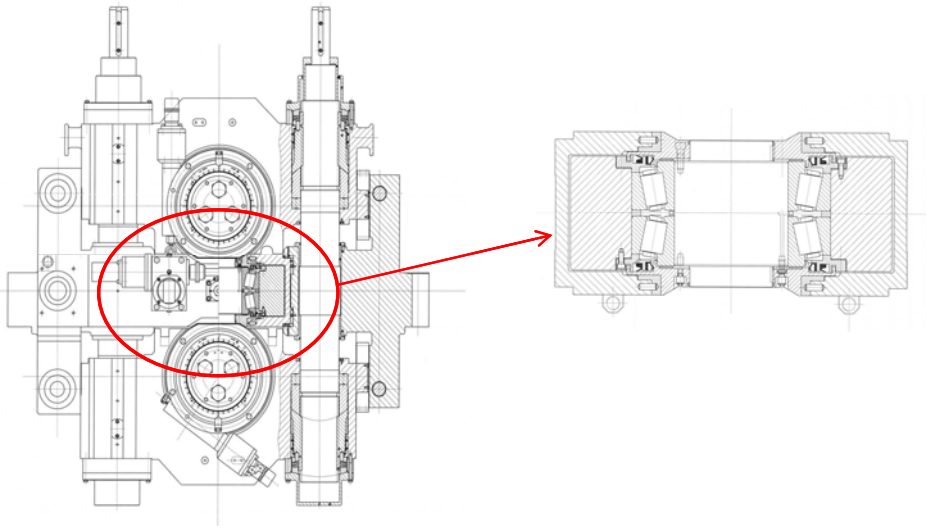

Figure 3 : RRU480 Universal Stand - Detail of Vertical Roll

Seven new universal RedRing® rolling stands type RU480 are installed online, plus eleven standby units, with the following dimensions:

Table 1: RRU480 Universal Stands for LIBRA - Main Dimensions

RRU480	HORIZONTAL ROLLS				VERTICAL ROLLS					
	max roll CL mm	min roll CL mm	barrel mm	max load tons	max roll CL mm	min roll CL mm	max roll dia. mm	min roll dia. mm	barrel mm	max load tons
UNIVERSAL configuration	990	870	340	440	1060	650	690	600	240	270
2-Hi HORIZONTAL configuration	820	600	1190	1190						

The same universal stands can operate can also operate in 2-hi horizontal configuration for rolling products which do not require the vertical rolls. The operation of changing from U- to H-configuration or vice-versa requires approximately 45min within the robot.
Rated maximum operation loads on rolls are 440tons for necks of horizontal rolls, and 270tons for bearings of vertical rolls.
Rolls are changed offline by means of a dedicated hydraulic robot, with a normal cycle time shorter than 30 min.
The stands are compatible with the possibility to install an online quick stand change system, which would allow a stand change cycle time shorter than 120sec.
The main features of RedRing® universal stands are :

- "Reduced Ring" i.e. short stress path means a small “spring” effect and thererofer better tolerances
- large bearing working angle
- floating chocks compensate for roll bending, hence edge loads avoided on roll neck bearings
- chocks support housing is extremely compact, for easy traversing of the stands
- chocks balancing guarantees an easy rolling condition, which means finished products with better tolerance from head to tail
- short and large diameter screw-down screws provide high strength and rigidity
- symmetrical adjustment of rolls
- utilities are connected by an automatic self-centering device
- engineered with state-of-art FEM tools, for a correct simulation of asymmetric stresses and strains
- asymmetrical loads to vertical rolls are self-balanced inside the stand itself, and axial thrust can be measured in the control system
- it follows that no additional force is applied to stand external parts (holder and bedplate)
- this greatly simplifies the stand construction concept, and at the same time it ensures longer life to all components
- extra rigidity of stand results in minimum strains in all conditions of operation

