Annex 2

Technical Specification

List of Contents

General Remark

All given data are preliminary

The present technical specification describes the technological rolling line of Assel mill.

The breakdown of the scope of supply is defined in Annex 3 of this technical specification. The work man ship for other subjects, relevant jobs or activities are according to the definition in Annex 3.

This technical specification focus on the Assel mill type AM 500 and on the sizing mill type 550 I 10 within the Assel mill rolling line.

1. GENERAL DESIGN DATA FOR THE NEW ASSEL MILL TUBE PRODUCTION

Bars (Billet in the storage before cutting into length)

Diameter:	150, 200 mm
Length:	4.0 - 8.0 m

Billets

Diameter:	150, 200 mm
Length:	min. 1,500 mm
	max. 3,800 mm
Weight:	max. 936.8 kg

Hollow Bloom

Diameter:	max. 150 - 245 mm
Length:	max. 9.000 mm

Assel Shell

Diameter:	min./max. 130 - 225 mm
Length:	max. 13,500 mm

Shell after Sizing Mill

Diameter:	from 221.2 - 89.9 mm
Length:	max. 20.2 m

Final Tubes (cold)

Diameter:	from 219.7 - 88.9 mm
Wall Thickness:	min. 5.6 mm
	max. 40.0 mm

2. ROUND BARS CUTTING AREA AND BILLET FEEDING TO THE FURNACE

Billet cutting area

Technical Data

Bar type, shape and size	continuous cast and/or rolled, with round section within 150 - 200 mm diameter
Bar length before cutting into lengths	max. 8,000 mm min. 4,000 mm
Bar max. weight before cutting into lengths	approx. 1,973 kg
Billet length after cutting	1,500 ÷ 3,800 mm
Billet weight max.	approx. 936.8 kg

3. ROTARY HEARTH FURNACE

Technical Data

Furnace type:	Rotary hearth furnace
Throughput:	40 t/h max.
Charge:	round billet Ø 150 - 200 mm Length 1,500 ÷ 3,800 mm
Production:	max. 130 pcs/h
Charge row:	single rows/double row
Charging temperature:	cold charge: 20 °C
Discharging temperature:	up to 1,300 °C
Uniformity of billet temperature:	± 15 °C cross section/length

4. TRANSPORT FACILITIES FROM THE ROTARY HEARTH FURNACE TO THE CONE TYPE PIERCER

Technical Data

Billet temperature:	up to 1,300° C
Billet diameter:	Ø 150, 200 mm
Billet length:	1,500 ÷ 3,800 mm
Billet weight max.	approx. 936.8 kg
Production:	max. 130 pcs/h

5. CONE-TYPE PIERCER CTP 1000

5.1 Piercing Mill inlet Side

Technical Data

Billet diameter:	150, 200 mm
Billet length:	max. 3.8 m
Design of inlet trough:	U-shaped trough of cast steel, hydraulically clamped
Entry pusher speed:	0.3 m/sec. (during start of rolling)
Advance and return speed:	1 m/sec.
Pushing force:	approx. 4 t

5.2 Piercing Mill Stand

Technical Data

Mill stand design: Mill stand with two work rolls, one above the other, and two guide shoes for tube guidance arranged one at each side

Number of work rolls:	2
Number of guide shoes:	2
Work roll diameter at highest point:	approx. 1000 mm
Rotating speed of the work rolls:	approx. 95 rpm

Feed angle:	8° - 15°
Cone angle:	15° fixed
Guide system:	Guide Shoes
Outlet speed	max 1.0 m/s
Rolling torque	490 KNm
Separating force	3900 KN

5.3 *Main Drive*

Technical Data

Main drive design:	The main drive is located at outlet side with single roll drive by AC-motor through universal shafts
Gear type:	Spur wheel
Type of shafts:	Universal joint shafts with sliding spindles
Number of motors:	2
Motor power:	approx. 2 x 2,800 kW
Overload:	1,5 times (load cycle to be defined by Seller)

5.4 *Outlet Side Cone-Type Piercer*
with travelling thrust block

Technical Data

Hollow bloom length:	max. 9.0 m
Design of outlet side:	Guide bed with three-roller steadiers and travelling thrust block
No. of three-roller steadiers:	6 (5+ 1)
No. of pinch rolls:	1
No. of conveying rollers:	6, driven by hydraulic motors
Transport speed:	approx. 1.8 m/sec.
Thrust block speed:	max. 4.0 m/sec.
Thrust block force:	approx. max. 170 tonnes
Thrust block drive:	By steel rope and drum

6. HOLLOW BLOOM TRANSPORT FACILITIES FROM CONE TYPE PIERCER TO ASSEL MILL

Technical Data

Hollow Bloom Characteristics

Outside diameter	245 ÷ 150 mm
Length	4,000 ÷ 9.000 mm
Max weight	approx. 936.8 kg
Max frequency	100 Pcs/hr
Travelling distance	approx. 12 m

7. ASSEL MILL ”AM 500”

Assel Mill Stand and Main Drive

Technical Data

Mill stand design:	Mill stand with motorised, adjustable work rolls, furnished with a quick-lifting device for the upper work roll
Number of work rolls:	3
Roll diameter:	max. 500 mm min. 450 mm approx.
Feed angle:	4° - 11° infinitely adjustable
Toe angle:	0 - 4° convertible
Adjustable range:	3° - 4°
Height of roll hump:	6.0 mm
D/t ratio:	approx. 20 : 1 (min. wall thickness 5.3 mm)
Separating force per roll:	90 t

Quick lifting system:	hydraulic cylinder with 25 mm stroke
Main drive system:	Individual roll drive by AC-motors via mounted bevel-helical gear box and universal shafts
Number of motors:	3
Rated power per motor:	prel. 750 kW
Overload capacity:	1.8 times (to be defined later)
Type of universal shafts:	Universal cross and bearing joint shafts

Description

The Assel stand consists of the main assembly groups described below:

Roll Housing

The roll housing consists of the housing base and the swivelling top. For roll changing, the housing top is swung up via two hydraulic cylinders, so that the three roll assemblies can be removed and exchanged by means of a crane and a removing device. The housing top with the housing base are hydraulically locked during the rolling operation by the four clamping cylinders.

The three work rolls are arranged in the roll housing with offsets of 120° each in such a way that the housing top section accommodates 1 roll and the base section 2 rolls.

Roll Bearing Assembly / Roll Assembly

The three roll assemblies essentially consist of the roll with shaft, antifriction bearings and the bearing housings. The bearing housings are located in a chock mounted in a drum. The chocks are designed for a toe angle of 4°.