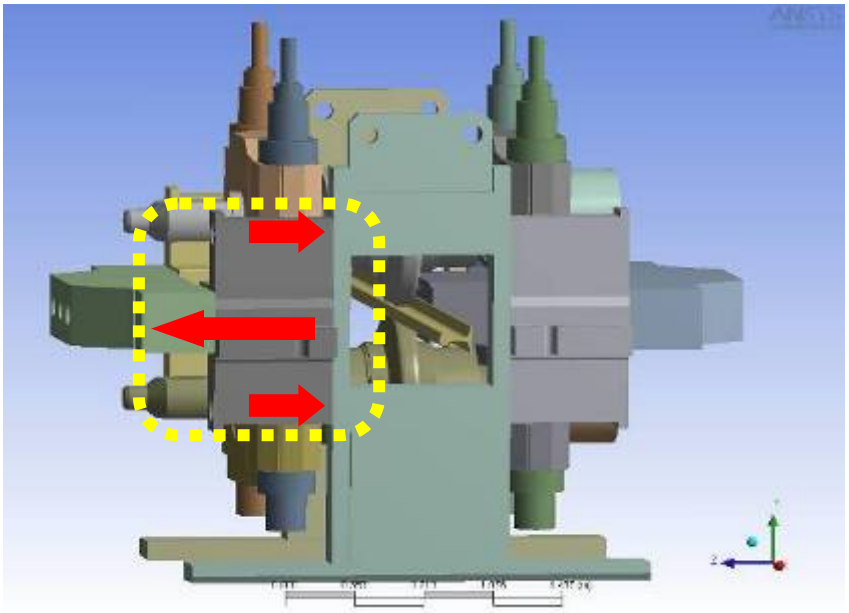

Figure 4 : RRU480 Universal Stand - Balance of loads on vertical rolls

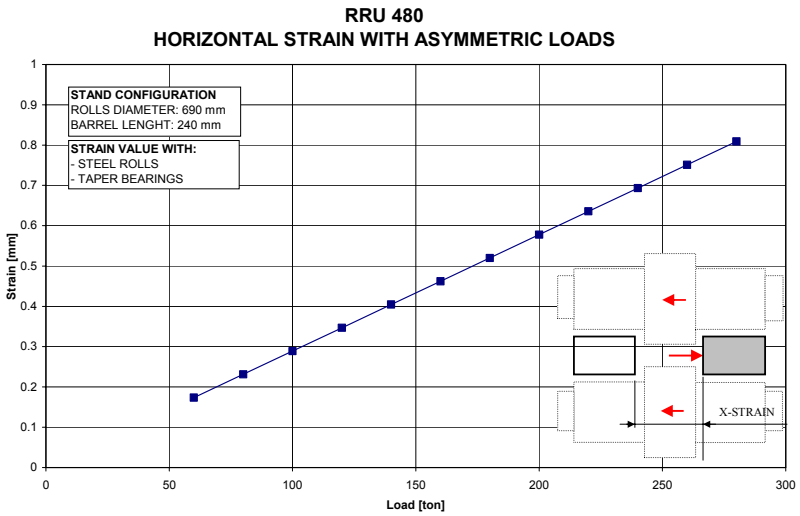

Figure 5 : RRU480 Universal Stand - Strain with asymmetric loads loads on vertical rolls

8 DESCALING

Four descaling header positions are provided :

- before existing roughing stand
- before intermediate stands (future)
- before new continuous train
- before last stand (future)

Descaler headers are served by 2 pumping stations, with total 6 pumps (including 2 standbys).
The rated duty for each pump is 497 lpm @ 225 bar.

9 STAMPING

The Rail Stamping Machine consists of a stamping head driven by an AC servo motor and moved at the same speed as rail by a hydraulic linear slide

- rail speed 2-6m/s
- rail temperature 800-1000 °C
- character groups stamped in the web middle, at 5m interval

10 HOT SAWING

Hot abrasive sawing is provided for nose / tail cropping, as well as for sample cutting.
As-rolled bar length is measured and the information used to calculate the position of nose and tail crops.

- abrasive type, disc dia. 1,800mm
- front and back cropping 0-3,000mm, with disposal system
- sample cutting of front, middle of back with automatic handling up to 500mm
- automatic stroke adjustment compensates for disc wear
- as-rolled bar measure to calculate the position of front / back crops
- vertical and horizontal clamping of rail on both sides of the disc, for secure cutting operation
- cutting area rate 6-15cm2/s
- disc usage rate >1000 cuts
- automated dust collection system

11 PRE-CAMBERING

During cooling, non-uniform mass distribution in the cross-section tends to bend rail inwards on the head side. If not corrected, this would make straightening very difficult. to compensate for bending, rails are pre-cambered before being deposited onto the cooling bank. Pre-camber geometries are calculated according to cooling models and rail parameters (grade, shape, specific mass, length and temperature)