Roll adjustment

The roll adjustment ensures the adjustments of roll gap and entrance angle - depending on the rolling requirements. This is done electromechanically with spindle drive unit. They are not interconnected mechanically and can be operated separately. One hydraulic cylinder each keeps the adjusting system free from play. The adjustment of the roll gap has been designed for a hollow bloom diameter range from 150 - 245 mm.

Drum

The roll chock with roll assemblies are mounted in a drum. As the roll feed angle is adjusted, this drum is turned into the proper position by an electric motor via spindle drive unit. All three drums have separate drives. The feed angle is infinitely variable between 4° and 11°. A drum clamping device - comprising two hydraulic cylinders each - locks the drum in position.

Roll Changing Device

The roll changing device to allow simultaneous changeover of the three Assel mill rolls by crane.

Quick Lifting Device/Quick Opening/Quick Closing

Between the exit-side pressure spindle, the roll adjustment and the roll chock (fixed bearing) of the upper roll, a hydraulic quick-action roll lifting device is provided that can be put in operation at the beginning and the end of rolling. A stroke controlled cylinder can move the roll chocks to any required position. The exact positioning of the rolls reduces the trumpet of the front end of the shell and the triangulation of the back end of the shell.

Baseplate

The complete roll frame rests on two base plates anchored in the foundation.

Main Drive System

The main drive system consist of three mounted bevel helical gear boxes for each roll assembly. Three universal joint shafts connect each gear box with the AC-motor. The gear boxes are supported against tilting during the changing of the work rolls. A pre-piped circulating oil lubricating system for each gear unit incl. pump unit and piping. For hydraulic system and cooling water please refer to item 14.

Assel Mill Inlet Side

For operation with retained and internal cooled fixed mandrel bar.

Technical Data

Inlet Table

Length of inlet table:	9,500 mm approx.
Number of three-roller guides:	5 prel.
Number of height adjustable and driven conveyor rollers:	9 prel.
Transport speed of conveyor roller:	0.12 - 1.2 m/sec.
Number of pinch roll:	1

Mandrel Bar inserter / retainer

Length of mandrel bar:	15,000 mm approx.
Max. length of the working part:	3,500 mm approx.
Mandrel bar diameter range:	60 - 170 mm approx.
- Chain travel distance:	16,000 mm approx.
- Chain speed:	3 m/sec. max.
- Chain drive:	AC-motor, gear box, sprockets

Retainer System

Number of hydraulic cylinders:	2
Cylinder stroke:	3,500 mm approx.
Cylinder speed	
Working speed:	0.07 - 0.20 m/sec.
Return speed:	0.4 m/sec.
Rotating speed of the mandrel before start of rolling:	170 rpm approx.
Retaining force:	35 t
Working temperature of the mandrels: (surface temperature before lubrication)	< 100 °C

Mandrel Bar Cooling System

Internal Cooling of Mandrel Bar

Pressure:	30 bar approx.
Capacity:	50 m³/h max. 30 m³/h average
Coolant:	water
Temperature:	inlet 28 °C approx. outlet 70 °C approx.

Mandrel Bar Lubrication System (complete unit Buyer's supply)

Lubricant:	emulsion of graphite and binders in water
Consumption:	80 gr./m² mandrel bar surface solids content

Description

The inlet side consists mainly of the inlet table with the mandrel bar lubrication. It is designed for operating with fixed internal cooled, restrained mandrel bar.

The inlet table receives the hollow bloom. The hollow blooms are then transferred to a lowerable stopper plate into the idling position of the mandrel bar.

The inlet table consists of three-roller guides, an adjustable and driven roller conveyor and a pinch roll unit.

The three-roller guides serve to support the hollow bloom and the mandrel bar during the rolling cycle and allow good guidance of the rotating hollow bloom. Using the cylinders and motorised screw jacks or controlled cylinders, the three-roller guides are adjusted to the different hollow bloom/mandrel dimensions to allow the various hollow bloom sizes to be rolled at constant mill centreline.

The guide rolls are moved by cylinders and levers to the three working positions:

- hollow bloom diameter
- mandrel bar diameter
- lowered during rolling

The driven roller conveyor serves to support and the transport the hollow bloom to the mill after the mandrel has been inserted. With the start of the rolling process, the adjustable roller conveyor is lowered as the hollow bloom is then guided by the three-roller guides during rolling.

The pinch roll unit is located near the Assel mill and ensures the feed of the hollow bloom into the mill.

The mandrel bar lubrication system consists of the lubrication box and the service device. It is located in line at the beginning of the inlet table. The mandrel bar is lubricated by passing through the lubrication box while being inserted.

The mandrel bar inserter / retainer is used to insert the mandrel bar into the hollow bloom, to move the mandrel bar forwards at a controlled speed during rolling on the Assel mill and to return the mandrel bar to its starting position at the end of the rolling cycle.

The mandrel bar inserter/retainer consists of the guide bed, the mandrel bar thrust block, the chain drive with motor, gearbox and sprockets and the hydraulic cylinders of the controlled movement of the mandrel bar during the rolling process.

The mandrel bar thrust block, consisting of a rotating hollow shaft mounted in antifriction bearings. The rotating shaft is connected to the mandrel bar by means of a locking device.

The mandrel bar is supplied with cooling water for the mandrel inside cooling through the rotating hollow shaft; the connection to the cooling water supply system is at the rear end of the mandrel thrust block.

Attached to the mandrel bar thrust block is a motor with free-wheeling coupling which allows the mandrel bar to be set in rotation before the start of rolling in the Assel mill.

The guide bed is provided with slideways, on which the mandrel bar thrust block is moved backwards and forwards.

During insertion of the mandrel bar into the hollow bloom, the thrust block is moved forwards with the mandrel bar. This movement is powered by a chain drive and an AC-motor. Sprockets are located at both ends of the guide bed and are driven via universal shaft, gearbox and motor.

Rolling with the mandrel bar with controlled forward speed is controlled by two retainer cylinders located in the guide bed.

The forward movement is precisely controlled by a flow control system. Within the guide beds the mandrel bar will be supported by lowerable rolls.

Assel Mill Outlet Side

Technical Data

Length of max. shell:	13,500 mm
Length of outlet side:	18,000 mm approx.
Number of lower driven guide rolls:	2 x 2
Number of upper guide rolls:	3
Number of lower height adjustable and driven roller conveyor rollers:	7
Number of non-driven upper conveyor rolls:	6
Kick-out device:	hydraulically actuated
Number of guide trough:	1

Description

The outlet side guides the shell as it leaves the Assel mill. The outlet side consists of two lower driven guide rolls which cover the whole length of the outlet and support the shell rotation during the rolling process. Both guide rolls are height-adjustable so that the various shell sizes can be rolled.

Three short upper guide rollers increase the effect even further. The guide rollers are adjustable that Assel shells with different dimension can be rolled with a constant pass line.

They are mounted on base frames in a welded construction. Driven conveyor rollers are arranged between the lower guide rolls on the same base frames. After the end of the rolling process the rollers are lifted to transfer the Assel shell out of the mill stand. Three upper guide rolls are positioned on the outlet side to assist the shell transport.

The discharge of the shell out of the pass line onto a cross transfer table will be carried out by hydraulically operated kick-out arrangement.

8. SHELL TRANSPORT FROM ASSEL MILL TO THE REHEATING FURNACE

Technical Data

Shell diameter:	130 - 225 mm
Shell length:	max. 13,500 mm

Description

The transport facilities behind the Assel mill to the reheating furnace mainly consist of a height adjustable run-out roller conveyor.

A rotary arm system, with electro mechanical drive, transfers the shell from the Assel outlet conveyor to the reheating furnace inlet conveyor. Both conveyor rolls are individually driven by electric motors.

9. REHEATING FURNACE

Technical Data

Outside diameter:	130 - 225 mm
Wall thickness:	5.6 - 40 mm
Max. length:	15,000 mm
Max. weight:	936.8 Kg
Max. frequency:	130 pcs/h
Inlet speed:	0.5 - 1.0 m/s
Min. inlet temperature:	650 °C
Max. outlet temperature:	1,100 °C
Heating uniformity:	± 10 °C over shell length and cross section

Technical Description

The furnace is a gas/oil fired walking beam furnace and is dimensioned that all shells in the a.m. size range will be heated to the required rolling temperature. This type of reheating contributes to reduce the temperature difference of the shell over the cross section and length for higher quality of the final product. The results of heating are monitored by installed pyrometer at the outlet side of the furnace.

10. TRANSPORT FACILITIES FROM THE REHEATING FURNACE TO THE SIZING MILL (under Buyer's responsibility)

Description

The transport facilities behind the Assel mill to the reheating furnace mainly consist of a height adjustable run-out roller conveyor.

10.1 Shell Descaler in front of Sizing Mill (under Buyer's responsibility)

Technical Data

Shell Diameter:	130 - 225 mm
Water Pressure on the Nozzles:	200 bar
Number of spray rings:	1 +1
Number of Nozzles:	6
Water Consumption:	about 240 l/min.

Description

The descaling unit in front of the sizing mill is used to descale the surface of the shells before entering the sizing mill.

The high-pressure water is provided by a pressure station with filter system, high-pressure pump and safety valve.

All the verification and relevant modification in this area will be done by Buyer.

11. SIZING MILL 550 I 10

The mill stand frame consists of the base frame with bolted rails to accommodate the roll stands and lateral positioning stops for adjustment of the roll stands to the mill centreline, together with the upper frame section with stand guide rails and oil-hydraulic cylinders for clamping the roll stands in working position. The mill stand is designed as a C-frame structure.

The mill drive is realized with ten (10) stands. The power of the main motor and the differential speed drive motor is transmitted through a distributor gearbox to the 10 drive shafts of the stands. The drive speed of each stand is given by the geared speed of the main motor and of the differential speed drive motor.

The drive shafts for the stands are arranged to be five in the upper line and five in the lower line. This allows to set the stands in the mill, one with upper ingoing drive shaft and the next with bottom ingoing drive shaft with the result of an overlapping of the rolls regarding the roll gaps.

The couplings on the gearbox output side engage automatically when the stands are pushed into the mill.

The roll stand changing system is used to change the size quickly from one tube size to the next. During stand changing, the roll stands are placed onto the stand changing carriages, which are designed with a loading area for max. 10 stands each and are moved by hydraulic motor.

A hydraulic station is required for the stand clamping cylinders and for the cylinders of the stand changing unit. (see item 14)

The cooling water system (open circuit) for cooling the roll stands during operation is connected to the water supply system of the plant. (see item 14)

Technical Data

Type of stands:	3-roll type stands
Number of stand positions (total):	10
Nominal roll dia.:	550 mm
Stand spacing:	approx. 500 mm
Max. permissible ingoing shell diameter:	230 mm
Min. exiting tube diameter:	89.0 mm
Max. wall (ingoing) :	40,0 mm
Shell temperature:	650 – 1,050 ± 10 °C
Mill stand changing:	by hydr. stand extracting rig and stand trolleys
Mill stand changing time:	10 minutes
Inlet speed:	max 1.20 m/sec (approx.)
Outlet speed:	max 1.80 m/sec (approx.)
Drive system:	differential drive through spur wheel and planetary gear box
Number of main motors:	1

Motor power:	750 kW
Motor speed prel.:	285 - 520 - 1,300 rpm overload factor 1.6
Number of superimposed motor:	1
Motor power:	750 kW
Motor speed prel.:	52 - 520 - 1,300 rpm overload factor 1.6
Drive power (preliminary):	520 - 1,300 rpm; overload factor 1.6

Sizing Mill Roll Stand Type 550 I

Technical Data

Mill stand type:	3-roll mill stand with internal bevel gearing
Rolls per stand:	3
Nominal roll diameter:	550 mm
Max. perm. ingoing shell dia.:	230 mm

Sizing Mill Roll Stands

Technical Characteristics

The roll stand is designed as a 3-roll stand. It is of rectangular form and consists of two cast halves which are bolted together in which the 3 rolls, offset at an angle of 120° to one another, together with their shafts and bevel drive gears are mounted. One of the roll shafts is extended beyond the mill stand and has a splinted coupling hub which engages in the automatic coupling sleeve on the drive.

The bevel gears and labyrinths are lubricated by a grease packing. The grease chambers of the bearing are packed with grease. Subsequent lubrication takes place during rolling by grease supply system and timer.

The rolls are cooled by hoses and pipelines mounted on the stand. The hoses or pipelines are equipped with nozzles. The connection to the cooling water supply line is made by plug-in connectors which are installed on the mill frame. The connection is made automatically when the stands are pushed into.

Roll Stands Change Over Unit for the Sizing Mill

For the quick change over of the roll stands, a hydraulic device is provided, to pull out the roll stands onto the carriage positioned in front of the mill.

The carriage will move to the side to leave space for the second carriage with the new set of roll stands.

The new set of roll stands will be positioned in front of the mill and inserted into the mill by means of the same hydraulic device.