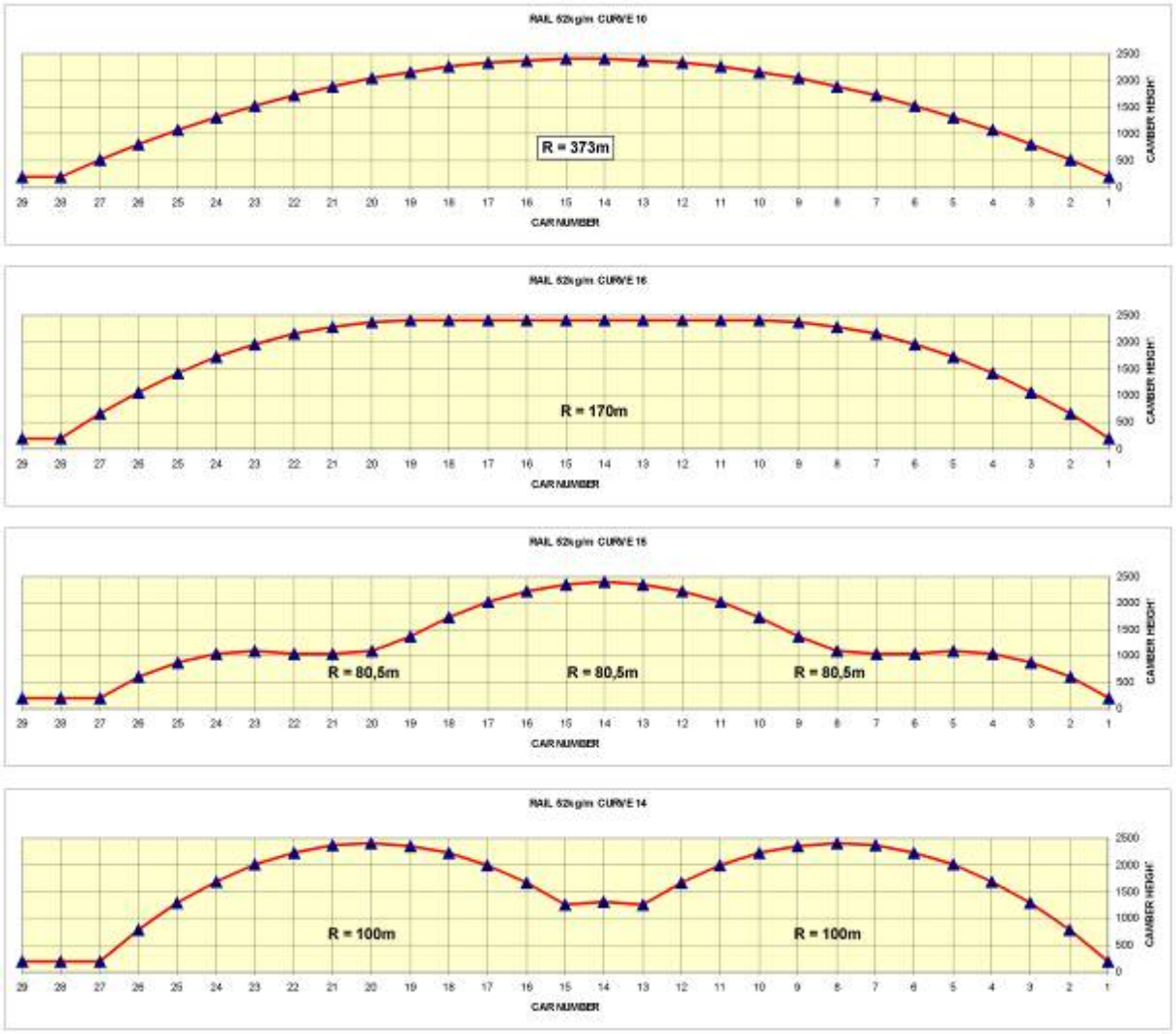

Figure 6 : Typical Pre-Cambering Curves

Pre-cambering consists of 39 equally spaced at approximately 3m distance, each one with an independently adjustable stroke, with the following operation sequence:

- rail is clamped on its web side
- rails is lifted
- cars travel forward independently, applying the desired pre-cambering form
- cars lower and deposit the rail onto the cooling bank

The lifting and clamping movements are hydraulically controlled, while travel movements are driven by gearmotors

12 COOLING BANK

The new cooling bank is 125m long and 25.4m wide.
It is operated with a walking beam type movement drive by a hydraulic system.
At the exit side, a rail extracting system with skid transfer cars moves the rails individually onto exit roller table.

13 MANIPULATOR

The rail exits from the cooling bed laying on its head / foot, and must be rotated 90° in order to be fed into the primary straightener
This is accomplished by a special manipulator which has also the additional features of :

- acting as stabilizing pinch roll for the first portion of the rail
- being capable to accept the rail in both head-foot orientations

Two straightening units are refurbished from existing Workington mill (Corus' scope). The primary unit has horizontal rolls and provides straigthening in the rail symmetry plane. The secondary unit has vertical rolls and provides straigthening in perpendicular direction with respect to rail symmetry plane.

14 DISCHARGE BANK

After straightening, rails are individually lifted from the roller table and deposited onto the chains of a discharge bank. The discharge bank provides temporary storage of rails waiting to be moved to storage pens or into wagons

- storage capacity: 12 rails at 125m length

15 CONCLUSIONS

Libra Project is a joined effort by Corus and Siemens VAI for revamping the existing Medium Section Mill in Scunthorpe (UK), it represents a key project in overall Corus strategic development plan. It also holds a great interest for Siemens VAI, due to the sophistication of technical content and to the acknowledgement of Corus / TATA brands.
Corus selected Siemens VAI as the provider of a technically-innovative solution, to guarantee the consistent quality and high performance required to meet the exacting demands of market. This revamp enables Corus to roll rails up to 120m maximum length, one of the longest in the world, which signifies lower operating costs compared to a mill designed for rails only. It also provides improved tolerances and better finishing quality to other structural sections.