The carriage moving device by hydraulic motor.

Scope of equipment

Sizing Mill 550 I 10

Mill Stand SM and Main Drive

- Rolling mill housing of welded design, comprising one housing girder to receive 10 stands. The housing top part is mounted and connected with the housing girder by lateral supports and in the top part the holding fixture with the stand clamping cylinders are fastened.

- all piping and wiring in and on the mill frame up to about 1 m outside mill frame including connecting flanges.

- the pre-piped circulating oil lubricating system for the gear unit, incl. pump unit and piping.

Main Drive

The mill drive is realized with one complete differential drive through spur wheel and planetary gearbox, consisting of:

- one (1) main motor,
- one (1) superimposed motor,
- one (1) planetary gearbox with spur wheels,
- ten (10) output journals and
- ten (10) couplings

- The fundamental base frame for gear box
- The base frame for the drive motors

Stand Changing Device

- Hydraulic cylinders for moving the roll stands

- Changing beams for 10 hooks for connection with the SM stands

- A deposit table for the stands in front of the changing carriage

- Changing carriages moving on a rail track, each equipped with a deposit table for stands

- A carriage moving device, driven by hydraulic motor.

- Piping and wiring on the mill.

Sizing Mill Change Assembly Parts

- Roll stands with 550 mm nominal roll dia.

Auxiliary Equipment for SM

a.) Roll Stand Turning and Handling Device

- One roll stand turning and handling device for handling one (1) stand.
- One roll stand handling device for handling three (3) stands.
- One movable greasing device

b.) Inlet and outlet Tubular Guides

- One inlet tubular guide for each size.
- Necessary outlet tubular guides to cover the tube size range.

c.) Idle Stands with Guiding Tubes

- Idle stands for the tube size range.
- Guiding tubes for idle stands as required for the tube size range.

d.) Transporting Stands Rollers

- Transporting stands with rollers for bridging stand positions not in use
- Rollers for transporting stands, as required for the tube size range.

12. TRANSPORT FACILITIES FROM THE SIZING MILL TO THE COOLING BED

The transport facilities from the sizing mill to the cooling bed mainly consists of height adjustable run out roller conveyor.

13. COOLING BED

Technical Data

Tube diameter:	89.0 – 219.7 mm
Wall thickness:	5.6 – 40.0 mm
Tube length:	approx. max. 22.0 m
Changing Type:	walking beam
Type of cooling bed:	Rack-Type

14. CENTRELIZED UTILITIES (under Buyer's responsibility)

14.1 Hydraulic Station for Assel Mill incl. Valve Stands

14.2 Grease Lubrication System for Assel Mill and Sizing Mill

14.3 Cooling Water Supply (open and closed circuit)

14.4 Air Pressure System

15. ELECTRICAL EQUIPMENT

General Definitions

The electrical design specifications and the defined scope of electrical equipment are limited to the borderlines of the related scope of supply for the:

- Cone type Piecer
- Assel Mill
- Sizing Mill

All other areas of the plant will be considered by the Buyer :

- Billet Preparation
- Cone Type Piercing Mill
- Rotary Hearth Furnace
- Reheating Furnace
- Sizing Mill
- Cooling Bed
- All connecting transports between the areas
- Central Utilities

Any equipment to supply, drive or control civil equipment, e.g. cranes, air-conditioning or ventilation of buildings and rooms, water treatment,. or for equipment outside the borderlines of the new pipe mill are not considered in this specifications and are not included in the defined scope of equipment.

General Design Specifications

Voltages (technical data to be confirmed)

High voltage:	to be defined by BUYER
Frequency:	50 Hz +/- 1 Hz
initial symmetrical short-circuit power SK:	to be defined by BUYER
Medium voltage:	10 kV +/- 10 %
Frequency:	50 Hz +/- 1 Hz
Initial symmetrical short-circuit power SK:	> 250 MVA (to be confirmed)
Low voltage:	380 VAC +/- 10 %
Frequency:	50 Hz +/- 1 Hz
Dynamic short-circuit power:	
Control voltage:	220 V AC +/- 10%
Frequency:	50 Hz +/- 1 Hz
Control voltage (PLC):	24 V DC
Solenoid valve voltage:	24 V DC
Separate supplies for	
Cabinet Heating :	380 / 220 V AC
Lighting :	220 V AC
Maindrives:	as per specifications of the electrical supplier

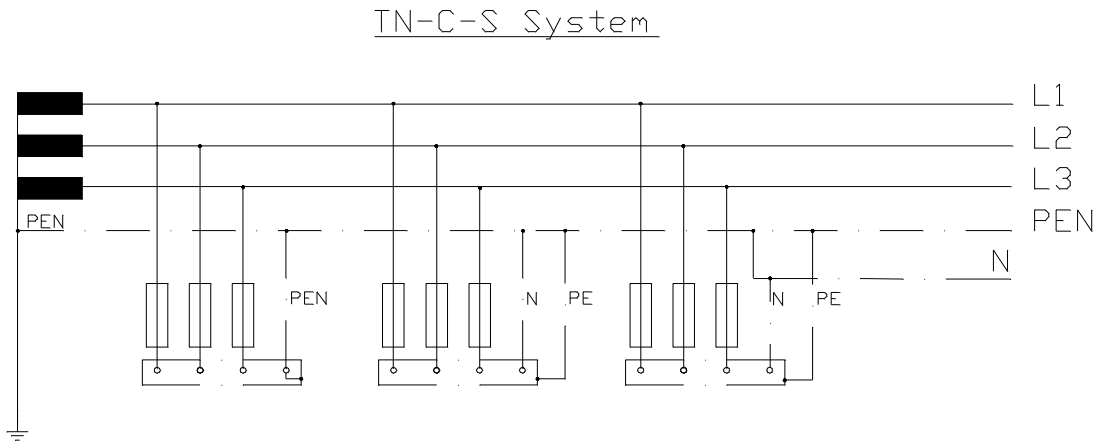
Protections

Neutral-point connection

For medium voltage system: insulated

For low voltage system: TN-C-S system*)

*) Protective earth- and neutral conductor are partly connected to one common Protective Earth Neutral conductor (PEN).



Codes and standards

The electrical equipment design and construction is in conformity with VDE, DIN and IEC standard specifications for electrical equipment and the related safety regulations (CE).

Cooling water for motor cooling and room ventilation

Quality:	Non-aggressive industrial water
Cleanness:	Mechanically cleaned
Cooling water inlet temp.:	10 - 28 ° C
Cooling water outlet temp.:	max 35 °C
pH value:	7 - 8
Water pressure:	4 bar min
	5.5 bar max

Temperature applicable to electrical equipment design

- Mill areas	max 45 ° C
	min 5 ° C
- Control stations	max 25 ° C
	min 18 ° C
- control room switch gear	max 35 ° C
	min 5 ° C

Power Supplies, Motors, Drives and Motor Control

Power Supplies

High voltage and the medium voltage distribution down to the transformer terminals is required for the specified equipment.

The design and the scope of equipment will be defined during the engineering phase of the project.

High – and Medium Voltage distribution – Scope of Equipment

The high voltage and the medium voltage distribution down to the transformer terminals to supply the respective areas.

Main transformers

The 3-phase AC main transformers must be manufactured in accordance with the related international standards (example: DIN 42 500, DIN 42 523 and DIN 42 524). The following main technical characteristics must be observed:

Rated Power*):	___ kVA
Rated primary voltage*):	___ kV ± 2.5%/± 5%
Rated secondary voltage*):	___ kV
Voltage adjustment:	manual stepping switch with five taps
Cooling:	ONAN

Vector groups:	Dyn 5 (or similar, to be defined)
Installation:	outdoors (to be defined)
Earthing:	fixed
Ambient temperature (max.):	40 °C
Type of protection:	IP 00
Insulation class:	A
Painting:Standard RAL	
Labelling:	country of installation

Technical data of the transformers are to be defined by the sub-supplier. The permissible overload capacity of the transformer corresponds to the specifications in DIN VDE 0536.

*) Remark

The rating of the main transformers needed for the specified areas is listed in the table below.

Each transformer shall be equipped with the following features.

- Oil level indicator
- Buchholz relay with warning and alarm contacts
- Drainage valve
- Oil thermometer with warning and alarm indication
- Transport eyebolts
- Wheels
- Oil filling

Special requirements for feeding AC or DC converters must be taken into consideration by the sub-supplier.

Main Transformers – Scope of Equipment

The final design and the scope of equipment will be defined during the engineering phase of the contract. For preliminary information, the main transformers needed for the equipment are listed in the table below.

Transformatorenliste/ Transformerlist

Pos. Item	Anlagenbereich Section	Anzahl Quantity	Nennleistung Rated power MVA	Spannungen/Voltages Primär Primary kV	 Sekundär Secondary V	Anzahl d. Phasen Number of phases	Frequenz Frequency Hz	Schalt-gruppe Vector group	Kurzschluß spannung short circuit voltage	Kühl-methode Method of cooling	Umgebungs-Temper. Ambient Temperature
	Supply of										
	Piercing Mill(to be add.)										
1	Assel Mill working rolls	1	3	10	690	3	50			oil	45°C
2	Assle Mill general	1	1	10	380	3	50			oil	45°C
3	Sizing Mill working rolls	1	2	10	690	3	50			oil	45°C
4	Sizing Mill general	1	1	10	380	3	50			oil	45°C

Anmerkung / Remark:
Alle Daten sind vorläufig / *all data are preliminary*

Low Voltage distribution

The design and the scope of equipment of necessary low voltage distribution in form of AC switchgears, including ingoing and outgoing feeders to supply the respective areas will be defined during the engineering phase of the project.

Low Voltage distribution – Scope of Equipment

The low voltage distribution from the main transformer terminals to the ingoing feeders of the specified areas:

LV-switchgears for equipment

Mainly consisting of:

Ingoing Feeder section

Including:

- lockable circuit breaker with overcurrent and short-circuit detection, provided with auxiliary contacts and undervoltage release.
- Ammeter, Voltmeter
- Emergency Stop-Pushbutton

AC switchgear

Precabled switchgear, including:

- all necessary power supplies and distribution (isolating transformers) for:
  - PLC
  - Control voltage
  - Magnetic brakes/couplings
  - Solenoid valves

- precabled switchgear, including all necessary equipment to supply, control and protect AC-motors with variable speed, mainly consists of frequency-converters, reactor or sinus filters if necessary and speed/frequency and current/torque controller.

LV-switchgears – Scope of Equipment

Pre-cabled switchgears, including all necessary equipment to supply, control and protect the motors or AC consumables of the specified areas.

Main drives

Required power converter functions and components per motor:

- Digital and adaptive speed control with secondary current control,
- Ramp function generator for speed selection,
- Components for basic speed set point selection and for injecting a correction speed value for set point variation,
- Component assemblies for the starting and stopping logic,
- Testing and alarm component assemblies,
- Thyristor / Transistor triggering component assemblies.

Field control circuit

Field controller functions and components for each motor:

- Digital and adaptive speed control in the form of EMF control and flux control
- Component assemblies for short-time over excitation for the purpose of reducing the field time constants, the speed variations being initially adjusted by the control stroke in the armature and then being followed up in the field,
- Component assemblies for the starting and stopping logics,
- Testing and alarm component assemblies,
- Triggering component assemblies for the thyristors / transistors.

Main Drives – Scope of Equipment

The main drives needed for the equipment are listed in the table below.

Umrichter Hauptantriebe / Main Drives Inverter List

Mech. Pos. Item	A n l a g e n b e r e i c h S e c t i o n	Stück-zahl Quantity	Umrichter Type Type-of Inverter	Nenndaten Nominal Data			Überlastbarkeit overloadfactor	Einzel-speisung Individual feeder	DC Bus Sammel-speisung Common DC Bus supply	Umrichter Betrieb Inverter operation
				Leistung Power [kVA]	Spanng. Voltage [V]	Strom Current [A]				
AM	Working Rolls	3	PWM	1000	1)		2		X	4 - quadrant
	Inserter / Retainer	1	PWM	400	1)		2,5		X	4 - quadrant
SM	Main drives	2	PWM	1000	1)		1,6		X	4 - quadrant

Anmerkung / Remark:
All data for the main drives are preliminary and have to be checked and confirmed by the electrical supplier
1) For the drive voltages, please refer to the main motor list

The piercing mill needs to be added

Motor Control Centers (MCCs)

All standard not speed controlled AC motors or AC consumables will be fed by MCCs (fixed mounted), with the following main features:

- Fused disconnecting switch
- main contactor
- motor protection switch or circuit breaker
- 20% spare space for future extension

Motor Control Centers – Scope of Equipment

Precabled MCC´s to supply, switch and protect the related AC-Motors or AC consumables of the specified areas.

Roller conveyor distribution boxes

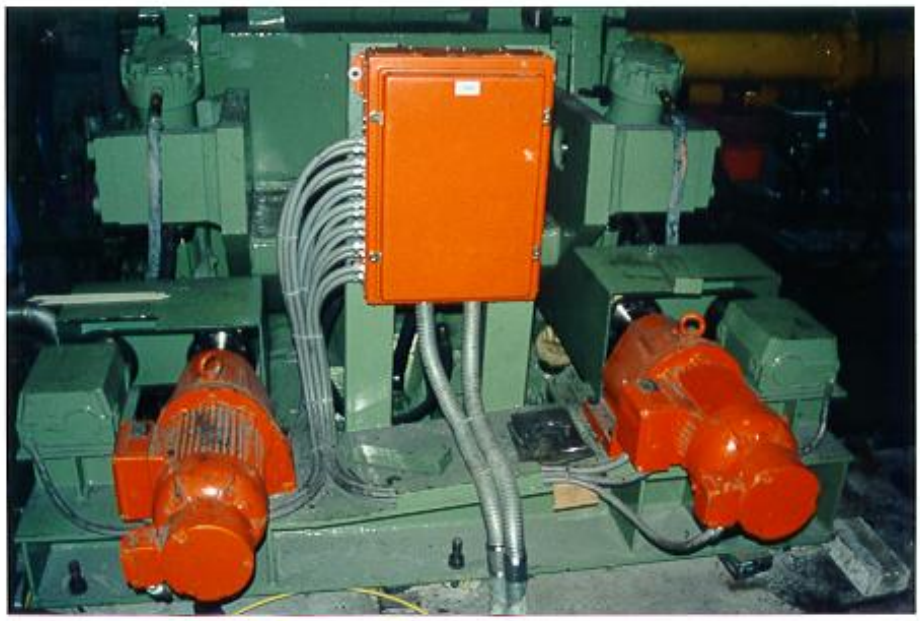
Including all necessary equipment to supply, switch and protect the related AC-Motors.

Roller conveyor distribution boxes – Scope of Equipment

Precabled roller conveyor distribution boxes to supply, switch and protect the related AC-Motors of the specified areas.

On-stand electrics (pre-cabling of equipment)

All electrical equipment on mill stands will be pre-cabled from the mounted motor, valve or sensor to terminal boxes. This terminal boxes (IP65) will be located close to, or if possible on the mill stand. The cables will be protected with flexible metal hoses and are routed via metal pipes. Main motors (as per the main motor list) will be cabled directly.



Picture: exemplary on-stand electric pre-cabling

Three-phase AC motors – general specifications

For all standard three-phase AC motors, roller conveyor motors and geared motors, following specification will be fulfilled:

Standard specs.	DIN/VDE/IEC recommendation
Insulation class:	F used at B
Enclosure:	IP 54 or IP 65
Shaft end:	Cylindrical shaft end with groove and key
Bearings:	Ball or roller bearings
Ventilation:	Self-ventilated, radial fan
Ambient temperature:	Hot mill environment, 45°C

All speed controlled AC Motors will be suitable to operate with IGBT - PWM (Pulse Width Modulated) frequency inverters.

Therefore the following parameters should be reached:

Typical dU/dt value: 5 kV/μs

The motors should be equipped with isolated bearings (low power AC motors to be defined).

AC Motors – Scope of Equipment

Standard three-phase AC motors, roller conveyor motors and geared motors for the specified areas.

Main - Motors

All Main - Motors have to be suitable for supply by a 4-quadrant-operating converter or inverter (with respect to admissible current-rise periods).
Tacho generators and or pulse generators are attached on the non-driven end of the motor shaft.

The cooling of the Main - Motors will be done with radial or axial fan, or if necessary, with mounted water to air heat exchangers of protection class IP54 or with centralised cooling systems.

The selection of the Main - Motors with respect to speed and inertia is with due consideration of favourable dynamics.

Thermal switches, mounted inside for warning and switch off are included. All Main Motors will be equipped with temperature transducers (PT 100 or similar) for bearing temperature supervision.

For all AC Main Motors which will be connected to IGBT / IGCT - PWM (Pulse Width Modulated) frequency inverters or similar drives, the following parameters should be reached:

Typical dU/dt value: 5 kV/μs

The motors should be equipped with isolated bearings.

Main Motors – Scope of Equipment

The main motors needed for the equipment are listed in the table below.

DS - Hauptmotorenliste / AC – Main Motor List

Mech. Pos. Item	A n l a g e n b e r e i c h S e c t i o n	Stück-zahl Quantity	Abkür-zung abbre-variation Motorlist	Nenndaten Nominal Data					Überlastbarkeit overloadfactor		Isol.-Klasse Isula-tion class	Schutz-klasse Type of enclo-sure IP	Bau-form Design
				Leistung Power [kW]	approx. Inertia Motor [kgm^2]	Drehzahl Speed [rpm]	Spanng. Voltage [V]	Strom Current [A]	Moment Torque	Strom Current			
AM	Working Rolls	3	MKL/T	750			690		2	2	F[1)]	54	B3
	Inserter / Retainer	1	MKL/T	300			400		2,5	2,5	F[1)]	54	B3
SM	Main motors	2	MKL/T	750		285 -520/1300	690		1,6	1,6	F[1)]	54	B3

Allgemeine Anmerkung / General Remark:
Alle Motordaten sind vorläufig / *all motordata are preliminary*

Remarks:
1) F used at B

The piercing mill needs to be added.

Basic Automation

General Description

The basic philosophy of the automation structure is based on the principles of distributed control, which leads to an architecture of independent working areas, connected via fast communication network.

Different level of automation and process control are defined as

Level 0
Actuators and Sensors, including supplies, drives and speed / current / torque controls.

Level 1
Basic automation by means of PLC´s (Programmable Logic Controller) and Visualisation PC´s to control the basic functionalities of the independent working area.

Level 1b
Process control of the product quality by means of QAS (Quality Assurance System) including technology computers.

Level 2
Production and tool planning, reporting and evaluation of production data, receiving from lower level automation systems.

As an overview, please refer to drawing "Basic Automation - PLC control area" and "Basic automation - configuration"

Remark
Because of the different automation systems of the electrical suppliers this configuration are only for reference.

PLC-System

The PLC consists of the following different plug-in modules which can be assembled in a rack and, if necessary, in expansion unit and installed in the switchgear:

- Voltage supply
- CPU (Central Processing Unit)
- Digital input/output boards (15% reserve, prewired)
- Analog input/output boards (15% reserve, prewired)
- Remote input/output boards (for control desks, etc.)
- Communication board
- Positioning controller boards
- Applications and system software
- Programming unit
- Special cable for connection of the PLC components
- Bus cables

A slot reserve of approx. 20% is to be provided for subsequent expansions at a later date.
The quantity of the needed in-/outputs depends on the requirements of the related area.

The Programmable Logic Controller (PLC) is provided to link, coordinate and evaluate the specific sequences of movements, functions and error messages and has essentially the following functions:

- Drive control
- Sequence control
- Interlocks
- Setpoint inputs
- Positioning controllers
- Error message processing

– Signal and data exchange with the HMI and other controllers or computers via a bus system
– Material flow tracking

Depending on the control point, various operating modes are possible, e.g.:
Automatic mode, Hand mode, roll changing/set-up mode, jog mode, weekend mode,...

A 20% capacity reserve of the CPU (static memory capacity and computing capacity) is to be provided.

The cycle times of the applied PLC should not exceed 50 ms. For travelling drives, which operate continuously for the process, intelligent peripheral equipment with the required operating speed must be applied. Typical cycle times are within the range of 1 to 10 ms. The cycle times and the sufficient speed of the closed-loop controls is to be proved and documented during system testing and commissioning. Within his scope of supply the supplier must enable the accessibility of signals for measuring processes.

Data protection in the PLCs is ensured by battery stand-up supply. System and application software is filed on floppy disks or CD ROM´s.

Communication

Data transfer within a control area between PLC and the interfaced, decentralised input/output devices is via a local bus system (e.g. Interbus-S, Profibus).

Data transfer between the controllers and visualisation systems of the individual plant area, the process computer (Level II) and further systems (e.g. measuring technology) is via a higher-ranking bus system (e.g. ETHERNET).

Further details of communication are specified in the attached Requirement Book:

Operator Terminals (Human Machine Interface HMI)

All necessary indication and relevant information to control and/or prepare the rolling process will be concentrate on Operator Terminals.

From this terminals the operator can handle:

Order-related data such as, e.g.:

- Order no. / rolling no.
- Starting material (diameter, wall thickness, material, temperature, etc.)
- Nominal speed train (steady-state), change of elongation rate
- Printout

Machine-related data such as, e.g.:

- Roll groove series (lower/upper roll groove)
- Roll speeds (transmission)
- Printout

Control-related data such as, e.g.:

- Preselection/display of operating mode
- Status information (process)
- Printout
- Preselection of manual or automatic mode

The necessary production data will be received from Material Tracking System on PLC-Level.
Independent from this, the operator can modify select or put in data manually.

Additionally to the Terminal, some commands will be carried out with standard switches, pushbuttons, key switches, master switches and the like, to guarantee safety functions and manual operation in case of fault.

Process Visualisation and Data Storage on Operator Terminals

To be independent from Level II-Computer System and to minimise order preparation and mill preparing time, each operating area will get it's own Operation Terminal.

On this Terminal, graphical visualisation of the area and a local Data Storage will be realised.

Process Visualisation of Local Area

Following functions will be part of the "Process Visualisation":

- Material Tracking of the matched area with indication of the actual billets/hollow blooms/shells/tubes in form of "walking beams".

  Display of the complete tracked material data by operator request ("Track ball"-use).

- easily complete "Area Control" by using "Trackball" and/or "Function keys" on several monitor masks, e.g. Hydraulic-Main pump on/off, ... indicated as symbols and/or clear English text on graphical masks

- local fault indicator

Intermediate Data Storage of Local Area for PM, AM and SM

to store and reactivate rolling lot data, transmitted from Level II Computer System or manual operator input, including mill setup data received from the Technology Computer System or manual operator input, with

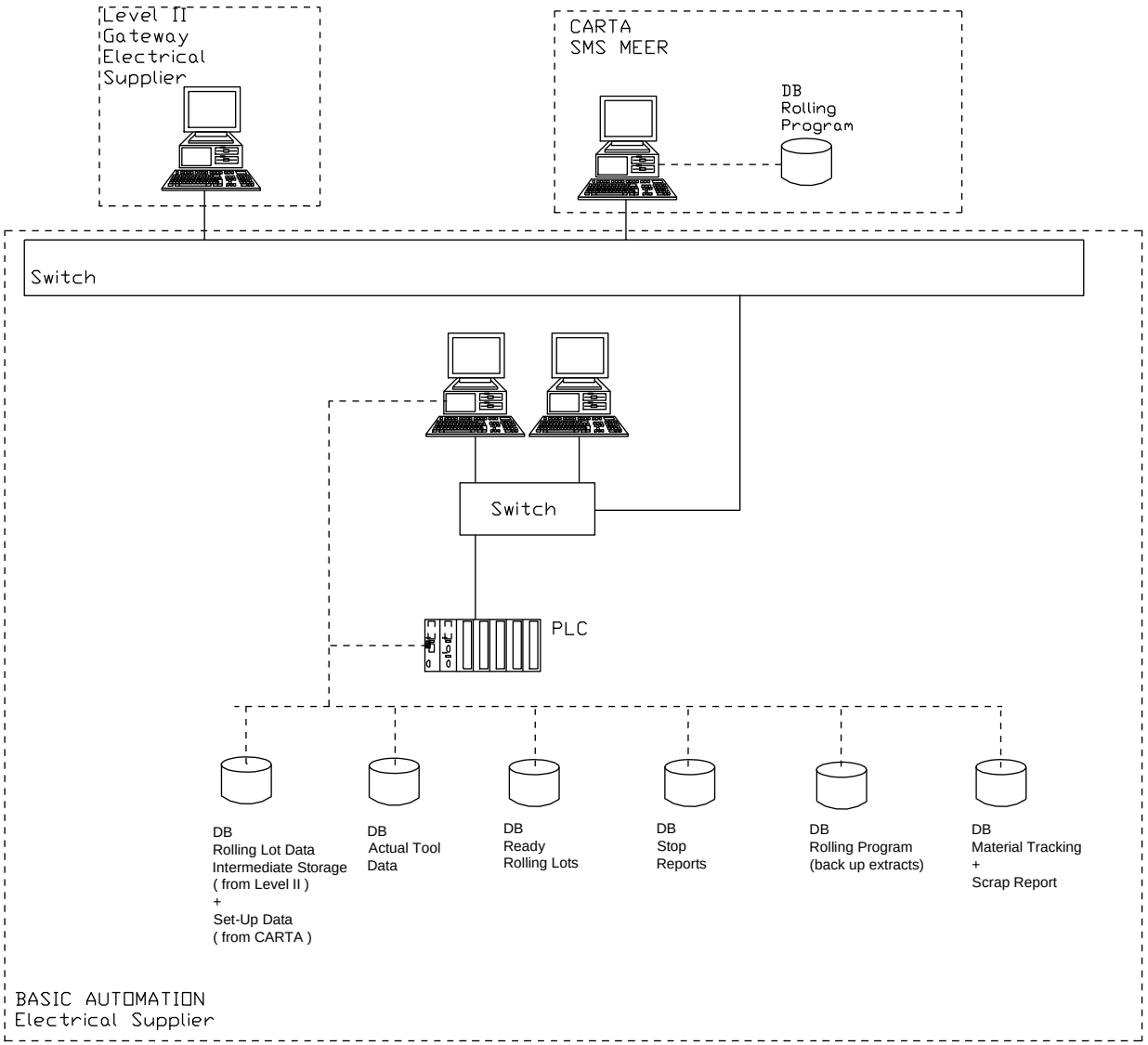
- Reference speeds for the main-drives according to production data

- Reference position for rolling gap, feed angle, guide shoes and the like. Reference values for auxiliary equipment, which is important to continue the rolling process in due time.
- Necessary tools and relevant production information for the operator, e.g. Mandrel bar diameter, plug diameter, roll stand position...

All PC´s used for Basic Automation functions, will be Industrial PC type.

The visualisation masks must be designed to show Vietnamese characters and german/english static text (language switch over). The translation of the english text will be done by the BUYER, dircetly in a table, created by the Supplier of the HMI´s.

The following drawing shows an overview of the Basic Automation System for each area of Piercing Mill, Assel Mill and Sizing Mill, incl database organisation, with possible <u>future</u> connection to Level II system or CARTA® Technologysystem:



Control desks & panels

All necessary switches, instruments and indicators to control the process and the auxiliaries will be mounted in control desks & panels.

The design of the main desks will adopted to the related operator station and to the special requirements of each area.

Local mounted device

All Local mounted devices, e.g. proximity switches, light barriers, limit switches, rotary cam switches and the like, are provided in encapsulated construction. The electric terminals are arranged within the encapsulation or within individual closed terminal boxes.
In hot sections light barriers and/or IR heat-sensors are used for the registration of materials.

All incremental and absolute encoders have to be installed in protective housings (stainless steel, at least IP54) for additional protection against mechanical blows.

Basic Automation – Scope of Equipment

General

The equipment for Basic Automation is related to the mechanical and electrical equipment according to the borderlines of the new pipe mill and in accordance to the specifications made above.

The quantity of Basic automation components is roughly estimated and needs to be detailed during design liaison phase of the contract.

Following main components of the Basic Automation for the Piercing Mill, Assel Mill and the Sizing Mill are foreseen:

Piercing Mill

2 Operator Terminals with 17” TFT monitors

1 Hardcopy printer (color)

1 PLC - system

Assel Mill

2 Operator Terminals with 17” TFT monitors

1 Hardcopy printer (color)

1 PLC - system

Sizing Mill

2 Operator Terminals with 17” TFT monitors

1 Hardcopy printer (color)

1 PLC - system

All components are including necessary Hard- and Software.

Control desks & panels

Piercing Mill

1 main control desk

2 local control desks

2 local control panels

3 local transportable remote controls

Assel Mill

1 main control desk

2 local control desks

2 local control panels

3 local transportable remote controls

Sizing Mill

1 main control desk

1 local control desk

All control desks and panels with more than 20 I/O´s will be equipped with remote I/O-stations.

Local mounted devices

1 lot of instruments and sensors in the necessary quantity, design and specification for the respective area, mainly consisting of:

- Hot product sensors (infrared photocells)
- Light barriers
- Incremental and absolute encoders
- proximity switches
- cam coding switches
- limit switches

The specification and scope of equipment for instruments and sensors to control and supervise hydraulics, oil lubrications, grease lubrications, water, compressed air and the like, e.g. pressure switches, flow switches, level indicators,.... are described in the mechanical scope of equipment.
The control of this equipment will be realised by the above mentioned PLC´s, since these units are not complete buy-out systems.

Material Tracking System on PLC Level I (for reference only)

Description

The main task of this system is to track the material from the billet weighing unit to the cooling bed. While passing the several working, respectively forming sections the material charge number and diverse measured process data will be tracked.

Each billet/hollow bloom/shell/tube get its own data set, including all accumulated datas.

The individual tracking will start by billets passing the weighing unit and will end by tubes entering the cooling bed.

From cooling bed to the discharging of the cooling bed, only the orderdata, including actual pieces and total weight, will be tracked.

The tracking of the material will be visualised on the "Local Area PC" in each operating section in form of "walking beams".

Data acquisition and communication with the PLC´s takes place in the following way:

At the billet weighing unit the operator starts a new rolling lot by confirmation or entering the new lot and charge number.

The material tracking system counts the billets, connects these numbers with lot number, charge number and the billets weight.

These data are intermediately memory stored.

The system tracks the billets through the heating furnace.

Tracking inside the furnace is only possible, if the following requirements are met:

- No billet passing inside the furnace
- First in / first out principle
- The system gets the furnace cycle
- In case of any problems in the furnace area, the billet numbers must be corrected by the user manually.

After leaving the furnace the data record of the billet will be filled up with the data:

- billet temperature at RHF outlet
- hollow bloom diameter behind CTP
- hollow bloom length behind CTP
- hollow bloom wall thickness behind CTP

The reference values are delivered by PLC, the actual values by measuring device or calculation. The material tracking system calculates the difference between actual and reference value. If the difference is outside a fixed tolerance value, an error flag to the PLC will be set.

Behind the Assel Mill the reference and the actual values of wall thickness, diameter, length and temperature (by PLC and measuring devices) are attached to the shells data record.

Actual and reference value are compared. If the difference exceeds a fixed tolerance the tracking system sets a signal to the PLC of the area.

The tracking system follows the shells through the reheating furnace and adds the actual inlet and outlet temperature to the shell data at the outlet side of the furnace.

In the area of SM the tracking system receives the tubes reference dimensions. These data are intermediately stored in the tubes data record, too. From the measuring equipment behind SM the tracking system gets the following actual values:

- length
- wall thickness,
- diameter,
- temperature

Order data tracking on the cooling bed is only possible if the following requirements are met:

- No tubes passing on the cooling bed
- First in / first out principle
- The system gets the cooling bed cycle
- In case of any problems in the cooling bed area, the datas must be corrected by the user manually.

Note:
Measuring equipment is not considered in this contract.

Note:
Additionally, the actual rolling adjustments of the CTP, the Assel Mill and the SM will be stored in the Material Tracking Data set for further evaluation.